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Safe Use of Symbols in Handover Documentation for Medical Teams

Julia Galliers, Stephanie Wilson, Rebecca Randell, Peter Woodward

Centre for HCI Design, City University London, England
Northampton Square, London EC1V 0HB. Tel: 020 7040 8427. Fax: 020 7040 8859

jrg@soi.city.ac.uk, steph@soi.city.ac.uk, R.Randell@leeds.ac.uk
peter.woodward.1@soi.city.ac.uk

Abstract

Concern has been reported about the safe use of medical abbreviations in documents such as handover sheets and medical notes, especially when information is being communicated between staff of different specialties (BBC, 2008, Sheppard et al, 2008). This paper describes a study to investigate whether the use of symbols in handover documentation that is shared within and between multidisciplinary teams (MDTs) has similar safety implications.

We asked 19 healthcare professionals from a range of specialties to identify 45 different combinations of 38 individual symbols. The symbols and combinations of symbols were extracted from 102 handover sheets taken from 6 different healthcare contexts in 4 London hospitals. 3 symbols proposed in Microsoft's Common User Interface guidelines for alert symbols were also included. Results reveal that while some symbols are well-understood, many others are either ambiguous or unknown.

These results have implications for the safe use of symbols in medical documents, including paper and electronic handover documents and Electronic Patient Records (EPRs), especially where teams comprise individuals from different professional backgrounds, i.e. MDTs. We offer initial suggestions for standardization and further research.

Keywords: healthcare, handover; handoff; symbols; safety; multi-disciplinary teams.

1. Introduction

Multidisciplinary teams (MDTs) in healthcare comprise professionals of different specialties, occupying different roles, and have an increasingly important role in patient care. Team members need to communicate about the patients in their care and this happens both at team meetings (Kane & Luz, 2009, Li et al, 2008) and outside of these meetings. When this sharing of information about patients accompanies the transfer and acceptance of responsibility for their care, it is known as "handover" (Wilson et al, 2009). Handover may occur between individuals on a MDT or between one MDT and another. The various communication and decision-making processes in MDT meetings and handovers are typically supported by documentation and it is essential for patient safety that this documentation is clear and unambiguous.

In this paper we focus on one potential source of ambiguity and confusion in medical documentation for MDT meetings and handovers: the use of symbols. Previous studies (e.g. Das-Purkayastha et al, 2004) have investigated the use of abbreviations in medical documents and consequent implications for safety, but there has not been any investigation of the role of symbols. We describe an experimental study that investigated how healthcare professionals of different roles and specialties interpret the symbols used to convey patient information in both handwritten and electronic handover documentation. We report and discuss the results of this study.

2. Motivation and Background

Every discipline has its own shorthand for terms that are commonly used and should be mutually understood by members of that community. Medical symbols and abbreviations, for example, are used to represent some aspects of patient information in the handover documentation that passes between MDTs and their members.

A handover is a transition point in patient care where one individual or team passes responsibility for, and information about, a patient to another (Wilson et al, 2009). These transitions cross boundaries of space (as the patient progresses from the care of one team to another) and time (as healthcare professionals change shift) and are important to a safe patient journey: poor transitions have been implicated in incidents of patient harm, poor outcomes and ineffective work practices (Healthcare Commission, 2009, Ye et al, 2007, Petersen et al, 1994, and Jagsi et al, 2005).

Shorthand notations are frequently employed in handover documentation for a number of reasons. Firstly, speed of communication is an important consideration. For example, there may be many patients to hand over at a shift change and the outgoing team will be anxious to convey the essential information about all patients prior to leaving, just as the incoming team will be keen to gather the essential information in an expeditious manner. Secondly, space is generally limited in handover documentation. The documentation typically consists of patient details on a form (paper or electronic or sometimes both) or on a whiteboard. Paper forms and whiteboards have fixed-size text entry fields. While electronic forms may allow text entry fields to expand, there is an imperative to keep entries brief, avoiding multi-page documents, in order to provide an 'at a glance' representation of what is relevant and important. This problem is even more acute with the small-screened mobile devices that are increasingly being used for certain types of handover eg. iBleep (iBleep, 2010) and MedicMate (MedicMate, 2010). In addition, shorthand forms of communication can act as alerts or warnings and there are many different alert symbols in use (Microsoft, 2008b). For example, ! written beside an item of information means "look out for this". Highlighting, underlining and circling are other ways of drawing attention to important information.

In summary, symbols are used as visual metaphors for the following reasons (Microsoft, 2008a):
- for quick and accurate recognition e.g. a warning or alert
- to speed the communication of frequently repeated or important information
- to represent items that otherwise would take many words to describe
- when the amount of space on the display is limited
- when a suitable icon/symbol exists and has a generally accepted meaning
- to highlight critical or important information

However, one major problem with all forms of shorthand is the potential for ambiguity and in a critical context, such as MDT meetings and handovers, this is potentially dangerous. There is no reported work on the safety implications of using medical symbols in documenting patient information but ambiguity caused by use of medical abbreviations is a known problem, e.g. Lilly and Guanci (1997). More recently, Das-Purkayastha et al (2004) conducted a small study investigating how well abbreviations used in ear, nose and throat (ENT) surgery were understood by junior doctors from other specialties. Their concern was with on-call doctors who must cover several different subspecialties and who may not fully understand the medical notes. They found that six out of thirteen commonly used abbreviations in ENT were unclear to over 90% of junior doctors from other specialties. They suggested either banning abbreviations from medical notes or listing the acceptable ones with explanations.

An audit by the paediatric department at Birmingham Heartlands Hospital (Sheppard et al, 2008) recorded 221 different abbreviations amongst 2286 instances of abbreviation use on 25 handover sheets. Of these, only 14% were recognised by the Trust Intranet Medical Dictionary (TID) and 20% by Mosby's Medical Dictionary (MMD). 56-94% of the abbreviations were recognised by paediatric doctors although other healthcare professionals recognised only 31-63%. They found no systematic approach to the widespread use of abbreviations in both handover sheets and medical notes and raised concerns about those abbreviations with multiple, very different interpretations such as TOF ("tetralogy of fallot" *and* "tracheo-oesophageal fistula").

Abbreviations are also a recognised problem for medication orders. For example, a patient on haemodialysis being treated for a viral infection with the drug acyclovir died because the order was written as "acyclovir (unknown dose) with HD". HD was meant to mean haemodialysis, thus warning that the acyclovir should be adjusted for renal impairment and given only once daily. It was misread as TID (three times daily) and the patient died (BBC, 2008). The Joint Commission on Accreditation of Healthcare Organisations (JCAHO) has published a list of prohibited abbreviations i.e. those that when misinterpreted can cause serious risk to patients. They are mostly abbreviated drug names and dosages (Cohen, 2006, JCAHO, 2004).

The aim of the research reported here was to investigate whether the use of symbols in handover documentation is similarly ambiguous. We undertook a study to investigate the use of symbols in handover with a particular focus on accuracy of recognition by healthcare professionals. We report the study, its main findings and discuss whether there is a need for standardisation on the use of symbols. We further consider implications for the development of electronic handover tools for increasingly multidisciplinary clinical contexts such as MDTs: our eventual goal is the development of innovative collaboration technology to support handover.

3. Empirical Study of Symbols in Handover Documentation

3.1 Method

Handwritten and electronic handover sheets (documents) were collected at 6 field sites in 4 different London hospitals: an emergency assessment unit, a general medical ward, a paediatric surgical ward, a high dependency unit, an acute medical ward and a paediatric ambulance retrieval service. A total of 102 handover sheets covering a number of different types of handover (shift-to-shift nursing, shift-to-shift medical, to and from on-call and night staff, inter-departmental transfer, inter-hospital transfer, hospital to community transfer i.e. discharge) were collected. From these, we identified 38 different symbols used by healthcare professionals in documenting patient information for handover. We excluded abbreviations from our analysis. The frequency of occurrence of each symbol was determined. It was immediately apparent that symbols are not used in isolation, rather they are used in combination with each other and with other information items, and this "context" of use is significant for interpreting their meaning (e.g. an ↑ symbol is used to qualify some measure, such as heart rate, denoting the fact that it has increased).

In the second stage of the study, we investigated which symbols were recognized by healthcare professionals and with what level of accuracy. 45 symbol cards were created for this purpose. Three of these contained the alert symbols proposed by the Microsoft Health Common User Interface (CUI) programme (Microsoft, 2008b) which aims to promote a common user interface for future healthcare applications including Electronic Patient Record (EPR) systems. The remainder of the cards contained instances of the 38 symbols and highlights taken from the sample handover sheets. As mentioned above, symbols are not used in isolation. Hence the cards retained the original contexts in which the symbols were used (see Figure 1 for examples). Some of the symbols and combinations of symbols came from the 56% of the handover sheets that were handwritten. These were handwritten onto the cards. The other 44% of the handover sheets were typed. Symbols from these were photocopied, cut out and pasted onto the cards.
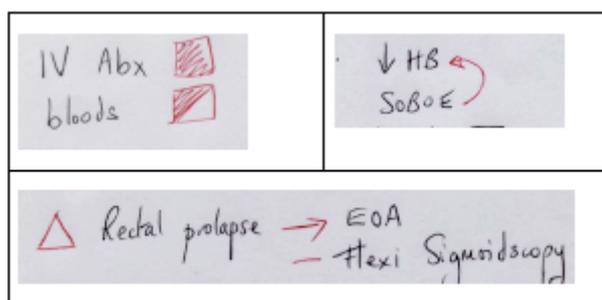

Figure 1: Examples of symbols in their context of use, as written on the cards

19 participants took part in the experiment, 10 of whom worked in hospitals other than the ones where the handover sheets had been collected. 10 were male and 9 were female. The participants comprised 10 consultants, 4 registrars, 3 nurses, 1 operating department practitioner and 1 advanced nurse practitioner i.e. 14 doctors and 5 nurses from different specialties, and with a wide range of experience of handovers in UK hospitals (and some also had experience abroad). We included these different types of healthcare professionals specifically to investigate whether symbol interpretation has the potential to affect safe communication within and between MDTs composed of individuals with different roles and from different specialties and sub-specialties.

Each participant was first asked to report the types of handovers they had experienced by selecting from a list of 9 different handover types. They were then shown the cards one at a time, ordered

randomly to remove any potential bias or learning from relationships between related symbols, and asked to read the card aloud. The response was recorded (anonymously).

The third and final stage of the study aimed to investigate, in a more qualitative manner, the attitudes and experiences of the participants to using and interpreting symbolic forms of communication in handwritten and electronic handover documentation. Participants were asked:

- Did they use symbols when writing up patient information in handover documentation?
- If so, what were their reasons for doing so and when might they choose not to?
- Had they ever encountered symbols or graphics in a handover communication that they didn't understand and, if so, what did they do?
- Did they regularly use any symbols that were not included on the cards?
- Had anyone ever misunderstood, or queried, any symbols or graphics they had used in a handover?
- Were there any symbols they may have used on paper handover sheets that couldn't be used, or had to be adapted, for an electronic medium, or vice versa?
- And how would they highlight a particularly important piece of information on a handover sheet?

3.2 Results

3.2.1. Results from examining the handover sheets
38 different symbols were identified amongst the 102 handover sheets. Some are found in many contexts and disciplines other than medicine and are used to represent non-medical concepts e.g. √ , +, >, x, ♀, ↑, ↓, → . Others are found in other contexts but were used here to represent specific medical concepts e.g. Ψ (used for psychiatry), # (mostly used for fracture), and ⬭ (used for abdomen). We found that only a few symbols were used frequently on the handover sheets; the others were used less frequently. The frequently occurring ones were:

- The most used symbol was a question mark. On average, there were 3 per sheet.
- After this, either a box □ or [] or () indicating a 'job to be done' or 'half done' or 'has been done' (see discussion below) occurred at a frequency of more than 1 per sheet (approximately one and a half per sheet).
- A dash occurred with similar frequency (approximately one and a half per sheet).
- + for 'positive' was found in 2 out of every 3 handover sheets.
- ↑ Up and ↓ down arrows, < 'less than' and > 'more than', @ for 'at' and the fracture symbol # were all found in roughly 1 in 3 handover sheets.

3.2.2. Results from the cards

The participant who recognised the most cards correctly recognised 39 out of 45; the two participants with the least correct answers each recognised 22. Therefore the participants' accuracy ranged from almost 90% (89.6) to less than 50% (48.8). On average, each participant recognised 31.68 cards i.e. an average success rate of 68.8%.

Some cards presented no problems: the majority of participants answered them with ease e.g. c with a dash above it (for 'with'; originally from shorthand), an exclamation mark (as an alert), a heart symbol beside 'monitor', @, and □ beside 'check bloods' were understood in the same way by all the participants.

The cards that were ambiguous were ambiguous in different ways: the same symbol having more than one interpretation or different symbols being used to express the same concept. Some examples of these cases are discussed below.

3.2.2.1 Symbols with more than one interpretation

One of the most ambiguous symbols was the horizontal arrow. Used before a phrase or word, it can suggest an action e.g. '→stop ABx' (stop antibiotics) or '→A&E' (send to A&E). However, it was also used after a diagnosis in some handover sheets and, depending on what the arrow pointed to, the meaning was not clear to many of the participants. In one example (see Figure 1), there was an arrow after 'diagnosis of rectal prolapse' which was frequently omitted or spoken as an 'and' when the participants spoke the card's meaning aloud, leaving it unclear whether they thought the 'examination under anaesthesia' and 'flexi sigmoidoscopy' that followed the arrow were instructions, i.e. 'to be done', or had been used to obtain the diagnosis.

Another example was 'chest pain →' and some way below this was a statement about oral antibiotics and a cough. One consultant said she uses a horizontal arrow to mean 'unchanged' e.g. '88/53 BP →' to mean this blood pressure is unchanged, yet she did not interpret 'chest pain →' as ongoing or unchanged; she said she did not know what it meant. The alternative meanings offered by participants were:

- unchanged/continuing/persistent
- 'subsequently' or 'leading to' some treatment i.e. 'subsequent to the chest pain the patient was treated with oral antibiotics and had a cough.'
- 'chest pain radiating somewhere'
- one participant suggested it was something to ask the patient i.e. do they have chest pain?
- Causation i.e. the cause of the chest pain is the cough.

There was even potential for ambiguity with vertical arrows e.g. is '↑morphine' an instruction to 'raise morphine' or a statement that it has already been raised? Sometimes bent arrows were used to highlight or indicate the importance of a piece of information, but they were also used to indicate causation e.g. 'Partial translocation of chromosome 18 'leading to' encephalopathic epilepsy'.

Another symbol used to mean different things was #. On some of the typed (electronic) sheets, this was used to denote a number. On haematology handover sheets, it referred to the 'round' of chemotherapy i.e. round 1, 2 etc… But otherwise (and to most of the participants) it meant a fracture.

2° was another problematic symbol. For example, '2° dehy' was interpreted as both secondary dehydration and secondary *to* dehydration (although this might be clarified in the context of an entire handover sheet). However, several participants' first response to this symbol was to say '2 hourly' before looking again and realising that this did not make sense. Two of them then rationalised this by saying '2 hourly fluids' (to combat the dehydration). Two others interpreted it as 2 degrees.

Δ meant 'diagnosis' to most of the participants. One consultant who had trained in the US did not know it (nor did he know # for fracture), but for the theatre nurse Δ meant triage. To the same participant, the Δ symbol written on a diagram of a body is used to indicate the position of a tourniquet.

The half-shaded box was considered very ambiguous by several participants. For example, on one of the cards a half-shaded box appeared beside 'bloods' and it was unclear whether the bloods had been taken and the results were not yet back, or the bloods had not been sent off yet, or some other 'half done' interpretation.

Ø means 'without' but some participants said they had problems remembering whether it meant 'with' or 'without'. Finally, a P in circle meant 'plan' to some participants but 'problems' to another. The US trained doctor said it means 'pending' in the US. In the UK, he thought it meant 'positive.' Another suggested 'pharmacy'.

3.2.2.2 Different symbols used to express the same concept

Different symbols used to express the same concept included the case of representing the state of a job to be done. A fully shaded box, ∎, implies the job has been done. Partially shaded (with the box divided diagonally and one half shaded) means a job is incomplete in some way and a clear box, □, implies the job is yet to be done. However, in some of the handover sheets the boxes were ticked or had a cross marked over them instead and, in some of the electronically produced documents, a + was used to indicate a job done instead of a box. This caused a lot of confusion. The majority of participants firstly assumed that the + used in this way indicated a positive reading, or something to be 'looked out for', but then seeing how many were there and in what context, eventually concluded it meant 'has been done.' Sometimes () or [] were used instead. These options all took some scrutiny before the participants read them correctly and many really disliked these notations.

Another case where different symbols were used for the same concept was the use of three crosses +++ or three asterisks *** to mean 'very high' or 'lots of', e.g. 'needs +++ encouragement'. This was also used in a relative way as a grading scheme e.g. ketones+++ or ketones++ or ketones+ . Finally, different symbols were used to highlight a piece of information, including using capitals, bold, colour, asterisks, arrows, boxes and the letters NB.

3.2.2.3 General observations from the card study

It was clear that context was of primary importance when participants were interpreting the meaning of symbols. Even the most obtuse phrase can be eventually deduced if there is sufficient context to allow it. However, the reading of a handover sheet should be quick and easy and not require lots of guessing, which many of the participants were not prepared to spend time doing. If they could not 'see' what something meant immediately, they said 'I don't know'.

Another very clear general observation was that many of the handwritten symbols were easier (or possibly more familiar) for all of the participants than those that were created electronically via a keyboard. Admittedly fewer participants were used to these, but even those who were struggled with the adaptations of, for example, a + sign for 'has been done' and () for 'to be done'. Symbols such as: ?, @ and # were easily understood in the typed documents, otherwise there was a marked preference for the handwritten symbols. There is more discussion on this in section 3.2.3.

There was some indication from this study that there are differences in symbol use and interpretation in other countries. Several of the participants had trained and/or worked elsewhere in the world and they pointed out these differences. There were also obvious differences depending on the specialty of the participant and this is a concern in the context of MDTs. For example, the theatre nurse clearly understood the delta Δ as indicating the position of a tourniquet on a diagram of the body, or as 'triage'. The haematologists (and some of the others) were more familiar with # as a number than a fracture. In other words, there were a few clear differences between specialties, even amongst quite commonly used symbols.

3.2.3. Results from the interviews

All of the participants (100%) said that they use symbols and/or graphics in handover documentation, although a minority (5 of the 19) said that they did so only occasionally. Some

also qualified the statement by saying that they only used 'the common ones' which they elaborated as being: ↓, ↑, < , >, Δ and □.

The main reason for using symbols given by 75% of the participants was that they take less time to write. 68% said they use ones that are 'generally understood' and 'widely recognized'. 42% mentioned saving space and the page looking less cluttered. Other reasons were speed of reading and scanning for particular issues such as the diagnosis, getting a complicated idea over in a simple way, legibility and habit.

Half of the participants said they assumed people will understand the symbols they use because the symbols are well known within their community, although 36% acknowledged that they would not use a symbol if the circumstances made them concerned about misunderstanding. 2 people (10%) said they would use them anyway e.g. 'I use arrows. I am aware that people do misinterpret but I use them anyway.'

The reasons given for *not* using symbols were all about circumstances where it was important to ensure that there was no misunderstanding e.g. when handing over to other specialties or to a different hospital or department (42%), when writing formal or legal documents about an adverse event (31%), when wanting to ensure there was no ambiguity (26%), for discharge notes (10%) and if they were not going to be personally present at a handover (5%).

Half of the participants said they were not aware of ever having used a symbol that had been misunderstood, 10% didn't know and 36% thought that they probably had. This was despite the fact that all participants recalled instances when they had not understood a symbol or graphic on a handover sheet (although 5 of the 19 said 'only rarely'). The predominant solution to this was to ask – either another colleague or the person who had written the document (94%). One person said she would look in the patient notes. However, 6 of the 19 participants (31%) commented that they would guess, whilst 5 (26%) said they would assume it was unimportant and 'muddle through'.

12 of the 19 participants (63%) had used electronically produced handover documentation, e.g. Word or Excel documents, discharge letter templates or bedside clinical information systems, and 1 participant said that a colleague had recorded a whole handover on a phone because he was late. Of these, 5 (41%) said they only used the 'easy' symbols when using a keyboard, e.g. @, # and +ve. Another 5 (41%) said they would always write in full when using a keyboard.

The symbols identified as being desirable in an electronic handover application were: ↓, ↑, ■, □, the 'with' symbol (c with a dash above, which one participant had adapted to w/) and an outline of a body with the ability to annotate it, for example, to show where pain is located ('Describing locations takes too long').

Participants reported that they highlighted important information using bold, red colour, larger fonts and capitals in electronically produced handover sheets. The same methods were used in paper sheets, but additional methods here included: underlining, boxes around words, asterisks beside words, crosses next to words, circling, writing NB and highlighter pens. Verbal backup of important information was mentioned by 36% of the participants. Several participants mentioned that some form of accepted, documented standardization would be beneficial.

4. Discussion and Conclusions

Firstly, we found that symbol use is widespread in handover documentation. This was evident in our examination of handover sheets and in the self-reports from participants. However, the handover sheets revealed only a few symbols that were used frequently. These were: ?, □ and ■, -

+, ↑, ↓, <, >, @, ! and #. In the interviews, some participants included Δ as a favoured symbol, although it was not present in large numbers in our handover sheets. Furthermore, a diagrammatic outline of a body or stick figure was considered very useful by many of the participants in order to show the position of, for example, pain, IV lines, catheters, tourniquets and other medical devices. It was present and annotated in 1 in 5 of our handover sheets.

The major finding from this study concerned participants' accuracy in interpreting the symbol cards. This ranged from 89.6% to 48.8%, with an average accuracy of 68.8% (31.68 cards). This figure indicates that there were numerous cases where a symbol was not recognised or was misunderstood and this was borne out by the interview data. All participants said that there had been at least one occasion in their career when they had not understood a symbol on a handover sheet.

The symbols and participants in our experiment purposefully covered several different medical specialties and, as discussed in section 3.2, interpretations of certain symbols varied according to the specialty of the participant e.g. 2° and Δ. Those who had trained in different countries also offered alternative interpretations to some of the symbols e.g. Δ and a P in a circle.

However, the question of safety in MDTs goes beyond recognition of symbols to include what action healthcare professionals take when they do not understand something on a handover sheet. Here, the greatest number of participants answered that they would ask someone else, something that obviously could not happen during this experimental study. Nonetheless, answers such as assuming that an unknown symbol was unimportant, 'muddling through' (26%), or guessing (31%), are worrying.

The results of this study highlight both the ambiguity of certain symbols and the extent to which the meaning of other symbols is not widely known. However, the study has its limitations. The group of 19 participants was a small sample although it comprised experienced doctors and nurses from top London teaching hospitals i.e. a group expected to have been exposed to a diversity of symbols. It is also difficult to know whether the various contexts and hospitals used as sources of handover sheets and symbols formed a truly representative sample. Finally, it should be noted that several participants mentioned awareness of reported problems with abbreviations. From this investigation, it seems possible that their confidence about symbol use (as opposed to use of abbreviations) is misplaced - that they are unaware how ambiguous some of these symbols are.

4.1 Recommendations

This is an initial study, the results of which have flagged that use of symbols in medical documentation, particularly within and between MDTs, is a safety issue. Our first recommendation is that this should be followed by a more comprehensive study across more healthcare settings and MDTs. However, we have also shown that healthcare professionals like to use symbols for all the positive reasons stated in section 2 and, particularly with increasing use of electronic handover tools and EPRs, we propose that this practice be supported, but in a safe way.

In order to do this, healthcare professionals firstly need to be made aware of the potential ambiguities of using symbols. In addition, a standardized list of recommended symbols should be developed and endorsed by professional bodies and then promoted during training, on notice-boards, via websites, and incorporated into paper templates and electronic tools. Our results indicate such a list might include: ?, □, ■, +, ↑, ↓, <, >, ! and @, as these 10 symbols were understood equally by participants from different specialties and backgrounds. However, as said above, further research is needed to verify this list. A standardized method for highlighting important information would also be beneficial.

Just as JCAHO (2004) prohibits use of certain abbreviations, we also suggest that a list of *unacceptable* symbols should be identified, endorsed and included during training and retraining. In this study, we found: #, Δ, Ø, →, 2°, half-shaded boxes, any form of horizontal arrow (including bent ones) and any variations on accepted symbols, such as + for 'done', () for 'to be done' and ^ for ↑, to be potentially unsafe.

Keyboard entry of symbols into electronic handover documents poses a challenge since many of the most common handwritten symbols are not readily available. Our study revealed that this leads staff to make substitutions e.g. [] for □. These were found to be particularly problematic and should be discouraged. Electronic handover tools and EPRs must address this issue e.g. by providing a menu or palette containing a standardized set of symbols that can be selected easily, particularly for those symbols that are unavailable on a standard keyboard i.e. ↑, ↓, □, ■. In addition, techniques such as tooltips could be used to help reinforce the correct meanings of symbols, assist learning and prevent mistakes: a textual explanation of a symbol would appear when the user hovers over it with the cursor.

Further investigation is needed, not only to validate the results reported here but also to explore new ways of offering symbols in electronic tools or even the possibility of creating new, effective symbols for standardized use. However, this study offers an important initial insight into symbol use in medical documents and represents a step towards safe documentation and communication within and between MDTs.

Acknowledgements

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