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SCIENTIFIC CONTRIBUTION

The elephant in the room: a postphenomenological view on the electronic health record and its impact on the clinical encounter

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Abstract
Use of electronic health records (EHR) within clinical encounters is increasingly pervasive. The digital record allows for data storage and sharing to facilitate patient care, billing, research, patient communication and quality-of-care improvement—all at once. However, this multifunctionality is also one of the main reasons care providers struggle with the EHR. These problems have often been described but are rarely approached from a philosophical point of view. We argue that a postphenomenological case study of the EHR could lead to more in-depth insights. We will focus on two concepts—transparency and multistability—and translate them to the specific situation of the EHR. Transparency is closely related to an embodiment relation in which the user becomes less aware of the technology: it fades into the background, becoming a means of experience. A second key concept is that of multistability, referring to how a technology can serve multiple purposes or can have different meanings in different contexts. The EHR in this sense is multistable by design. Future EHR design could incorporate multistable information differently, allowing the provider to focus on patient care when interacting with the EHR. Moreover we argue that the use of the EHR in the daily workflow should become more transparent, while awareness of the computer in the specific context of the patient-provider relationship should increase.

Keywords Electronic health record · Postphenomenology · Transparency · Multistability

Abbreviations

COW	Computer-on-wheels
EHR	Electronic health record
ICD	International classification of diseases

Introduction

Picture a group of medical professionals gathering in front of the reception desk of a hospital ward, getting ready to start morning rounds. There are doctors, nurses, students, maybe a pharmacist and care manager joining in. What do you see? When answering this question, one may describe white coats, another may refer to social interactions. Coffee mugs will probably come up. However, one answer that is somewhat less likely to be heard, is the topic of this paper: computers. Most hospitals have installed several desktop computers scattered throughout the ward for care providers to use. Others have introduced mobile units or 'COWs' (computer-on-wheels) that accompany the care providers on their rounds. And less frequently, medical personnel have tablets and smartphones available to access the electronic health record (EHR).

Studying the use of computers in a medical setting confronts us with an apparent contradiction. On the one hand, electronic records are the subject of many scholarly articles and books. Although the EHR has solved a wide variety of problems that accompanied the paper record, it also

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generates a number of new problems and questions. There is a vast body of literature analyzing its impact on patient-provider communication, privacy, security and clinical research, among other things (Goodman 2015; Wachter 2015; Crampton et al. 2016; Patel et al. 2017). On the other hand, the EHR can seem to be invisible at times, as our example suggests, when the computer is perceived as a mere vessel of information, a means to an end that does not hold our attention. Or, as our title alludes, the EHR may be the proverbial elephant in the room, in everyday life at the hospital ward or in the consultation room as well as on a philosophical level. The EHR is rarely approached from a philosophical point of view, resulting in the lack of a theoretical framework to analyze its use in the clinical setting. However, we believe that such a framework is essential to develop a better understanding of its effects and to find solutions to the problems the EHR has introduced.

This paper will therefore apply concepts from philosophy of technology to the EHR, combining philosophical analysis with empirical investigation in a case study (Rosenberger and Verbeek 2015, p. 9).

Electronic versus paper records

The transition from paper records to the EHR has been described as one of the most important changes in modern healthcare delivery (de Ruiter et al. 2016). The earliest examples of a clinical record, dating back to the ancient Egyptian era and recorded as papyrus texts, were mainly concerned with collecting case histories for didactic purposes (Gillum 2013, p. 853). The Hippocratic reports were similar chronologically structured narratives that helped medical students learn from previous patients (Goodman 2015, p. 3). After 1800, significant changes occurred in the use and meaning of the medical record. Disease classification was introduced, physicians' observations and quantitative measurements gained importance, and medical records more often became instruments for the evaluation of therapeutic efficacy in a growing move toward more evidence-based practices (Goodman 2015, pp. 3–4). However, their primary purpose remained teaching medical students.

It is only in the 20th century that individual patient records as we now know them come to the fore. Physicians in private practice kept a longitudinal record of all the information they collected on the patient for their own reference and to document the care provided, while hospitals also collected all patient data in a single record, thus developing a tool that was better suited for direct patient care as well as quality improvement (Gillum 2013, pp. 854–855). Over time, these records served not only as documentation of care for the care providers to refer to, but as evidence of the care provided in case of allegations of malpractice or billing audits. The increasing volume of information included in these records transformed them into inefficient and complex piles of paper in more recent years. Even if all the information is legible, it requires a great amount of time and effort to extract information from a paper record, or to exchange it with others. The electronic record was developed as a solution to these and other problems of paper records, while at the same time offering new functionalities.

One of the main differences between paper and electronic records is a higher level of organization of information in EHRs. Next to the priority given to quantitative data (e.g. lab results, radiology imaging, vital signs) and physicians' observations of the patient, the use of flow sheets further structures these patient metrics (de Ruiter et al. 2016, p. 51). Classification systems such as the International Classification of Diseases—10 (ICD-10) reduce complex narratives to diagnostic and procedure codes (Libicki and Brahmakulam 2004 (RAND report); Hirsch et al. 2016). This reduction allows for the information to be much more easily used for purposes other than individual patient care: billing in the first place, but also the generation of research data and quality measurement and assurance. Since coded information is 'machine readable,' it can be used to allow the computer to recommend care or to prevent errors in ordering. Coding is in this sense at the heart of the multifunctionality of the EHR.

EHRs' benefits and problems

The potential benefits of EHR use are widely acknowledged: a more efficient health care system, increased patient safety and better care coordination and communication between care providers (healthit.gov). However, a 2012 review paper only found a positive impact in half of the analyzed studies, with others showing no benefit or a negative effect (Lau et al. 2012). Some have argued that we do not yet reap the full benefits of health IT systems because they lack a sufficient level of interoperability, ease of use and patient-centeredness (Kellermann and Jones 2013). Others have described an increasing focus on institutional priorities, shifting away from individual patient care toward other functionalities such as financial reimbursement, risk management, quality and safety improvement and meeting regulatory and accreditation standards (de Ruiter et al. 2016, p. 53).

The fact that the extent of documentation in the electronic health record is often directly related to reimbursement has had unintended effects such as copy-and-paste notes, over-documentation and upcoding (Sheehy et al. 2014). As one doctor describes: "reading the electronic chart has become a game of looking for a small needle of new information in a haystack of falsely comprehensive documentation and outdated, copied text" (Horwitz 2012). Interestingly, on

the one hand the problem of EHR notes is having *too much information* available, with the relevant clinical information being crowded out, and on the other hand coding presents the problem of producing *too abstract information*, stripped of clinically relevant details. Although this problem has been described and understood for many years, it still persists.

We believe that applying insights from the field of philosophy of technology may be useful here. Within this paper, we will focus on three intertwined research questions. How are the exchange and management of clinical information affected by the EHR? How does EHR use impact the patient-doctor relationship? And can a philosophical analysis help us to imagine a different design that benefits the clinical encounter? To answer these questions, we will present a postphenomenological case study of the EHR which focuses on its clinical use and the patient-computer-doctor interaction.

Postphenomenology

Before focusing on the specific analysis of the EHR, we would like to explain why we turn to a postphenomenological case study. Postphenomenology combines the empirical nature of Science and Technology Studies with the conceptual and normative approach of the classical philosophy of technology (Rosenberger and Verbeek 2015, p. 10). This allows the development of an in-depth study of the unique characteristics that distinguish the EHR from other types of technologies, while keeping a focus on the bigger philosophical questions related to the clinical encounter. Science and Technology Studies on the one hand, present a strong empirical approach, but often fail to answer more in-depth philosophical questions (Rosenberger and Verbeek 2015, p. 10). Classical phenomenology on the other hand, has been criticized for tending toward a dystopian view on technology, emphasizing the ways in which technology alienates human beings from themselves and from the world they live in (Rosenberger and Verbeek 2015, p. 10). By combining elements from both, postphenomenology offers a framework where case studies focus on how human-technology relations change our view on and interaction with the world around us, avoiding both utopian and dystopian tendencies.

Don Ihde, the founding father of postphenomenology, defines the framework as a "modified or hybrid phenomenology incorporating aspects of pragmatism and turning to the phenomena of technoscience" (Ihde 2009, p. 45). Instead of focusing on technologies as objects or artifacts, Don Ihde puts the human-technology relation central (Ihde 1990, p. 26). In the clinical world, this provides an interesting background to study patient-computer-doctor relationships. Postphenomenology acknowledges that technologies are not neutral: they mediate how we interact with the world. This *technological mediation* can influence our relation to the world in many different ways, sometimes opening up to us new ways of access, other times narrowing this access (Achterhuis 2001, p. 144). By mediating human experiences, technologies also mediate our moral decisions and actions—in this sense, technologies can be seen as *moral mediators* (Verbeek 2011, p. 52).

In our case study of the EHR, we will focus on two postphenomenological concepts: transparency and multistability. We will introduce both before turning to the EHR.

Human-technology relations

As previously discussed, postphenomenology studies human-technology relations. Don Ihde has described four types of human-technology relations, or four possibilities of developing a bodily-perceptual relationship with technologies (Rosenberger and Verbeek 2015, p. 13). The concept of *transparency* is closely related to the first type of human-technology relation—the embodiment relation.

1. *Embodiment relations*: technologies can become incorporated as if they were part of one's own bodily experience (Ihde 2009, p. 42). The user's experience of the world is reshaped through the device: the most useful example to grasp embodiment relations with is that of wearing eyeglasses, which mediate the vision of the user (Rosenberger and Verbeek 2015, p. 14). Moreover, once the user is accustomed to wearing them, s/he often stops noticing the glasses but focuses the attention outwards, to what is seen. This is what Don Ihde defined as a *(quasi)transparent* technology: it becomes a means of experience, not an object of experience in use (Ihde 2009, p. 42). The technology fades into the background of a user's awareness (Rosenberger and Verbeek 2015, p. 14). The degree of transparency depends on the type of device, but also on how familiar the user is with the technology. Wearing glasses can feel quite awkward at first, but they become more transparent after a while. However, Don Ihde provides a comparison with a hearing aid, which for many people never reaches the same level of transparency and embodiment (Rosenberger and Verbeek 2015, p. 15). Transparency presents itself on a continuum: a technology can be more or less transparent. This also applies to health care.
2. *Hermeneutic relations*: the emphasis here is on reading or interpreting what a technology shows us (Ihde 2009, p. 43). It could be quite straightforward, like reading the temperature measured by a thermometer, or more complex, like interpreting the X-ray image of a patient's chest. Again, transparency comes to the fore. A medical student will probably struggle to interpret the black and white shadows on the screen, while the X-ray image will

often appear in a perceptual gestalt to the experienced radiologist (see also Rosenberger and Verbeek 2015, p. 17).

3. *Alterity relations*: we sometimes interact with technologies as quasi-others (Ihde 2009, p. 43). This resembles the interaction we would have with another human—it often entails a kind of dialogue or exchange (Ihde 1990, p. 100). The most relevant example of this type of human-technology relation is probably that of the interaction with a robot, one that Don Ihde also discusses; a more mundane example is the ATM machine with which we interact in a back-and-forth play of questions and answers in order to withdraw money (Rosenberger and Verbeek 2015, p. 18). In alterity relations, the technology becomes opaque, or is least transparent (Van den Eede 2011, p. 149). We interact with the technology itself and are very much aware of it. This clearly distinguishes alterity relations from embodiment or hermeneutic relations.
4. *Background relations*: in this category, Don Ihde considers technologies that are part of the environment we live in. Examples are a thermostat or refrigerator running in the background (Rosenberger and Verbeek 2015, p. 18). There is a move beyond transparency here, in that these technologies are a 'present absence', shaping our environment without requiring direct action (Rosenberger and Verbeek 2015, p. 19).

Multistability

Multistability means a technology can be put to multiple purposes, or has multiple stabilities or variations (Rosenberger and Verbeek 2015, pp. 25–26). These different stabilities can be (but do not have to be) predetermined in the design. For example, a chair can be used to sit on, but also to stand on to take a box from the top shelf, or to block a parking spot while waiting for the moving truck. The chair was not specifically designed for these alternative functions. On the other hand, a Swiss army knife or a smartphone are examples of technologies that are inherently and deliberately multistable (Ihde 2012, p. 326). Don Ihde developed the concept of multistability through studies of visual illusions. An interesting example is that of the duck-rabbit illusion, where one can see either a rabbit (looking to the right) or a duck (looking to the left) in the same image (Fig. 1). Important to notice here is that the two appearances—the duck and the rabbit—cannot be seen at the same time. They are distinct variations, sometimes called 'gestalt switches' (Ihde 2009, p. 13). The viewer has to switch from one image to the other, although they are both present in one picture.

Postphenomenological case studies often focus on analyzing these multistabilities. A good example is Robert Rosenberger's variational analysis of the public bench and

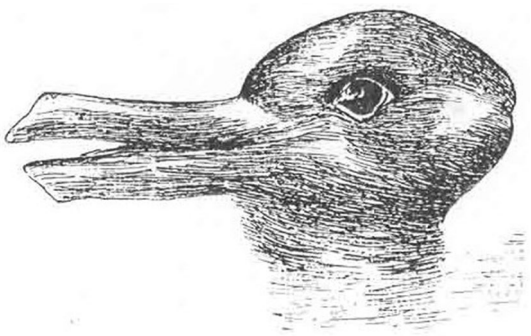

Fig. 1 Duck-rabbit illusion. *Source* Jastrow (1899)

Fig. 2 Public bench, London, UK. *Photo credit* Robert Rosenberger

the identification of its distinct stabilities of bench-as-seat and bench-as-bed (Rosenberger 2014). A public bench can be used to sit on, but people could also lay down and sleep on it. Certain modifications to a bench—such as dividers—may eliminate its bench-as-bed stability without influencing the bench-as-seat stability (Fig. 2). Such 'sleep prevention benches' discourage homeless people from using it as a bed, and thus control the whereabouts of the homeless population (Rosenberger 2014, p. 387). However, someone who only uses the bench to sit on, will probably not even notice the implication of this alteration. This type of in-depth examination, which also considers social and political impact or unintended consequences, is characteristic of postphenomenological case studies.

Case study of the EHR

The empirical part of this research is based on ethnographic fieldwork in a tertiary care hospital in Pittsburgh, PA, USA (observation of the use of the EHR and COWs during rounds

for approximately 9 h) and on the first author's (TM) own experience of using the EHR on a daily basis for outpatient consultations in a group practice of five physicians in Belgium. She (TM) combines clinical work as a primary care physician with a research project in philosophy of medicine focusing on the EHR. This specific situatedness comes with certain strengths and weaknesses, but the fact that the researcher is embodied and embedded in a social perspective is part of any postphenomenological analysis (Rosenberger 2014, p. 386). To the best of our knowledge, this paper presents the first[1] postphenomenological case study of the EHR.

Multistability

From notes to codes

The multistability of the EHR is most explicit in the way information is presented in a structured or coded manner. We will therefore focus on this *informational multistability* of the EHR. As mentioned above, classification systems such as ICD-10 consist of diagnostic and procedure codes that allow for a standardized representation of information. A code is often a reduction of a much richer, more complex and more 'messy' narrative. The ICD has a complex history, starting out as a classification system for causes of death evolving to include morbidity as well (Hirsch et al. 2016, p. 596). Later versions of the ICD system were tailored to categorizing needs for hospitals and show an increasing level of granularity (Hirsch et al. 2016, p. 597). This reduction and standardization allow for medical information to become *multistable* and reusable. The EHR is accessed by medical and administrative personnel for various purposes, in very different ways. For example, a nurse will access and use the EHR differently from a surgeon, or from a person conducting a fiscal review. They will often even work in different sections of the EHR, but core information will be shared by all.

Coded information can be put much more easily to many purposes. A coded piece of medical information can be pulled out of the patient care context, and be used for research, billing or quality improvement purposes, without requiring much effort. Importantly, unlike unstructured notes, codes can easily be read and "understood" by machines, so that they can drive decision-support alerts, automated quality reporting, and computer validation of "medical-necessity" of ordered tests for a given diagnosis, just to mention a few examples. We already briefly mentioned the work of de Ruiter, Liaschenko and Angus focusing on institutional priorities (de Ruiter et al. 2016, p. 53). The need to (re)use information in the EHR for different purposes has only increased over the last years.

There are at least four distinct purposes or stabilities of the shared information: *individual patient care, financial reimbursement (billing), quality-of-care control and (scientific) research.*

The copy-paste issue

Coding presents a specific challenge to clinical notes in the EHR, but there is another issue related to multistability that has haunted the EHR for a long time. We already briefly mentioned the copy-and-paste phenomenon, or the duplication of data from one location to another in the EHR (Sheehy et al. 2014). Combined with related issues such as overdocumentation, upcoding and autopopulation, this often results in a phenomenon called 'note bloat': notes become filled with trivial or redundant data (Stewart et al. 2015, p. 525). Translated to the concept of multistability in the EHR, this is information often very specifically aimed at the stability of financial reimbursement and is of little or no importance to other stabilities. When a care provider tries to find the necessary information needed for patient care, it risks becoming a needle-in-a-haystack operation. Copy-paste notes are less multistable, but rather focus on billing, rendering the information much less suited for other purposes.

Postphenomenology: duck-rabbit illusion

It is interesting to draw an analogy between this EHR specific informational multistability and the duck-rabbit illusion mentioned earlier. *Care providers are currently asked to construct their notes and codes as a duck-rabbit illusion: they are burdened with the task of producing multistable notes and codes.* The duck or image aimed at describing individual patient care, needs to be clearly recognizable in the given information. At the same time, the rabbit should be in there too, as a second image-in-image that needs to provide the information for financial reimbursement. If we consider all four mentioned stabilities, this results in an even more complicated drawing: this would mean producing a sketch in which a duck, rabbit, frog and cat can be discerned, for example.

We need to be aware of the fact that the only way in which to produce a duck-rabbit illusion (or even more complicated drawings), is through the *loss of detail in each stability*. A

[1] Other authors have conducted postphenomenological studies of concepts and topics in health care though—we will mention just three studies here, but there are many more publications. Anette Forss provided a very interesting analysis of the interaction between practitioners, microscopes and cells or the patient in cytology labs (Forss 2012). Marjolein de Boer and Jenny Slatman applied the concept of technological mediation to better understand the impact of technologies on the agency of women with breast cancer (de Boer and Slatman 2018). And lastly, Adam Rosenfeld analyzed the multistability of brain-dead bodies in the book Postphenomenological Investigations (Rosenfeld 2015).

highly detailed illustration of a duck, with brightly colored feathers, wings and webbed feet will make it very hard to discern a rabbit in the same drawing, and vice versa. In order to produce a drawing where both animals can be recognized, it needs to be stripped of most of its specific details: it becomes *an abstract image*. As such, it leads to an impoverished, compressed and sometimes odd end result. This analogy clearly describes the tension between the need for multistable information on the one hand (that will have to be structured and standardized) and the need for expressivity and richness in clinical notes on the other hand (allowing for providers' and patients' impressions and thought processes, and for uncertainty) (Rosenbloom et al. 2011).

Another problem may occur that is related to the copy-paste issue discussed above. Because institutional priorities such as billing can be very demanding on the specific information that needs to be included in notes, some care providers tend to draw a rabbit in their notes. By copying and pasting information, they make sure to include all necessary details for billing purposes. However, this type of note becomes quite useless for patient care, as the image of the duck is mostly lost, or bits and pieces need to be put together from an abundance of irrelevant information. Both problems—loss of richness in detail and focus on billing purposes—relate to the informational multistability that is increasingly embedded in and expected of the EHR, although they have a different outcome. Overly structured and coded data will lead to a patient file that contains mostly numbers and codes, lacks a narrative, and presents the information in a very sober manner, while the focus on billing purposes will lead to an EHR that contains repetition and is cluttered with clinically irrelevant data.

A different approach to multistable information

As stated before, very often it is the case that care providers are burdened with the task of constructing this complex display of information. They are asked to keep in mind two or more purposes for the information while taking notes. This can be achieved through coding and related structured entry systems, which requires the care provider to use predefined standardized clinical data, often extended with dropdown choice structures (Rosenbloom et al. 2011). However, based on this postphenomenological view on the multistability of medical information in the EHR, we recommend considering an alternative approach. Since the primary responsibility of health care providers is to treat the patient, everything else being supportive or secondary, we would argue that the primary duty of EHR implementation should be to ensure the best possible support for the clinical encounter, especially to improve health information exchange between different care providers and with the patient, particularly as it relates to how health care providers (and patients) use the system. From this perspective, information input systems could be developed that allow the care provider to focus on one stability: *patient care*. This alternative, although still a work in progress, is already available:

> "With flexible documentation, healthcare providers record patient care episodes using relatively unstructured approaches, such as using dictation with transcription, speech-recognition software, or typing using a loosely templated CBD system. Once the clinical documentation is complete, post hoc text processing algorithms can be used to produce structured data." (Rosenbloom et al. 2011).

Post-hoc text processing could involve searching for key narrative-text strings or string patterns, or more complex natural language processing systems (see also Nguyen et al. 2018). What is of importance here is that other stabilities can move to the background and no longer require awareness of the care provider. This would compare to asking care providers to draw a very detailed duck, while text processing systems extract a rabbit (and frog, or cat) afterwards. Surely, both systems—structured input or post hoc text processing—come with benefits and problems. Post-hoc extraction of information will produce more abstract information for billing and research purposes and runs the risks of making errors in classification, probably creating more challenges to produce relevant information. Or, in other words, it is challenging to extract a rabbit or cat from a detailed duck image. From a postphenomenological point of view, we would argue that at least a debate is warranted to answer the question what purpose EHR information should serve first and foremost. If serving all stabilities of patient care, billing, research and quality control is the aim, then structured input may be the best choice. However, if we want to give priority to patient care, the alternative system of post hoc text processing should be considered. Here, the informational multistability is preserved, but priority is given to a narrative approach of the clinical notes and thus to patient care. In either way, there are major implications of this choice for EHR design and architecture that are not sufficiently addressed at this point.

Transparency

As mentioned above, a technology can be described as transparent when it becomes a means of experience, not an object of experience in use (Ihde 2009, p. 42). Yoni Van Den Eede has studied the concepts of 'transparency' and 'opacity' as heuristic instruments in a reflection on technological mediation (Van Den Eede 2011). Peter-Paul Verbeek wrote a commentary in reply to his work (Verbeek 2012). We will use insights from both to define the concepts of transparency and opacity as clearly as possible within the context of the EHR

and health care. Yoni Van Den Eede discerns a 'transparency of use' from a 'transparency of context'. We will also adhere to this distinction, although in a slightly altered way. The transparency of use focuses on the technology itself. As Yoni Van Den Eede explains:

> "'Transparent' here means that something is not perceived, that it is 'invisible,' or escapes conscious attention—it still *is* there in some capacity, but one sees 'through' it. On the contrary, 'opaque' is something that lies clearly in view or to which deliberate attention is paid, but in any case, importantly, 'through' which one cannot look" (Van Den Eede 2011, p. 154).

Peter-Paul Verbeek provides the classic example of wearing a pair of glasses (transparent technology) versus learning how to drive a car (opaque technology, at least in the learning process) (Verbeek 2012, p. 392). Yoni Van Den Eede then describes the same conceptual pair on the level of 'context'. We will adhere to the definition Peter-Paul Verbeek provides:

> "Here, transparency refers to people's *awareness* of the conditions, impacts and consequences of technologies. If these remain invisible, technologies are 'contextually transparent'; if they do become visible, a form of 'contextual opacity' emerges" (Verbeek 2012, p. 393; his emphasis).

He further clarifies that transparency at the level of use is a form of perceptual 'neutrality'. It represents an *experiential* form of the distinction between transparency and opacity, whereas transparency of context embodies a more *cognitive* dimension of the distinction (Verbeek 2012, p. 394). Transparency of context "concerns our *awareness* of the mediating role technologies play rather than our direct *experience* of the technologies themselves" (Verbeek 2012, p. 394; his emphasis).

Based on these insights, we would like to define the conceptual pair of transparency and opacity at the two levels—of use and context—for the specific situation of the EHR as follows. Here, 'use' can be defined as the actual interaction with the EHR: most often that will be the medical professional *using* the record, but it can also be the patient accessing or *using* her or his own health data. This is no different from the definition that both Yoni Van Den Eede and Peter-Paul Verbeek adhere to. However, we would define 'context' in this specific situation as the *context of the patient–doctor relationship*. The emphasis then, is not so much on the social and political dimensions of the technology, but on the "awareness of the mediating role technologies play", as Peter-Paul Verbeek points out[2] (Verbeek 2012, p. 394). In other words, transparency in the context of the patient–doctor relationship means both parties are unaware of the impact the EHR has on their interaction. The EHR is not a topic, not a conscious part of their conversation. On the contrary, opacity at this level would mean that both medical professional and patient are very much aware of the role the EHR plays in their interaction.

This leads to two specific questions: Is the EHR transparent or opaque in its use? And is it transparent or opaque in the context of the patient–doctor relationship?

Opacity in use

When observing the use of the EHR by medical professionals during hospital rounds, it can be described as predominantly *opaque in use* in at least two aspects. First, COWs or mobile units are physically opaque. A mobile unit is about the height of an adult person, with a computer screen at eye level, a keyboard underneath a small table and a frame on wheels that allows it to be moved around. Quite often, because of their size, they are not taken into the room but left in the hallway while the medical team talks to the patient. Nurses in particular often keep their mobile unit on the hallway, and move back and forth between the patient and the mobile unit. Sometimes taking them into the room is not even allowed, for example when the patient suffers from a contagious disease. This physical opacity is one of the reasons why the number of COWs used during rounds is limited. In our experience, a team of 7 to 9 medical professionals will use 2 to 3 mobile units. The other team members will turn to a paper summary and jot down notes, which, if necessary, will be entered into the EHR afterwards.

Second, working within the EHR also comes with a high level of opacity. Finding information or putting in orders requires a lot of clicking in drop-down menus, or going through different tabs and screens. One paper observes how a busy 10-h shift at an emergency department results in a dazzling total of about 4000 mouse clicks (Hill et al. 2013). Part of this opacity is not specifically technology-related, but rather related to safety and privacy checks. For example, the computer logs out quite fast when it is not being used, to prevent unauthorized access. This also means that medical professionals have to go through the log-in procedure several times during rounds. Overall, the interaction with the EHR is often described as *not user-friendly*. As mentioned before, sometimes the paper interface seems to be preferred over the digital interface. To-do lists are jotted down on the

[2] Strictly, this could also be seen as a form of 'use', but use in the context of the patient–provider relationship. 'Context' as introduced by Yoni Van Den Eede, would rather refer to a meta-level of health care organization. However, we will focus on use within the context of the patient–provider relationship and refer to this as our focus on context.

paper summary, and the actual orders are entered into the computer afterwards when rounds are finished.

Transparency in the context of the patient–provider relationship

This opacity in use is accompanied by a *transparency in the context of the patient–doctor relationship*. The EHR is rarely integrated into the conversation with the patient. Both medical professional and patient seem to consider the EHR as part of the work flow of the care provider. In this sense it is not a topic of conversation, just as the stethoscope is not a topic of conversation. Even when the mobile unit is in the room with the patient, and the medical professional is interacting with it, it is ignored on the level of the conversation, instilling a 'black box'-like status. One patient succinctly describes it this way: "They're looking at the computer constantly when I'm in the room. I know they're not on Facebook but I don't know what they are doing." (Lee et al. 2016). In this sense, the EHR is the proverbial elephant in the room: it is there for everyone to see, taking up its physical space, but it is not directly referred to by either party, although more often all parties—both care providers and patients—do interact with it. A recent study by Traber Giardina et al. showed that a majority of patients did not receive an explanation or interpretation when they digitally consulted their results through the patient portal system. Almost half of the participants turned to the internet to find more information (Giardina et al. 2018).

When the information in the EHR does come up, it often upholds its 'black box'-like status. References to the EHR are often vague and non-specific, as the first author heard while doing the ethnographic fieldwork: "It said in *the thing* that you have been taking medication for this." The exception to this most often occurs when discussing results and treatment plans. The EHR becomes opaque when the doctor turns the screen toward the patient and shows where the kidney stones are located, for example, or when errors in a medication list are corrected. This however, is rarely the case in other instances. We thus conclude that the EHR is mainly transparent in the current context of the patient–doctor relationship.

Recommendation for future use: transparency in use and opacity in context

We want to argue—in line with Yoni Van Den Eede and Peter-Paul Verbeek—that we should strive for the opposite of the current situation: transparency in use, and opacity in the context of the patient–doctor relationship. Yoni Van Den Eede concludes (Van Den Eede 2011, pp. 156–157):

> "From a 'use' (or designer's, or engineer's) viewpoint, awareness of the technological mediation must be as low as possible. From a 'context' (or individual's, or reformer's, or victim's) viewpoint, consciousness of it should be as great as can possibly be accomplished".

Peter-Paul Verbeek further argues that both can work well together, and that designers should aim for this "transparency in use while keeping up a contextual opacity" (Verbeek 2012, p. 394). We want to further discuss what this means for the EHR.

A *transparency in use* could be reached on two levels. First, introducing tablets could make the work flow and access to the EHR better adapted to the specific requirements of working in a hospital or clinic. For example, a disposable cover could protect the tablet while working with patients who suffer from a contagious disease and thus enable care providers to interact with both patient and EHR at the same time. A fingerprint recognition could ease the log-in procedure without compromising safety or privacy demands. Second, a more intuitive interface could improve the workflow within the EHR by reducing the number of required clicks to navigate through the information.

The *opacity in the context of the patient–doctor relationship* is even more important, in the sense that it could impact the interaction between patient and care provider in a more fundamental way. An example of what this could mean is described by Robert Wachter, who interviews Tom Delbanco in his book *The Digital Doctor*. Delbanco is a strong advocate of patient access and one of the founders of the OpenNotes initiative (Wachter 2015, pp. 174, 176). This application allows doctors to share their visit notes with patients. Delbanco describes a memorable encounter with a patient, which perfectly fits the idea of contextual opacity. During his conversation with this patient, Delbanco noticed several little signals that pointed toward a possible problem of alcohol abuse (Wachter 2015, p. 173). He wanted to write this down in the record, but realized the patient would be able to read it, so he decided to first have a conversation about this with the patient (Wachter 2015, p. 174, quoting Tom Delbanco):

> "I'm wondering whether I should write, as part of our understanding of each other, "alcohol abuse". If you don't see it as a problem, there's no point in writing it. On the other hand, if you think it is, we should write it down, agree on it, and work on it. There was a long pause and he said, "Doc, I think you should write it down". And that was the key to opening an aggressive intervention with his drinking and his life. I got a social worker involved. We got his wife involved, and that was a turnaround in his life."

What is of interest to us here, is that what is or is not written down in the record, is an actual topic of conversation here.

It goes even further in this specific case, because it opens up the conversation about a sensitive topic and leads to a treatment as well. "Seeing" the EHR in this way in a patient-doctor conversation, having both parties work together to put in information (or to extract information, or to construct a treatment plan, for that matter) has the potential to strengthen the patient–doctor relationship, instead of weakening it because the doctor is absorbed by a medical professional's tool without patient involvement.

Conclusion

This postphenomenological case study of the EHR focuses on the concepts of multistability and transparency. Care providers are currently asked to enter information in a multistable form, meaning that it can be used for multiple purposes: not only for individual patient care, but also for billing purposes, quality of care control and research, amongst others. This means they have to present the information as a duck-rabbit illusion, in which both (or more) stabilities can be perceived. One important way to achieve this is through the use of coded information. However, we should be aware of the inevitable loss of detail this creates in every separate stability. Therefore we argue that in a medical setting, we should weigh the importance of detail in individual patient care against the need for a multistable presentation of medical information. Alternatively, we could ask doctors to focus on one stability—patient care—and have artificial intelligence systems (such as natural language processing) extract other stabilities. This choice implies a different EHR design.

The EHR as we now know it, is predominantly opaque in use and transparent in the patient–provider relationship. This means it lacks an intuitive interface and awareness in patient-provider conversations. We argue that an opposite approach could be beneficial: a transparency in use would mean that EHR technology is mobile, intuitive and flexible, requiring minimum effort to put in information. The opacity in the patient–provider relationship requires the EHR to become an active part of the interaction between patient and care provider, in which its content and approach are topics of discussion. The fact that patients are increasingly given access to their own medical record, could be considered a first step in this process.

Future research

To our knowledge, this paper presents the first postphenomenological case study of the EHR. Further research will be necessary both on a conceptual and empirical level. First, we should question which goals we want to achieve through EHR use, and adjust its design accordingly. How we put in information will be determined by what we want to use it for. This will require a careful exercise in organizing priorities and integrating new technologies. How should we integrate episodic and longitudinal care into the EHR? Do we use narrative or coded information, or both, and how should we balance them? Which functions should be given priority? This brings us to the empirical part of future research. In order to develop recommendations for improvements, we need more studies analyzing the current use and impact of the EHR on the clinical encounter. Although many different research fields are involved (medicine, ethics, IT, law, sociology, etc.), studies are often conducted in separate worlds that do not communicate. We hope this application of philosophy of technology in the medical context may be of further use to the fields of bioethics and philosophy of medicine.

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