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EHR Usage Problems: A Preliminary Study

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Abstract. Electronic health record (EHR) systems were initially developed to improve health care delivery by facilitating the healthcare professionals' access to electronically-stored patient information, but problems are regularly reported in the literature. We present here a preliminary study conducted at a 950-bed university hospital. They have implemented an EHR in 2012 to remove their paper-based system. After few years, physicians complain that the EHR is *"too complex"*, *"too slow"*, *"unsatisfying"*, and *"which interacts with too many health software"*. This preliminary study was based on individual interviews inspired from critical incident technique with 9 hospital professionals (physicians and pharmacist) to establish a global diagnostic of the EHR's usability failures/difficulties and their potential impacts. Results show that professionals faced to many constraints impacting their work but more importantly the patient care, with recent outstanding examples. This work is a first step of a larger study to help the hospital to map usability failures, their context of use and associated risks/impacts, and to provide solutions to fix it.

Keywords. Usability, EHR, Patient Safety, Medical informatics applications

1. Introduction

Electronic health record (EHR) systems aim to improve healthcare delivery by facilitating healthcare professionals' access to electronically-stored patient information [1]. Yet, numerous researches have shown that poorly designed health technologies (including EHR) influence negatively the process of patient care, clinician workflows and health professionals work [1–5]. In the case of EHR, many physicians confront problems while using them. They often feel frustrated due to their complexity, and to their lack of intuitiveness and of efficiency; they consider their use as time-consuming and source of errors [3,6]. Consequently, supported by several studies [2,6,8–10], medical associations [11,12] provide software designers and healthcare facilities with recommendations to facilitate usage of EHR. Nowadays, it is known that successful implementation of EHR depends on a combination of technical, social and organizational factors [3,12]. Nonetheless, dramatic accidents due to EHR's usability problems, for instance, are still reported [13].

We present here a preliminary study conducted in a 950-bed university hospital. In 2012, an EHR was implemented to substitute for the paper-based system. Due to many

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physicians complains about the EHR, the chief information officer (CIO) created an *EHR group* approved and supported by the hospital board. The group was composed of the CIO and 14 medical and pharmaceutical specialists involved in the deployment and improvement of the EHR. Initially, this group was in charge of facilitating the EHR usage by improving the system, based on the physicians' and pharmacist's needs or complaints. Trained hospital technicians and physicians developed and modified add-ons to adapt the EHR to local needs. Unfortunately, this strategy reached quickly its limits. The French market being not a priority for the EHR company due to its small size, the latter did not provide enough and fast services to the hospital.

In 2017, the *EHR group* and the hospital board decided to explore how the EHR impacts the user's activities and cares delivered to patients in order to improve the ease and safety of use. For this purpose, the *EHR group* asked our human-factors team to explore and to take stock on related issues with the EHR and to understand more precisely *i)* the difficulties met by physicians and pharmacists while using the EHR and *ii)* their usability causes (EHR weaknesses), and *iii)* their potential impacts on the work situation. This paper presents a preliminary study providing an overall diagnostic of physicians' and pharmacists' difficulties and their potential impacts.

2. Methods

This study was conducted from April to July 2018. Data were collected by one HF master student during her field practicum and one experienced HF expert through individuals interviews with members of the *EHR group*. These interviews aimed at obtaining a detailed analysis of the difficulties experienced by daily users.

Interview protocols were inspired by Flanagan's critical incident technique [14]: participants were asked to list all weaknesses of the EHR, to remember problems they have met when they used it, and, if possible, to illustrate them with an actual situation they faced. Contrary to Flanagan's method, the participants were not asked before the interview to prepare examples of faced situations. Participants profession/specialty and experience were also collected. Interviews were supported by a grid and were audio-recorded.

All data were transcribed and analyzed by the HF trainee; results from the analysis were cross-checked by the HF expert. The analysis aimed at identifying potential underlying usability flaws that could negatively affect the use of the EHR, if any. More precisely, the analysis allowed to link usability weaknesses of the EHR, to their impact on the work situation and/or patient safety. We also noted the frequency each weakness was cited.

3. Results

3.1. Overall results

Nine interviews (average time 50 min) were conducted with participants from various specialties (laboratory pharmacist, clinical pharmacist, anesthetist, radiologist, infectious disease specialist, cardiologist, emergency physician and two neurologists). Six *EHR*

group members did not answer the invitation. Overall, interviewees reported 55 different weaknesses of the EHR.

3.2. Most reported usability weaknesses and their impact

Most reported weaknesses concerned information inaccessibility, technical difficulties and missing functionalities (cf. Table 1): issues such as “too many clicks”, “slow network”, “too many tabs”, “problems of browsing” appeared during the medical round, the discharge letter writing, the order of tests or medications, the patient information gathering, and the lab tests results search. The most expressed impact on the professional’s work practices is the waste of time; two physicians estimated they lose 1h30mn per medical round due to network slowness, bugs and difficulties to retrieve the relevant information. Furthermore, they also reported damages for patients (e.g. delayed patient care) along with a dramatic accident partly due to usability problems.

Table 1. Most cited EHR’s usability weaknesses and their impacts.

Usability Weaknesses (nb)	Consequences on the work situation
Too many tabs. Around 7 tabs consulted per patient during a medical ward. (7/9)	Waste of time to have a complete overview of the patient case, leading to an increase of the cognitive workload; relevant information is missed.
EHR not presenting all relevant information. Data are scattered across the EHR and between the EHR and other software (7/9)	Data are missed; clinicians waste their time switching between several software; they sometimes ask nurses for the needed information
EHR not detailing information. Scales of diagrams for blood pressure or temperature cannot be adjusted. (4/9)	Data about arterial pressure or temperature are not readable and cannot be correctly interpreted, whereas a half a degree evolution is a crucial information in pediatrics or geriatrics.
Lab results are not easily accessible. Data are scattered amongst several tabs in the EHR with various levels of detail and between the EHR and the laboratory information system (LIS). (5/9)	Results are missed; clinicians waste their time switching between the EHR and the LIS; clinicians regularly call the lab to find the results and to know whether a taking of blood is already prescribed or performed.
Interface is not personalized. Each clinician accesses the same homepage with the same information. (4/9)	Waste of time to access relevant contextualized information; relevant data are missed.
Alerts not relevant. There are too many alerts without severity distinction. (4/9)	Virtually all alerts are overridden without being read first, leading to missing potentially critical information, such as treatments coming to an end, incorrect dosage or potential drug-drug interaction.
No information on already ordered radiological exam and blood tests. Prescribers or technicians cannot know whether a patient has a radiological exam already planned or recently done. (4/9)	Duplicate demands leading to double irradiation, double injection of contrast agent, double blood test, or to use wrong test tubes; systematic cross-checking leading to professionals’ stress.
Complex browsing. Screens with up to 5 scrolling bars simultaneously; no dual windows; no automatic save of data entered, etc. (5/9)	Clinicians waste their time switching between tabs; notes and data entered are lost when switching to another tab without saving first; clinicians are lost in the software, leading sometimes to abandon.

3.3. Detailed instance: a medicine facility in quarantine

One interviewee reported a noteworthy instance that occurred a few days before his interview. This section depicts this situation where the combination of organizational and EHR usability weaknesses led to quarantine the internal medicine facility following the discovery of a patient infected by multidrug resistant bacteria (MRB) (Figure 1).

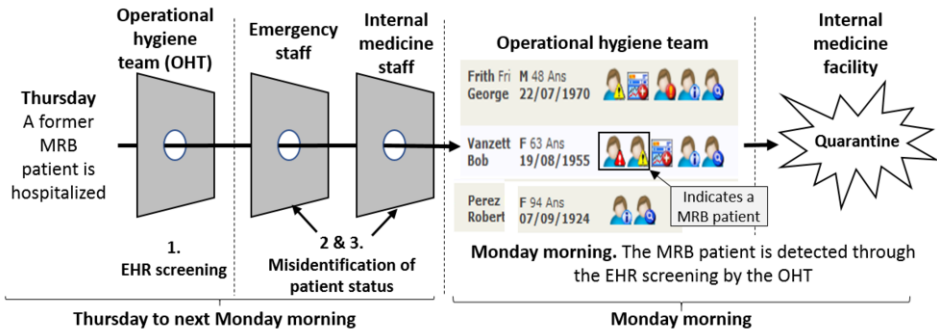


Figure 1. Schematic representation of the key facts that led to the quarantine of the internal medicine facility. Numbered elements represent the broken barriers that should have prevented from the occurrence of this incident (cf. main text). The screenshot represents the icons indicating a MRB patient in the EHR patients list. (*fictive patient case*).

On a Thursday morning a patient with several previous MRB diagnostics was admitted to the emergency department. His most recent MRB results were negative and so, no specific hygienic actions were undertaken. Emergency staff followed the procedure and prescribed a new MRB test at patient admission. The result was positive and confirmed a few days later but none of these results was noticed until next Monday; the patient was transferred to the internal medicine facility, while specific hygiene procedures should have been carried out. Normally, this incident should have been stopped by three barriers during the patient care process:

EHR screening by the operational hygiene team (OHT). The OHT is expected to check the presence of MRB patients in the hospital each Monday by screening icons in the EHR patients' list. This barrier was inefficient because the OHT perform the screening only on Monday while the patient was admitted on Thursday.

Display of patient status. As soon as the positive MRB results are available, two icons appeared next to the patient name. Only the association of the two icons (screenshot in Figure 1) means a positive MRB result; separately, each icon has another meaning (respectively risk of fall and special diet). Icons are visible to the whole staff. Yet, the emergency and the internal medicine staffs misinterpreted the combination of both icons; they did not know its meaning rendering this barrier inefficient.

The positive status of the patient was identified only on the next Monday by the OHT during the weekly EHR screening. This discovery immediately led to quarantine the whole internal medicine department: human resources were completely reorganized, strict hygiene measures and patient care procedures were implemented, the facility was decontaminated, all new suspicious patients in the ward were MRB tested, and recently discharged patients were recalled. This problem caused the dissatisfaction of the professionals regarding the EHR: they pointed out the absurdity of the use of a combination of two icons to indicate a MRB patient while both icons have other meanings.

4. Discussion

This preliminary study based on interviews adapted from TIC indicates that the concerned EHR is source of constraints and errors, with risks for patients care. Results are consistent with the literature: there are still well-known usability failures that hamper the use of EHR (e.g. clinicians skip the alerts; users do not know how to go on; prescribers are placed under pressure) [5,7]. The main limit of the study was to restrain the interviews to the members of *EHR* group because of their role in the physician's complaints centralization. Nevertheless, it also constitutes a strong base to carry out a more detailed analysis of the usability causes to those problems in order to propose solutions to the *EHR* group of the hospital. In further researches, we will first implement an ergonomic inspection of the EHR, and then perform systematic observations in several facilities *i)* to observe the EHR usage, *ii)* to link usability failures/difficulties with their associated risks/impacts, and *iii)* to provide solutions to fix them.

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