



Card sorting to evaluate the robustness of the information architecture of a protocol website



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ARTICLE INFO

Article history:

Received 4 March 2015

Received in revised form 2 September 2015

Accepted 2 December 2015

Keywords:

Card sort

Information architecture

Mental models

Human centered design

Medical protocol

Website

MRSA

Evaluation methods

ABSTRACT

Objectives: A website on Methicillin-Resistant Staphylococcus Aureus, MRSA-net, was developed for Health Care Workers (HCWs) and the general public, in German and in Dutch. The website's content was based on existing protocols and its structure was based on a card sort study. A Human Centered Design approach was applied to ensure a match between user and technology. In the current study we assess whether the website's structure still matches user needs, again via a card sort study.

Methods: An open card sort study was conducted. Randomly drawn samples of 100 on-site search queries as they were entered on the MRSA-net website (during one year of use) were used as card input. In individual sessions, the cards were sorted by each participant (18 German and 10 Dutch HCWs, and 10 German and 10 Dutch members of the general public) into piles that were meaningful to them. Each participant provided a label for every pile of cards they created. Cluster analysis was performed on the resulting sorts, creating an overview of clusters of items placed together in one pile most frequently. In addition, pile labels were qualitatively analyzed to identify the participants' mental models.

Results: Cluster analysis confirmed existing categories and revealed new themes emerging from the search query samples, such as financial issues and consequences for the patient. Even though MRSA-net addresses these topics, they are not prominently covered in the menu structure. The label analysis shows that 7 of a total of 44 MRSA-net categories were not reproduced by the participants. Additional themes such as information on other pathogens and categories such as legal issues emerged.

Conclusions: This study shows that the card sort performed to create MRSA-net resulted in overall long-lasting structure and categories. New categories were identified, indicating that additional information needs emerged. Therefore, evaluating website structure should be a recurrent activity. Card sorting with ecological data as input for the cards is useful to identify changes in needs and mental models. By combining qualitative and quantitative analysis we gained insight into additional information needed by the target group, including their view on the domain and related themes. The results show differences between the four user groups in their sorts, which can mostly be explained by the groups' background. These findings confirm that HCD is a valuable approach to tailor information to the target group.

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1. Introduction

Picture a medical protocol database, designed to enable health care workers to find relevant protocols for providing safe care to

infectious patients, that only retrieves search results for queries that exactly match the indexed expert-driven terms. For example, a nurse lacking the medical expert jargon will be unable to find instructions when searching for: "how to wear a gown", instead of "personal protective equipment protocol". Ill-fitted technology like this fails to meet user-needs and the context of use, which may lead to frustration and, particularly in health care, possibly dangerous situations. As a reaction, developers and designers aim to put the intended end user central during development by applying Human Centered Design (HCD). This design approach promotes taking on a user perspective to ensure that technology design fits with its users' abilities and preferences, and thereby promotes better usability

Abbreviations: MRSA, Methicillin-resistant Staphylococcus aureus; HCW, healthcare worker; HCD, Human Centered Design.

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<http://dx.doi.org/10.1016/j.ijmedinf.2015.12.003>

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and effective use [1]. Involving users, as well as other stakeholders, in development and testing technology, is helpful to increase this human-technology match [2,3]. This contributes to a pleasurable user experience and recurrent use (e.g., website visits). Additionally, HCD can be of paramount importance to ensure that the target group can use the technology the way it was intended. Accordingly, HCD has been found to contribute to the acceptance and uptake of technology [1]. Therefore, even though involving the target group in the development phase costs time, effort, and money, doing so seems worth it. Especially in health care situations, costs to involve users in development may be high due to the specific health care setting, where health care workers (HCWs) are primarily occupied with providing care and may lack time to be involved [4]. Likewise, it may be difficult to involve patients, due to health issues that limit their physical ability to participate and the often temporal status of patient. So, opportunities to involve HCWs or patients to improve the design are likely limited, while the consequences of unusable or rejected design might negatively affect the user's or the patient's health. Therefore, getting the technology right at once is important.

1.1. Card sorting

The HCD approach aims to foster the fit between human and technology, a better usability, and information technology that is supportive of user tasks [1,2]. Card sorting is a HCD method that is used often to create an effective information structure that matches the mental models of the target group and enables them to find, interpret, and apply information easily [1,5]. In this method, the researcher selects and prints excerpts of the information representing the content of the website or other medium onto digital or paper cards. Participants representing the target group are then asked to sort the cards into piles that are meaningful to them. A pre-defined set of piles can be used in a closed card sort, for example to test a readily existing website structure. In contrast, in an open card sort participants are fully free to create and name as many piles of cards as they think are necessary. All the participants' sorts are then analyzed to surface which cards are most often placed together in one pile. These clusters of related cards serve as a basis to structure the website, for example by basing the main categories on the clusters [5,6]. In this approach, the frequency with which two cards are placed in the same pile by the participants, as well as the similarity between pile labels is of interest to establish the preferred structure and categorization of the information. Card sorting is usually applied as a formative method to evaluate a website's architecture [7,8]. Not much is known about the extent to which card sort results lead to long-lasting information architectures that still fits user needs some time after implementation. By evaluating a website with medical protocol-based information, we strive to gain insight into card sort driven information structure on a long-term basis.

1.2. A protocol website

A mismatch between user information needs and available information resources is problematic, especially in care settings where Methicilin-Resistant Staphylococcus Aureus (MRSA) is prevalent. Patients carrying or infected with this drug-resistant bacterium require highly protocolized care. Therefore, the protocol website www.MRSA-net.nl was developed to accommodate information needs regarding MRSA of both the general public (including patients) and HCWs, and support better adherence to MRSA prevention and control measures [9–12].

For the development of MRSA-net, various HCD methods were applied [11]. The website offers protocol-based information that is structured and formulated to match the target groups' information needs, both in German and in Dutch. The MRSA-net structure was

derived from card sort studies and user evaluations. The design and presentation of information is matched to user needs and preferences. This includes clear instructions in text or video on how to perform certain infection control measures, information regarding treatment, matters concerning HCWs' or patients' personal lives, and background explanations.

After entering MRSA-net's homepage, users choose between HCW and public content (see Fig. 1). Hereafter, they arrive at an overview page, tailored to their choice. The HCD development process resulted in 12 main categories for the general public target group, and 10 main categories for the professional (HCW) target group. These main categories remain visible when viewing target content (see Fig. 2). Also, an open search field and frequently asked questions can be accessed from here.

1.3. Study aim

In this study, we investigate to what extent the user-driven website MRSA-net actually complies with user information needs, over one year after its release. More specifically, to evaluate whether the card sort driven design process resulted in an information structure that still meets the needs of the four target groups, we performed a (second) card sort. In this study we use ecological data, i.e., search queries entered in the open search field, after one year of usage. This approach enables us to identify possible flaws in the information structure, based on actual use.

2. Method

An open card sort method was conducted to evaluate the professional as well as the public content on MRSA-net. Therefore, four groups participated: German and Dutch HCWs and German and Dutch members of the general public.

2.1. Materials

For the open card sorts, we used search queries that users entered on the MRSA-net's open search field which were retrieved from the website's log data. These data represent user information needs, which may or may not have been met by the MRSA-net content. A random sample of 10% of all search queries was taken from the logged search words in the timeframe January–April 2009 ($N=971$ and $N=694$ for German and Dutch searches, respectively). In this period, log data showed that MRSA-net use stabilized at about 11,000 unique users per month. Words and sentences in these entries that overlapped, were difficult to interpret, or appeared to be unrelated to MRSA (out of context) were removed. For example: *MRSA symptoms* and *symptoms MRSA* appear as two different search phrases, and were merged in our search phrase sample. Also, a search entry such as *Outdoors* (in Dutch: *buitenlucht*), is considered too vague to interpret and was removed from the sample. In addition, evident typos were corrected to improve readability. In case of removal of search phrases from the sample due to aforementioned reasons, an additional random sample was drawn and checked until a sample of 100 words/phrases was created. This procedure was performed for all four categories of content (HCW: Dutch, German; Public: Dutch, German), resulting in four sets of 100 words/phrases that were printed onto paper cards. The materials that were used in this study differ from the card sort materials that were used for the initial creation of MRSA-net. The current study uses ecological input (search words representing actual information needs during website use). Contrasting, in the card sort study that guided MRSA-net's design, cards were created based on users' reactions to and problems with using MRSA protocols.

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