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Major Article

The value of participatory development to support antimicrobial stewardship with a clinical decision support system

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Background: Current clinical decision support systems (CDSSs) for antimicrobial stewardship programs (ASPs) are guideline- or expert-driven. They are focused on (clinical) content, not on supporting real-time workflow. Thus, CDSSs fail to optimally support prudent antimicrobial prescribing in daily practice. Our aim was to demonstrate why and how participatory development (involving end-users and other stakeholders) can contribute to the success of CDSSs in ASPs.

Methods: A mixed-methods approach was applied, combining scenario-based prototype evaluations (to support verbalization of work processes and out-of-the-box thinking) among 6 medical resident physicians with an online questionnaire (to cross-reference findings of the prototype evaluations) among 54 Dutch physicians.

Results: The prototype evaluations resulted in insight into the end-users and their way of working, as well as their needs and expectations. The online questionnaire that was distributed among a larger group of medical specialists, including lung and infection experts, complemented the findings of the prototype evaluations. It revealed a say/do problem concerning the unrecognized need of support for selecting diagnostic tests.

Conclusions: Low-fidelity prototypes of a technology allow researchers to get to know the end-users, their way of working, and their work context. Involving experts allows technology developers to continuously check the fit between technology and clinical practice. The combination enables the participatory development of technology to successfully support ASPs.

Clinical decision support systems (CDSSs) are a relatively well studied and widely used form of eHealth technology to support physicians in prudently prescribing antimicrobial agents.[1] This makes these systems a valuable asset for an antimicrobial stewardship program (ASP). An ASP—a multilevel program based on a theragnostic approach[2]—is intended to deal with the global health problem of infections with multidrug-resistant organisms by guiding prudent use of antimicrobial agents based on adequate diagnostics.[2,3] Despite promising results,[4] the implementation of such programs remains challenging.[5] Implemented systems are not always used or adhered to.[6,7]

A recently performed scoping review[1] dug deeper into this phenomenon. It showed that end-users were hardly involved in the development of the CDSSs. This means that it is very likely that CDSSs are successful at reflecting clinical standards, but fail to support their users in practice.[1] It has been suggested that this contributes to low use and adherence rates.[6,8] Studies show a need for a behavioral and/or social approach to the development of interventions in ASPs.[9,10] This can be done by adopting a participatory development approach (ie, involving end-users and other stakeholders).

Via the description of the development process of a CDSS for ASPs, we aimed to demonstrate why a participatory development approach renders important insights to develop successful ASP-supporting technology. In addition, we describe what kind of information it yields that contributes to the success of the technology.

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All authors were involved in the design of this study. NBdJ performed data collection. NBdJ and JW performed data analysis. All authors were involved in drafting the manuscript. All authors read and approved the final manuscript.

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This is done by applying a mixed-methods design to gain insight into the potential end-users' perceived needs and to cross-reference those perceived needs with actual needs. Perceived needs were evaluated via scenario-based prototype evaluations among medical resident physicians, with a low-fidelity prototype of a CDSS for an ASP. Actual needs were evaluated via an online questionnaire among a larger group of physicians. The questionnaire focused on clinical practice of a specific aspect of ASPs (ie, diagnostic tests and parameters) that is often overlooked, but is—in our view—a pillar of ASPs.[2] The approach and methodologies for participatory development that are described herein are in this case applied to prescribing antimicrobial agents. However, an ASP is more than prescribing antimicrobial agents. It also requires infection prevention and control (IPC) measures. The approach that is described in this article is also very suitable for and should also be applied to the development of supportive IPC measures.

METHODS

Within this section, the scenario-based prototype evaluations and online questionnaire are described.

Scenario-based prototype evaluations

Gaining insight into the perceived needs of potential end-users of a technology can be more difficult than it seems. Merely inquiring about needs without offering some concrete example of what the technology might look like requires great imagination. In this part of the study, physicians were presented with an example of what a CDSS might look like. In addition, they were given a real-life scenario that they could encounter in clinical practice. Offering a scenario triggers participants to think about how they make clinical decisions. Also, it makes it easier for them to imagine what it would be like to work with the technology in clinical practice.[11] Thus, participants can visualize and verbalize their perceived needs while researchers gain insight into the ways end-users work and think.

Participants

The prototype evaluations took place at an 800-bed teaching hospital. Participants were selected via convenience and snowball sampling and were invited via e-mail. Six medical resident physicians were invited and participated in the study.

Procedure and materials

First, participants were asked about their background and work processes to gain insight into the context within which the results should be interpreted. Specifically, questions focused on experience with prescribing antimicrobial agents and on support systems that are currently being used for that purpose.

Then, participants were presented with a low-fidelity prototype of a CDSS. The prototype of a CDSS to support the prudent prescribing of antimicrobial agents was created based on what we learned from prior research about existing CDSSs.[1] The prototype (see Fig 1) was created using Balsamiq software Version 2.0 (Balsamiq Studios, LLC, Sacramento, CA), allowing the physicians to click through the screens of the prototype. To guide them in doing so, a real-life scenario was developed in cooperation with a clinical microbiologist:

> A patient is referred to you by his general practitioner. He has a high fever and an increased respiratory rate. You suspect that the patient has pneumonia.

Participants were asked what kind of support they would like to receive in the given situation and why. The individual prototype evaluations took about 45 minutes each. With permission of the participants, all prototype evaluations were audiorecorded.

Data analysis

Verbatim transcripts of the audiorecordings were analyzed using a codebook. To do so, the coder (NBdJ) read and reread all transcripts to familiarize herself with the data. Based on these data a codebook was developed. It contained codes related to the various topics of interest; that is, experience with support systems, need for a CDSS, type of support needed, and the evaluation of the low-fidelity prototype CDSS. Two researchers (NBdJ and JW) independently coded 10% of the dataset to check the reliability of the codebook. This resulted in a Cohen's kappa of 0.807, indicating very good reliability. For data analysis, the codes were grouped and quotes were summarized. Descriptive statistics were calculated for all codes.

Online questionnaire to gain insight in current ASP practice

An online questionnaire was used to cross-reference some of the findings of the prototype evaluations. This was done to disclose potential say/do problems,[12] to investigate the use context and the prototype's fit with it, and to show why one should not only ask

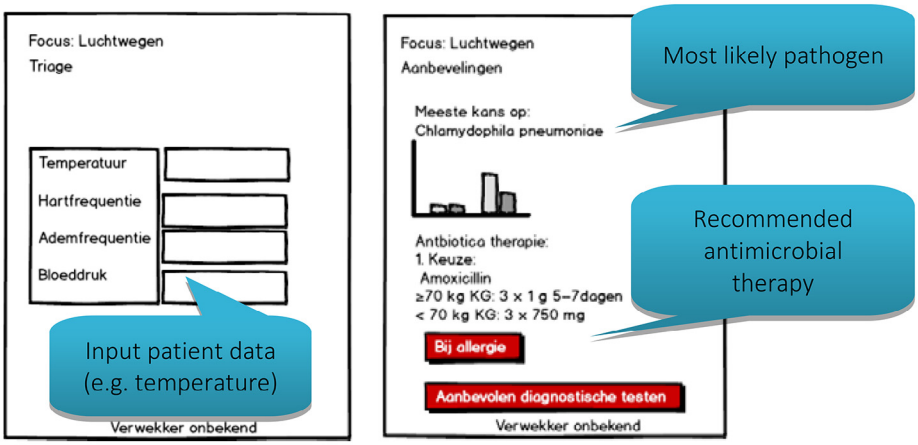

Fig 1. Example screens of the prototype (in Dutch) of a clinical decision support system for antimicrobial agent prescribing.