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Major article

Antibiotic information application offers nurses quick support

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Background: Nurses can be crucial contributors to antibiotic stewardship programs (ASPs), interventions aimed at improving antibiotic use, but nurse empowerment in ASPs adds to their job complexity. Nurses work in complex settings with high cognitive loads, which ask for easily accessible information. An information application (app) was developed to support nurses in ASPs. The efficiency, effectiveness, and user satisfaction regarding this antibiotic app were tested in a pilot study.

Methods: The app was introduced into 2 lung wards of a local teaching hospital. During the 8-month pilot study, the 62 nurses of the wards had access to the app. Changes in user satisfaction regarding information support, safety attitudes, and ASP behavior were assessed with a questionnaire. At baseline, 28 nurses completed the (e-mail) questionnaire; after the study, 18 nurses participated. Scenario-based tests were done to assess app efficiency and effectiveness at baseline (n = 16) and in a randomized control (without the app, n = 17) and intervention condition (with the app, n = 17).

Results: Significant improvements were found regarding task support ($P = .041$), reliability ($P = .004$), unobtrusiveness ($P = .000$), relevance ($P = .002$), user friendliness ($P = .000$), speed, and hyperlinks ($P = .001$). An improvement in communication was observed regarding nurse-physician understanding ($P = .034$). With the app, nurses solved the scenarios faster than without it.

Conclusions: The human-centered design approach and persuasive strategy of task support were effective in reducing time needed to find information. Stewardship-related behaviors need active education strategies.

Nurses often work in complex medical settings and are required to check and act on various information flows and actual patient progress.[1,2] This results in a high cognitive load, with risks of errors and suboptimal care.[3] As more and more information and communication systems are in place to provide up-to-date information,[4] integrated displays facilitate the timely processing and interpretation of information in clinical settings.[5] With such systems, it is especially important that the design and content are adjusted to the target group with respect to their cognitive tasks and processes and the specific (clinical) setting in which they are used.[6]

Technology can therefore be supportive of health care processes in clinical settings, partially because it has the ability to support or reinforce behavior.[7] It may be especially assistive in overcoming the challenges with adherence to guidelines and clinical protocols, for example by applying persuasive technology.[8] The main goal of persuasive technology is to motivate users to reach goals via technology through persuasion, and not coercion or deception.[8] The persuasive systems design (PSD) model, proposed by Oinas-Kukkonen and Harjumaa, describes various strategies that can make technology persuasive.[8] These strategies include supporting primary tasks (facilitating core tasks that need to be performed via the technology), offering dialogue support (easy interaction with—and via—the system), offering system credibility support (via cues of trustworthiness and reliability of the system and its contents), and offering social support (creating the motivation to use the system via social cues, such as comparisons or observations).[8] The PSD model

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has been applied to facilitate health behaviors of patients, but it has also shown to retain its value in enabling health care workers to perform tasks more efficiently and with greater enjoyment.[9]

Technology, especially when it is intended to be persuasive, has a strong potential for supporting nurses during their daily tasks. In this study, we focus on the information situation regarding antibiotic use, as part of the implementation of an antibiotic stewardship program (ASP). These programs aim to improve antibiotic use in clinical settings by offering a bundle of interventions aimed at the key stakeholders (prescribers, pharmacists, or clinical microbiologists).[10] These improvements in the use of antibiotics are needed to control the increase in antimicrobial resistance. This has become a serious threat to patient safety because pathogens that have become resistant to antibiotics can cause infections that are difficult or impossible to treat.[11] This is especially true in clinical settings, where patients' health is already weak and bacteria can be transferred easily among patients.[12,13] Besides a need for new antibiotics (the development of which takes considerable time and resources), experts state the importance of using antibiotics only when it is really necessary, using only the appropriate type, in the appropriate dosage and duration.[10] At the core of ASPs is the prospective audit of patients who receive antimicrobial treatment, including intervention and feedback. Also, the use of certain antimicrobials may be limited (formulary restriction), and preauthorization can be required for use of specific antimicrobial agents.[14] Besides these interventions that directly intervene with prescribing behavior, interventions that support changes in prescribing, such as education, implementation of guidelines and clinical pathways, and dose optimization, are recommended.[14] ASPs therefore usually include strategies that inform prescribers about preferred antibiotics to use in certain situations. Furthermore, information sharing regarding symptoms, patient status, laboratory results, and local resistance patterns in order to timely adjust treatment is proposed as an important part of ASP.[14,15]

The role of nurses in ASPs often remains unaddressed and unclear. Nurses have been proposed as important actors in care involving antibiotic therapy.[16-18] However, nurses are not responsible for evaluating antibiotic appropriateness or ensuring timely therapy adjustment (de-escalation). For this, the prescriber, pharmacist, and clinical microbiologist or infectious disease expert jointly consider diagnostic results and changes in current patient status.[14] Even though nurses are not directly involved in these core processes, they are important contributors to ASPs. Nurses spend much time with the patient, put antibiotic therapy into practice, and monitor the treatment's effect on the patient. In case of (sudden) changes or abnormalities, nurses are the eyes and ears of the physician. From this perspective, nurses have great potential in recognizing suboptimal antibiotic therapy. Also, nurses have a potentially important reflective role to play regarding antimicrobial use; they work with different residents and physicians on the ward and can notice differences in prescribing behaviors.[19] Other research demonstrates that in nursing home settings and long-term care facilities, nurses are a target group for awareness, education, and information strategies aimed at changing prescription behavior at wards.[20] In an earlier needs assessment, we found that to be able to take up a proactive role, nurses need to have access to—and be supported by—information.[21] Such information includes concrete instructions on how to prepare and administer antibiotics. Also, information on acute responses to antibiotics, possible side effects, or allergic reactions should be readily accessible. Furthermore, nurses need access to information on how to administer a certain antibiotic and possible drug-drug interactions that may occur. In addition, more general information on the type of antibiotic and working mechanisms is needed, especially when the nurse is new to a certain antibiotic.[21] Having access to this kind of information helps nurses carry out regular tasks and enables them to critically monitor and evaluate patient progress. To support information finding and use of information regarding the aforementioned types of information in a clinical setting, the Antibiotic App was developed. This application (app) offers centralized information, developed according to a human-centered design approach.[21] In this app, readily available information sources are integrated into a single system, offering the nurse a quick way to find information. After starting the app, the nurse can select an antibiotic. Afterward, a dashboard overview of all information types appear, from which the information button that matches the nurse's information need can be selected. From here, information supporting practical tasks (eg, instructions for administering or preparing parenteral antibiotics) and background information (eg, information on side effects, allergies, or the working mechanisms of the antibiotic) is available via the app (Fig 1). The app is available without login via the nurses' medication registration system that is used during medication rounds. The app relies mostly on primary task support as a persuasive strategy, as was previously confirmed in analyses of user evaluations of the app.[22]

OBJECTIVE

In this pilot study, we evaluate the Antibiotic App regarding its contribution to user satisfaction with antibiotic information, effectiveness, and efficiency. The app is part of the nurses' information situation: all available information sources and their usability and satisfaction. We expect that by providing the app, the information situation will improve. As a result, we expect the app to support nurses in their antimicrobial-related tasks by making information easier and faster to find and allowing it to be applied more effectively as a result. The information support that the app provides should translate into a better overall appreciation of the information situation, should translate into improved communication and teamwork, and is expected to also affect behaviors related to antimicrobial stewardship (alerting and commenting on suboptimal antibiotic therapy).

MATERIALS AND METHODS

To assess app effectiveness, efficiency, and user satisfaction regarding information support, we applied various methods. A questionnaire was created to measure the information situation regarding satisfaction with information sources and their usability, both before and after implementation. In addition, communication and teamwork, safety behavior, and antimicrobial stewardship–related behavior were assessed via questionnaires. Furthermore, to assess whether nurses are better able to find and apply information more efficiently with the app than without the app, we conducted scenario-based user tests.

Design and procedure

All baseline measurements were conducted before the app was introduced at the wards via clinical lessons and by distributing fact sheets and flyers. The app was introduced in March 2013 as an addition to readily available information sources. Nurses were free to use their preferred information source (app or regular) during the pilot period. All postimplementation measurements were done 8 months after introducing the app at the wards. The nurses therefore had ample opportunity to use the app and, if so desired, integrate it into their daily work practice. App log data of this pilot period show daily and steady use.[23] During the pilot, only log data were collected. All other results stem from data collected during baseline (preimplementation) or postimplementation measurements. The long pilot period prior to postimplementation measurements diminishes possible effects because of the novelty of the system