Computerized decision support to improve guideline implementation in cardiac rehabilitation: the CARDSS project

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Chapter 4

A pilot study with a computer-based guideline implementation system for cardiac rehabilitation

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Arie Hasman
Nicolette de Keizer
Niels Peek
Abstract

Background: New national guidelines for cardiac rehabilitation (CR) were released in the Netherlands in 2004. To improve guideline implementation, a computer-based guideline implementation system with decision support functionalities, named CARDSS (Cardiac Rehabilitation Decision Support System) was developed concurrently. CARDSS assists in the decision making for CR goals and therapies by showing guideline recommendations to users. As system usability is critical for success, the objective of this pilot study was to evaluate CARDSS' usability in practice.

Methods: A six-week pilot study with CARDSS was conducted in four CR centres. After the pilot study, CARDSS users were requested to fill in a questionnaire. As the new guidelines could also be a source for rejection of CARDSS, the questionnaire assessed users’ opinion separately on the guidelines and on CARDSS' usability. In addition, all data stored in CARDSS, including log files, anonymized patient data, guideline recommendations, and therapy decisions were analyzed. Participants were interviewed to clarify findings.

Results: During the pilot study 134 patients were enrolled in CR with CARDSS. CARDSS was used by 11 different professionals. Five system bugs were identified which all could be resolved in one day. In addition, two problems with the guidelines were identified. Concordance to the guidelines on a patient level was 68% for CR therapies and 83% for CR goals. Overall, users were satisfied with CARDSS' usability. Several changes were made to CARDSS after the pilot study, based on users' recommendations.

Conclusion: Our results suggest that CARDSS is potentially feasible in practice. The high concordance of CR professionals to guideline-recommendations is promising, although the recorded data was not validated. To assess the effect of CARDSS on guideline concordance, a cluster randomized trial is being conducted amongst Dutch CR centres.
Introduction

Outpatient cardiac rehabilitation (CR) is a multidisciplinary rehabilitation and secondary prevention approach for patients who suffered a cardiac incident or underwent a cardiac intervention. The provision of CR is critical to both ensure that patients are in the best possible physical, psychological and social position to return to and maintain their normal place in society, and that their future cardiovascular risk is reduced [1-5]. CR has proven to be cost-effective in different economic evaluations conducted in North America and Europe [3]. However, in many Western countries CR services are under-utilized, poorly standardized and do not follow the available scientific evidence [3;6;7].

In the Netherlands cardiac rehabilitation is offered in about 100 outpatient clinics [8]. The first Dutch national guidelines for CR were published in 1996 [9]. Despite these guidelines, measurements showed that the CR programme offered to patients was often incomplete, the design was monodisciplinary instead of multidisciplinary, too little attention was paid to secondary prevention, and a great deal of eligible patients were not referred to CR [10]. With the aim to improve the provision of evidence-based cardiac rehabilitation and to reduce practice variation, new guidelines for CR were published in 2004 [11]. Consistent with international standards [2;3], these guidelines proclaim that cardiac patients should be offered an individualized multidisciplinary rehabilitation programme. To this end, the guidelines describe a needs assessment and therapy indication procedure which requires answering 15 to 40 questions about the patient’s history and current situation. The answers give insight into the objective and subjective reduction of the patient’s physical capacity, the psychological and social functioning of the patient, and his or her risk behaviour. Several instruments, such as the questionnaire ‘quality of life for cardiac patients’ [12], are used to quantify the various aspects of the patient’s condition. Eventually, it is determined which of 15 possible goals (e.g., ‘increase exercise capacity’, or ‘quit smoking’) should be set for the patient’s rehabilitation programme and which of four different therapies (exercise, information, relaxation, and lifestyle change) are most appropriate for this purpose.

With the aim to increase concordance to the new CR guidelines, a computer-based guideline implementation system with decision support functionalities, named CARDSS (CArdiac Rehabilitation Decision Support System), was developed concurrently with the guidelines [13]. Systematic reviews on the effects of computerized decision support (CDS) have shown that CDS can improve practitioner performance and guideline concordance [14-17]. Known success factors for guideline-based CDS were taken into account during CARDSS’ development [13]. CARDSS actively assists its users, predominantly rehabilitation nurses and physiotherapists, in making therapy decisions for CR patients in concordance with the guideline
recommendations. Therefore CARDSS prompts users to assess and enter the necessary patient information, determines each patient's rehabilitation needs, and assists in formulating a patient-specific rehabilitation programme [13]. In addition, it provides various patient information management services (e.g., administration functionalities, visualisation of patient progress, and management reports) to users. The objective of this pilot study was to evaluate both the new guidelines and the usability of CARDSS in clinical practice.

Methods

To evaluate the feasibility of CARDSS, a six-week pilot study with the system was conducted in several Dutch CR outpatient centres. During the pilot study, CR professionals were requested to use the CARDSS software for assessing all their patients’ needs for CR and select the CR goals and therapies that according to them are relevant for the patient concerned; the CARDSS system did show which CR goals and therapies the guidelines would recommend for the patient based on the collected needs assessment data. In addition, professionals were free to use CARDSS’ other functionalities such as printing patient reports, generating management reports, and evaluating the progress of patients during the CR programme.

Participants

To be able to provide quick hands-on assistance in case of problems, it was decided to include only centres in the proximity of the Academic Medical Centre in Amsterdam, from which the pilot study was coordinated. Four centres in the Amsterdam region were invited to participate in the pilot study. All these centres accepted our invitation and agreed to actively use the CARDSS system for the needs assessment of every CR patient during the pilot study.

Study enrolment

Prior to the pilot study, one of the researchers (RG) assisted the ICT department of the participating centres in installing CARDSS on either one or more local computers or the hospital network. At the start of the pilot study users received a two-hour training course on working with CARDSS.

Since CARDSS was not yet used in a clinical setting, it was decided to start with the pilot study in the participating centre nearest to the Academic Medical Centre in Amsterdam. After ten days the other three centres were enrolled in the pilot study, with two to four days between each enrolment.
Data
Several sources of information were used to evaluate the usability and usefulness of CARDSS. First, CARDSS' log files were analyzed to retrieve information on user logins and technical anomalies like system crashes. Secondly, concordance of the multidisciplinary team decisions with the guidelines was determined for all CR goals and therapies individually. Concordance was defined at patient level and implied treating patients who should have been treated and not treating patients who should have been untreated, according to the guideline. In addition, we determined the number of patients that were undertreated (withholding treatment from patients who should receive it) and overtreated (treatment of patients who should be left untreated).

Also, questionnaires were given to the caregivers at the end of the pilot study. The questionnaire addressed two different aspects: (i) users' opinion on the recommendations of the guideline, (ii) users' opinion on the usability of CARDSS and its decision support functionalities. The questions from the second section were partially based on the work of Trivedi et al. [18] but the questions were translated to Dutch and adapted to our situation. During personal interviews caregivers were asked to clarify some findings and provide suggestions for system improvements.

Results
During the pilot study a total of eleven caregivers used CARDSS during a period of six to eight weeks in the period of September to December 2003. Table 1 shows some general information on the use of the CARDSS software during the pilot study. The users found a total of five bugs in the system, each of which could be fixed within one day. Two bugs (i.e. not being able to enter text with an apostrophe, and not being able to adjust previously entered patient information) occasionally led to a crash of CARDSS, but no patient information was lost.

<table>
<thead>
<tr>
<th>Table 1. Information about the use of the software during the pilot study.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td># caregivers</td>
</tr>
<tr>
<td># times logged in</td>
</tr>
<tr>
<td># bugs found</td>
</tr>
<tr>
<td># times telephonic or personal assistance provided</td>
</tr>
</tbody>
</table>

The number of patients enrolled in CARDSS during the pilot study was 134 as shown in Table 2. A total of 415 therapies was recommended. For 40 patients, one or more
recommended therapies were not selected, and in three cases a not-recommended therapy was selected. In sum, concordance to the guidelines on a patient level was 68% for rehabilitation therapies. Table 2 shows that Hospital B and Hospital D often decided not to offer patients a therapy that was recommended by the guideline. During interviews the professionals from these hospitals indicated that this non-concordance to guideline recommendations was predominantly caused by the fact that they were unable to provide lifestyle change therapy to their patients due to a lack of facilities. When discarding the therapy decision in which a lack of facilities was the reason for non-concordance, guideline concordance was over 95%.

Table 2. Information on the number of patients included in the pilot study and on the therapies and goals recommended by the guidelines and selected by the users.

<table>
<thead>
<tr>
<th></th>
<th>Hospital A</th>
<th>Hospital B</th>
<th>Hospital C</th>
<th>Hospital D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No patients screened</td>
<td>35</td>
<td>46</td>
<td>30</td>
<td>23</td>
<td>134</td>
</tr>
<tr>
<td><strong>Therapies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Therapies recommended (avg per patient)</td>
<td>112 (3.2)</td>
<td>119 (2.6)</td>
<td>102 (3.4)</td>
<td>82 (3.6)</td>
<td>415 (3.1)</td>
</tr>
<tr>
<td># Recommended therapies not selected (%)</td>
<td>7 (6.3%)</td>
<td>24 (20.2%)</td>
<td>1 (1.0%)</td>
<td>17 (20.7%)</td>
<td>49 (11.8%)</td>
</tr>
<tr>
<td># Not recommended therapies selected</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Goals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Goals recommended (avg per patient)</td>
<td>293 (8.4)</td>
<td>253 (5.5)</td>
<td>265 (8.8)</td>
<td>213 (9.3)</td>
<td>1024 (7.6)</td>
</tr>
<tr>
<td># Recommended goals not selected (%)</td>
<td>1 (0.3%)</td>
<td>0 (0%)</td>
<td>3 (1.1%)</td>
<td>88 (41.3%)</td>
<td>92 (9.0%)</td>
</tr>
<tr>
<td># Not recommended goals selected</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

A total of 1024 rehabilitation goals was recommended by the system. For 22 patients, one or more goals that were recommended by the guidelines were not selected by the user, and for six patients, one or more goals were added to the ones recommended. In sum, concordance to the guidelines on a patient level was 83% for rehabilitation goals. However, professionals from hospital A, B, and C stated during interviews that they were not always consistent in adding or removing goals to patients’ rehabilitation plans. Data on concordance to goals might therefore be unreliable.
At the end of the pilot study, seven of the eleven questionnaires were returned. In one centre, three users jointly filled in one questionnaire. In another centre, two professionals did not fill in a questionnaire because they were too inexperienced with CARDSS to answer the questions.

Prior to this pilot study, only one of the participating CR professionals was familiar with the content of the revised needs assessment procedure described in the CR guidelines 2004. The majority of professionals (5/7) found that the CR guidelines 2004 were an improvement to the 1995/1996 guidelines. They found the quality of life questionnaire very useful for doing part of the screening (5/7), but several professionals considered guideline recommendations regarding the objective assessment of a patients’ exercise capacity (4/7) and the assessment of patient’s risk behaviour (3/6) not easily applicable in practice. For the objective assessment of a patients’ exercise capacity, the guidelines recommended conducting either of two exercise tests. However, professionals from two of the participating pilot hospitals

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Table 3. Users’ opinion on the usability and feasibility of CARDSS

<table>
<thead>
<tr>
<th></th>
<th>Totally agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Totally disagree</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The system response times are fast enough.</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. It is not hard to learn the working of the software</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. Before the start of this pilot, I already had some general computer skills.</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4. The colours and layout make the software attractive.</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5. The images and icons clarify the use and functionalities of the software.</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6. I can get to the required information without much effort.</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7. The reports that can be printed are complete and clear.</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. The software is fun to work with.</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9. Software functionalities are in line with our way of working.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10. I found that using the system was useful.</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11. The software makes the narrative guideline more comprehensible</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12. The software stimulated the use of the guideline and the decision tree.</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

NA = No answer
indicated that they lacked the facilities to carry out either of the two recommended exercise tests. Second, professionals indicated during interviews that in their opinion, the assessment of patient’s risk behaviour resulted in lifestyle change therapy being recommended too often by the guidelines. Upon analysis of the quantitative data of CARDSS, an inconsistency was discovered in the assessment of risk behaviour in the guidelines: a contra-indication for group-based therapy (e.g., emotional or social instability) was assessed in one part of the needs assessment procedure, but was not taken into account when recommending group-based lifestyle change therapy. This incidentally resulted in the lifestyle change therapy being recommended although a contra-indication existed.

Table 3 shows that the users were satisfied with the usability of CARDSS and the way that decision support was provided to users. Response times were fast enough (7/7) and it was easy to use (7/7) even though some caregivers indicated that they had hardly any experience with computers before the pilot study (3/7). The graphics made the software attractive (7/7) and the interfaces were logical and complete. The software was fun to use (5/7). Most caregivers agreed that the software makes the decision tree more comprehensive than the paper version (5/7). All of the respondents finally indicated that they would like to continue using CARDSS in their institutions if minor additional functionalities would be implemented (7/7). Some of the ‘minor’ additional functionalities to CARDSS proposed by professionals during the interviews were:

- It should be possible to collect patient information that is not described in the guideline’s needs assessment procedure, but that institutions or individual professionals consider relevant to properly conduct or evaluate the patient’s rehabilitation programme.
- It should be possible that patient’s quality of life questionnaire is filled in multiple times, for example during and after the rehabilitation programme, to evaluate the patient’s progress made during the rehabilitation programme.

Discussion

This paper described a pilot study that was conducted to evaluate the feasibility of the CARDSS guideline implementation system for CR. CARDSS’ users were positive about its functionalities and the way it provided decision support based on the recommendations of the CR guidelines 2004. All participating professionals indicated that they wanted to continue using CARDSS if minor additional functionalities were implemented. Results on guideline implementation were encouraging, with a guideline concordance of 68% for CR therapies on patient level. Adjusted for a lack of
facilities, guideline concordance is even above 95%, which is much higher than expected based on earlier measurements [19].

Several factors may have biased our results on guideline concordance. The pilot study was conducted to evaluate the feasibility of CARDSS and not to measure the actual guideline concordance of the teams in the four CR centres. Therefore no data audit was conducted to verify the quality of the data in CARDSS. Although all caregivers indicated they had accurately specified in CARDSS which therapies were offered to patients, this information could be unreliable. Therefore, it is possible that recommendations of the system were not followed without this fact being recorded in the CARDSS' database. Also, guideline concordance may have been positively influenced by the ‘volunteer’ and Hawthorne effects and a selection bias [20]. Finally, the findings on the effect of CARDSS are limited by the fact that we used no control group to determine the concordance level without the system or to measure the role of the ‘checklist effect’ [20].

With the help of the pilot study, two problems with the new guidelines were indentified. As CARDSS carries out the recommendations of the guidelines and therefore also includes these errors, this may have negatively influenced the opinion of users towards CARDSS’ usability. The pilot study with CARDSS was conducted prior to the release of the guidelines. Therefore, the identified problems in the guidelines could be discussed during meetings with the guideline authors who resolved these issues prior to guideline publication: a third possible exercise test was introduced that could be performed by all hospitals and the erroneous recommendation was adjusted. Subsequently, also in an update of CARDSS these issues were addressed.

To be effective in improving guideline implementation, CARDSS should first be adopted in practice. System usability and usefulness are critical issues that determine whether or not the systems will actually be adopted in practice [17;18]. However, the new guidelines might also be a reason for rejection of CARDSS. As CARDSS was developed concurrently with the guidelines, they were not yet officially published and also not validated in a clinical setting with real patients. Therefore, the guidelines may not be optimally applicable in daily practice, professionals might disagree with certain choices made by the guidelines, or possible errors or contradictions may still exist. The pilot evaluation study results suggest that CARDSS meets the requirements of daily practice and that caregivers involved in CR are satisfied with the system’s functionalities.

Currently, a large-scale cluster randomized trial is conducted among Dutch CR centres to rigorously assess the effect of the computerized decision support incorporated in CARDSS on guideline concordance. To adjust for potential sources of bias, the participating CR centres will either work with an intervention version of CARDSS,
having full functionality, or with a control version, which comprises patient records and information management services but provides no decision support. Both versions of CARDSS record patient data, guideline-based recommendations, and rehabilitation therapies that are actually pursued in each patient’s programme. After a period of six months, the effect of receiving guideline-based recommendations on guideline concordance is assessed by comparing the data that have been recorded in the two arms of the trial. If the computerized decision support does enhance concordance, then future costs for maintaining and updating CARDSS are justified by more effective rehabilitation programmes.

Reference List


