


Relevance and Limitations of Decision Support Systems for Outpatient Cardiac Rehabilitation



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Mini Review

Decision support systems (DSS) are defined as any computational applications that improve the abilities of an individual or group of individuals to make decisions [1]. In the recent years, its use in clinical practice is gaining acknowledgment as its benefits in terms of reducing diagnostic errors [2], increasing conformity with clinical guidelines [3,4] and potentially increasing the health care quality [5-7] have been reported. Cardiac rehabilitation (CR), a multidisciplinary and comprehensive intervention to improve the physical, mental, and social capabilities of patients with cardiovascular diseases [8], can be an important field to the application of DSS. The challenging decision-making process in the outpatient CR involves the analysis about many factors, including the clinical characteristics of the patients, its values and preferences, and the indications and restrictions to the exercise training and other interventions' prescription [9-11]. Thus, the development and use of DSS in cardiac rehabilitation may be a good alternative, helping the professionals in the daily practice and potentially increasing the health care quality in this field.

There are different types of DSS, but the most suitable for clinical DSS is the knowledge-driven, that uses artificial intelligence and statistic inference in codified knowledge to provide assistance in specialized problem solutions, suggesting or recommending actions¹. The knowledge representation for knowledge-driven clinical DSS can be based on rules, clinical guidelines or probabilistic networks [12]. The clinical decision making is characterized by the presence of uncertainty and causality, making the probabilistic networks suitable for the development of DSS [13], once they are methods representative of the uncertain knowledge, allowing the manipulation of the uncertainty by based mathematical principles [14]. To identify previously developed DSS for outpatient supervised

CR, we conducted a systematic search in the main health electronic databases (PubMed, Embase, Cochrane Central Register of Controlled Trials and Physiotherapy Evidence Database [PEDro]), and informatics databases (IEEEExplore and Science Direct).

The search strategy was adapted for each database and included the indexed terms and their synonyms for "Clinical Decision Support Systems" and "Cardiac Rehabilitation", combined by Boolean terms. The searches were updated until 04/12/2018, without date or language restriction, resulting in 189 registers. After duplicates removal and studies' selection, two DSS for outpatient supervised CR were identified: the CARDSS ("Cardiac Rehabilitation Decision Support System") [9] and the EXPERT ("Exercise Prescription in Everyday Practice and Rehabilitative Training") [10]. CARDSS is a record system with DSS functionalities focused on the patient assessment for CR indication and to increase the guidelines adherence during the CR process, providing recommendations based on a knowledge representation of the Dutch guideline for CR [9]. CARDSS was developed for use in a computer and was distributed to CR centers in Holland that accepted to be included in a randomized controlled trial and was also for sale at the country. The randomized controlled trial included 31 Dutch CR centers, showed an improvement in the guideline's conformity about the exercise of 3.5%, the educative interventions of 23.7% and the relaxing therapies of 41.6% with CARDSS use [7].

EXPERT was developed by a group of experts in chronic diseases from 11 European countries, with endorsing of the European Association of Preventive Cardiology. The knowledge representation for EXPERT was also based on clinical guidelines and is focused in exercise prescription in CR, including exercise intensity, frequency, duration, type, number of sessions and

rehabilitation program duration and extra modalities of exercise indicated. EXPERT was also developed for use in a computer and is still in testing before the planned implantation in CR centers of the Europe [10]. It is important to notice that both systems were developed only for use in computers. One of the characteristics that were recognized to influence the success in the DSS use is the ability to provide assistance to decision-making at the place and moment of the decision. With the availability and increased familiarity of people with mobile devices, the development of DSS for smartphones and tablets can be a way of increasing the proximity between the system and the user, with more potential of success in its use [15,16].

Another important point is that both systems had the knowledge representation based on local guidelines that, although developed based in the recent evidence, need constant updating and may not represent the clinical guidelines worldwide. Also, none system was identified using probabilistic networks in the knowledge representation. Previously our research group described the development and validation of two influence diagrams (a type of probabilistic network) [11] that are being used as the knowledge base for a new mobile-designed DSS for outpatient CR, however, this system is still not available. With this small review of the available options of DSS in outpatient CR rehabilitation can be seen that the current developed systems are available only in restricted geographic areas, leaving other regions, mainly the middle and low-developed countries with no options of DSS in this field.

d. Also, the systems are restricted for use in computers, which may not represent the best approach for a pretended routinely use of a DSS.

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