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Decision Support in Medicine: A Survey of Problems of User Acceptance

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Abstract

Computer-based clinical decision support systems (CDSSs) are still today not in widespread use, although there has been extensive research and development for several decades. We have, based on the literature of the last years, summarised some of the problems that may lead to low user acceptance and that should be addressed more extensive in future developments of CDSSs

We describe different aspects of the usefulness of CDSSs according to the elements (relevance, validity, and work) of a formula of usefulness of information, and, in a short section, refer to the discussion about clinical guidelines.

1. Introduction

From the beginning of data processing with computers people have been trying to use its principles and methods also in medicine. Today there is a market where we can buy hardware and software to support information management in radiology, laboratories, etc. and there is a growing number of products that contribute to building electronic patient records or setting up clinical workstations for ward doctors and nurses.

But computer-based systems for clinical decision support, although developed and investigated in numerous academic projects, are still today not widespread. We know about projects that indeed reported improvements in decision making caused by the introduction of clinical decision support systems (CDSSs) (see e. g. [1], [2], [3]), and some of these CDSSs *are* used in routine work, like the decision support components of the HELP-system at LDS hospital ([4]) or CATIPO, a system for therapy planning ([5]). But different publications from the 1990's show, that in general the spreading and routine use of CDSSs was still very low in that decade ([6], [7], [8], [9]), and we did not find publications reporting a substantial change up to now.

So, why are CDSSs not widely used? This contribution summarises different problems mentioned in the literature of the last years which may have led to this fact. Of course, our summary cannot be complete, especially because we leave out technical aspects, like the implementation of different artificial intelligence approaches, but also philosophical aspects concerning AI basics. Also the problem of the legal force of electronic documents, that undoubtedly has a large influence on the acceptance of computer-based application systems, is not subject of this contribution.

Our aim is to summarise some factors that influence user acceptance of CDSS and should be addressed more extensively in future development of CDSSs. The reader may ask himself and her / his colleagues: Do we already have good solutions? What has to be done

in the new decade? How can our theoretical efforts be transformed to practically useful products? Who must be involved in developing these products?

2. Information needs and decision support systems

Problems of user acceptance may be summarised with the help of a formula of the usefulness of information (see [14], [15], [16]) that was also applied, for example, in [8] or [17]:

$$\text{usefulness} = \frac{\text{relevance} \bullet \text{validity}}{\text{work}}$$

Usually it is not easy to assign meaningful numeric values to the elements of the formula in order to carry out quantitative evaluations. But a quantitative evaluation does not necessarily have to be the major aim of using the formula. We use it to discuss the usefulness of CDSSs in a qualitative way as in [17]. The arguments on user acceptance of CDSS discussed in the following subsections are structured according to the elements of the formula.

2.1 The relevance of information provided by decision support systems

Medical routine work needs broad knowledge

The questions concerning medical problems that arise in the daily routine work, are usually complex and do often include information about different subfields of medicine. A lot of CDSSs, particularly advisory ones, are often limited to a special subfield of medicine, and therefore do not cover the range of information needed in routine work ([17], [18]).

The patient is in the focus

Many questions, in particular those concerning diagnostics, therapeutics and care, arise during consultations and are related to a certain patient respectively his/her problems:

> "One important founding was that the questions were asked in a „non-generalised but practice related fashion" that would make it hard to find the answers. Thus doctors would ask "Should I test the serum procainamide level in this patient?" rather than "What are the indications for measuring the serum procainamide?" [8])

Retrieval systems such as Medline do not provide the user with information directly related to the problems arising in the daily routine work. The user has to generalise from the concrete medical problem. Thus the provided information looses relevance, because in medical routine work the patient is in the focus of thinking and acting.

Additionally, the presence of a CDSS may disturb the conversation between patient and doctor ([19]).

The importance of discussions and psychological support

In [17] the authors refer to physicians who are convinced that discussions ("verbal context") do better allow to concentrate on relevant details. Additionally, a discussion with a colleague can give psychological support:

> "Certain questions have to be put to a human being."
>
> "... when you have a seriously ill patient, you want to talk to someone. This means a lot then." ([17])

This kind of support is just as relevant as medical knowledge. To answer the question about reasons for the low acceptance of CDSSs, we must take into account user needs, which go beyond the demand for that kind of information we usually have in mind:

> "... the need for information is often much more than a question about medical knowledge. Doctors are looking for guidance, psychological support, affirmation, commiseration, sympathy, judgment, and feedback. This "information need" is particularly poorly explored, and yet it may well be the most important need and the biggest stumbling block to a technical solution." ([8])

2.2 The validity of information provided by decision support systems

The information provided by CDSSs must be valid in order to contribute to the improvement of diagnostics and therapeutics systematically.

Validity must be recognisable

An important problem of the acceptance of CDSSs relates to the fact that the user must be convinced of the validity, i. e. correctness and completeness, of the information provided (see also section 3). This problem is quite different from the first one. Even if an information *is* valid, the user does not necessarily have to be convinced of the validity. CDSSs must be able to explain in an appropriate way how the data entered by the user are interpreted and how the results are produced ([17]).

Manual data input as source of invalidity

Apart from the medical knowledge represented in CDSSs also the data describing the medical problem to be solved must be correct and as complete as possible. A lot of application systems still require manual input of data and repeated collecting of data to feed the computer is ([18]). Manual data input is error-prone and thus may cause a lack of validity of the information derived by the CDSS. In this context it is also important to make sure that users can easily check whether the data entered are correct. For example, the dialogue with an advisory CDSS, that helps to find a solution step by step, must allow to check the input of preceding steps of the dialogue at any time. [17] reports a lack of acceptance caused by the absence of these features.

2.3 The work and time expended for the use of decision support systems

In publications on the acceptance of CDSSs also problems of a high work expenditure to use them are reported ([8], [19]). Each of these problems contributes to a decrease of the attention focussed on the medical problem respectively the patient.

Manual data input

A high expenditure of work and time to use a CDSS does not only result from an inappropriate user interface design or long computing times, but is also needed, when a CDSS does not contain all (or most of the) relevant information describing the problem to solve or when a CDSS is not able to query these information automatically from other sources. The manual input of the describing information needs time and is error-prone.

Operability

Unclear or not intuitively designed user interfaces lead to the problem that application systems are difficult to use and hard to learn.
The problem the time needed to use CDSSs applies particularly to retrieval systems, e. g. literature data bases such as Medline. Especially the evaluation of the results of a query is time consuming. In [19] an average time of approximately 30 minutes to find an answer of

a question by the help of Medline is reported. That is more time than usually is available in the daily routine work.

Additionally, to be used successfully retrieval systems require abilities like

- the knowledge about query languages,
- the appropriate use of Boolean operators (when offered by the system), and
- the appropriate selection of search terms.

Parallel usage of different application systems

When the application systems to be used are not integrated sufficiently they have to be used in parallel, i. e. users have to switch from one to another frequently. For example, to solve a patient related problem it may be necessary to use

- a conventional, paper based patient record,
- a computer-based CDSS for therapy planning, and
- an electronic retrieval system.

In this setting, not only the time expended and the error-proneness increase with the manual data input, but also the mental expenditure needed to switch between the systems. It is necessary to reorient one's mind according to the function mode, use strategy, and the information provided. Regarding the complexity of medical problems such an additional expenditure of mental resources normally is not acceptable in clinical setting.

In summary, an inappropriate design of a CDSS and a lack of integration into the information system distract users from medical questions and force them to focus on the operation of the CDSS.

3. The discussion about clinical guidelines

When talking about problems of user acceptance of CDSSs we should take into account the discussion about clinical guidelines. Arguments against guidelines include possible limitations of the autonomy of decision makers, the domination of special interest groups in the creation of the guidelines, a lack of consideration of methodological principles when formulating guidelines, difficulties to find a consensus etc. (see e. g. [10], [11], [12], [13]). This discussion, in our opinion, influences the acceptance of CDSSs: A lot of CDSSs, especially those that generate advice, e. g. for diagnosis or therapy, may be considered to be some kind of clinical guideline. And, vice versa, clinical guidelines are often the foundation for CDSSs. Where a guideline is not accepted or cannot be established by reasons inhering in a specific medical subfield also a CDSS may experience low acceptance.

4. Concluding remarks

As already mentioned in the introduction, there exist several publication that show a benefit when using CDSS in clinical setting. But we have to be aware that these CDSSs often are research prototypes or are designed to fit into a specific hospital information system (see e. g. [9]). How can we have our research results appear as CDSSs that can be used successful in several hospitals, in outpatient setting etc., i. e. used widespread?

We have summarised some problems of user acceptance of CDSSs that go beyond technical aspects. Of course, the problems mentioned in section 3 cannot be solved without suitable technical solutions, especially to integrate CDSS into hospital information systems. It should be seen as an additional challenge for research in AI to combine aspects of the applicability of CDSS with theoretical findings, e.g. about computer-based reasoning. This challenge includes the task of linking together fields like psychology, sociology, medicine, and informatics.

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