Computerized Decision Support for People with Disabilities: Review and Outlook

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Abstract

People with disabilities often need professional support and advice in daily life decisions such as choosing a job, a health care plan, or an access product that best fits their needs. However many people face barriers to professional support due a large part to lack of funding and lack of adequately trained providers. Recent years have seen many applications of computerized decision support, showing great potential to aid decision-making with populations as diverse as people with disabilities. In this paper, we review the state of the art technology and research on decision support systems for people with disabilities, and point out problems, potentials, and research needs.

Keywords
Decision support, people with disabilities, computer access, clinical decision support, inclusive design, cloud computing.
Introduction

Many people with disabilities do not have the funding to seek professional advice on important decisions such as finding jobs, legal issues, selecting access technology, etc. For those who are covered or can afford by themselves, there is always a shortage of adequately trained support providers (World Health Organization 144). Some applications of computerized decision support have shown the potential to aid decision-making with populations as diverse as people with disabilities (Beak 2; Bigham, Ladner, and Borodin 3; Gerdes, Karl, and Jäckel 16; Hine et al. 85; Gross et al. 597). They can be used by people with disabilities themselves (sometimes with the help of family, friends, or caregivers), or assist health care practitioners who provide services for people with disabilities, or provide a platform through which people with disabilities can call up assistance anywhere and anytime they need it. This paper reviews the current state of research in decision support systems for people with disabilities, and provides possible implications for future research.

Discussion

Supporting clinical decisions for people with disabilities

Computerized decisions support systems have been widely used in clinical settings such as diagnosis aids, prescribing systems, etc., and have shown improved practitioner performance and patient outcomes (Garg et al. 1223; Hunt et al. 1339; Kaushal, Shojania, and Bates 1409). But applications that support decision-making for people with disabilities are few, and limited empirical evidence of their effectiveness exists. Such applications are reviewed as follows.

- Computer Access Selector (Stapleton, Garrett, and Seeger 351) allows clinicians to use a series of device criteria to identify the most appropriate device from a list of known devices.
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- **Computer Aided Support for Deciding on Applications for Rehabilitation – “CEBRA”** (Gerdes, Karl, and Jäckel 16) helps funding administrators assess whether to approve an application for rehabilitation devices. A half-year long pilot study was conducted to compare the approval rate of administrative decisions and that of the system recommendations, showing a similar rate of 80%.

- **The rehabilitation interventions selection tool** (Gross et al. 597) provides clinical decisions support to categorize injured workers toward optimal rehabilitation interventions. The algorithm was developed using machine learning techniques, based on the personal information of workers receiving compensation, their type of rehabilitation undertaken, and the outcomes. The system outperformed clinicians in selecting intervention programs that lead to successful return-to-work (classification accuracy ROC = .94 versus .86).

- **The Disability Grading Decision Support System** (Chi et al. 473) can determine the presence, severity, and category of disability an individual has. It was developed to assist the Taiwan government in allocating social welfare and medical resources.

  In addition, computerized assessment tools present evaluation tests for a range of computer operations to help clinicians identify clients’ needs and preferences for computer access technologies. See Simpson et al. (4) for a comprehensive review of assessment tools.

**Supporting daily life decisions for people with disabilities**

In addition to clinical purposes, decision support systems have also been used to help people with disabilities make daily life decisions.

- **WorkWorld** (Hine et al. 85) and its web-based version **PlanIT** (Beak 2) are job recommendation systems to help people with disabilities achieve higher income through
the best use of work incentives and benefits. The systems integrate users’ personal situations and information about benefit programs and program policies across multiple agencies to make employment-based recommendations.

- *The health care plan decision support system* (Hanson, Smith, and Simon 5) helps people with physical disabilities choose health plans that best meet their needs. The support includes both low-tech forms such as brochures and guidebooks, as well as high-tech products such as videos and a CD-ROM computer program.

- *The Computer/Electronic Accommodations Program* (Department of Defense) provides users with a web-based questionnaire for needs assessment and access devices recommendation. Users are asked to rate their abilities in vision, hearing, cognition, communication, and motor skills, as well as their job requirements such as note taking or text editing. Then the system recommends access solutions that can be provided by the government agency.

**Problems, Potentials, and Research Needs**

The reviewed clinical decision support for access technology selection are mostly device-centric and designed for clinicians who already have a certain level of expertise in assistive technology (AT). But for most clinicians, AT is only a portion of their practice. They will find the systems hard to understand if they cannot keep up with the ever-increasing variety of AT. In this regard, decision support systems holds the potential to support AT selection in a preference-based way that is understandable for non-specialized clinicians, as well as help practitioners keep up with AT advances.

A major limitation in many of the reviewed systems is that they are stand-alone programs that do not necessarily connect to continuously updated information sources. As technologies
and policies rapidly change over time, the systems may not be able to provide reliable and correct information, and may deliver perverse suggestions (Beak 7). Future development of support tools should consider moving the service into the cloud environment, and linking to information that will be updated to keep up with technology and policy changes.

For decision support tools to be used by people with disabilities, designing accessible and usable interface is challenging but often inadequately considered and evaluated. For example, designers would assume that users are computer-literate (Hine et al. 86), or can read, understand and answer the questions (Beak 20) which may not be true for many users. The common process of decision-making—information searching and filtering, decision forming, evaluating and selecting—further complicates the design. Universal design principles should be followed to maximize the number of people who can use the system (Vanderheiden 2). Usability testing with target users is also necessary to identify accessibility issues. Research is required to study what decision support interfaces can be used by people with a diverse range of types, degrees, and combinations of disability.

Assistance-on-demand holds great potential to be applied to the supported decision-making model. Supported decision-making is to empower people whose rights to make decisions are taken away due to cognitive limitations (e.g., to vote, sign contract, defend themselves in court, choose medical treatments, etc.), to regain these rights through the help of their authorized and trusted support providers (“Nidus”; Stainton 287; United Nations and Inter-parliamentary Union 89–91). The support person may explain the issues, and when necessary, interpret the preferences and signs of the individual. The use of assistance-on-demand techniques will allow support to be delivered from remote by one or more providers. It can significantly reduce the
cost of face-to-face support. Future research may explore user and stakeholder needs, privacy and policy issues of remote and on-demand supported decision-making.

Recent years have seen an increasing number of patient-centered applications that support self-management for people with chronic conditions. One example is the CHESS system which provides web-based information, social support, and problem-solving tools for breast cancer patients (McTavish et al. 599). It has shown improved health outcomes and emotional well-being (Shaw et al. 133). Such applications and research may potentially be extended to assist people with disabilities or aging-related limitations.

Conclusions and Future Research

Computerized decision support systems have been used to aid decision-making for people with disabilities in both clinical settings and daily life. Applications include clinical decision support such as needs assessment, AT selection, rehabilitation interventions selection, etc.; and daily-life decision support such as job recommendation, health plan purchase, and AT selection. But their effectiveness to improve decisions and/or decision outcomes is noticeably missing from literature. Many of the clinical support tools in this review tend to be device-centric and oriented toward access technology experts so nonspecialized clinicians may have difficulty to use. In addition, universal design is often inadequately applied to the development of decision support systems to be used by people with disabilities. The effectiveness of these tools would be compromised if they provide recommendations based on stand-alone data sources, most of which are not kept up-to-date with policy or technology changes. One opportunity for potential improvement is the use of data in the cloud. An open-source, joint collaborative tool is under development to use data federated from multiple databases (EASTIN, AbleData, GARI, etc.) to help people with disabilities find out access technology with best fit in a preference-centric way,
and assist practitioners in clinical selections and keeping up with technology advances (Vanderheiden and Treviranus 517). Future research may also explore the possibilities of using assistance-on-demand technology in supporting decision-making for people with disabilities, as well as using computerized decision support to help people with disabilities manage chronic conditions and health behaviors.

Acknowledgement

The contents of this paper were developed with funding from the National Institute on Disability and Rehabilitation Research, U.S. Department of Education, grant number H133E080022 (RERC on Universal Interface & Information Technology Access). However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.
Works Cited


