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Systematic review and design brief

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Usability of web-based tools designed for communication and decision-making in dementia: systematic review and design brief

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Abstract

Introduction: There is an increased number of web-based tools designed for people with dementia and their family caregivers and addressing communication and decision-making. The loss of cognitive functions associated with dementia can impact individuals' experiences and use of web-based tools. There is a need for high quality and user-friendly web-based tools that support communication and decision-making for people with dementia and their family caregivers.

Objective: To identify usability requirements, usability testing methods, and design suggestions from studies focusing on web-based tools for communication and decision-making support in dementia care.

Methods: We conducted a systematic review with narrative synthesis. Five databases were systematically searched in February 2023. The quality of the included studies was assessed using the Mixed Methods Appraisal Tool.

Results: A total of 1,032 articles were identified and 7 fulfilled inclusion criteria. Web-based tools addressed technology usage, health promotion, home modification information, shared decision-making facilitation, and information needs and social isolation. Methods to test usability included surveys, interviews, focus groups, cognitive walkthroughs and think-aloud procedures. Findings suggested reducing cognitive load, enhancing readability, providing clear language, and emphasising the need for additional support for people with dementia. Design recommendations include optimising information delivery and presentation, enhancing visual elements, streamlining navigation, providing concrete examples, using clear language, and offering training and tailored support.

Conclusion: Usability requirements ranged from visual appearance and navigation to delivery of content and support needed. This review contributes to efforts to improve design and development of web-based tools targeting communication and decision-making in dementia care. Further research should address tailored support to enhance usability for people with dementia.

Protocol registration: PROSPERO ID - CRD42022338438

Keywords: dementia, web-based tools, communication, decision-making, usability, web design, systematic review

1.Introduction

Dementia is a progressive neurodegenerative illness that leads to significant cognitive and functional decline. It is generally characterised by impairments in memory, language, and sensory awareness as well as changes in personality [1]. The World Health Organization (WHO) projects a rise in global dementia cases reaching 78 million by 2030 and 139 million by 2050 [2]. Dementia currently ranks as the seventh leading cause of death worldwide and the fourth among those aged 70 and older [3]. In countries such as the UK and Belgium, dementia has become the leading cause of death among women, a trend likely to be mirrored in other countries [4,5].

During the dementia trajectory, people with dementia and their families may be required to make important decisions concerning various aspects of daily living such everyday activities or financial decisions, as well as decisions such as treatment options or choices for end-of-life care [6]. Decision-making can be hampered by the decline in cognition associated with dementia, such as the decline in communication abilities which is a key component of decision-making [7]. Indeed, the ability to communicate can be greatly affected throughout the dementia trajectory, creating obstacles like word-finding difficulties, reduced contextual understanding, or an inability to concentrate during conversations [8]. These communication challenges can cause frustration and stress for people with dementia and their family caregivers and can have a negative impact on their social relationships, personal well-being, and self-image [9,10]. Such challenges in both decision-making and communication underscore an urgent need for effective support systems for both people with dementia and family caregivers.

The availability and use of web-based tools designed for people with dementia and their family caregivers have seen a notable surge over the years and have targeted, among others, communication and decision making. Such tools can enhance communication, facilitate decision-making, and improve overall quality of life for those affected by dementia [11–13]. These tools encompass a wide range of software, spanning from websites to communication programs, and are all accessible through computer, tablet, or mobile interfaces [14]. However, the loss of cognitive functions associated with dementia can also impact individuals' experiences and use of web-based systems[15,16]. For instance, people with dementia can struggle with tasks such as remembering where they are during a task or process within a system, or experience increased problems with perception of colour, shape and movement [15]. Because of the dementia related changes experienced by people living with dementia, many have recognised the importance of designing dementia-inclusive interfaces with a focus on usability [15,17,18]. Usability is defined as the degree to which a product, service or system can be used with effectiveness, efficiency and satisfaction by certain users in a specific context to achieve an objective [19]. According to the World Wide Web Consortium (W3C), the international community for the development of web standards, there are certain usability barriers that are common to web users with disabilities, which can be grouped on the basis of four principles: perceivability, operability, understandability, and robustness [20]. These principles are the required foundation to develop any accessible web content. Given the increasing reliance on digital solutions in healthcare, ensuring that web-based tools targeting communication and decision-making are accessible, user-friendly, and tailored to the needs of people with dementia is essential for optimising their effectiveness and promoting positive outcomes.

Previous systematic reviews have mostly focused on evaluating usability with family caregivers [21] or have investigated usability of cognitive intervention technologies [22] or of mobile apps for dementia care [23,24]. However, little is known about usability requirements of web-based tools for people with dementia and their family caregivers targeting decision-making or communication. Given the increase of web-based tools in dementia care, there is an urgent need for high quality and user-friendly web-based tools that support communication and decision-making and that are appropriate for the varying cognitive level of people with dementia. To improve the design of such web-based tools, a better understanding of usability requirements for people with dementia is required. The aim of this systematic review is to synthetise usability requirements for the use of web-based tools and design suggestions reported in studies geared towards supporting communication and aiding decision making for people with dementia. Specifically, this systematic review aims to: (1) identify the usability requirements of web-based tools specifically designed for people living with dementia and aimed at supporting communication or decision making, (2) explore the various usability testing methods employed to evaluate web-based tools designed for people with dementia, and (3) examine and compile the suggested improvements derived from studies focusing on web design, evaluation, and usage of web-based tools aiming to supporting communication or decision making for people with dementia. It is expected that this review will help inform the development of new web-based tools to be adapted to the needs of people with dementia and their caregivers.

2. Methods

We carried out a systematic review of the literature following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidance [25]. Narrative synthesis was selected for this review as it can be used to translate the evidence into a clear and structured design brief on how to design web-based tools for people with dementia [26].

2.1 Eligibility criteria

Studies were included if they met the following criteria:

- The study population included people living with any type of dementia/mild cognitive impairment (MCI) or a blend of people living with dementia/MCI and caregivers; and
- The study included web-tools mainly or partly aimed at supporting communication or decision making concerning living with dementia; and.
- The study described measurements or characteristics of usability testing.

Studies were excluded if they met the following criteria:

- The study included web-tools that are intended for therapeutic purposes only; and
- The identified paper was a systematic/literature review, a meta-analysis, an editorial, a newspapers article, a magazine, a book chapter, or a conference paper; and

- The paper was written in a language other than English.

2.2. Data sources and search strategy

We developed search strategies (see appendix A) with guidance from an information specialists at the University of Nottingham. Literature searches were conducted in MEDLINE, Embase, PsychINFO, Web of Science, and Scopus on 10 February 2023 with no limit on publication date. We adapted search strategies with relevant Boolean operators and search characters for each database. A combination of search terms for 'dementia, 'web-based systems' and 'usability' was used to capture all relevant literature. We used a combinations of MeSH terms and keywords to search the databases. EndNote 20 was used to store and manage the references exported from the databases alongside identifying and removing duplicate citations. The references were then uploaded into Rayyan QCRI, a systematic review application tool.

2.3 Study selection and data collection

Two reviewers (FM and CD) independently reviewed titles and abstracts against the inclusion and exclusion criteria. They obtained full-text articles for the included studies and assessed their content against the inclusion and exclusion criteria. Disagreements were resolved through discussion between the two reviewers. FM reviewed the final list of selected studies.

2.4 Data extraction and data synthesis

The primary reviewer (FM) extracted the data using standardised data extraction forms. Data were extracted on (1) study information and characteristics, (2) participant demographics, (3) description of the tools (i.e. aims, topic and features), (4) methods used to evaluate usability, (5) usability results (positive, negative, and successful elements/suggestions for improvements). CD provided a second independent review of the completed data extraction forms. Information was then qualitatively synthesised to identify common themes.

2.5 Quality assessment

The primary reviewer (FM) completed the initial quality assessment. CD provided a second independent review of the quality assessment. Given the diversity of the included studies, the Mixed Methods Appraisal Tool (MMAT) was used to evaluate the quality of the studies [27]. The MMAT was selected for its capacity to evaluate different study designs. Reponses were assessed using a categorical scale, where each response was categorised as "no", "can't tell", or "yes" based on specific methodological quality criteria [27]. The scores were calculated as high, moderate, or low quality based on the MMAT matrix. Disagreements were resolved through discussion between the two reviewers.

3. Results

3.1 Overview

The web-based database identified a total of 1726 references. After duplicates were removed, 1032 references remained, and their titles and abstracts were screened according to the inclusion and exclusion criteria. Of these, 966 were excluded as they did not focus on people with dementia or on relevant tools, leaving 66 papers for full-text screening. After a full-text screening process, 7 references were included in the review. Figure 1 presents the PRISMA flow diagram [25].

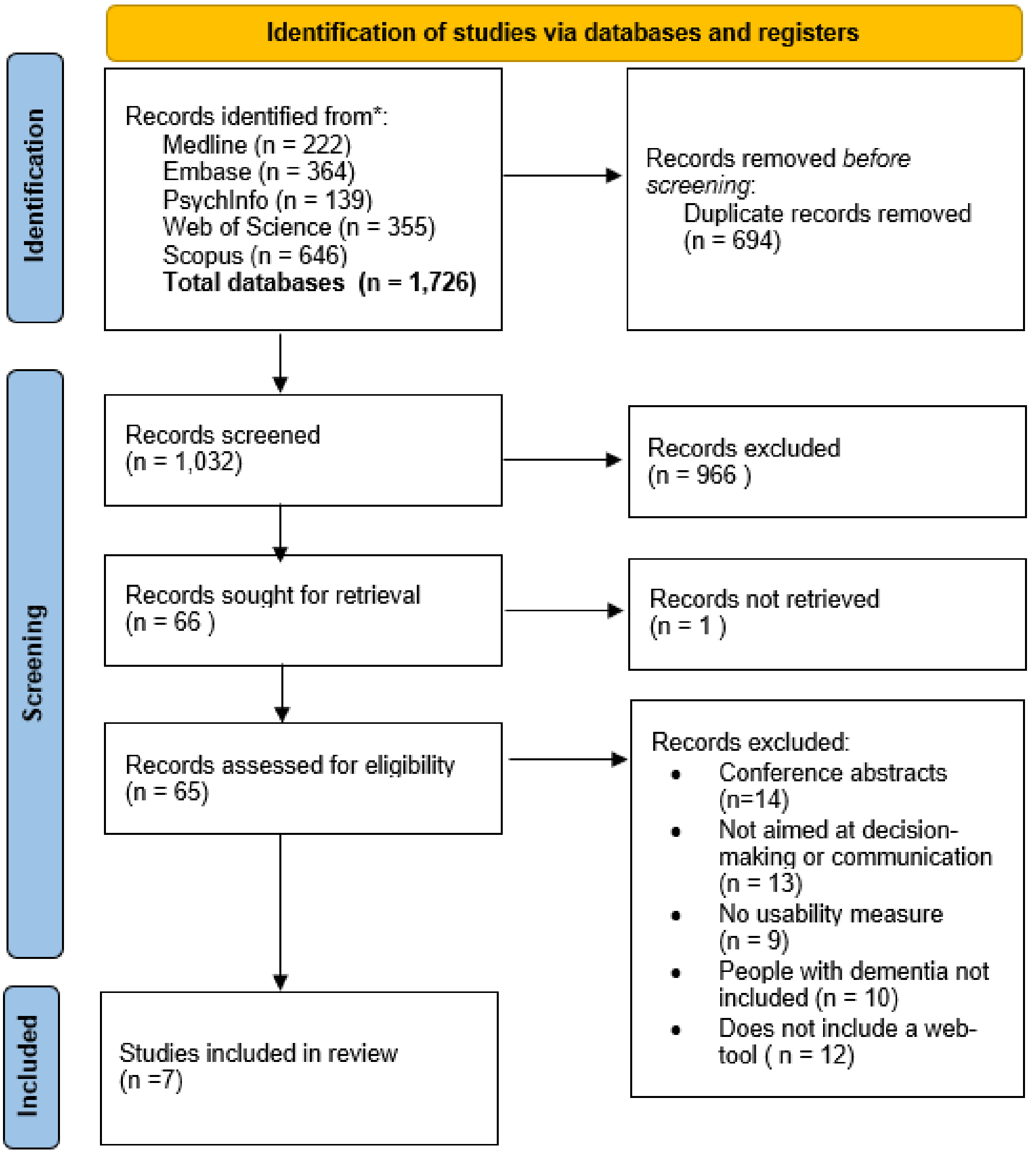

Figure 1: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) diagram of the search and review process

3.2 Study characteristics and summary of web-based tools

An overview of the study characteristics is presented in Table 1. Included studies were conducted in 6 countries: United States, Spain, United Kingdom, Netherlands, France, and Italy. Most of the included articles were published within the past three years (n=5) [28–32]. Two included articles evaluated ehcoBUTLER (global ecosystem for the independent and healthy living of elder people with mild cognitive impairments), using different methods [30,31]; and three included articles evaluated Caregiverspro-MMD (platform for self-managed interventions and mutual assistance community services), using different methods [28,33,34].

The target populations for the web-based tools included people with dementia or MCI (n=172), family caregivers (n=127), health professionals (n=21), and case managers (n=7). The web-based tools focused on a variety of topics, including decisions for technology use in care [32]; promoting health, well-being, and independence [30,31]; providing information about home modifications [35]; facilitating shared decision-making [36], addressing information needs and social isolation [28,33,34].

The web-tools reviewed in the studies aimed to support people with dementia and their family caregivers through a range of features. Usability enhancements, including clear and simple navigation systems, were found in 2 out of 7 studies [30,31]. Options for customisation or personalisation of topics were included in 2 out of 7 studies [33,34]. Multimedia elements such as images, videos, links, and audio were used in 5 out of 7 studies [30–34]. These web-tools aimed to provide engaging and user-friendly experiences tailored to the specific needs and challenges faced by people with dementia and their family caregivers.

3.3. Quality assessment

The quality of included studies was moderate to high: 5 out of the 7 studies appraised using the MMAT met above 80% of quality criteria [28,30,32–34], whereas 2 out of 7 met between 50% and 79%[31,36]. An overview of the quality assessment tool and scores can be found in appendix B.

Table 1: Summary of web-tools targeting information or communication for people with dementia and their caregivers

Study (year)	Design	Aims of the study	Web-tool name and aim	Content of the web-tool	Specific features described	Setting (country)	Sample
Berridge et al (2022) [32]	Pilot study	Describe the intervention's motivation and development process, and the feasibility of using this self-administered web application intervention in a pilot sample	Let's Talk Tech Self-administered web application that aims to facilitate conversation, decisions, and planning for technology use in elder care.	4 featured technology modules (location tracking, in-home sensors, web cameras, and artificial companion robots). Each module aims to: give information about the technology and communicate the risks and benefits of the technology, prompt discussion between the dyad and encourage documentation of the preferences of the person with dementia.	(1) Provision of a summary document that summarises choices, (2) automatic audio option, (3) sentences reviewed for clarity.	United States	29 dyads of people living with dementia and family caregivers
Castilla et al (2020) [31]	Usability study	Test the usability of the ehcoBUTLER for people with MCI	ehcoBUTLER Information and Communication Technology that aims to promote the health, well-being, and independence of older people, especially those with MCI at the social level	Offers different modules about: healthy lifestyle, leisure and free time, emotional, social, and cognitive care.	(1) navigation system, which follows a linear structure (step-by-step), (2) human-looking avatar that explains where they are on the platform and what they can do next through audio and text, (3) buttons have	Spain	28 people with MCI

					different colours depending on type of action they allow, green to continue, red to interrupt, and orange for secondary actions		
Contreras-Somoza et al (2022) [30]	Qualitative focus group study	Explore the perceptions and feedback level of the ehcoBUTLER potential primary users and stakeholders to improve the development of this platform according to their needs, preferences, and suggestions.	ehcoBUTLER Information and Communication Technology that aims to promote the health, well-being, and independence of older people, especially those with MCI at the social level	Offers different modules about: healthy lifestyle, leisure and free time, emotional, social, and cognitive care.	(1) ergonomic design, (2) especially designed for use on tablets, (3) linear navigation system, (4) human-looking avatar, which provides explanations, (5) different colours for each button depending on actions	Spain	49 participants (13 people with MCI, 13 people with dementia, 12 family caregivers, 11 health professionals)
Howe et al (2020) [33]	RCT	Assess the extent to which family caregivers and people with dementia engage with the CAREGIVERSPRO-MMD platform and explore users' feedback on how useful and usable the platform is.	CAREGIVERSPRO-MMD platform Online platform that aims to provide informational and social support to community-dwelling people with dementia (with mild to moderate dementia) and their informal caregivers.	Social media style "News Feed" that provides informational articles covering a wide range of topics such as memory loss, health and social care, caring, local support groups. Social networking element which allows users to send	(1) Home screen which contains links to the news feed function and the friends function, (2) users can connect to each other as "friends", (3) users make posts and can comment on or like any posts that are shared with them,	United Kingdom	37 dyads of people with dementia and family caregivers

				messages and share information with other users.	(4) users can select which topics they are interested in receiving information about		
Span et al (2014) [36]	Development and usability study	Identify design issues that should be considered for designing a user-friendly interactive web tool to facilitate shared decision making in care networks of people with dementia.	DecideGuide Interactive web tool that aims to facilitate people with dementia, family caregivers and case managers to communicate with each other in making shared decisions.	Web tool based on the principles of open communication and information, which is composed of: (1) three perspectives: i.e the care manager, the family caregiver, the person with dementia, (2) each participant uses the tool on their own, (3) three pillars: chat function, deciding together, and individual opinion.	(1) Available for tablets, laptops, and computes	Netherlands	6 people with dementia, 4 family caregivers, 7 case managers
Wolverson et al (2022) [28]	RCT	Explore the experiences of dyads consisting of people with dementia and family caregivers using the Caregiverspro-MMD website.	CAREGIVERSPRO-MMD platform Website that aims to address information needs and isolation through provision of information about dementia and caring, and a social network to facilitate peer support.	The website incorporates: (1) A newsfeed similar to those on social media, which delivers information and can be used to post content, like and comment on posts by users, (2) calendar, (3) resources section	(1) training and support programme with an initial home-based training session, written user guides, and regular group trainings.	United Kingdom	22 people with dementia and 21 family caregivers

				with information about local and national agencies, (4) the ability to save ‘favourite’ information for future use, (5) brain training games			
Zafeiridi et al (2018)[34]	Usability study	Evaluate the usability and usefulness of Caregiverspro-MMD platform for people with dementia or MCI, family caregivers, and health and social professionals.	CAREGIVERSPRO-MMD platform Web-based platform that aims to improve the quality of life of people with dementia or MCI and reduce caregivers stress.	Early prototype of the platform which features: (1) a home page that enable users to share and reply to messages, (2) a personal profile, social network and invitations pages, (3) calendar, (4) a forum which allows sharing of information, tips and support from users, (5) questionnaires to monitor health and well-being, (6) information about local resources	(1) gamification engine designed to increase user engagement, (2) machine learning engine to present the features of the platform to users	Italy, United Kingdom, Spain, France	24 people with dementia or MCI, 24 family caregivers, and 10 professionals

Table 2: Usability evaluation methods and user feedback

Study	Method	Positive feedback	Negative feedback	Successful elements or suggestions for improvement
Burridge et al (2022) [32]	Survey; Interviews	Overall assessment • Perceived as useful. Visual appearance • Length and amount of information Delivery of content • Descriptions clearly worded. • Balanced (neutral), presentation of information.	Delivery of content • Difficulty relating the scenarios to their own lives; need for more concrete and visual examples.	• Give concrete scenarios to illustrate the information provided. • Consider length and amount of the information provided
Castilla et al (2020) [31]	Task analysis; Interviews	Overall assessment • Users rated the system as easy to use and useful. Navigation • High task completion rates, suggesting an intuitive design.	Overall assessment • Users pressed the screen for too long, activating the second button (e.g., copy) instead of the primary button (e.g., continue) Delivery of content • The avatar's synthetic voice was too fast. Navigation • Attentional focus towards the centre of the screen to the detriment of the elements placed at the bottom or sides. • Users clicked outside of the buttons.	• Combine linear navigation with audio and help text and a design in which the main interactions (e.g., to continue the task) are placed in the centre of the screen. • Adjust the speed of the synthetic speed and add short time separation between phrases.
Contreras-Somoza et al (2022) [30]	Focus groups	Overall assessment • Portable and large touch screen	Overall assessment • Difficulty using keyboard or mouse.	• Personalise the system for the users.

		Visual appearance • Simple appearance • Ergonomic design • Appropriate colours and font Delivery of content • Personalised content and experiences • explanations and instructions	Delivery of content • Artificial appearance and voice Support needed • Difficulty to use independently for people with dementia.	• Include larger icons and keep amount of text small. • Offer pre-training for users
Howe et al (2020) [33]	Survey	Overall assessment • Perceived as useful. • Easy to use	Overall assessment • Generally, more useful to family caregivers than to people with dementia Support needed • Help needed for people with dementia to use.	• Provide training sessions to demonstrate how to use the platform
Span et al (2014) [37]	Focus Groups; Cognitive walkthrough; Think-aloud	Visual appearance • Combination of buttons and icons • Green colour • Predominantly simple webpages Delivery of content • Personalised tool • Provides examples	Navigation • Difficulty with login • Unclear navigation structure • Too many webpages Visual appearance • Font and buttons size too small, and too close together. • Lack of contrast • Technical issues with the chat and timeline functions • Excessive information and examples • Excessive use of colours in the examples • Colour red associated with danger or feeling unwell.	• Use pleasant and harmonious colours. • Use clear and harmonious buttons throughout the interface.

			Delivery of content • Use of smileys perceived as childish and unclear. • Unclear formulation of questions or text • Tool is too directive	
Wolverson et al (2022) [28]	Interviews; Focus groups	Delivery of content • Continued access to information • All information grouped on one platform. • Both formal and informal information provided Support needed • Regular support and training sessions • Written user-guides and handouts	Delivery of content • Difficulties to use a tablet. • Lack of time to use the tool	• Develop a website where users can easily access, use and save information, without lengthy searches. • Ensure balanced tone and content of information
Zafeiridi et al (2018)[34]	Survey (quantitative and qualitative)	Visual appearance • Bigger colour contrasts and font sizes • Images and icons rather than text menus	Overall assessment • Concerns for privacy of information put in the platform. Visual appearance • Emoticons were confusing. Navigation • Difficulty to find previously posted content Delivery of content • Content too direct, e.g. avoid the use of “dementia” for “memory problems”	• Prefer less busy pages, more images, larger font sizes and colour contrasts, and fewer colours on each page • Provide clear explanations about privacy clauses

3.4 Key findings

Across the 7 articles, several general themes were apparent: overall usability assessment, visual appearance, navigation, delivery of content, and supported used of web-based tools. An overview of the study methods and outcomes from user feedback is presented in Table 2.

3.4.1 Usability requirements of web-based tools designed for people with dementia

3.4.1.1 Overall usability assessment

More than half of the studies provided a general assessment of the usability of their platform (n=4 out of 7) [31–34]. Overall, users found the platforms useful and user-friendly [32,33], although participants in one study mentioned that it would be more useful for caregivers than for people with dementia [33] and prior knowledge in technology was needed [33]. Three studies reported on the usability of the devices used, with tablets being perceived as easy to use in one study [30] and difficult to use in two other studies [28,31]. Using a keyboard and a mouse was reported to be too difficult for people with dementia in one study [30]. Finally, participants expressed concerns for the privacy of their data in one study [34]. More detailed feedback revolved around the following themes: visual appearance, navigation, delivery of content, and support needed.

3.4.1.2 Visual appearance

One of the main characteristics that emerged from the majority of studies (n=4 out of 7) is the necessity for a sophisticated and harmonious design. Participants in three studies provided feedback on the need to use appealing, simple and clear colours [30,34,36]. People with dementia or MCI appreciated platforms that used simple colour schemes. Furthermore, two studies also observed a preference for larger font sizes, larger button sizes, and larger image or icon sizes [30,34]. Finally, platforms with excessive text were not considered visually appealing and decreased usability for people with dementia [32,37]. Participants highlighted the need for shorter amounts of texts in two studies [32,36]. Similarly, participants in two studies preferred the use of icon and images over text [34,36]. Although, one study noted that the use of icons should always be used in context, as participants in their study found the use of emoticons confusing [34].

3.4.1.3 Navigation

Three studies addressed navigation-related issues [31,34,36]. Difficulty in finding specific buttons was reported by people with dementia in one study [31]. Other issues included lack of signposting and challenges in understanding the navigation structure, mentioned in one study[36], and an attentional focus towards the centre of the screen at the detriment of elements placed at the bottom of the screen which was mentioned in another study [31]. However, overall intuitive navigation and high task completion rates were observed in one study [31]. Participants in one study also mentioned disliking having to navigate through too many webpages or screens [36]. Finally, difficulties with login[36] and difficulties with finding content from previous sessions [34] were mentioned in one study each.

3.4.1.4 Delivery of content

The delivery of content received significant attention in six studies[28,30–32,34,36]. Two studies addressing decision-making about technology use and shared decision-making reported on the need to provide clear and concise textual content and also identified difficulties with understanding of examples or relating to examples provided, suggesting the need for concrete and visual examples [32,36]. Furthermore, user feedback in four studies emphasised the need to have a balanced, neutral or non-directive presentation of information [28,32,34,36]. Challenges related to an assistive voice, which provides information about where they are on a page and what users could do next. This assistive voice being too fast was noted in two studies [30,31]. The possibility to personalise content and the ability to use the web-tool in a flexible and independent manner were noted to increase usability in one [28] and two [30,36] studies respectively. Finally, positive user feedback was reported in one study regarding the availability of dementia-related information on a single platform [28].

3.4.1.5 Supported use of web-based tools

Support needs were highlighted in three out of the seven included studies [28,30,33]. Difficulty using the web-tool independently for people with dementia and extra support needed was mentioned by participants in two studies [30,33]. Recommendations for support were formulated by the researchers in three studies and included providing regular training sessions[28,30,33] offering assistance for technical difficulties[29], individually tailored support to use the web-tool [30], and providing different levels of content and difficulty based on users' cognition levels[30].

3.4.2 Usability testing methods

Studies conducted with people with dementia or MCI, family caregivers, health professionals, and case managers used several different methods to collect usability feedback. In total, 3 studies used surveys to identify whether users were likely to use and accept the website features[32–34]. Of these one combined both quantitative and qualitative surveys[34], while the others used solely quantitative surveys [32,33]. Five studies with people with dementia also used interviews and focus groups to record users’ experience of using the web-tools [28,30–32,36]. Furthermore, one study employed a cognitive walkthrough procedure and a think-aloud procedure by recording users’ thoughts as they used the website [36]. One study conducted usability tests by observing tasks completion rates [31]. Two studies only used one of the methods above to assess usability [30,34], three combined two of these methods [28,31,32], and one used a combination of three methods [36].

3.4.3 Successful design elements or suggestions for design improvements

Based on their findings, all studies gave an overview of the successful elements of their designs or suggested improvements to increase usability. Three studies recommended ensuring sufficient colour contrast, using larger font and button sizes, and using understandable language to contribute to a better user experience [30,34,36]. One study suggested to carefully consider the length and amount of information presented, and to provide clearly formulated textual content and concrete examples to contribute to a user-friendly experience[32]. Furthermore, researchers of two studies recommended to provide a simple and intuitive interface that aligns with users' interests and cognitive levels, for example by opting for linear navigation (n=2)[28,31]. Recommendations for support were addressed in three studies and included providing regular training sessions [28,30,33]offering assistance for technical difficulties [29], individually tailored support to use the web-tool [30], and providing different levels of content and difficulty based on users' cognition levels[30]. Table 3 summarises these recommendations into a design brief for web-based tools for people with dementia.

4. Discussion and Conclusion

4.1 Main findings

This article presents the findings of a systematic review aimed at identifying and synthesising usability requirements for web-based tools targeting communication and decision-making for people with dementia and their family caregivers. We identified seven studies, which covered a broad spectrum of topics, including care technology usage, health promotion and independence, home modification information, shared decision-making facilitation, and addressing information needs and social isolation. The studies employed a range of methods including surveys, interviews, focus groups, cognitive walkthroughs and think-aloud procedures to gather usability feedback. Most studies included in the review reported positive feedback on the usability of the platforms, with users generally finding them useful and user-friendly. However, concerns were raised about the need for prior technological knowledge and the need for additional support. Findings from this systematic review ranged from user feedback on visual appearance and navigation, to delivery of content and support needed to use web-based tools.

Visual appeal emerged as a pivotal factor, emphasising the importance of a sophisticated and harmonious design, simple colour schemes, larger fonts, and images over excessive text. Navigation challenges were also reported, including difficulty finding specific buttons and understanding navigation structures, highlighting the need for intuitive designs. Moreover, suggestions were made for effective content delivery, demonstrating the importance of clear and concise information. Overall, these findings align with the research of Ancient and Good [15,16] and the guidelines of the World Wide Web Consortium (W3C) (i.e. the main international standards organisation for the World Wide Web) on cognitive accessibility [38–42], which stated the need for clear and concise language, predictable and consistent design, and user-friendly features that support comprehension and task completion. Our findings thus further reinforce these key considerations, and contribute valuable insights to the existing body of knowledge on designing user-friendly web-based tools for people with dementia, especially for tools targeting communication and decision-making in dementia care. Furthermore, this systematic review's focus on web-based tools complements findings from previous reviews investigating usability for mobile apps in dementia care [23,24]. Engelsma and colleagues et al. (2021) formulated design suggestions for mHealth based on usability barriers related to cognition (e.g. show limited information), perception (e.g. implement speech recognition), physical ability (e.g. use large screen- and font sizes), and frame of mind (e.g. provide video communication when applicable) [24]. While design suggestions in terms of visual appearance seem to align, our findings provide specific insights into the usability of web-based tools in terms of navigation and content delivery, which differ from considerations for mobile apps.

Additionally, our systematic review reveals that even web-based tools deemed user-friendly by people with dementia and their family caregivers still require additional support for people with dementia. This underscores the importance of providing various forms of assistance to enhance usability. Previous research has demonstrated that people with mild dementia can learn or re-learn to use technology such as touchscreen technology for instance through training interventions [43]. Assistance and guidance – either by a family caregiver or a designated person – has led to positive outcomes in terms of adoption of technology by people with dementia and family caregivers [44], however our findings point to the need for continuous support following adoption to facilitate usability of web-based tools. Key forms of support identified in this review are: tutorials and instructions embedded within the platform, offering step-by-step guidance, and face-to-face training provided by trained personnel.

Another notable finding is that most of the studies included in this review were conducted within the last three years. This temporal emphasis reflects the recent recognition of the potential of web-based tools in supporting people with dementia [45]. This could be due to an improved technological literacy among people with dementia over the years, although some cohort differences may still be present [46]. It may also reflect several other factors such as the development of better and more affordable technology over time, as well as a more favourable disposition towards technology use among the current generation of people with dementia compared to a decade ago [47].

4.2 Practice Recommendations

Taking into account the findings of this review, we constructed a design brief to help tailor new and existing web-based tools targeting communication or decision making for people with dementia (Table 3).

Table 3: Design brief for the development of web-based tools for communication or decision-making designed for people with dementia

Visual appearance	**For web designers:** • **Enhance visual appearance**: increase colour contrast, use larger fonts and buttons, and incorporate recognisable icons for improved visibility and interaction. • **Create harmonious interface**: Use pleasant colours, minimise busyness, include more images, and maintain consistency in button design for a user-friendly experience. **For researchers or clinicians:** • **Optimise information**: Condense and organise information into smaller pieces with clear headings for easier comprehension.

Navigation	**<u>For web designers:</u>** • **Enhance navigation**: Implement a combination of linear navigation, audio cues, and help text to guide users through the web-based tool. Place essential interactions, such as task continuation, prominently in the centre of the screen for ease of use. • **Streamline information access**: Develop a web-tool that allows users to easily access, use, and save information without the need for lengthy searches. Employ efficient search functions, clear organisation, and intuitive categorisation to facilitate seamless information retrieval and enhance user efficiency.
Delivery of content	**<u>For web designers:</u>** • **Personalise the system**: Customise the web-based tool to cater to individual users' needs and preferences. Incorporate options for user preferences, such as font size, colour schemes, or language settings, to enhance usability and accommodate diverse user profiles. **<u>For researchers or clinicians:</u>** • **Provide concrete scenarios**: Illustrate the information provided through tangible and relatable examples or scenarios. This helps people with dementia better understand and apply the content, improving engagement and retention. • **Use understandable language**: Use clear and easily comprehensible language throughout the web-based tool. Avoid jargon or complex terminology, opting instead for simple and concise explanations. This promotes clarity and accessibility for people with dementia, facilitating their understanding and interaction with the tool.
Support	**<u>For researchers or clinicians:</u>** • **Offer training and pre-training**: Provide training sessions to demonstrate how to use the web-based platform effectively. Additionally, consider offering pre-training materials or resources that familiarise users with the tool's functionalities, enhancing their confidence and competence in using it. • **Provide tailored support**: Offer individually tailored support to users, addressing their specific needs and challenges in using the technology. This may involve one-on-one guidance, personalised tutorials, or assistance from trained personnel to ensure a smooth user experience.

4.3 Strengths and limitations

This is the first systematic review focusing specifically on the usability of web-based tools designed to address communication and decision-making needs for both people with dementia and their family caregivers. Our findings have revealed important evidence-based usability requirements for web-based tools targeting communication and decision-making for people with dementia. Furthermore, our study offers practical recommendations that can directly inform the development of web-based tools for people with dementia and their family caregivers. Despite its contributions, this systematic review has certain limitations. We limited our search to articles published exclusively in English, potentially excluding valuable research conducted in other languages. Furthermore, we did not factor in the quality assessment of the included studies, as the majority of the included studies demonstrated good to fair methodological quality. Studies with varying degrees of methodological quality were all considered equally in the review to maintain a comprehensive representation of perspectives. However, it could potentially affect the overall robustness of the synthesised findings and our recommendations.

4.4 Implications and Future Directions

The results of this systematic review add to increasing our understanding of digital health in the context of dementia and have revealed important usability requirements for web-based tools targeting communication and decision-making for people with dementia. Importantly, it highlights the need to provide additional support to facilitate the use of web-based tools for people with dementia and their caregivers, even when usability of web-based tools is positively evaluated. To optimise support for people with dementia, future research should explore innovative approaches in delivering tailored tutorials and instructions aligned with cognitive abilities and preferences. This is especially essential given the growing reliance on online tools and services in healthcare. Another area of future research is the visualisation of information and content for people with dementia. Presenting information in a clear, concise, and visually appealing manner is crucial for people with cognitive impairments. Exploring how to effectively design and present information on web-based tools to enhance comprehension and engagement for people with dementia is an important avenue for future investigation. Furthermore, people with dementia and their family caregivers represent a diverse and heterogeneous group, varying in their needs, preferences, and technological literacy. Caution should be exercised when applying the recommendations derived from this review to people with dementia and their caregivers without considering their specific characteristics and circumstances. The recommendations emerging from this review would also benefit from being reviewed by people living with dementia, through patient and public involvement for example. Finally, the rapid advance in artificial intelligence (AI) technology and machine learning is likely to influence web accessibility in the future [48], therefore future research may look into the benefits and challenges of integrating AI in web-based tools for people with dementia.

4.5 Conclusion

This systematic review identified key recommendations highlighting the need to reduce cognitive load, improve readability, and provide clear and concise language in web-based tools that aim to support communication and decision-making for people with dementia and their family caregivers. Additional support for the use of web-based tools in the form of tutorials, instructions, or face-to-face training is necessary and warranted to enhance usability for people living with dementia. Limitations include a focus on English-only articles and the inclusion of studies with varying methodological quality in the development of our recommendations. Future research should address innovative approaches in delivering tailored support and information visualisation for people with dementia.Overall, this systematic review contributes to the growing understanding of usability requirements for web-based tools targeting people with dementia, paving the way for improved design and development of web-based supporting communication and decision-making.

5. Summary points

What is already known

- Web-based tools for dementia patients and their caregivers have significantly increased, focusing among others on communication and decision-making.
- Dementia-related cognitive decline can affect how individuals use web-based systems, leading to difficulties in tasks like navigation and perception. This highlights the importance of designing user-friendly, dementia-inclusive interfaces.

What this study adds

- This review emphasizes the need for reducing cognitive load, enhancing readability, and using clear, concise language in web-based tools targeting communication and decision-making for dementia patients and their caregivers.
- This review highlights the need for additional support, such as tutorials or face-to-face training, to enhance the usability of web-based tools for people with dementia.

6. Supplementary materials

Appendix A: Search strategy performed in the databases Medline, Embase, PsychInfo, Web of Science Core Collection, and Scopus

Appendix B: Quality assessment tables

7. Declarations

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Authors' Contributions

All authors have substantially contributed to the research and approved the version to be published. All authors contributed to the review conception and design. The search, screening, selection, and synthesis were performed by FM and CD. The original draft was prepared by FM. MPC, CD, LVdB and

LP were involved in the review and editing of the manuscript. MPC, LVdB and LP were involved in supervision.

Conflicts of interest

The authors declared no potential conflicts of interest regarding the research, authorship and publication of this research.

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