Review

Research on Older Persons' Access and Use of Technology in the Arab Region: Critical Overview and Future Directions

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Abstract: This paper presents the findings of a scoping review that maps exploratory evidence and gaps in research on information and communication technology (ICT) access and use among older persons in the Arab region. This review is part of a larger project that studies ICT access and use and related challenges faced by older adults in Qatar. A search was conducted in eleven scientific databases and search engines covering empirical studies published in English and Arabic between January 2016 and June 2021. Eleven studies were retrieved in the final corpus. A thematic analysis alongside the PRISMA for scoping reviews (PRISMA-ScR) was used to retrieve the findings. Our analysis identifies smartphones and social media applications for communication and information sharing as the most accessed and used technologies by older persons in the region. Moreover, our review highlighted the importance of the sociocultural factors in shaping ICT access and use by older persons in the region. The functional limitations of older persons in interaction with certain technology factors such as usability, functionality, and accessibility were also highlighted as major challenges inhibiting ICT access and use by this population segment. This scoping review provides a comprehensive overview of ICT access and use, and the factors affecting them among older persons in the Arab region. It highlights the scarcity of research on the subject in the region. It also stresses the fact that there is a need for more research on older persons and their caregivers in the context of the Arab world. More culturally appropriate need-based and adapted technologies are also recommended. Our review is a comprehensive source for researchers and technology developers interested in targeting and engaging older adults in the Arab region.

Keywords: older persons; Arab region; information and communication technologies; scoping review

1. Introduction

Information and communication technology (ICT) or information technology (IT) refers to all forms of technology that are repurposed or used as is to process, store, or communicate [1]. ICT has proved to be positively associated with improved outcomes when used by older persons as a source of support for various tasks across multiple environments. Research studies targeting older persons' ICT use have focused on a variety of aspects, including improving vocational and employment skills [2–4], enhancing daily living skills [5,6], providing means for communication and social inclusion [2,7,8], and supporting emergent literacy [4,5,9]. The COVID-19 pandemic has led to an inevitable surge in the use of ICT by older persons due to the social distancing norms and lockdowns [10]. ICT became the most effective way to keeping older persons informed and socially connected [10]. Consequently, the COVID-19 pandemic brought the issue of digital divides, mainly those associated with older age, to the forefront of the public agenda [11]. The term 'digital divide' is understood in various ways. In this paper, the term digital divide

refers to disparities among older persons and younger persons regarding their opportunities to access ICT (first level), make diverse and effective use of them (second level), and benefit from such use (third level) [12]. Older persons are the most affected by the digital divide [11,13] and, at the same time, are considered the fastest-growing segment of ICT consumers [14]. In the last 50 years, life expectancy at birth has increased by approximately ten years, while fertility rates have been declining [15]. The proportions of older persons worldwide have increased, mainly in occidental countries [15]. Even though Arab countries have a different aging trend, as their aging population shares are growing in less significant and less homogeneous ways compared to the occident [16], the 60+ age group is nevertheless increasing due to improvements in healthcare, legislation, and social and financial status [16]. In the Gulf Cooperation Council (GCC) countries, the ageing population will rise by 10.47 percent by 2030. By 2050, the GCC's aging population is expected to be at an all-time high of 20.66 percent, the highest in the Arab region, followed by the North African countries, Asia, and the least developed countries [16]. Recent evidence shows that older persons in the Arab region also experience a digital divide [13]. Data from periodic surveys conducted by the Arab Barometer indicate that internet access and use differ by demographic variables, one of which was a 'generational divide' between younger and older cohorts, described as a 'severe' divide [13].

Growing commitments to bridge disparities in social, health, economic and other accessibility areas in a rapidly aging region, together with global pledges to the United Nations (UN) Decade of Healthy Ageing (2021–2030), which aimed at empowering older persons, requires that this knowledge gap is filled sooner rather than later [17,18]. For instance, the health and well-being strategies of some Arab countries' governments have associated digital literacy with healthy aging. The State of Qatar, for example, has clearly emphasized the importance of accessibility of digital services for healthy aging [19]. Qatar's Mada Assistive Technology Centre launched the best practice of using assistive technology for older people [20]. In addition, the kingdom of Saudi Arabia, through its 2030 vision, has established several services that support the digital inclusion of the elderly [21].

From a research perspective, ICT access and use by this population segment have become an area of study for many scientists in the region [22]. In order to better understand the digital divide in the Arab region in the context of the region's aging population, this paper aims to shed light on the state of ICT access and use by older persons and the factors affecting them through a scoping review of existing literature in this area that engaged older adults in their research and development processes.

This review is unique in its focus on shedding an up-to-date light on ICT access and use by older persons in the Arab region. This review is, to our knowledge the first on the subject in the region. Its novelty, the research gaps it identifies, and the stemming recommendations are of great relevance to all researchers, technology developers, and policymakers interested in promoting ICT access use among older adults in the region.

2. Materials and Methods

A scoping review was carried out from 20 April 2021 and progressed till 2 May 2021. A scoping review is an initial exploration of the available research literature. It follows a systematic method to map evidence in a particular area and identify its scope, size, and nature [23]. This scoping review followed guidelines recommended by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Extension for Scoping Reviews (PRISMA-ScR) [23].

2.1. Study Context

This scoping review is situated within a larger project that investigated ICT access and use and the related challenges among older persons in one of the countries of the Arab region, Qatar, by: (1) describing the ways in which technology has been accessed and used by this segment of the population; and (2) describing and better understanding the obstacles and facilitating conditions to its access and use of technologies. This larger

project engaged older persons and their caregivers via a series of 40 semi-structured interviews and their input was discussed and validated with a panel of key decisions makers in Qatar via 4 discussion panels throughout the course of the study. This project was conducted by a team of researchers from different scientific fields (psychology, information technology, etc.).

This scope review is a first and needed step to inform the above project design and discussion. It is also an initial exploration towards the development of a comprehensive overview of the research and current status of the digital divide in the Arab region among older persons [22].

2.2. Search Strategy

2.2.1. Search Sources

We searched the following nine bibliographic databases/search engines: ACM Digital Library, IEEE Xplore, Scopus, Ageline, CINAHL, Embase, MEDLINE, PsychINFO, and Proquest. For Arabic papers, we extended our search to Al Manhal and the Arabic version of Google Scholar. To validate the choice of the databases, previous literature reviews on similar subjects were reviewed, and three researchers in the domain of gerontology, human–computer interaction, and sociology were consulted to confirm and supplement the list of databases selected.

2.2.2. Search Terms

The search terms were selected based on three elements: (1) the targeted population (e.g., older adults, older persons, elderly persons), (2) a regional focus on the Arab League countries and region (e.g., Arab, Middle East), and (3) technologies used (e.g., mobile technology, mHealth). The search terms were derived from previous reviews [24]. Furthermore, search terms were derived from the Medical Subject Headings (MeSH) index in MEDLINE and the suggestions of the interdisciplinary research team experts interested in informatics, information technology, gerontology, and services targeting older persons. Appendix A shows the all-search strings applied within each electronic database consulted in our scoping review.

2.2.3. Inclusion and Exclusion Criteria

For studies to be included in this review, they had to convey primary research findings on technologies accessed, used, or developed for older persons and their caregivers in the Arab region, i.e., all 22 countries members of the Arab League as of 2021. Only studies including older adults as testers or participants in the research were included. Older persons in the Arab region are all citizens who are 65 years and up. The review focused on primary peer-reviewed articles, theses, dissertations, conference proceedings, and reports. We excluded reviews, conference abstracts, proposals, and editorials. The selection criteria required studies to be written in English or Arabic and published from January 2016 to June 2021.

2.2.4. Filtering Process

The database search started on 20 April and continued until 2 May 2021. Initially, 5051 potentially relevant articles were retrieved as shown in Figure 1. The selection of studies was conducted with the help of Rayyan—a web-based systematic review tool [25]. The studies were imported to Rayyan as research information system (RIS) versions, in which we screened abstracts and included or excluded studies according to our eligibility criteria.
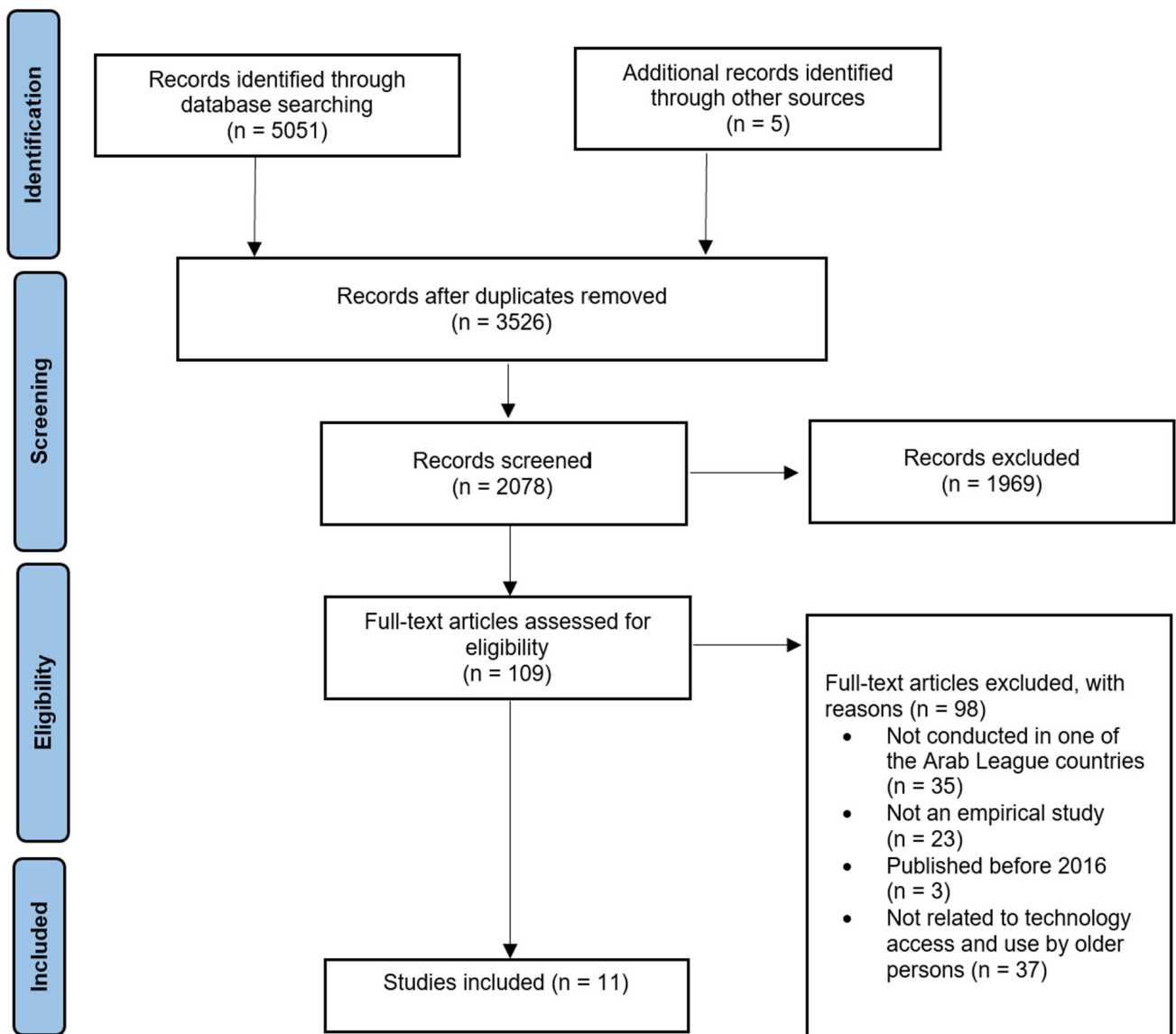
Figure 1. Flow chart of the study selection process.

Additional strategies were implemented to validate the search strategy and increase the likelihood that all studies included were potentially relevant [26]. First, critical articles pointed out to us by experts were searched within our search results. Second, an ancestral search was conducted by searching the reference lists of papers identified in the search. Finally, an author search was carried out to determine further studies by the authors of the selected studies identified in our initial search. These additional strategies yielded five papers.

After deleting duplicates, 3526 publications were identified. First, the titles of all citations of potentially eligible studies were reviewed. Second, the abstracts were screened. This process resulted in the retention of 109 publications. Third, the full articles of these publications were independently screened by two reviewers. In case of disagreement, a third reviewer was consulted, and a consensus was attained by further discussion among the three reviewers.

Due to the limited number of retrieved studies and the collaboration of three reviewers in the selection process, Cohen's kappa test to examine the inter-coder agreement was not employed [27]. The third reviewer intervened to reach an agreement in the first and second step of the selection process, respectively, resulting in a unanimous agreement

for all selected and eliminated papers. The PRISMA diagram, in Figure 1, illustrates the selection process of the studies and shows reasons for exclusion.

2.3. Data Extraction

Data related to (1) the characteristics of included studies, (2) demographics of the participants, (3) ICT access and use by the older population in the Arab region, and (4) the reported factors affecting their ICT access and use were extracted into an Excel spreadsheet with predetermined labels for each description. Two reviewers independently conducted the data extraction process, and a third reviewer resolved any disagreements.

2.4. Study Quality Assessment

Scoping reviews are considered a technique to 'map' the relevant literature in the field of interest where many different study designs might be applicable [23,28]. While systematic reviews aim to answer questions from a relatively narrow range of quality assessed studies, scoping reviews are less likely to address particular research questions and assess the included studies' quality [29]. Accordingly, assessing the quality of the included studies in this review was not among its objectives and was not carried out.

2.5. Data Synthesis

Extracted data were synthesized following a narrative approach. The data charted from the retrieved studies were classified under four themes: (1) characteristics of the publications reviewed, (2) characteristics of the older persons and their caregivers engaged in the studies, (3) the technologies accessed and their uses, and (4) the challenges reported by study participants when using or accessing IT.

We employed the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) framework to contextualize the challenges reported by study participants when using or accessing IT [30]. Following the ICF model, technology access and use are approached as the outcome of complex interactions between factors related to the older persons and their environment that unfold over time [31]. This interactional perspective provides a comprehensive view of why and how older persons access and use ICT. Consequently, we synthesized the reported challenges and facilitating conditions around older persons' ICT access and use into three categories of factors: personal, environmental, and technology factors. Figure 2 provides an overview of these factors:

- Personal factors include the abilities of the older persons, such as a decline in their fine motor skills and their attitudes towards technologies.
- Environmental factors encompass all factors that affect older people's ICT access and use external to the older persons themselves, such as caregiver support.
- Technology-related factors are part of the environmental factors. However, since this paper's focus is ICT access and use, we analyzed technology-related factors separately. This category encompasses factors explicitly related to the technology, such as usability.
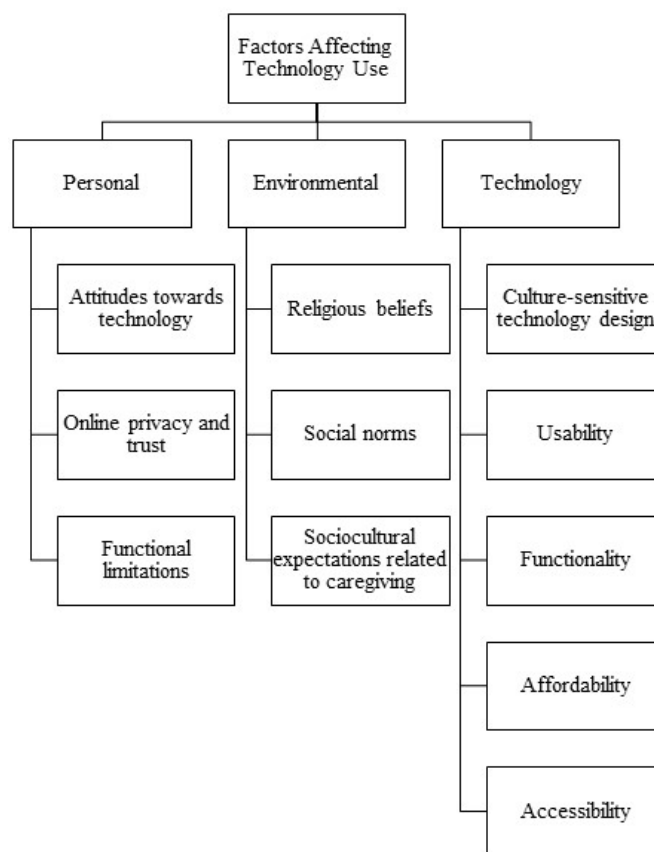
Figure 2. Overview of factors affecting technology use identified in the review.

3. Results

A total of 11 relevant citations were identified through our search strategy. In this section, we first present the characteristics of the selected papers and their participants' demographics. Second, we answer the research objectives. Two distinct themes were analyzed: (1) technology access and use by older persons in the Arab region and (2) reported challenges and facilitating conditions around older persons' ICT access and use.

3.1. Characteristics of Included Studies

Table 1 presents the main characteristics of the 11 studies included in this review. One important finding is that most of the studies (10) were conducted in Saudi Arabia, and the other in the United Arab Emirates (1). More than half of the studies (6) were published after 2018. Four of the papers are conference proceedings, while five are journal articles. The other two papers are dissertations. Most papers (7) utilized a quantitative research approach. Only one paper used a qualitative research approach, and three used mixed-method strategies.

Table 1. Inclusion and exclusion criteria.

Included Papers Are	Excluded Papers Are
Primary/empirical studies	
Peer-reviewed	
Published in English or Arabic	Gray literature
Published from 2016 onwards	Conducted outside the 22 Arab League countries
Targeting and engaging older persons in the research	Not available in full-text format (e.g., abstracts, posters)
Studies conducted in Arab League countries	
Focusing on technologies accessed and used by older persons	

Table 2 presents the demographics of the participants of the 11 studies included in this review. Eight out of the 11 included studies reported their participants' number and gender distribution. Both female and male older persons took part in the included studies. The percentage of male participants in the included studies outweighed the female participants in six out of the 11 papers [3,6,9,32–34]. The average age group of the older persons was from 60 to 80+ years old [2,3,6,32–34]. Only one study reported on older persons under 60 [9]. The living setting was classified in this review into participants who are: (1) living alone, (2) living with family, (3) living with extended family, (4) living with friends, (5) living in a residential home, and (6) living in a long-term health facility. In the included studies, four out of 11 papers reported that participants over the age of 55–80+ lived with their family members, particularly in Saudi and Arab households [2,9,32,33]. Three studies reported that the older persons' living context was with their extended family [9,32,33]. Moreover, our analysis identified several methodological concerns in the reviewed papers, mainly the non-mention of any ethical approval prior to the research and details related to the data collection and analysis such as the number of the participants and their characteristics (see Table 3).

Table 2. Characteristics of included studies.

[Reference N]	Country	Type of Publication	Research Approach
[7]	United Arab Emirates	Conference proceeding	Quantitative
[4]	Saudi Arabia	Conference proceeding	Quantitative
[6]	Saudi Arabia	Thesis	Quantitative
[32]	Saudi Arabia	Journal article	Quantitative
[33]	Saudi Arabia	Journal article	Mixed
[8]	Saudi Arabia	Journal article	Quantitative
[34]	Saudi Arabia	Journal article	Quantitative
[3]	Saudi Arabia	Conference proceeding	Mixed
[5]	Saudi Arabia	Journal article	Quantitative
[2]	Saudi Arabia	Dissertation	Mixed
[9]	Saudi Arabia	Conference proceeding	Qualitative

Table 3. Demographics of the participants.

Source	Participants' Number and Gender Distribution	Age Range	Living Setting	Caregiver Type
[7]	Not specified	Not specified	Not specified	Not specified
[4]	36 participants	Not specified	Not specified	Not specified
[6]	40 participants Male (92.5%, $n = 37$) Female (7.5%, $n = 3$)	Aged 60–74 years	Not specified	Not specified
[32]	81 participants Male (74.07%, $n = 60$) Female (25.92%, $n = 21$)	Aged 60–72 years	Not specified	Not specified
[33]	134 participants Male (84.32%, $n = 113$) Female (15.67%, $n = 21$)	Aged 60–80+ years	Not specified	Not specified
[8]	Not specified	Not specified	Participants: - living in a social care home	Social care professional
[34]	194 participants Male (63.9%, $n = 127$) Female (36.1%, $n = 70$)	Aged 60–80 years	Participants: - living alone (8.8%, $n = 17$) - living with family (82.5%, $n = 160$) - living with extended family (7.2%, $n = 14$) - living with friends (1%, $n = 2$) - living in a social care home (0.5%, $n = 1$)	Not specified

Table 3. *Cont.*

Source	Participants' Number and Gender Distribution	Age Range	Living Setting	Caregiver Type
[3]	194 participants Male (63.9%, *n* = 127) Female (36.1%, *n* = 70)	Aged 60–80+ years	Participants: - living alone (8.8%, *n* = 17) - living with family (82.5%, *n* = 160) - living with extended family (7.2%, *n* = 14) - living with friends (1%, *n* = 2) - living in a social care home (0.5%, *n* = 1)	Not specified
[5]	Not specified	Not specified	Not specified	Not specified
[2]	45 participants Male (53%, *n* = 24) Female (47%, *n* = 21)	Aged 65–80+ years	Participants: - living with family	Not specified
[9]	14 participants Male (57.2%, *n* = 8) Female (42.85%, *n* = 6)	Aged from 55–71 years	Participants: - living with family - living with extended family	Family members and domestic caregivers

3.2. Technology Access and Use by Older Persons in the Arab Region

The most prominent of the technologies identified in our review were smartphones [2,6,9,32–34]. Three papers reported on smartwatches [4,5,7]. The other three papers studied ambient assistive living (AAL) [8,34]. Older persons reported using smartphones for calling purposes, paying bills, and online banking applications and e-government services [2]. WhatsApp and Snapchat, two popular social media applications in the Arab region, were used to document the aging experiences of older persons [9,32]. These studies also spotted an increased daily use of these social media applications for communication and information sharing among older persons [9,32]. A range of smartphone functions and applications, including mHealth, were reported in five out of 11 studies [2,6,9,32,33].

mHealth technologies are mobile devices (e.g., smartphones and tablets) and software integrated with mobile medical services and healthcare systems via wireless devices or used for health self-care and management. As the focus of this paper is on ICT use by older persons and their family members and caregivers, only health self-care and management technologies were considered and analyzed. Six of the reviewed studies reported the use of mHealth applications with supportive functions [4–7,32,33], including medication management [32] and information recall, such as remembering personal details and familiar people the older persons meet in their daily living [4], supporting caregivers by tracking older persons' status (e.g., heart rate) at any time and place through communication between a smartwatch and the older person's smartphone [4,7].

AAL involves technical systems that enable and support older persons in their activities of daily living to promote independence and a healthy lifestyle [35]. Our findings highlight that AAL was used to remotely monitor older persons who might have emergencies and alert caregivers when needed [5,7]. Other remote technologies studied were smart homes features and live or recorded surveillance cameras [34].

More than half of the studies pertain to developing new technologies that are not yet in the market [2,4,5,8,32,33]. Among these technologies, we used the technology readiness level (TRL) [36], to identify the different stages of development of the technologies studied in the papers mentioned above.

According to TRL, there are nine technology readiness levels, with one being the least ready and nine being prepared for use in real-life conditions [36]. Three out of the 11 studies in our corpus [3,7,34] introduced technologies classified as 'developed technology.' Six out of 11 papers focused on technologies classified as 'technology under development' [2,4,5,8,32,33]. Of the included studies, six studies introduced technologies that are either being validated in the lab with a small set of users (TRL 4) or at the prototype level, where the technology is being tested in the wild with real users in their authentic settings (TRL 7) [2,4,5,7,32,33].

3.3. Reported Challenges and Facilitating Conditions around Older Persons' ICT Access and Use

Figure 2 presents an overview of the factors affecting ICT access and use reported by the older persons and caregivers participating in the reviewed studies. As explained in the data extraction section, we used the ICF to organize these interacting factors into three categories: personal, environmental, and technology related.

3.3.1. Personal Factors

Among the factors affecting ICT access and use among older persons in the Arab region, that are mainly intrinsic to the person, our review identified these factors:

Attitudes towards technology: Two studies found that personal attitudes toward the technology, its perceived usefulness, and its perceived ease of use accurately predicted technology utilization rates [32,33]. For example, when the technology aligned with participants' values and beliefs, that fostered a more positive attitude toward the technology and a greater willingness to accept it [32].

Online privacy and trust: The included studies report that older persons might choose not to use AAL in their daily living due to (a) concerns about personal data, (b) household safety and security limitations on the adoption of AAL technologies, (c) usability of technology, and (d) older persons' refusal to be monitored through a surveillance camera and to be monitored remotely as this may attack their privacy [5,6,34]. Alsulami and Atkins [34] surveyed 194 older persons living in Saudi Arabia, in which 94.3% of the sample were Saudi citizens, on barriers and challenges affecting their use of AAL and revealed that concerns around privacy and security of personal data were a limiting factor. The lack of trust surrounding application operation was also identified as a problem for ICT access and use by older persons in the region [6]. One example was the reoccurring need to confirm that an operation step, such as clicking a button, will subsequently lead to an action from the application [6].

Functional limitations: Four studies reported a range of physical, cognitive, and psychological limitations that impact ICT access and use by older persons [2,5,6,34]. Fardoun and Mashat [5], who developed and tested a smartwatch application that helps memory recall by taking photos, stated that during the testing phase some participants could not remember to tap the watch screen or were physically unable to point the smartwatch in the correct direction [5]. Additionally, physical challenges experienced by older persons when using technology were slow movement and shaky hands for persons living with dementia [6]. Another common limitation experienced by older persons was psychomotor-related challenges, including functional limitations such as visual and hearing impairments; this tended to result in an inability to operate the technology comfortably and correctly [2,6,34].

Further, a study which surveyed 45 senior citizen in Saudi Arabia on the use of and attitude towards a smartphone application showed that declining visual and auditory abilities result in low self-esteem when dealing with new technologies [2]. Several studies reported older persons' experiences of low self-efficacy and confidence around new technology, some of which were due to limited personal experience with the technology [2,32]. Some study participants experienced stress, boredom, and confusion from mobile application navigation [6]. Conversely, an existing and familiar technology, or a well-designed technology, increased confidence and had a higher usage rate [4,9,32]. For example, Nassir and Leong's field study [9] showed that WhatsApp was reported to be easy to use, with flexible functionalities utilized by participants regularly.

3.3.2. Environmental Factors

ICT access and use by older persons depended on environmental factors that are often outside the technology and older persons' control. Our paper brought up the importance of the sociocultural factors in shaping the access and use by older persons of ICT in the region. Sociocultural factors are a collective property that includes ideas, beliefs, laws, customs,

knowledge, morals, and art to distinguish the older persons in the Arab region from other groups of people in other areas [6].

Religious beliefs and practices: Religious beliefs and practices acted both as a facilitators and as barriers to ICT use by older persons in the Arab region [2]. One paper noted that some participants rejected virtual interaction due to a strong preference for direct in-person socialization regarding religious education [2]. The paper detailed that many still use traditional cell phones that do not have cameras as many venues still prohibit using cameras, such as wedding ceremonies and educational institutions [2]. On the other hand, spreading religious messages to others through virtual means was also an identified motivation encouraging the use of smartphones [2]. In the Gulf region, cultural, mainly religious, practices prohibit direct non-familial cross-gender interactions with flexibility depending on the region [9]. However, through virtual, online means, such as WhatsApp, cross-gender social interactions are possible and are considered socially acceptable [9]. Thus, some participants enjoyed social media's ability to allow them to have direct communication with others without restriction, judgement, or third-party intervention [9].

Social norms: Other sociocultural influences on technology access and use included prevailing social norms and socially accepted practices. For instance, many older Saudi Arabian study participants used smartphones to stay in contact with others, and those who did not were encouraged to through social pressure from family and friends [2]. On the other hand, some Saudi Arabians rejected smartphones because internet censorship exercised by the government reinforced negative perceptions within this population about the internet [2]. Additionally, the lack of trust was identified as one of the problems encountered by older users when using mobile applications [6]. For example, older users reported not trusting products that differ in their exterior design and colors from what they are used to in their culture [6].

Sociocultural expectations related to caregiving: Arabic culture and social expectations and norms give attention to taking care of, or finding care for, older persons while keeping them in their family's home [3]. Older persons accept AAL technologies as they grant them more autonomy and independence [3]. Additionally, the low levels of older persons living in social care homes means higher costs for staff per social care home [3]. One paper noted that AAL technologies might be appealing due to their potential ability to reduce staff numbers and increase efficiency in social care homes [8].

3.3.3. Technology-Related Factors

Culturally sensitive design: Culture becomes a facilitating condition when the technology adheres to cultural values. Two papers highlighted how adapting an application to a specific culture via language, color, symbols, icons, and images that carry positive culturally specific connotations led users to become more open to and accepting of the technology [6,32]. Alsswey and Al-Samarraie [32] investigated older Arab users' acceptance of mHealth user interface (UI) design-based culture. Their results showed that older Arab users had a positive attitude toward using mHealth, which had been designed with consideration of their cultural background. The researchers concluded that culture is essential in promoting users' acceptance of mHealth, and encouraged mobile designers and developers to consider the many facets of culture while developing mHealth applications.

Alsswey [6] interviewed 40 older persons from three Arab countries (Jordan, Palestine, and Syria) to identify their challenges when using mobile applications. They concluded that technology's perceived ease of use, usefulness, and benefits depend on its interface's design characteristics and suitability for users. Their findings highlight the need to consider and adapt different cultural factors, such as icons, colors, language, and symbols, in the design of an interface to reflect the cultural values and background of the older persons in the Arab region [6]. For example, the use of Islamic and Arabic architectural pictures for backgrounds and application icons and the availability, quality, and clarity of the Arabic language of the interface were identified as essential design elements that could increase older users' satisfaction and acceptance [6].

Usability: In our review, attitudes towards technology were strongly associated with how much it is perceived as easy to use by older persons [6]. In return, older persons' perceived ease of use of technology is related to the convenience, clarity, and simplicity of the main design elements of the user interface (e.g., layout, images, colors, font, language, and buttons).

The integration of cultural aspects in the technology design was essential to ensure technology usability [6]. Furthermore, faced with the problems they encounter when using mobile applications, older users experienced boredom and confusion. For example, systematic instructions, commands, and navigation from one screen to another to perform a specific action created a feeling of boredom among the participants. In addition, the use of many options in application design, non-Arabic language, and complex user interface design were identified as sources of confusion for the older users participating in this project [6].

Functionality: This includes the set of operations that an interface supports. Usability and functionality are often seen as a design tradeoff. Two papers identified basic hardware and software issues that act as barriers to an application's functionality, including issues surrounding the display, navigation, touchscreen or keyboard, connectivity, and the physical size of devices [2,5,34].

Some concerns related to tracking have been observed where the caregiver cannot accurately detect the older person's location [6]. Similarly, real-time monitoring and data storage issues arise when caregivers use tracking platforms that enable scalable data collection from multiple older persons [6,33].

Affordability: Another factor affecting the access and use of the technology was affordability [34]. With lower incomes, they were not willing to pay significant amounts of money to purchase any technology [34].

Accessibility: Lastly, accessibility remains a factor in technology utilization [2,5,6,34]. In three of the reviewed papers, accessibility was highlighted as a significant factor to ICT use as it is not adapted to the needs of older persons, mainly those with limited physical and psychological abilities [2,5,6].

4. Discussion

In this paper, we reported a scoping literature review on ICT access and use and the related factors that have been investigated in studies conducted with older adults in the Arab region. In doing so, we also reviewed research gaps in the area and in this field of research. We selected 11 primary studies based on inclusion and exclusion criteria. Based on our two research questions, we extracted data and empirical evidence from the studies and synthesized them to answer our research questions.

4.1. Call for More Inclusive Research on Older Persons' ICT Access and Use in the Arab Region

The fact that only 11 studies met the inclusion criteria indicates a scarcity of evidence and research regarding ICT access and use among older persons in the Arab region compared to other regions of the world and other fields of technology-related study. While older persons in the Arab world are increasingly using technology, there remains less information about access, use, and the policies that guide that use. Our paper identifies the countries that have prioritized this area in their research agenda, namely Saudi Arabia, and calls upon us to reflect on the reasons why insufficient evidence exists in the rest of the Arab countries. While most older persons in the Arab countries share similar historical and cultural backgrounds, founded mainly on religion, they are not a homogenous group [37]. Future work should encompass and compare ICT access and use by older persons in other Arab countries. This would provide a more accurate overview and different perspectives on and insights into ICT access and use status among older persons in the region. There is also an need to examine the barriers and opportunities for ICT access and use by older persons and how they play out differently across different countries and, for example, urban or rural divides within each country. Other demographic attributes such as gender,

age cohorts, intergenerational living arrangements, socioeconomic status, education etc. could also provide crucial insights, enabling us to nuance our findings further. More specifically, our scoping review indicated the need to delve deeper into context-specific challenges, mainly cultural factors that could benefit technology developers and researchers in devising appropriate solutions for older persons in the region.

The aging population is increasing. It also is changing [14]. In the upcoming years, a new cohort of older persons will come forth who were more exposed to ICT use in the workplace and daily life than current and previous generations. In addition, new technologies are emerging every day. The COVID-19 pandemic challenged many previous assumptions about technology use and accelerated digital transformation and ICT access and use across the board [38]. For these reasons, research into ICT and aging becomes 'outdated' relatively quickly compared with other fields of study. Researchers in the field should be alert to technology advancement and the shifting demographics and needs of the aging populations. As shown in our review, many technology development projects are currently based on personas that portray older persons through assumptions that simplify our interactions with senior persons as end users. If not updated continuously, these personas have a 'best before' date and would probably fail to reflect the new aging cohort's needs and characteristics. It is still necessary and important to engage older persons in research and technology development and commercialization processes. Creating more inclusive research is the way to respect the ability of older persons to identify their own needs in order to work to support their varying abilities, challenges, and preferences [31,39].

4.2. Call for Decolonizing Research Methods in Aging and Human–Computer Interaction (HCI)

The cultural specificities of the Arab region make research methods developed and applied in other countries unfit to document the access and use of ICT by older persons in the region [9]. By 'decolonizing' research methods, we aim to promote the necessity of serious consideration of the interplay between who, where, to whom, and how research methods or approaches are not developed or adapted to the target end users or research participants. Previous research has shown that research methods in aging and HCI are not culturally universal, and that it is necessary to adapt methods or even develop new methods when conducting fieldwork with older persons in the Arab region [9,40].

As shown in our paper, privacy concerns and cross-gender communication were two significant challenges facing researchers engaging older persons in the region [5,6,34]. Cross-gender communication challenges occur mainly when male researchers conduct face-to-face interaction and interviews with older female persons. Conversations are often mediated through a proxy (a chaperone or a relative), which might place a limitation or the research [5,6,34]. Privacy concerns in conducting research with older persons in the Arab region are described by Nassir and Leong [9] as a bi-directional process where the participants show a heightened sense of privacy, requiring the researcher to answer personal questions in order to build trust while the older person may be reluctant to interact with the researcher in domestic settings characterized by the lack of privacy. Another privacy-related issue worth taking into account is the possibility of older persons being reliant on the assistance of domestic workers dedicated to their care, or a private nurse if needed [41]. In instances where the primary caregiver was a domestic worker or private nurse, researchers were refused access to an interview with them, presumably to maintain the older person's privacy or a preference that rather than someone external to the family, a family member speaks on the older person's behalf [41].

Our paper also highlighted the challenges relating to accessing older persons' perspectives within the Arab Muslim context: primary caregivers may have concerns about their health and stress levels, and minimize their direct engagement in studies. Such a situation was encountered in a recent survey with caregivers of persons with dementia in Qatar. The researchers were discouraged from engaging even informally with the older loved one, and contact was solely with the caregiving family member [41]. Caregiving children tend to shield their aging parents, especially those with chronic physical ailments or cognitive im-

pairment, out of respect for their social standing in society and their privacy. This tendency was found to be rooted in a combination of a sense of religious duty, conservativism, particularly in relation to the state of health of family members, and the social shame associated with cognitive diseases [42,43]. If not understood well before undertaking home-based research involving older persons and their caregivers, such considerations could affect access and quality of engagement, hence undermining the quality and relevance of data.

It is apparent, therefore, that the lack of documented culturally sensitive methodological approaches and resources in the Arab region related to engaging older persons and their caregivers is a gap. We invite researchers interested in this population to adapt and even to develop research methods that reflect the lived realities of this population, rather than relying on standard Western research methods and approaches. By documenting their methods and reporting on their challenges, these researchers would inform future research and establish better guidelines that have better chances of success within the Arab culture. We also invite more innovative approaches to engaging with families that are the least intrusive, participatory, and navigate the social concerns particular to Arab Muslim cultures. This is in line with current global trends in human-centered interaction research that advocate for a more inclusive approach to design and the call for decolonization of the applied participatory research methods [40,44,45].

4.3. Call for Culturally Suitable ICT Adapted to Older Persons in the Arab Region (Rather than Requiring Users to Adapt to Technology)

Our findings show that when the technology does not adhere to cultural values, culture becomes a significant barrier to technology access and use by older persons in the Arabic region.

This discrepancy could be explained by greater apprehension and less confidence among older persons to adopt new technologies or a lack of consideration of new technologies to older persons' needs [13], which aligns neatly with the findings of our scoping review.

Our review also confirms that accessibility and usability are major factors affecting technologies' use by older persons in the Arab region. Technologies developed without taking this segment of the population into account neglect to consider the environmental factors and functional abilities limiting the use of technologies. Websites, mobile applications, and services are often designed without having older persons in mind [2]. Our review of accessibility-related challenges is in accordance with the accessibility concerns in other Western studies.

Older persons constitute the most increasing ICT customer segment. They are also increasingly accessing and using ICT. In the following years, the new generations of aging persons will include many adults who adjusted to using ICT in the workplace and their communication methods. Technology developers, designers, and researchers need to make adjustments so that the technology is adapted to the older users, rather than the older users struggling to adapt to the technology. These adjustments must be based on a better understanding of: (1) the aging process, (2) the progressive decline in functional abilities during the aging process and the need for scalable technologies, (3) the wishes and needs of the older users, that could be possible only via more inclusive technology research and development processes, and (4) better integration of cultural factors in the design elements and process.

Adapting technologies to the needs of an older person is a necessary but not a sufficient condition to deal with the digital divide experienced by older persons, mainly in the Arab region. Older people's ICT adoption needs to be treated as more than merely a question of usability or a functional decline or limitations related to aging. Cultural values, attitudes, biases, stereotypes, and stigma related to age are also key aspects that must be taken into account and urge the need to deconstruct stereotypes about older persons and technology use.

4.4. Call for Deconstructing Stereotypes about Aging and Technology

It is essential to adapt the technology to the needs of older persons and promote a change in attitudes towards aging, older persons, and their technology use [46]. Stereotyping (how we think), prejudice (how we feel), and discrimination (how we act) based on age are referred to as ageism. Ageism is not new and remains in effect to this day. In 1969, Butler [46] first coined the term 'ageism' to describe 'prejudice by one age group toward other age groups' (p. 243). Ageism differs from other forms of oppression, such as racism and sexism, in two significant ways. First, it is the one source of disadvantage that all people are susceptible to experiencing, should they live long enough. Other '-isms' involve bias against relatively stable subpopulations that do not vary across the life course. It is also more subtle, accepted, and challenged less often than other '-isms.' However, it is more pervasive than sexism and racism across 28 countries in Europe. In addition, because our culture is ageist, we learn this form of bigotry from the time we are born. As a result, we ultimately oppress ourselves [47].

Ageism affects technology access and use by older persons: Older persons are often stereotypically portrayed as incapable and technophobic. These stereotypes toward aging are behind the development of prejudices (feelings), such as that older adults are not able to learn how to use new technologies. This will lead to discriminatory behaviors such as offering them fewer opportunities to learn new technologies or excluding working older persons from responsibilities and projects that have a heavy focus on emerging technologies. Seemingly, these discriminatory situations would contribute to the internalization of age stereotypes, and older persons would show a reluctance to adopt different and new technologies and underestimate their performance or technology skills. This way, this stereotype of older adults as technophobic is reinforced and the digital generational gap is widened. The culture of age stereotypes can also affect older persons' perception and understanding of their capabilities, and hence contribute to self-directed ageism in which an older person believes that they are too old to use technology. Ageism has the power to act as a self-fulfilling prophecy by deepening the original stereotypes and widening the digital divide. Fighting ageism has to be brought to front in all efforts to promote services and better quality of life for older persons, including technology access and use. Here are some stereotypes we need to deconstruct about aging, focusing on technology access and use:

Aging brings changes in ability rather than a disability: Currently, when designers, developers, and researchers focus on older persons' functional limitations, they often consider them as separate disability boxes such as vision, hearing, physical, and cognitive [14]. We risk underestimating their ability to function without accommodation when we do this. This may undermine their independence and make them feel negatively labeled as 'persons with disability.' The reality is that when we age, it is likely that all of these abilities will decline to a lesser or greater extent. However, aging is not a synonym of disability. Some abilities (e.g., those related to semantic memory) do not decline until very late in life. Aging has to be thought of as a process that brings changes in ability rather than a disability. The focus here would be on a usability approach that considers older persons' abilities, challenges, and preferences and has a deeper and more inclusive understanding of the aging process and decline in functional abilities.

Older persons are able to learn new skills and technologies: Various studies pointed out that older adults can learn new skills as well as their younger counterparts and can perform some tasks equally well as younger persons do. Haase et al. [48] conducted a population-based assessment of the barriers and facilitators to using technology for web-based socialization among 400 older persons in the Canadian province of British Columbia during the COVID-19 pandemic. They found that 55.9% (n = 223) of their respondents reported that they had adopted new technology since the beginning of the pandemic. They concluded that older adults could learn how to use technologies [48] effectively. Adequate training and support are essential to elevate awareness, reduce self-directed ageism, and hence bridge the digital gap.

5. Conclusions

The goal of our scope review was to provide a contextualized account of ICT access and use by older persons in the Arab region to inform future research to deal with the digital divide between persons in the region. This paper crucially highlights the absence of scholarly attention to the rapidly evolving state of access and use of technology among older populations in the Arab region. We envisage a dramatic shift in ICT usage for older persons in the Arab region as the current generation of adults (Generation X and Millennials), who are more technology informed and connected, enter their senior years in a continuously digitalized society. How this change plays out remains dependent mainly on our responses to and shaping of the emerging trends. In this paper, we have outlined what we see as some key trends and issues that need to be examined urgently. They will have substantial consequences in the future.

This review yielded rich insights into ICT access and use by older persons in the Arab region, but their potential generalizability is limited. First, although we used a comprehensive list of search terms and multiple databases, our search strategy was limited. Only published studies available in Arabic and English were included in this scoping review. For instance, we suspect that potentially relevant papers would be published in French in North African Arabic League member countries such as Tunisia and Algeria. Second, most of the reviewed studies were conducted in Saudi Arabia; it is possible that older persons residing in other Arab countries would have had very different experiences. Finally, we did not assess the quality of the included studies. Additional empirical studies are needed to better understand how older persons from other Arab countries are accessing and using ICT and the challenges they could meet.

Appendix A

Database(s): Ovid MEDLINE(R) 1946 to Week 4 April 2021
Search Strategy:

Table A1. Search strings applied within each electronic database.

#	Searches	Results
1	(ICT or Tech* or IT or Internet or Emerging technology or everyday technology or assistive technology or computer* or mobile* or App* or smart home or Information communication technology or Aids or e-health or m-health or u-health or Digital health or Digit* telemedicine or telerehabilitation or video conference or remote consultation or telepresence or monitoring or video conference or telesurveillance or virtual monitoring or tele homecare or telemonitoring or home monitoring or digital health or e-coaching or assistive technology or smart phone or telehealth or geriatric technology or teleassistance or telemonitoring or Coach*).mp. [mp = title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	10,838,615

Table A1. *Cont.*

#	Searches	Results
2	limit 1 to yr = "2016–2021"	9774
3	(older adults or aging or Aging population or Ag* or Child* or Retired or older persons or caregiver or Carer or seniors or older citizens or Family).mp. [mp = title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	13,689,584
4	limit 3 to yr = "2016–2021"	2,443,230
5	(Arab or Algeria* or Middle East or Bahrain* or Bahraini or Comoros or Comorian or Djibouti* or Djiboutian or Egypt* or Egyptian or Iraq* or Iraqi or Jordan* or Jordanian or Kuwait* or Kuwaiti or Leban* or Lebanese or Libya* or Libyans or Mauritania or Mauritanian or Morocc* or Oman* or Omani or North Africa or Palestin* or Palestinian or Qatar* or Qatar or Saudi* or KSA or Somalia* or Somali or Sudan* or Sudanese or Syria* or Syrian or Tunisia or Tunisian or United Arab Emirates or UAE or Emarat* or Yemen* or Yemeni).mp. [mp = title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	138,094
6	limit 5 to yr = "2016–2021"	34,451
7	2 and 4 and 6	12,064
8	1 and 3 and 5	952
9	(Arab* or Middle East or Arab world).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	148,049
10	limit 9 to yr = "2016–2021"	38,931
11	1 and 3 and 9	952
12	(((((ICT or Tech* or IT or Internet or Emerging technology or everyday technology or assistive technology or computer* or mobile* or App* or smart home or Information communication technology or Aids or e-health or m-health or u-health or Digital health or Digit* telemedicine or telerehabilitation or video conference or remote consultation or telepresence or monitoring or video conference or telesurveillance or virtual monitoring or tele homecare or telemonitoring or home monitoring or digital health or e-coaching or assistive technology or smart phone or telehealth or geriatric technology or teleassistance or telemonitoring or Coach*) and older adults) or aging or Aging population or Ag* or Child* or Retired or older persons or caregiver or Carer or seniors or older citizens or Family) and Arab) or Algeria* or Middle East or Bahrain* or Bahraini or Comoros or Comorian or Djibouti* or Djiboutian or Egypt* or Egyptian or Iraq* or Iraqi or Jordan* or Jordanian or Kuwait* or Kuwaiti or Leban* or Lebanese or Libya* or Libyans or Mauritania or Mauritanian or Morocc* or Oman* or Omani or North Africa or Palestin* or Palestinian or Qatar* or Qatar or Saudi* or KSA or Somalia* or Somali or Sudan* or Sudanese or Syria* or Syrian or Tunisia or Tunisian or United Arab Emirates or UAE or Emarat* or Yemen* or Yemeni).mp. [mp = title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	952
13	limit 12 to yr = "2016–2021"	952

Database(s): Embase 1974 to 30 April 2021
Search Strategy:

Table A2. Search strings applied within each electronic database.

#	Searches	Results
1	(ICT or Tech* or IT or Internet or Emerging technology or everyday technology or assistive technology or computer* or mobile* or App* or smart home or Information communication technology or Aids or e-health or m-health or u-health or Digital health or Digit* telemedicine or telerehabilitation or video conference or remote consultation or telepresence or monitoring or video conference or telesurveillance or virtual monitoring or tele homecare or telemonitoring or home monitoring or digital health or e-coaching or assistive technology or smart phone or telehealth or geriatric technology or teleassistance or telemonitoring or Coach*).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	16,014,493
2	limit 1 to yr = "2016–2021"	433,852
3	(older adults or aging or Aging population or Ag* or Child* or Retired or older persons or caregiver or Carer or seniors or older citizens or Family).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	156,158
4	limit 3 to yr = "2016–2021"	44,080
5	(Arab or Algeria* or Middle East or Bahrain* or Bahraini or Comoros or Comorian or Djibouti* or Djiboutian or Egypt* or Egyptian or Iraq* or Iraqi or Jordan* or Jordanian or Kuwait* or Kuwaiti or Leban* or Lebanese or Libya* or Libyans or Mauritania or Mauritanian or Morocc* or Oman* or Omani or North Africa or Palestin* or Palestinian or Qatar* or Qatar or Saudi* or KSA or Somalia* or Somali or Sudan* or Sudanese or Syria* or Syrian or Tunisia or Tunisian or United Arab Emirates or UAE or Emarat* or Yemen* or Yemeni).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	23,849
6	limit 5 to yr = "2016–2021"	80,400
7	2 and 4 and 6	9232
8	1 and 3 and 5	9111
9	(Arab* or Middle East or Arab world).mp. [mp = title, abstract]	7098
10	limit 9 to yr = "2016–2021"	4671
11	1 and 3 and 9	594
12	(((((ICT or Tech* or IT or Internet or Emerging technology or everyday technology or assistive technology or computer* or mobile* or App* or smart home or Information communication technology or Aids or e-health or m-health or u-health or Digital health or Digit* telemedicine or telerehabilitation or video conference or remote consultation or telepresence or monitoring or video conference or telesurveillance or virtual monitoring or tele homecare or telemonitoring or home monitoring or digital health or e-coaching or assistive technology or smart phone or telehealth or geriatric technology or teleassistance or telemonitoring or Coach*) and older adults) or aging or Aging population or Ag* or Child* or Retired or older persons or caregiver or Carer or seniors or older citizens or Family) and Arab) or Algeria* or Middle East or Bahrain* or Bahraini or Comoros or Comorian or Djibouti* or Djiboutian or Egypt* or Egyptian or Iraq* or Iraqi or Jordan* or Jordanian or Kuwait* or Kuwaiti or Leban* or Lebanese or Libya* or Libyans or Mauritania or Mauritanian or Morocc* or Oman* or Omani or North Africa or Palestin* or Palestinian or Qatar* or Qatar or Saudi* or KSA or Somalia* or Somali or Sudan* or Sudanese or Syria* or Syrian or Tunisia or Tunisian or United Arab Emirates or UAE or Emarat* or Yemen* or Yemeni).mp. [mp = title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]	594
13	limit 12 to yr = "2016–2021"	594

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