

## Psychological outcomes of eCare technologies use for informal carers: A scoping study

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*K. Smole-Orehek, S. Hvalič-Touzery, A. Petrovčič, V. Dolničar, M. Debevc, I. Kožuh. Psychological outcomes of eCare technologies use for informal carers: A scoping study. Gerontechnology 2019;18(1):15-28; <https://doi.org/10.4017/gt.2019.18.1.002.00>* **Background** The use of eCare technologies could address some of the challenges related to demographic changes and decreased care potential. However, little is known about eCare technologies' potential in relation to the psychological outcomes for informal carers. **Research aim** This study aims to provide an overview of the psychological outcomes of eCare technologies use for informal carers. **Methodology** A scoping study was done, where peer reviewed papers, written in English, investigating the use of eCare technologies in informal care and their psychological outcomes on informal carers, were included. Non-scientific studies, and studies which focused on psychological counselling or training through the Internet or phone, were excluded. The data search was conducted in Academic search complete, Scopus, ProQuest and Science Direct databases, from 12 October 2017 to 17 October 2017 and included 16 studies published since 2013. **Results** Six psychological outcomes were identified (peace of mind, reassurance, anxiety, depression, stress and burden). Out of those psychological outcomes, positive outcomes of eCare technologies use for informal carers were counted 37 times and negative outcomes only eight, suggesting a positive prevalent pattern of eCare technologies use for informal carers. **Conclusion** The outlined interplay between the positive and negative psychological outcomes suggest that the use of eCare technologies in informal care warrants further research, for instance whether the eCare technologies actually fulfil older people and informal carers' needs.

**Keywords:** Telecare, ageing, long-term care, psychological outcomes, informal care

### INTRODUCTION

The global aging trend indicates that care for older people is significantly important in recent years and will remain at least until 2060. The ageing of Europe is a demographic phenomenon, where the most significant change is the transition towards older population structure. The population aged 65 years and over is increasing in every EU Member State, with a 19.4% share of the EU-28 population (Eurostat, 2016). With increasing age and longevity, the need for long-term and informal care will increase significantly in the coming decades. Informal care<sup>1</sup> allows older people to stay at home longer and delay their entry into

institutional care. Thus, supporting those who want to continue living independently in their homes and avoid institutional care settings is a growing social challenge (Mynatt, Rowan, Jacobs, & Craighill, 2001). In general, older people desire to age in place, remain independent and, at the same time, receive care by family members, which can consequentially increase the burden of care of their informal carers (Eurostat, 2016; Huber et al., 2013; Sixsmith & Sixsmith, 2008).

Further, informal carers across the EU provide over 80% of all cares, with women providing approximately two thirds of that care (Hoff-

mann & Rodrigues, 2010). However, there are substantial differences in the prevalence of informal care across Europe, with some European countries relying strongly on informal care (i.e. Portugal, Spain, Italy and Slovenia), while countries like Denmark and Sweden have a much larger share of formal care (Bauer & Sousa-Poza, 2015). Nevertheless, informal carers remain the major providers of long-term care (Albertini, Kohli, & Vogel, 2007), not only because many relatives prefer that informal carers take care of their older family members (Hoffmann & Rodrigues, 2010), but also because it significantly reduces demands on the public health and social care system (Bauer & Sousa-Poza, 2015). Despite their important role in maintaining the sustainability of the current welfare systems, the supportive measures for informal carers are unequally available in different European countries, leaving many informal carers without the necessary support (Bauer & Sousa-Poza, 2015; European Commission, 2014a). By its very nature, care substantially occupies informal carers' time, energy, and attention (Yikilkan, Aypak, & Görpelioglu, 2014), while the inadequacies in state support place additional pressure on them. There is a considerable research on informal care that refers to its negative aspects, such as the negative psychological and physical health outcomes for informal carers (e.g. Bijker, Kleiboer, Riper, Cuijpers, & Donker, 2016; Mckechnie, Barker, & Stott, 2014; Pesantes, Brandt, Ipince, Miranda, & Diez-Canseco, 2017; Rha, Park, Song, Lee, & Lee, 2015). However, it has also been demonstrated that informal caring can be perceived as a positive experience (Walker, Powers, & Bisconti, 2016; Wennerberg, Eriksson, Danielson, & Lundgren, 2016; Yu, Cheng, & Wang, 2018).

While society anticipates informal carers will keep providing care, existing supportive measures seem to only partly cover their needs. According to Haslwanter and Fitzpatrick (2017), eCare technologies have the potential to address the challenges related to longevity and decreased care potential. These potentials of information and communication technologies (ICTs) have also been recognized by European policy (e.g. Eurocarers, 2016a). The terms of "telecare" and "assistive technology" (AT) are widely used; however, the definitions are very vague. Therefore, for the purposes of our study, we will use the term *eCare technologies*. We base our understanding of eCare technologies on Doughty et al. (2007), who defined them as the care technologies centred on telecare and home use, as described in telecare umbrella model two (Doughty et al., 2007), focusing on informal carers of older people. Telecare umbrella model two includes three different technologies

groups, namely telecare, assistive technologies (ATs) and telemedicine. According to Doughty et al. (2007), incorporated within ATs, a range of sensor aids offer support via monitoring devices. These devices can be combined in a variety of units and are collectively called telecare. *Telecare* is a term used for preventive technologies which include electronic, telecommunications and information systems use. It includes a wide range of applications, from alarms to the monitoring of vital signs (Doughty et al., 2007). According to Doughty et al. (2007), telecare and ATs are groups of technologies that are focused on home use, whereas telemedicine is a group of technologies that are focused on institutional use. In our study, we focus on home care; therefore, telemedicine technologies are excluded. Our definition of eCare technologies is thus in line with Doughty et al.'s (2007) understanding of telecare and assistive technologies.

While many studies have focused mainly on the various outcomes of the use of eCare technologies for older people (Khosravi, Rezvani, & Wiewiora, 2016; Lilholt, Hæsum, Ehlers, & Hejlesen, 2016; Siegel & Dorner, 2017), fewer studies have focused on the impact of eCare technologies on their informal carers (e.g. Blusi, Asplund, & Jong, 2013; Jarrold & Yeandle, 2009; Lauriks et al., 2007) and were not focused specifically on the psychological outcomes. The aim of this study is to provide an overview of inductively identified psychological outcomes of eCare technologies use for informal carers, which is, to the best of our knowledge, a largely unexplored field within the literature. Accordingly, this scoping review narrows the gap in the literature with respect to the psychological outcomes of eCare technology use for informal carers and the most frequently reported positive and negative psychological outcomes in empirical studies.

The remainder of this paper is structured as follows. Section 2 discusses the methodology of the scoping study, including identifying the research questions, identifying relevant studies, the study selection and charting the data, as well as collating, summarizing and reporting the results. Section 3 details the results of the scoping study along with the general study characteristics and psychological outcomes of eCare technologies' use. Finally, section 4 summarizes the highlights of the discussion and provides our conclusion and suggestions for future work.

## METHODS

This study followed the five-step scoping study process defined by Arksey and O'Malley's (2005) methodological framework: (1) Identifying the research questions, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5)

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Table 1. Summary of analysed studies

| Authors, year of publication                      | Study type and methodology used <sup>a</sup>   | Study cases  | Country   | Study's aim  | Positive or negative psychological outcomes of eCare technologies' use on informal carers <sup>b</sup>       |
|---|--|--|---|--|--|
| Andersson, Erlingsson, Magnusson, & Hansson, 2017 | Integrative literature review.   | 14 studies focusing on working carers of older people.                               | N/A <sup>c</sup>  | To examine a largely unexplored area within the empirical literature, namely, ICT-mediated support for working carers of older people.   | Positive outcomes:<br>- More peace of mind<br>- Less stress<br>- Less burden                                 |
| Arntzen, Holthe, & Jenioft, 2016                  | Qualitative longitudinal study, with in-depth interviews and observations.                     | Family carers of people with mild to moderate dementia (n=12).                       | Norway.   | To explore what characterized the implementation process when the AI was experienced as beneficial to the younger people with dementia and the family carer in their daily life.   | Positive outcomes:<br>- Less anxiety<br>- Less stress<br>- Less burden<br>Negative outcome:<br>- More stress |
| Bergström & Hanson, 2017                          | Integrative literature review.   | 123 studies focusing on carers of older people.                                      | N/A <sup>c</sup>  | To explore studies concerning ICT support of adult carers of older people and to identify study characteristics that have a potential impact on carer outcomes.  | Positive outcomes:<br>- Less depression<br>- Less burden   |
| Carretero, Stewart, & Centeno, 2015               | Qualitative study, with cross-case study.  | 12 ICT-based services for informal carers and paid assistants.                       | Sweden, Italy, Canada, Spain, Hungary, UK, Austria, USA, Germany. | To explore the benefits of ICT-based services for informal carers and paid assistants of older people living in the community.   | Positive outcomes:<br>- More peace of mind<br>- Less anxiety<br>- Less depression<br>- Less burden           |
| Correa & Domènech, 2013                           | Qualitative study, with in-depth interviews and focus groups.                                  | Informal carers of older people who are users of telecare service (n=not specified). | Spain.  | To explore the processes of technical mediation in the family setting in relation to home telecare targeted at older people. The study aims to boost our understanding of the day-to-day relationships between technological devices, older people and their families. | Positive outcomes:<br>- More peace of mind<br>- More reassurance   |
| Davies, Rixon, & Newman, 2013                     | Systematic review.   | 7 studies focusing on informal carers of people with social care needs.              | N/A <sup>c</sup>  | To document and evaluate the quantitative evidence base for the effect of telecare interventions on outcomes for informal carers.  | Positive outcomes:<br>- Less depression<br>- Less stress<br>- Less burden                                    |
| D'Onofrio et al., 2017                            | Systematic review.   | 25 studies focusing on informal carers of people with dementia.                      | N/A <sup>c</sup>  | To investigate the use of ICTs to support the range of activities of daily living for people with dementia considering the technologies of "ambient intelligence" and the technologies that can be used by patients and carers.  | Positive outcomes:<br>- Less stress  |
| Gibson, Dickinson, Brittain, & Robinson, 2015     | Qualitative study, with semi-structured individual interviews.                                 | Family carers (n=26), people with dementia (n=13).                                   | The UK.   | To explore how people with dementia and their family carers use AI in their everyday lives, identify the types and range of devices they use, and the issues which influenced technology adoption within their usual care routines.                                    | Positive outcomes:<br>- More peace of mind<br>- More reassurance<br>- Less burden                            |
| Groeneveld, Boess, & Freudenthal, 2013            | Qualitative case study, with community-based co-design (group discussion, generative session). | Informal carers (n=60), older people (n=4).  | The Netherlands.  | To gain insight into the added value of community-based co-design for the development of technology-based support for informal care.   | Positive outcome:<br>- More peace of mind<br>Negative outcome:<br>- Less peace of mind                       |

Notes:

<sup>a</sup>Following Arksey & O'Malley (2005), we combined two criteria – "study type" and "methodology used" into one.

<sup>b</sup>Following Arksey & O'Malley (2005), we modified these criteria as "outcomes measures" and "important results".

<sup>c</sup>N/A = not applicable.

Table 1. Summary of analysed studies (cont.)

| Authors, year of publication                          | Study type and methodology used <sup>d</sup>   | Study cases   | Country                            | Study's aim   | Positive or negative psychological outcomes of eCare technologies' use on informal carers <sup>b</sup>                                 |
|---|--|---|------------------------------------|---|--|
| Hall et al., 2014                                     | Qualitative explorative study, with focus groups.  | Family carers (n=35) of older person and/or child.  | The USA.                           | To explore the perspectives of family carers regarding potential integration of Smart Wear technology into their family caregiving relationships.   | Positive outcomes:<br>- More peace of mind<br>- Less anxiety<br>- Less burden<br>Negative outcomes:<br>- More anxiety<br>- More stress |
| Hanward, 2016   | Quantitative study (nationally representative panel survey), ethnographic observations and qualitative study, with semi-structured interviews. | Informal carers (n=1028) with additional 15 interviews.   | The USA.                           | To investigate how carers are currently using technology, what functions carers are interested in and barriers that innovators need to overcome to adequately meet carers' needs.   | Positive outcomes:<br>- More peace of mind<br>- More reassurance   |
| Hattink et al., 2016                                  | Qualitative explorative evaluation study, with semi-structured interviews.   | Informal carers (n=32), persons with cognitive impairment and/or dementia (n=42); professional home-care workers (n=6). | The Netherlands, Germany, Belgium. | To integrate three previously developed AT systems into one modular, multifunctional system, which can support people with dementia and carers throughout the course of dementia.   | Positive outcomes:<br>- More reassurance<br>- Less stress<br>- Less burden<br>Negative outcome:<br>- Less peace of mind                |
| Lexis et al., 2013                                    | Quantitative study.  | Informal carers of frail older people (n=16), clients (n=19), formal carers (n=16).                                     | The Netherlands                    | To evaluate potential effects of the Quiet Care system in a relatively small population on three levels: the client, the formal caregiver and the informal caregiver.   | Positive outcome:<br>- Less burden   |
| Magnusson, Hansson, Sandman, & Rosén, 2014            | Quantitative descriptive intervention study.   | Informal carers (n=36), people with dementia (n=20), professionals (n=30).  | Sweden.                            | To highlight the complexity surrounding the implementation of advanced electronic tracking, communication and emergency response technologies, namely, an extended safety and support (ESS) system for people with dementia living at home. | Positive outcomes:<br>- More reassurance<br>- Less anxiety   |
| Nijhof, van Gemert-Pijnen, Woolrych, & Sixsmith, 2013 | Mixed methods: intervention study.   | Informal carers of people with dementia (n=14), professional carers (n=14).   | The Netherlands                    | To evaluate a commercially-available monitoring system for older people with dementia living at home.   | Positive outcomes:<br>- More reassurance<br>- Less anxiety<br>- Less burden<br>Negative outcome:<br>- More burden                      |
| Pritchard & Brittain, 2015                            | Qualitative study, with focus groups, semi-structured interviews, observational fieldwork.   | Carers of older people (n=9), older people (n=47).  | The UK.                            | To demonstrate how pendant alarms both mediate and are mediated by the social environment and social relations that they are embedded in and how this can cause the device to produce irrational and undesirable outcome.                   | Positive outcome:<br>- More peace of mind<br>Negative outcome:<br>- Less peace of mind   |

Notes:

<sup>a</sup>Following Arksey & O'Malley (2005), we combined two criteria – "study type" and "methodology used" into one.

<sup>b</sup>Following Arksey & O'Malley (2005), we modified these criteria as "outcomes measures" and "important results".

<sup>c</sup>N/A = not applicable.

collating, summarising and reporting the results. Such framework provides transparency to scoping review methodology and the reliability of its findings. Furthermore, it is an appropriate approach to explore studies that use various methodologies, which we are expecting to find in our searched topic (Levac, Colquhoun, & O'Brien, 2010).

A scoping study examines the following research question: What are the psychological outcomes of eCare technologies' use for informal carers of older people?

## Identifying relevant studies

The literature search was conducted in the following four databases: Academic search complete, Scopus, ProQuest and Science Direct (through internal database Dikul). A search strategy was developed to capture the most relevant research studies (e.g. original empirical research and literature reviews (Peters et al., 2015)). The search terms were classified into four main groups: (1) Different variations of the term *informal carer* (e.g. informal caregiver, family caregiver), (2) a broader set of keywords of relevant eCare technologies (e.g. telecare, telemonitoring, eCare), (3) keywords to describe eCare technologies' features (e.g. monitoring, device, detectors, alarming, ambient assisted living), and (4) variations of keywords that illustrate psychological outcomes. The initial search was performed from 2 October 2017 to 6 October 2017, but the results were too general in terms of psychological outcomes. Thus, an updated database search was run from 12 October 2017 to 17 October 2017, using the extended search group on the psychological outcomes (e.g. anxiety, depression). We constructed a search string using the disjunction "OR" logical operator between individual keywords within each group of keywords and the conjunction "AND" logical operator between groups of search terms. Due to the rapid technological change, date restrictions were set for the last five years to capture recent and up-to date eCare technologies. For grey literature, we searched through the references of the selected studies. The scoping study included English-language publications only.

## Study selection

Before the scoping study analysis, we identified inclusion and exclusion criteria for the studies. The inclusion criteria were: (1) Peer-reviewed studies, (2) studies published in English, (3) studies with research aimed at investigating the use of eCare technologies for informal carers, and (4) studies that examined the psychological outcomes of eCare technologies use for informal carers. Moreover, the following exclusion criteria were applied: (1) Non-scientific study, (2) no eCare technologies, informal carers and emotion mentioned in the study, (3) study described emo-

tions of older people only, excluding emotions of informal carers, and (4) studies that reported only psychological counselling, training or education through the Internet or phone, which is in line with our eCare technologies definition.

## Charting the data

Out of the 16 studies included in the scoping study, five were qualitative studies, two were systematic literature reviews, two were integrative literature reviews, two used mixed methods, one was a quantitative study, one a case study, one a review, one an explorative evaluation study and one study included a panel survey, ethnographic observations and semi-structured interviews. The literature reviews included in this study had a different focus than our study in terms of sample (i.e. narrowed samples; working carers or carers of people with dementia) and study aim (i.e. general outcomes of ICT use for informal carers and not just psychological). The majority of the studies were conducted in the Netherlands ( $n = 4$ ), followed by the UK ( $n = 3$ ), the US ( $n = 3$ ), Spain ( $n = 2$ ), Germany ( $n = 2$ ), Sweden ( $n = 2$ ), Italy ( $n = 1$ ), Austria ( $n = 1$ ), Hungary ( $n = 1$ ), Canada ( $n = 1$ ), Norway ( $n = 1$ ), and Belgium ( $n = 1$ ), but two studies were international, therefore the sum of the countries should not be considered as a one country per study. The detailed results of the scoping study analysis of the selected studies are presented in *Table 1*. According to the methodological framework proposed by Arksey and O'Malley (2005), each study was analysed considering the following criteria: (1) Publication details: author(s) and publication year, (2) study type, (3) study population(s), (4) the study's aim, (5) methodology used, and (6) the study's key factors.

## Collating, summarizing and reporting the results

The database search generated 397 studies in four selected databases and three studies in an additional grey literature search, totalling 400 studies. After duplicates were removed, 362 studies remained. A two-stage screening process was used to evaluate the relevance of the studies identified in the search. At the first level of screening, only one researcher was reviewing the 362 titles and abstracts according to pre-set inclusion and exclusion criteria. The reasons for exclusion in the first level of screening are displayed in *Figure 1*. Through this process, we identified 104 publications relevant for full-text screening. The second level of screening included full-text screening, and if a study did not fulfil the eligibility criteria, it was excluded at this stage. In the second level of screening, the same researcher identified 21 studies that met the inclusion and exclusions criteria. After 21 studies were selected, another researcher thoroughly read through the selected studies, and a third

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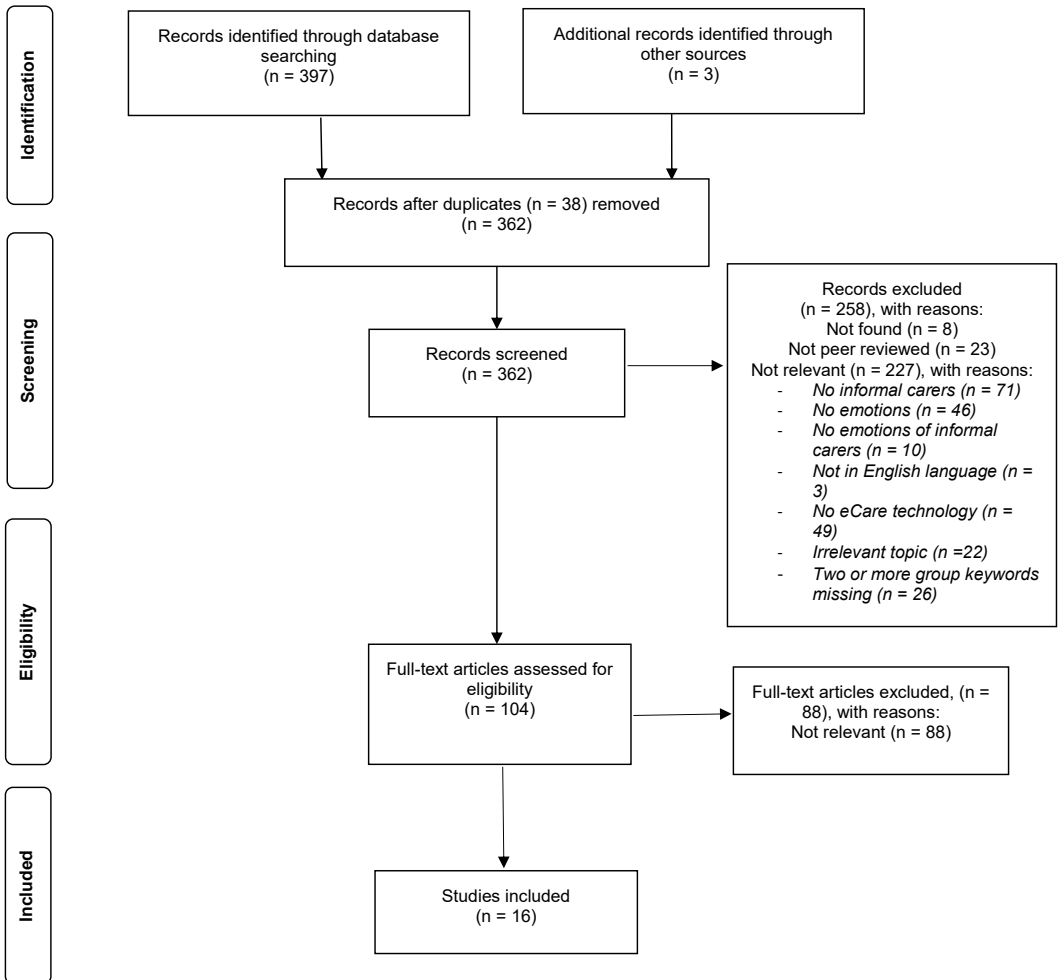


Figure 1. Prisma flow diagram

researcher was involved in the final discussion for study selection. All three researchers agreed to exclude five additional studies because they were not relevant. At the end, 16 studies were selected for review (Figure 1).

## RESULTS

### General study characteristics

The studies included in this scoping study focus on different eCare technologies used to support informal carers of older people, such as telecare (n = 13) and a combination of telecare and ATs (n = 3). Studies also focused on different eCare technologies users. Ten studies had very narrow user focuses. Namely, seven studies dealt with people with dementia and their informal carers, one study focused on employed informal carers and one on older people in rural areas. Conversely, six studies investigated a more general sample of older people and their informal carers.

Studies consistently unveiled that positive psychological outcomes were present for informal carers when eCare technologies were used. The psychological outcomes were determined according to the emotions reported in the results section of the included studies. Specifically, psychological outcomes were considered positive if positive emotional outcomes were reported, whereas outcomes were considered negative if negative emotional outcomes were reported. Of the 16 studies, six types of psychological outcome were identified (peace of mind, reassurance, anxiety, depression, stress and burden). Out of those six psychological outcomes, 46 psychological outcomes were counted in all the selected articles.

Altogether, 37 positive psychological outcomes of eCare technologies use for informal carers were identified in all the selected studies, specifically: less burden (n = 10), more peace of mind (n = 8), more reassurance (n = 6), less stress (n = 5), less anxiety (n = 5) and less depression (n = 3). A total

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Table 2. Psychological outcomes of eCare technologies use for informal carers

| Authors                    | eCare technologies description  | Peace of mind | Reassurance | Anxiety | Depression | Stress | Burden |
|----------------------------|---|---------------|-------------|---------|------------|--------|--------|
| Andersson et al., 2017     | Different ICT-mediated support: monitoring and video technology.  | +<br>-        |             |         |            | +      | +      |
| Amtzen et al., 2016        | Cooker alarm with temperature sensor; automatic day and night calendar; speaking arm-wrist watch; timer on coffee machine; digital calendar, digital messages and reminders; message-box reading a message when activated; GPS – tracking device; electronic door-lock; colour coding; labelling to support localisation of objects, groceries; memory clock; simple mobile phone; medicine dispenser with alarm. |               |             | +       |            | +      | +      |
| Bergström & Hanson, 2017   | ICT-based services.   |               |             |         | +          |        | +      |
| Carretero et al., 2015     | Different ICT services: home alarm systems, telecare, tracker devices (GPS), and gas, temperature and bed sensors.  | +             |             | +       | +          |        | +      |
| Correa & Domènech, 2013    | Home telecare: technological agents (pendent alarm and terminal).   | +             | +           |         |            |        |        |
| Davies et al., 2013        | Automatic and remote monitoring of real-time emergencies and lifestyle changes over time.   |               |             |         | +          | +      | +      |
| D'Onofrio et al., 2017     | The Internet-based Savvy Caregiver: computer–telephone integration system; video monitoring. Video monitoring.  |               |             |         |            | +      |        |
| Gibson et al., 2015        | Buddi'; simple handheld device: a pendant alarm, fall detector, GPS location monitor and activity monitor connected to a telephone monitoring service (monitors movements and activities).  | +             | +           |         |            |        | +      |
| Groeneveld et al., 2013    | Monitoring emergency situations (monitoring and alarming): device and alarming bracelet.  | +<br>-        |             |         |            |        |        |
| Hall et al., 2014          | Smart Wear technology: devices integrated into clothing that monitor care-recipients.   | +             |             | +       |            | -      | +      |
| Harward, 2016              | Emergency monitoring and alerting technologies  | +             | +           |         |            |        |        |
| Hattink et al., 2016       | Activity monitoring; motion sensors and temperature sensors. The Rosetta-system: to enable the combination of three previously developed systems, i.e. the Cogknow Day Navigator, the EMERGE system and the Unattended Autonomous Surveillance system (UAS).  | -             | +           |         |            | +      | +      |
| Lexis et al., 2013         | Activity monitoring; QuiteCare system: motion sensors and temperature sensors.  |               |             |         |            |        | +      |
| Magnusson et al., 2014     | Four features: GPS; built-in cellular speakerphone; fully programmable GeoSkeepert (speed dialling numbers, automatic answering, various alerts (e.g. when battery is low); geofencing area via a user-friendly web-based interface.  |               | +           | +       |            |        |        |
| Nijhof et al., 2013        | AdLife monitoring system: early warning system to detect a situation before it requires emergency intervention.   |               | +           | +       |            |        | +      |
| Pritchard & Brittain, 2015 | Alarm pendant.  | +<br>-        |             |         |            |        |        |

Note: + = positive psychological outcome of eCare technologies use; - = negative psychological outcome of eCare technologies use; both + and - = positive and negative psychological outcomes of eCare technologies use

of eight negative psychological outcomes of eCare technologies use for informal carers were identified in seven studies, specifically: less peace of mind (n = 4), more stress (n = 2), more burden (n = 1) and more anxiety (n = 1). The positive and negative psychological outcomes of eCare technologies use for informal carers are displayed in Table 2.

## Positive psychological outcomes of eCare technologies use

### More peace of mind and reassurance

The use of eCare technologies can contribute to the informal carers' peace of mind (Andersson et al., 2017; Carretero et al., 2015; Correa & Domènech, 2013; Gibson et al., 2015; Groeneveld et al., 2013; Hall et al., 2014; Harward, 2016), their sense of relief (Carretero et al., 2015; Hall et

al., 2014) and their reassurance of the safety of the person they care for (Correa & Domènech, 2013; Gibson et al., 2015; Harward, 2016; Hattink et al., 2016; Magnusson et al., 2014; Nijhof et al., 2013). Some studies included in our review, revealed that informal carers relate older peoples' safety with their peace of mind (Andersson et al., 2017; Hall et al., 2014; Pritchard & Brittain, 2015) and their reassurance (Correa & Domènech, 2013; Hattink et al., 2016; Magnusson et al., 2014).

A national representative panel study in the US (Harward, 2016) found a high interest among informal carers in technologies that provide peace of mind and reassurance. The highest percentage of informal carers reported that they would use the technology that ensures home safety (77.5%) and sends them an alert when the care recipient needs urgent care (72.4%). In the qualitative interviews (n = 15), emergency monitoring and alerting technologies were frequently mentioned as the technologies that informal carers would need in order to have a peace of mind. Lower priority was given to routine monitoring, such as monitoring daily patterns (e.g. movement around the house), opening and closing of doors, bathroom use and sleep (Harward, 2016). Additionally, a British study (Pritchard & Brittain, 2015) revealed that telecare devices, such as alarm pendants, can allow informal carers and older people to feel safe in their homes and provide feelings of peace of mind, especially to people with long-term illness (Pritchard & Brittain, 2015). Other studies found informal carers' reassurance and peace of mind as a result of their awareness of the constant monitoring of care recipients (Hall et al., 2014; Lexis et al., 2013). For instance, Hall et al. (2014) argued that it was especially reassuring regarding vulnerable care recipients due to wandering and the possibility of getting lost. Also, Lexis et al. (2013) found evidence in a Dutch pilot intervention study in which three quarters of the informal carers (12 out of 16) confirmed that such an approach allowed them to avoid interrupting their daily activities. Likewise, authors of a qualitative Spanish study summarized construction of security in terms of peace of mind as "the silent presence of the artefacts that brings to the home the possibility for the constant presence of others" (Correa & Domènech, 2013, p. 3077). They concluded that home telecare services, such as pendant alarms, may be recognized in the process of mediation, meaning that the telecare user is never alone and that the informal carer is present, even when s/he is away. The awareness that informal carers are going to be notified in case of emergency by a pendant alarm brings them a feeling of assurance and a sense of security.

In addition to the abovementioned studies, Andersson et al. (2017) found in their integrative lit-

erature review that eCare technologies could be utilized at the times and places most convenient to working carers, which made reconciling work and caring easier and also resulted in their increased peace of mind. Namely, "peace of mind was associated with carers being able to view status reports at their convenience or being notified when pre-scheduled patterns of daily living were altered" or by being able to communicate with older family members through video technology (p. 264). They also found that informal carers felt reassured that the person they care for was taken care of when they were not present.

### *Less burden, anxiety, depression, and stress*

Several studies indicated that eCare technologies have a potential to reduce informal carers' burden (Andersson et al., 2017; Arntzen et al., 2016; Bergström & Hanson, 2017; Carretero et al., 2015; Gibson et al., 2015; Hall et al., 2014; Hattink et al., 2016; Lexis et al., 2013; Nijhof et al., 2013), stress (Andersson et al., 2017; Arntzen et al., 2016; Davies et al., 2013; D'Onofrio et al., 2017; Hattink et al., 2016), anxiety (Arntzen et al., 2016; Carretero et al., 2015; Hall et al., 2014; Magnusson et al., 2014; Nijhof et al., 2013) and depression (Bergström & Hanson, 2017; Carretero et al., 2015; Davies et al., 2013). According to Carretero et al. (2015, p. 167), the eCare technologies and services had a positive influence on informal carers in terms of "better physical and mental health, less burden, better emotional condition, fewer depressive symptoms, and a certain amount of relief from sorrow". They assumed that these improvements are "the direct effect of informal carers' use of technologies for personal support and social integration and the indirect impact of other technologies such as those for care coordination (Carretero et al., 2015, p. 168).

Informal carers in the Swedish study on extended safety and support (e.g. advanced electronic tracking, communication and emergency response technologies) for people with dementia stated that the telecare system had increased their sense of security, partly or completely reduced their anxiety and stress and had a positive impact on their everyday life because their relative had the tracking device with them when they were out on their own (Magnusson et al., 2014). Likewise, a qualitative intervention study on a monitoring system for older people with dementia in the Netherlands found that the system alleviated informal carers' anxiety while they were not able to personally visit or call the person they care for (Nijhof et al., 2013). The system also appeared to reduce the burden of care on the informal carer (Nijhof et al., 2013). An English qualitative study among informal carers and people with dementia found that informal carers use a monitoring system (telecare or GPS monitors) to reduce their own physi-



cal and emotional burdens of care (Gibson et al., 2015). A study in the Netherlands, Germany and Belgium involving people with dementia and their carers found that integrated ATs reduced informal carers' stress and burden, as long as they could rely on the support of the technological system (Hattink et al., 2016). Further, a Norwegian qualitative study among younger people with dementia and family carers found that the use of ATs can both promote and reduce stress for the informal carers (Arntzen et al., 2016).

In addition to the previously discussed research, several systematic reviews reported improvements in the psychological health of informal carers and their reduced burden of care (Andersson et al., 2017; Bergström & Hanson, 2017; D'Onofrio et al., 2017). Bergström and Hanson (2017, p. 8) results based on three studies using standardised tests for depression and anxiety, demonstrated that the most prevalent outcome variable of eCare technologies for adult carers of older people was "carers' level of depression, depressive symptoms or negative mood followed by levels of carers' burden or perceived burden". According to D'Onofrio et al. (2017, p. 932), there is an increasing "body of evidence suggesting the potential for ICTs to support dementia care at home". For example, one pilot study found that the GPS intervention (tracking device) allowed older people to go outside alone, and, consequently, informal carers and older people themselves were less stressed. Another study found positive psychological outcomes of using robots in care due to the monitoring of the home activities of older people with dementia. Its positive psychological outcomes on the informal carers were a decline in stress and frustration (D'Onofrio et al., 2017). Moreover, in an integrative literature review of eCare technologies for working carers, Andersson et al. (2017) found the potential for telecare services to reduce the burden of caring and to promote informal carer well-being. They also found that the use of remote home monitoring (telecare) and online carer support was associated with reduced work stress and the stress that they are experiencing while the care recipients are alone. Another literature review (Davies et al., 2013) indicated that telecare is effective in the reduction of carers' stress and burden.

## **The negative psychological outcomes of eCare technologies use**

Seven out of the sixteen studies reported negative psychological outcomes of eCare technologies on informal carers (Andersson et al., 2017; Arntzen et al., 2016; Groeneveld et al., 2013; Hall et al., 2014; Hattink et al., 2016; Nijhof et al., 2013; Pritchard & Brittain, 2015), such as reduced peace of mind (Andersson et al., 2017; Groen-

evelt et al., 2013; Hattink et al., 2016; Pritchard & Brittain, 2015), increased burden (Arntzen et al., 2016; Nijhof et al., 2013), increased anxiety and stress (Hall et al., 2014). One study was an integrative literature review (Andersson et al., 2017), while the other studies used qualitative methods.

In the Dutch study, the informal carers indicated that they constantly checked the monitoring device while away from home to confirm that everything was well with their relative (Groeneveld et al., 2013). An American qualitative study indicated that electronic monitoring technology could induce anxiety and stress in several ways: complicated use, information overload creating confusion, insecure transmission of information (i.e. potentially providing the information to unknown third parties), hypersensitivity or overreactions to the information and ambiguous family caring role due to having access to information that was only available to the professionals in the past. The study also mentions that negative perception of the monitoring technology would likely contribute to the distress for the family (Hall et al., 2014). In addition, a qualitative Dutch study on monitoring systems for older people with dementia living at home reported that burden of care increased in situations in which the sensor identified a need for additional care (Nijhof et al., 2013).

The results in Andersson et al.'s (2017, p. 267) study indicated that in terms of peace of mind, working carers could experience "the feelings of false security using a telecare system that was limited to providing information on older people's potential needs, rather than providing emergency alerts". With regard to emergency alerts, another study on integrated ATs found that informal carers experienced false alarms as bothersome; however, they indicated that they would prefer getting many false alarms to missing one actual alarm when their relative is in actual danger and needs their help (Hattink et al., 2016). Furthermore, a UK study examined the effects on alarm pendants or telecare use on older people and their informal carers. The study revealed some negative consequences, such as emotional distress for informal carers due to a false alarm call and the distressing experience of an informal carer who had slept through an alarm triggered by her partner who had fallen (Pritchard & Brittain, 2015). The study also found "that in the case of alarm pendants, these can include low levels of efficacy, increased work for older people and their carers and feelings of dehumanization" (Pritchard & Brittain, 2015, p. 124). Shortcomings in the design of ATs that resulted in complicated and non-user-friendly procedures, as well as inconvenient settings which were difficult to alter, were contributory factors to negative emotions among informal carers and younger peo-

ple with dementia in another study (Arntzen et al., 2016). The study also found negative emotional attitudes toward ATs were generated when the aid behaved in an unexpected manner (e.g. made a noise), was difficult to gain control over or “demanded” too much of the participants. But, similar to Hattink et al.’s (2016) findings, the experienced usefulness overshadowed the inconvenience of ATs in some cases.

## DISCUSSION

The purpose of this scoping study was to identify and describe the evidence from the qualitative, quantitative and mixed-method studies and existing reviews to investigate the psychological outcomes of eCare technologies use for informal carers. After considering the predefined inclusion and exclusion criteria, 16 studies were included in the scoping study analysis, indicating that existing research on the use of eCare technologies for informal carers is relatively scarce. The studies consistently revealed that positive psychological outcomes of eCare technologies use for informal carers prevail. Six psychological outcomes were identified: peace of mind, reassurance, anxiety, depression, stress and burden.

The analysis revealed three key findings. First, our study unveiled a wide range of positive psychological outcomes of using eCare technologies for informal carers, such as peace of mind and reassurance, as well as decreasing levels of informal carers’ stress, anxiety, depression, and burden. It also showed which specific features of eCare technologies contributed most to positive psychological outcomes for informal carers. For instance, home alarm systems, sensors for gas, temperature and bed occupancy (Carretero et al., 2015), and GPS tracking technologies were found to ease anxiety. Moreover, Davies et al. (2013) highlighted features of technological devices which can help informal carers cope with stress and provide peace of mind about the care recipients’ safety. These features allow remote monitoring of individuals (real-time monitoring of emergencies and lifestyle), which alerts carers and/or care services when set parameters are exceeded (e.g. bed pressure sensors alert carers if a care recipient is out of bed for longer than expected), or automatically trigger a response when an emergency occurs (e.g. gas shut off valves) (Davies et al., 2013; Harward, 2016).

The second key finding is that eCare technologies help informal carers with their professional lives (Andersson et al., 2017). Informal carers were allowed to fulfil their caring tasks successfully and concurrently and to maintain productive and active lives. In particular, employed informal carers generally experienced increased peace of mind and were able to combine work

and care better while using eCare technologies. For instance, remote safety monitoring tools allowed informal carers to not miss working days due to caring. A reconciliation of work and care and the reduction of work dropout could be benefits of these new technologies, which was also recognized in a recent Eurocarers report (2016b). Enabling carers to combine work and care could also have a significant economic impact, because “between 7% and 21% of informal carers reduce their working hours and between 3% and 18% withdraw from the labour market” (European Commission, 2014b, p. 9).

Third, the results of our scoping study showed that use of eCare technologies also has some negative psychological outcomes for informal carers. In particular, anxiety and stress levels increased due to false alarms and device malfunctions (Arntzen et al., 2016; Groeneveld et al., 2013), which contributed to a decrease in the informal carers’ feelings of security. In order to calm informal carers, the device has to be reliable and trustworthy. Additionally, informal carers experience false alarms as bothersome; therefore, eCare technologies developers should consider reducing false alarms to the minimum and be mindful that even one false alarm can produce many negative emotional responses towards the technologies’ acceptance and use (Dolničar, Petrovčič, Šetinc, Košir, & Kavčič, 2017; Peek et al., 2014).

The findings of the present research may have a wide range of implications. Our research has demonstrated the positive aspects of eCare technologies. By knowing that eCare technologies have the potential to reduce negative emotions related to informal care (e.g. anxiety), the importance that informal carers, as end-users, become explicitly targeted and systematically involved in the development of eCare solutions is even higher (also noted in Eurocarers reports, 2016a, 2017). Further research is needed in the evaluation of eCare technologies interventions and their psychological outcomes for informal carers. Moreover, future interventions should recognize the most vulnerable groups of dyads (of informal carers and care recipients) and identify which needs and preferences are prioritized by these dyads. The results of the interventions should become the foundation of the individualized programs offered by the eCare technologies developers (Bergström & Hanson, 2017). Studies have shown that end-user participation and user-centred design processes are highly successful in increasing the acceptability and usability of technological products and services; therefore, dyads should be actively included in the process of eCare technologies development (Bergström & Hanson, 2017; Dolničar, et al., 2017; Eurocarers,

2016a; Gutman & Sixsmith, 2013). In addition, there is a need for more scientific evidence of cases in which eCare technologies actually fulfil care recipients' and informal carers' needs and that are cost efficient. Further investigation is also needed on the psychological outcomes of eCare technologies on different groups of carers (e.g. working carers, young carers, older carers, formal carers) and on key technological features that have a psychological impact on informal carers.

Furthermore, the technologies' accessibility and acceptability are still low due to informal carers' limited digital skills and knowledge (Eurocarers, 2016a); therefore, informal carers' digital skills should be further encouraged and developed. In addition, there is a lack of eCare technologies and policies tailored to explicitly address the informal carers' needs and their special situations (Bergström & Hanson, 2017; D'Onofrio et al., 2017). Designers of eCare technologies typically concentrate their work on the services' functionalities and applications, but their focus should broaden to also include the informal carers' needs, perspectives and issues. The solutions to these challenges should be considered and addressed on the EU and national level, for example, by providing targeted initiatives that focus on appropriate extensive digital training and education. Additionally, a broad spectrum of research and development (R&D) of eCare technologies for informal carers is needed (Eurocarers, 2016a; Kluzer, Redecker, & Centeno, 2010). As Gutman and Sixsmith (2013) stated, for more productive R&D, a more cooperative transdisciplinary approach in the R&D of eCare technologies processes is needed, as well as better knowledge transference, in order to facilitate end-user and stakeholder involvement. The availability, accessibility, acceptability, affordability and appropriateness of eCare technologies are the future challenges that need to be addressed.

The conclusions drawn herein must be considered in the context of several limitations. First, this scoping study contained a small number of selected studies. Even though other technological solutions were identified during the search, we did not include Internet-based interventions (psychological counselling via the Internet or phone; training and education via the Internet or phone) and the study was narrowly focused on psychological outcomes rather than the determinants of those outcomes. Second, the studies included in the scoping study were done in 12 different countries, mostly in Europe and three in the US. Therefore, the results are likely to be generalized to Western society and its cultural values. In addition, the studies used in

this scoping study included a narrow range of informal carers, therefore its limitation is a narrow focus and more research needs to be done in order to capture a broader range of diagnoses and symptoms of older people and their informal carers' needs. Despite our search keywords being broadly inclusive in order to capture all studies, the search was limited to four databases and to English studies only. In addition, only two selected articles (Bergström & Hanson, 2017; Carretero et al., 2015) reported the anxiety and depression outcomes measured by the reliable standardised anxiety and depression tests. Other selected articles based their anxiety and depression outcomes either on self-reports by the study participants or they do not provide the information on the measures used. However, this scoping study also has strengths: it employed a thorough search strategy, and strict inclusion and exclusion criteria were applied. It also addressed important understudied topics, as psychological outcomes in relation to eCare technologies have seldom been investigated. More active involvement of end-users in the eCare technologies' design and development process, as well as more in-depth understanding of the psychological outcomes of eCare technology use, may inform future studies and developers of eCare technologies, researchers, policy makers, informal carers and other stakeholders who work with innovative forms of support for informal carers of older people.

## CONCLUSION AND IMPLICATIONS

This scoping study involves a very compelling and under-studied topic among the informal carers of older people. It revealed positive and negative psychological outcomes of eCare technologies use for informal carers. It contributes to many important understandings of both what we know and how we know it. A theoretical implication of our study is the identification of several positive and a few negative psychological outcomes, as well as a comprehensive list of these psychological outcomes. It can serve as a basis for a catalogue to which future authors can systematically add specific technological features that can contribute to positive or negative psychological outcomes. Moreover, we found that eCare technologies help informal carers with their professional lives and with the reconciliation of work and care. These findings can be presented as a foundation for researchers who would like to focus their studies on psychological outcomes of eCare technologies use on employed informal carers. In addition, an implication for practice is that informal carers may become more specifically targeted end-users, as well as more involved in eCare technologies development.

## Endnotes

1. Studies use different definitions of carers, which differ depending on the caring activities (OECD, 2011, p. 87). Family care refers to relatives, most often children and/or spouses, however, informal care is a wider term, which includes both family members, neighbours and friends (Jegermalm, 2006). For the purposes of this study, we will refer to the concept of informal care.

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