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Review

Robotic Animal Use among Older Adults Enrolled in Palliative or Hospice Care: A Scoping Review and Framework for Future Research

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Abstract: As the population of older adults increases, there is an anticipated rise in the utilization of hospice and palliative care. Many significant advancements in technology have been used to address the unique needs of this demographic; however, an unexplored area of research is the use of robotic animals as part of end-of-life care. The purpose of this scoping review was to examine the state of the literature on robotic animal use among older adults enrolled in palliative or hospice care and to offer a framework for future research. Following a guide for scoping reviews, we identified relevant studies and then charted, collated, summarized, and reported the data. Two articles were selected for final review. The results found that decreased medication use, behavior change, and emotional benefits were potential outcomes of robotic animal use in hospice and palliative care. Perceptions of the robot and ethical considerations were also discussed. Overall, the study findings point toward the potential uses of robotic animals as part of end-of-life care, however, more empirical research is critically needed.

Keywords: social robotics; animal robot; palliative care; hospice; end-of-life

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1. Introduction

The primary purpose of both hospice and palliative care is described as promoting good quality of life and alleviating a person's suffering [1]. Palliative care is an interdisciplinary approach to care that addresses an individual's physical, emotional, social, spiritual, and practical needs [2]. It can be provided to those living with a serious illness throughout the entirety of their illness, or during the final stages of their disease while they receive hospice care [2]. Hospice is a program that offers end-of-life care; it can be administered in a nursing home, assisted living facility, and at a person's home [1]. Individuals may choose hospice when they are close to the end of their lives, typically due to the final stages of an illness. In 2015, in the United States (US), an estimated 1,426,000 individuals received hospice services; 94.6% were aged 65 or older [3]. As the population of older adults grows, there is an anticipated rise in the utilization of hospice and palliative care, along with an increased demand for tailored interventions and greater use of technologies that address the unique needs of this demographic [4,5].

Digital health is defined as the field of knowledge and practice associated with the development and use of technology to improve health outcomes [6]. Despite being a component of healthcare for several years now [7], there is very little research that situates palliative care in the broader digital health landscape [5]. Indeed, palliative care is relatively new and arguably has not been fully integrated into the core framework of Western

medicine. Researchers and clinicians are still identifying best practices for end-of-life care in a way that parallels the standards set in other areas of healthcare and social services. However, there have been significant advancements in technology in recent years, bringing forth promising opportunities to enhance hospice and palliative care. The integration of technology may significantly improve client care, leading to more accurate diagnoses and prognoses, better communication, enhanced symptom tracking and well-being monitoring, and improved communication and decision-making [5,8]. An emerging, yet often unexamined area of research is the potential use of socially assistive robots ("social robots") as part of hospice and palliative care [9].

Social robots "portray social abilities to socially assist or support humans" ([10], (p. 412)). One type of social robot that has been commonly used as a therapeutic tool is robotic pets [11,12]. Robotic pets appear or behave like pets or companion animals [13], as cited in [14]. A systematic review of older adults' contacts with robotic pets in residential care homes found that robotic pets reduced agitation and loneliness, and improved quality of life [15]. A scoping review of low-cost robotic pets for older adults with dementia suggested positive outcomes related to mood and affect, social interaction/communication, and companionship [14].

Animals, in the context of social robots, may take on a transformative role, offering companionship and fostering emotional connections through their interactive and responsive features. Some of the most well-known examples of robotic pets used with older adults include PARO, JustoCat [15], and the Joy For All cat [14]. PARO is one of the most widely studied robotic pets [16]. PARO is a baby harp seal with soft white fur and large eyes that was designed for therapeutic use to support older adults with dementia and other cognitive impairment/s [17]. PARO is capable of opening and closing its eyes, moving its neck and flippers, and making sounds in response to users [18]. PARO has been used in research to address agitation and mood disturbances as well as to increase social interactions in assisted living and nursing home settings [17]. In a cluster-randomized controlled trial using PARO to address agitation among older persons living with Alzheimer's disease and related dementias (AD/ADRD), researchers found lower levels of agitation and higher cognitive functioning among participants who interacted with PARO [19]. Moyle and colleagues [20] also used a cluster-randomized controlled trial examining PARO's effects on motor activity and sleep patterns among long-term care residents with dementia. Study findings suggested that the intervention did not improve residents' sleep patterns, but there was some evidence that PARO addressed residents' agitation.

JustoCat is a furry cat robot that has shown promise in reducing agitation among individuals with late-stage dementia [21]. JustoCat is a battery-charged robot that can shake its body, raise its paw, purr [22], and was designed to comply with Swedish hygiene routines required in long-term care and hospital settings [21]. Perrson [23] explored the interaction between JustoCat, residents, and care workers in long-term care in Sweden. Their results suggested that active engagement by the care workers with the resident and the robot produced better outcomes than residents who passively engaged with the JustoCat.

The Joy for All robotic cat has fur and uses built-in sensors to respond to touching/petting which result in cat-like responses (e.g., purring, meowing) [24]. A scoping review reported that most older users had positive perceptions and experiences using the Joy For All robotic cat [14]. For example, in a small-scale, qualitative study, older adults living with dementia engaged with the Joy For All robotic cat for several weeks [25]. The findings suggested that while not all study participants accepted the cat robot, there were some observed benefits such as stimulating communication and reducing anxiety [25].

While research suggests that having a living pet (e.g., dog) may help ameliorate loneliness in later life which can in turn support overall health and well-being [26], there are often barriers to pet ownership including cost and daily care of the animal [27,28]. Older adults may face other barriers such as mobility, transportation, and housing issues. These barriers could make traditional pet care, such as feeding, walking, and cleaning up any messes, problematic. These obstacles highlight why older adults may benefit from

using robotic pets instead of having live animals [28]. There has been increased use of robotic pets for therapeutic purposes in lieu of animal-assisted approaches. Research shows that robotic pets can be comparable to animal-assisted therapy in that they may help calm agitated behaviors, help with mood disturbances, and increase the quantity and quality of social interactions among older adults [17].

There are several scoping reviews and a growing body of research supporting the use of robotic pets as a therapeutic tool with older adults. However, none of these scoping review studies specifically focused on outcomes relevant to palliative care and hospice including end-of-life, dying, or death. Moreover, none of the older adults in these studies were reported to be enrolled in hospice or palliative care. For example, Koh and colleagues [14] conducted a scoping review of interventions using low-cost robotic pets focused on older adults living with dementia in their own homes, nursing homes, and other supportive care settings. Study findings highlighted the promise of low-cost robotic pets in supporting the psychosocial needs of persons living with dementia. Similarly, a systematic review of engagement with robotic pets among older adults living in care homes suggested beneficial effects on health and well-being [15]. Additionally, a scoping review by Guerra and colleagues [29] examined the openness of community-dwelling older adults to using robotic pets; the study findings suggested that participants were open to the technology.

Despite evidence from these scoping reviews regarding the use of robotic pets with older adults, little is known empirically about the specific use of robotic pets as a component of hospice and palliative care. This gap in the evidence base is concerning as lay online content (e.g., websites for the general public) reveals that many hospice providers are purchasing and integrating robotic pets in their care settings, particularly in the U.S. For example, Community Hospice and Palliative Care in Florida [30] received a donation of 100 robotic cats and dogs to use with socially isolated end-of-life patients living with AD/ADRD. Similarly, Capital Caring Health [31], a hospice provider in the mid-Atlantic region, offers a Robotic Companion Pet Therapy Program for Veterans, persons with AD/ADRD and children as part of their end-of-life services. Additionally, the Hampton Veterans Medical Center in Virginia received 10 robotic pets from the American Red Cross to the Armed Forces to live with their patients in hospice or palliative care [32].

Given the current and projected growth in the numbers of older adults utilizing hospice and palliative care as well as public websites reporting the use of robotic animals in interventions by hospice and palliative care providers, it is critical to examine the extant peer-reviewed literature on this specific topic. Importantly, there currently are no such systematic reviews of this nature and bringing awareness to the current studies (or lack thereof) on this topic would provide a succinct overview for hospice and palliative care providers that wish to pursue robotic animal interventions. Therefore, this scoping review aims to answer the research question: What is the state of the literature about robotic animal use among older adults enrolled in palliative or hospice care?

2. Methods

A scoping review is typically conducted when a topic of research is largely understudied to systematically search, synthesize, and report on the extant literature [33]. Although published scoping reviews point toward the utility of robotic pets with older adults more generally, to date, there has been no systematic examination of the literature that focuses on hospice and palliative care. Thus, this scoping review fills an important gap in the extant research.

The Arksey and O'Malley [34] framework guided this scoping review. Articles included were peer-reviewed, published in English, had participants who were age 65 and older, and were documented as receiving hospice or palliative care in any setting. The data were summarized using Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram [35]. The protocol for this study was registered with The Open Science Framework (OSF) (https://osf.io/krh4f/, accessed on 6 June 2024).

2.1. Types of Sources

Informed by the Joanna Briggs Institute (JBI) approach [36], this scoping review considered experimental and quasi-experimental study designs, including randomized controlled trials, non-randomized controlled trials, before and after studies, and interrupted time-series studies. In addition, analytical observational studies, including prospective and retrospective cohort studies, case–control studies, and analytical cross-sectional studies, were considered for inclusion. The review also considered descriptive observational study designs, including case series, individual case reports, and descriptive cross-sectional studies for inclusion. Qualitative studies were also considered if they focused on qualitative data, including, but not limited to, designs such as phenomenology, grounded theory, ethnography, qualitative description, action research, and feminist research. All studies must have been peer-reviewed.

2.2. Search Strategy

An initial limited search of Web of Science, Cumulated Index in Nursing and Allied Health Literature (CINAHL) Complete, AgeLine, American Psychological Association Psychology Information (APA PsycInfo), Health Source—Consumer Edition, Medical Literature Analysis and Retrieval System Online (MEDLINE), Social Work Abstracts, and Institute of Electrical and Electronics Engineers Explore (IEEE Xplore) was undertaken with a scholarly librarian to identify articles on the topic. The text words contained in the titles and abstracts of relevant articles and the index terms used to describe the articles were used to develop a complete search strategy. Based on the recommendations of a scholarly librarian, the researchers used a sensitive search strategy which captured a broad section of the literature. While this type of search may result in a large pool of irrelevant studies [37], the likelihood of overlooking or missing relevant studies is significantly lowered by using this approach. A key term search strategy was employed using the terms listed in Table 1. The search strategy, including all identified keywords and index terms, was adapted for each included database and information source. Boolean operators and modifiers were used to refine the search results including the use of an asterix (i.e., *) that attaches to the stem of a word and searches for any word that contains that stem or the letters preceding the asterisk [38].

Table 1. Search strategy.

Database	Search Strategy
MEDLINE	Line 1: robo * Line 2: animal OR pet OR dog OR cat OR seal OR companion Line 3: hospice OR palliative OR "end of life" OR terminal * OR dying OR death OR end-stage

Two reviewers screened the reference list of all sources of evidence included for additional studies. Studies published in English prior to 1 June 2023, were included.

2.3. Study Selection

Following the search, all identified citations were collated and uploaded to Covidence (https://www.covidence.org (accessed on 5 December 2022)), a software tool for scoping reviews [39]. Covidence assisted the researchers with removing duplicates, storing the articles, and provided a platform for applying the inclusion and exclusion criteria. As per the JBI approach [36], titles and abstracts were screened by two independent reviewers for assessment against the inclusion criteria for the review. Next, they reviewed potentially relevant sources in full and assessed the full text of selected citations in detail against the inclusion criteria. The reasons for excluding sources of evidence in full text that did not meet the inclusion criteria were recorded in Covidence. Disagreements were resolved at each stage of the selection process through discussion until consensus was reached. The

search results and the study inclusion process were reported in full and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping review (PRISMA-ScR) flow diagram and checklist (see Figure 1).

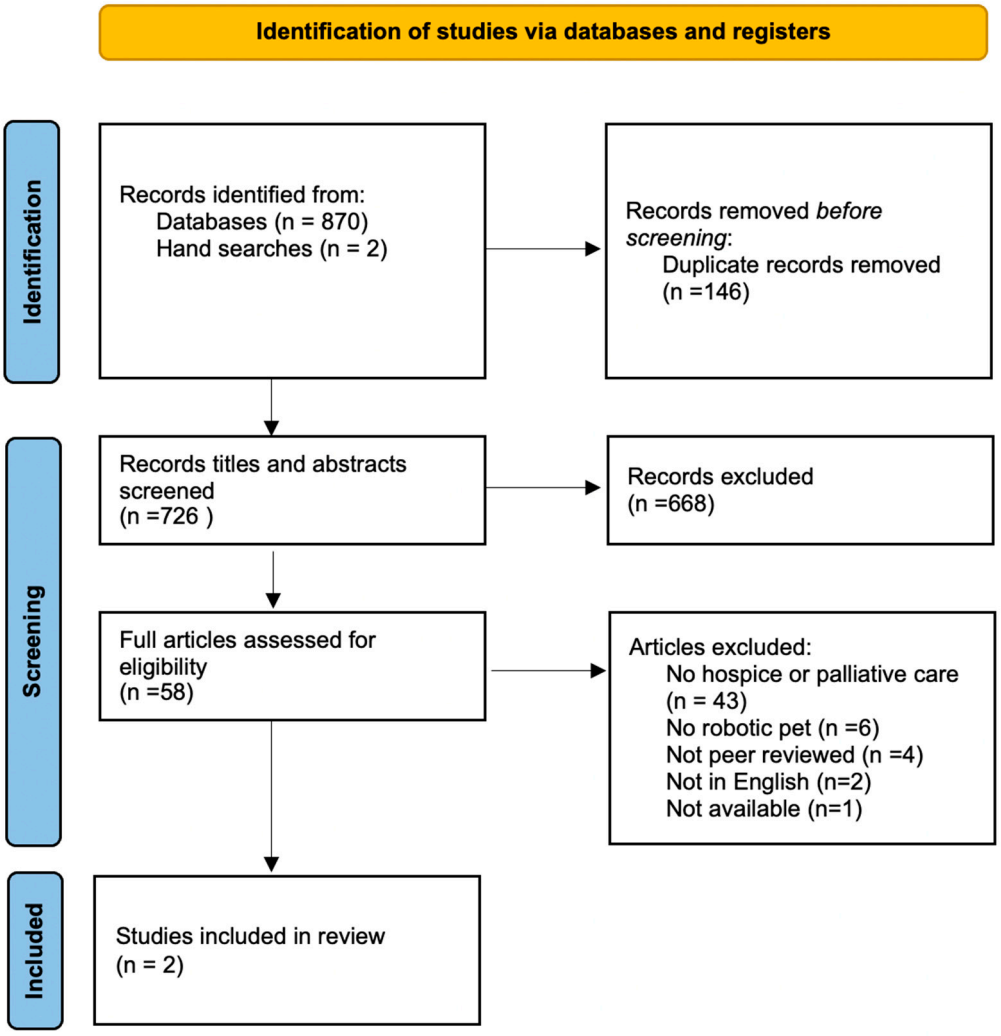

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart.

2.4. Data Extraction

Data were extracted by two independent reviewers using a data extraction tool developed by the reviewers. The data extracted included specific details about the participants, concept, context, study methods, and critical findings relevant to the review question. Tables of final extraction are provided (see Table 2). The final data extraction table was modified and revised as necessary while extracting data from each included evidence source. Any reviewer disagreements were resolved through discussion or with an additional reviewer/s. When required, authors of papers were contacted to request missing or additional data. This was performed regarding one article, but that article was ultimately rejected upon further review.

Table 2. Data extraction.

Title	Robotic Seals as Therapeutic Tools in an Aged Care Facility: A Qualitative Study.	Use of a Robotic Cat to Treat Terminal Restlessness: A Case Study
Lead Author	Birks, Melanie; Bodak, Marie; Barlas, Joanna; Harwood, June; Pether, Mary	Brecher, DB
Publication Year	2016	2020
Location	Australia	U.S.A
Setting	Aged care facility	Veterans Affairs Community Living Center
Population	Older adults	Veteran Age 90
Sample	Therapists (n = 3)	Case study (n = 1)
Methods	Qualitative thematic analysis	Case study
Aim/Purpose	Identify, explore, and describe the impact of PARO. PARO is used daily as a diversional therapy with residents in an individual or group activity. Each therapy session lasted 30–40 min. During the sessions, residents were encouraged to engage with Paro. After approximately four months, interviews were conducted with the participants for about one hour each.	The case study examined the effectiveness of using a robotic cat to assist with the treatment of an older adult with terminal restlessness.
Type of Robot	Seal; PARO	Cat; Joy for All Ageless Innovation
Perception of Robot	Mixed views	Not clearly stated
Outcomes	Behavioral and emotional benefits	The use of robotic cats may enhance the older adult's quality of life and their ability to interact with loved ones before entering the active dying process. In addition, robotic cats may have a role in decreasing terminal restlessness as they have positive physical and emotional effects which can be used to supplement pharmacological interventions.
Measures	Interviews with the three therapists who were asked to share their experiences and observations using PARO, data were transcribed and thematically analyzed	Minimizing pharmacological treatments for behaviors
Major Findings	Three major themes were identified from the analyses: "a therapeutic tool that's not for everybody", "every interaction is powerful", and "keeping the momentum". The findings support using PARO as a therapeutic tool, showing improvement in emotional state, reduction of challenging behaviors, and improvement in social connections.	The case study showed robotic cats can have a positive role in terminal restlessness as they can impact physical and emotional well-being and can be used to supplement pharmacological therapy.

3. Results

We identified 872 articles and removed 146 duplicates. Next, we screened the title and abstract of 726 articles. We conducted a full article review of 58 articles, during which 56 were excluded for the following reasons: no participants reported to be enrolled in hospice or palliative care (n = 43), no robotic pet (n = 6), not peer-reviewed (n = 4), not published in English (n = 2), and not available (n = 1). A total of two studies were included in the review: (1) a case study which examined the use of a robotic cat to treat terminal restlessness; and (2) a qualitative study which examined the use of the robotic seal PARO as a therapeutic tool in an aged care facility. The sample sizes in the two studies ranged from one to three participants. See Figure 1 for an inclusion flow chart.

3.1. Participants and Study Settings

The first was a case study of one participant, a 90-year-old veteran, who was admitted to a hospice unit in the United States [40]. The participant had a wife and three children. He required assistance with activities of daily living and had a diagnosis of Alzheimer's disease along with terminal restlessness, hypertension, coronary artery disease, and anemia. He exhibited psychiatric behaviors described as "striking staff during mealtimes, cursing, and refusal to participate in community activities" ([40], (p. 1)) and he had impaired verbal communication skills.

The second study [41] included selected residents from a 127-bed aged care facility in Australia. There were no demographic details provided about the residents as the focus of the paper was on the experiences of three recreational therapists who used PARO as part of a therapeutic intervention. The authors did report that some of the residents in the study were people living with dementia and at least one participant was receiving palliative care [41].

3.2. Study Design & Delivery

In the study by Birks and colleagues [41], the facility had purchased several PARO robotic seals and asked the research team to evaluate their use with residents. An event was held at the facility to launch the use of PARO, during which time the research team explained the study to staff, residents, family members, and friends. Before the intervention, the recreational therapists received training sessions from a facility manager who had worked with PARO. The training was designed to develop knowledge of how PARO could be used as a therapeutic tool to positively impact the daily experiences of residents in the facility. Next, the recreational therapists used PARO daily as part of recreational therapy in individual or group activity sessions lasting 30–40 min over about four months. The residents were encouraged to interact and engage with PARO by touching and talking to the robot. No details were provided as to how many residents participated in these sessions and how many sessions were provided in an individual or group format. The recreational therapists were asked to keep a journal of these interactions and were asked to complete semi-structured interviews about their experiences.

In the case study by Brecher [40], an older adult was prescribed lorazepam and haloperidol for his terminal restlessness. According to Brecher ([40], (p. 2)) the medications were reported to have "minimal therapeutic effect." The case study reported that rather than escalate the use of medications, the Joy For All robotic cat was used to augment the current medications and behavior therapy. The justification for using the robotic cat was that the facility had used Joy For All cats with persons living with dementia to assist with agitated behavior and poor response to medication. In the case study, the patient interacted with the robotic pet by stroking it, watching it move, and hearing the robotic cat purr [40]. The case study did not specify how long or how often the robotic cat was used (e.g., treatment dose), but Brecher [40] reported that during the last 24 h of the patient's life, the robotic cat was on his bed.

3.3. Perception of Robotic Pet

The study exploring the use of PARO as a therapeutic tool in aged care facilities reported that the recreational therapists' perceptions of how the residents reacted when engaging with the robotic seal ranged from "outright dismissal" to "curiosity to excitement" ([41], (p. 2)). Additionally, the recreational therapists reported that PARO elicited positive responses from residents with dementia, depression, or under palliative care. As it related to the families of residents, the recreational therapists reported that family members' reactions to the robotic pet were mostly positive. Birks and colleagues [41] also found that the recreational therapists perceived some negative perceptions among the staff, suggesting that PARO could be infantilizing, a waste of resources, that residents could not comprehend the benefit of the robots, and concerns that the robot could be monitoring the staff behavior.

The case study by Brecher [40] did not include any information about the older adult's perception of the robot. However, Brecher ([40], (p. 2)) reported that the patient's family was "grateful for the staff support and minimization of the need for medication as they were able to witness a respectful and peaceful death of their loved one".

4. Outcomes

4.1. Decreased Need for Medication

The case study by Birks and colleagues [41] did not report any outcomes related to medication. However, Brecher ([40], (p. 2)) stated that the patient entered the dying process and was completely bed-bound over the last three days of his life during which time the robotic cat "negated the need for his scheduled benzodiazepine". Although the study indicated that haloperidol was available as needed every two hours, it was not reported whether the patient was administered this medication. Brecher [40] further stated that the robotic cat was with the patient during the last 24 h of his life, and during this time frame the patient did not require pharmacological therapy for terminal restlessness.

4.2. Behavior Change

The case study by Brecher ([40], (p. 2)) suggested that after introducing the robotic cat to the patient, there was a "significant positive clinical response" within 24 h. Brecher ([40], (p. 2)) reported that the physical aggression demonstrated by the patient "almost completely disappeared" as he interacted with the robotic cat (e.g., stroking, watching, hearing it purr).

Similarly, Birks and colleagues reported that the recreational therapists observed behavioral benefits for the residents with negative behaviors (e.g., disruptive, loud) who became calmer and more relaxed due to their interaction with PARO [41]. The recreational therapists also noted positive resident behaviors described as "beautiful, pleasing, sparkling eyes, giggling, and a powerful experience" related to engagement with PARO ([41], (p. 4)).

4.3. Emotional Benefit

The case study by Brecher [40] did not indicate any direct emotional benefit for the participant who engaged with the robotic cat. However, the study did suggest that along with medication, robotic cats may have a positive emotional effect for addressing terminal restlessness which is "often characterized by anguish" ([40], (p. 1)).

Birks and colleagues [41] reported emotional benefits for participants. The study suggested that the recreational therapists described participants as coming "out of their shells" and "showing exuberance" ([41], (p. 2)) when seeing PARO. Recreational therapists also reported that they observed an emotional bonding occur between some residents and PARO that manifested as "something towards which they could express affection, talk, and welcome back like an old friend" ([41], (p. 3)). For residents at the end of life, the recreational therapists reported that the robotic pet could provide "happiness and comfort" ([41], (p. 1)). Birks and colleagues ([41], (p. 6)) further indicated that some residents who were withdrawn, facing isolation, and at the end-of-life stage were able to "verbalize their internalized world" with PARO, which may have helped the resident feel less alone.

5. Ethics

Ethical concerns were not discussed in the case study using the Joy For All robotic cat to treat terminal restlessness [40]. However, ethical issues surrounding education and training were discussed in the qualitative study using the PARO seal as a therapeutic tool [41]. The qualitative study described that some staff viewed the use of a robotic pet as infantilizing older adults [41]. The authors noted that this may have been related to their lack of understanding or education on the device highlighting the need for more education and training for staff [41].

6. Discussion

This scoping review is the first to identify and synthesize the evidence on the use of robotic pets among older adults receiving hospice or palliative care. The two studies included in the final sample of articles used PARO the seal and a robotic cat as part of palliative care. Overall, these findings are consistent with previous literature supporting the use of social robots in forms such as seals and cats with older adults [20,21,42,43]. Furthermore, research suggests that robots may have a variety of potential uses in palliative and end-of-life care that include social and therapeutic uses [9].

In our scoping review, perceptions of the robot were mixed among staff [41]. In general, these findings align with other research suggesting that healthcare and social workers were more positive than negative about the use of animal-like robots with persons living with dementia [44]. However, the PARO study in our scoping review included residents both with and without memory impairment and the researchers emphasized that cognitive status could potentially influence the reaction of individuals engaging with the robot [41]. Our scoping review also found that staff in the PARO study reported mixed impressions about the residents' engagement with the seal. These findings are consistent with a systematic review by Vandemeulebroucke et al. [45], suggesting that older adults often have both positive and negative views about socially assistive robots. The toy-like appearance of robotic pets may evoke feelings of infantilization, which in turn may negatively impact an older adult's perceptions of a robotic pet [45]. Likewise, Nwosu and colleagues [9] argue that patients, caregivers, creators/designers, and policy-makers have different expectations and acceptance of robots which poses as a potential weakness for their use in end-of-life care.

Our scoping review findings point towards the importance of inviting and preparing older adults to interact with a robotic pet in ways that promote dignity and autonomy at the end of life. Strategies for ensuring that robotic pets are implemented in a respectful way may include using language about the robotic pet that emphasizes its potential therapeutic benefits as opposed to framing it as a toy, maximizing client choice in whether and how they would like to incorporate the robotic pet into their daily activities, customizing the interactions with the robotic pet based on the preferences of the individual, encouraging social engagement/interaction when using the robotic pet, and training staff to create a respectful environment for interaction.

Findings from our scoping review underscore the potential use of robotic pets as a non-pharmacological intervention to possibly reduce the need for certain medications in hospice and palliative care. It is well documented that individuals at the end-of-life may experience a range of physical symptoms, including delirium, sleep deprivation, immobilization, dehydration, cognitive impairment, visual and hearing impairment, and terminal restlessness [40]. Due to concerns with pharmacological (i.e., medication) interventions, including efficacy and side effects [40], rising costs [46], inability to holistically treat psycho–social–spiritual issues [47], and the ethics of "chemical restraints" ([48], (p. 1)), robotic pets show promise as an alternative therapeutic tool. Moreover, some research points toward the use of PARO as a nonpharmacological approach for pain relief [18]. Indeed, research is increasingly showing the promise of nonpharmacological interventions to improve the quality of life for older adults receiving hospice care. Cardoso et al. [47] and this scoping review contribute to the literature by highlighting the need for additional research on this topic and exploring the potential use of robotic pets as an intervention that reaches beyond pharmaceutical approaches for persons at the end of life.

Our scoping review findings highlight the potential for robotic pets to reduce agitation for persons enrolled in hospice or palliative care. Agitation at the end-of-life is not uncommon and can cause distress to family members and staff [49]. Among hospice patients with dementia, agitation may manifest as loud talking, excessive movement, resisting care, and verbal or physical aggression [50]. Persons who have advanced cancer and are at the end-of-life may also experience terminal agitation [51]. PARO has been used successfully in several studies to reduce agitation in persons with dementia [20,52] and in persons with

post-stroke depression [53]. However, one study suggested that PARO is more clinically appropriate for use with persons with low to moderate agitation [19]. Thus, additional research is needed to explore the potential use of robotic animals to reduce agitation specifically for persons receiving hospice or palliative care. For example, future studies might examine how robotic animals could provide a positive distraction to reduce agitation, or how the sensory features of the robot (e.g., fur, purring) may have a calming effect and promote relaxation.

The emotional benefits of robotic pets for persons at the end-of-life emerged as a theme in our scoping review. Research suggests that persons who are dying may experience emotions such as fear, loneliness, and sadness when thinking about their own death [54]. Incorporating techniques in palliative care that can address and strengthen an individual's psychological, spiritual, and social needs may improve their comfort and improve their quality of life [47]. Robotic pets may offer one such technique, offering comfort and social companionship [9] to potentially mitigate feelings of loneliness [28]. Researchers also found that in place of pharmacological intervention, the PARO robotic seal offered a promising alternative for addressing symptoms of anxiety and depression in older persons with dementia [11]. Despite the emotional benefits generally associated with robotic pets, more research is needed about their use with people receiving palliative care and hospice services. Future studies might explore if the presence of a robotic pet can alleviate sadness or manage anxiety as part of hospice or palliative care. Robotic pets may also promote a sense of social connection through interactive activities with others such as family members or staff [55]. Additionally, the inherently playful features of robotic pets may also enhance mood and boost emotional well-being at the end-of-life.

Our scoping review also raises important questions about ethical approaches to using robotic animals as part of hospice or palliative care. In line with other researchers such as Gustafsson and colleagues [21], we argue that presenting robotic animals as live animals is deceptive, particularly for persons with dementia. As in other studies of social robotics, end-user (e.g., patient) participation is critical for the ethical integration of these new technologies [56]. Trustworthiness, compassion, and humanity are integral to any interventions designed for successful human–social robot interaction [57]. Moreover, socially assistive robots should be used as a complement to, rather than a substitution for, human companionship [58] as there are concerns that robots could worsen social isolation [9]. Like Hudson and colleagues [28], we also argue against the use of robotic pets in palliative care or hospice in ways that are deceptive, that reduce or replace human contact, or that infantilize persons at the end-of-life.

Regarding the expressed hesitation around older adults' technical abilities in operating and interacting with robots [59], creating simple and easy-to-use interfaces to increase older adults' ease of use and interaction with robots are recommended in the literature [60]. Providing basic training for older adults before the interactions start will also be helpful. Overall, when designing social robots for therapeutic interventions in healthcare, it is crucial to involve patients and caregivers right from the start. This should go hand in hand with an ongoing focus on ethical considerations throughout the design process [61], as distrust of robots is cited as a potential weakness of robotic technology in palliative and end-of life care [9].

One of the most important points for discussion is that the scarcity of peer-reviewed studies on this topic is concerning, albeit unsurprising. Despite a common understanding of the importance of palliative care research, addressing gaps in scientific knowledge has been slow-moving given a myriad of obstacles researchers commonly face. For example, researchers must navigate challenges arising from sparse funding, institutional capacities, the availability of skilled researchers, as well as challenges specific to the subject and its demographics, such as attrition and heightened human subjects' protection. Moreover, Chen and colleagues argue that researchers also face public and professional misunderstanding of palliative care and aversions to topics related to serious illness and end-of-life [62]. Given that lay online content suggests that robotic animals are being used in interventions for

persons enrolled in hospice or palliative care, a lack of empirical evidence found by this scoping review highlights concerns for research as well as clinical practice.

7. Limitations and Strengths

Some study findings should be interpreted with caution. This search only yielded a small final number of articles. This small sample could be a result of the exclusion of grey literature such as white papers, conference presentations, and dissertations/theses. However, our focus was on peer-reviewed research. It is also possible that researchers have included participants enrolled in hospice or palliative care but did not report this information at the time of publication. If this was the case, future studies must specifically report on outcomes for these participants within the context of hospice or palliative care service provision as no conclusions can be drawn without this information. Furthermore, articles published in languages other than English were not included in this review studies, and thus some data may have been overlooked. Finally, scoping reviews do not consider the quality of the studies. However, the justification for using this methodology lies in the overarching goal of the scoping review: to broadly examine the evidence related to robotic pet use among older adults enrolled in hospice or receiving palliative care.

There are several strengths connected with this scoping review. First, the methodological framework used in the scoping review process was transparent and rigorous. Incorporating the expert consultation of a scholarly librarian for the database selection and search terms enhanced the study methods. The screening and data extraction process involved two independent reviewers and incorporated the use of a tool known as Covidence, reducing the risk of reviewer error or article selection bias. Additionally, both reviewers met regularly to discuss and resolve all conflicts. Second, the scoping review bolsters support for the need for future research on the use of robotic pets among older adults receiving hospice or palliative care. Researchers can use the findings from this scoping review as a foundation to further explore the use of robotic pets among this population of older adults. It is important to note that a scoping review focusing on robotic pet use among individuals with dementia found the cost of robotic pets can become excessive [14]. JustoCat retails for $1530, while the popular PARO seal costs upwards of $6000 [14]. We anticipate that as in other cases of technology that were previously cost prohibitive (e.g., home computers, smartphones), robotic pets will become increasingly affordable and ubiquitous. Currently, some robotic pets can be purchased off the shelf (e.g., Joy for All) costing approximately $125 to $140 USD [24].

8. Implications

The present study explores a small, but important area in the realm of innovation, accessibility, and quality of palliative care. There is a growing movement throughout the U.S. to make 'palliative care everywhere' [63]; however, to do so, innovation is essential, as are studies that support the expansion of cutting-edge ideas.

Indeed, the integration of technology into palliative care can lead to improved quality of life for individuals and their loved ones. As hospice and palliative care continue to evolve, it is essential to embrace new technologies to ensure that individuals receive the best care possible. The findings from this scoping review suggest that the potential positive impacts of using robotic pets with older adults receiving hospice or palliative care may include improving the older adults' mood, decreasing depression and loneliness, and decreases the need for pharmacological intervention [40,41]. However, further research is critical to better understand the potential of robotic pets to meet the needs of individuals receiving hospice or palliative care. Leveraging innovative technology such as robotic pets may be a useful therapeutic approach for improving older adults' quality of life at the end of life.

We propose that future research should be informed by well-established frameworks of practice such as the Canadian model to guide hospice and palliative care [64]. This model was chosen because it provides a comprehensive understanding of how people experience

health and illness. Together, the eight equally important domains categorize the complex issues individuals and families face when trying to relieve suffering and improve quality of life [64]. Furthermore, the model is guided by 10 principles that are relevant to robotic animal use in research: (1) person–family centered, (2) ethical, (3) high quality, (4) team-based, (5) safe and effective, (6) accessible, (7) adequately resourced, (8) collaborative, (9) advocacy-based, and (10) evidence informed/knowledge-based [64].

In Figure 2, we mapped the outcomes from our scoping review as well as from a search of the extant research related to animal robot interventions with older adults onto each domain of the model. The patient and family are at the center of the model which is a clear reminder that they are the focus in palliative and hospice care. In the domain of *disease management*, primary and secondary diagnoses such as dementia [14] and post-stroke recovery [53] as well as co-morbidities such as wandering [20] have been examined in previous studies. In the *physical domain*, study outcomes included pain [18], decreased medication use [40,65], and decreased blood pressure [66]. Several studies mapped onto the *psychological domain* with outcomes such as decreased negative behaviors [40,41,52], increased expression and extroversion [41], increased calm, relaxation, happiness, and comfort [28,41], increased positive affect [41] and positive emotional effects [40], increased pleasure [67], decreased depression [65] and improved psychological well-being [68]. The *loss/grief* domain included a study from our scoping review suggesting that family members reported witnessing a respectful and peaceful death [40], which can contribute to positive bereavement outcomes. In the *social domain*, outcomes focused on decreased isolation [41,69], improved relationships [70–72], and improved social connections [28]. The *end-of-life/death management* domain included studies suggesting the use of animal robots for preparation for death [40,73]. Two studies mapped onto the practical domain, focused on activities of daily living [25,74]. Finally, the *spiritual domain* included outcomes such as companionship [75] and resilience/purpose in life [68].

Using this framework, we suggest that future research should examine outcomes holistically across multiple domains as there are complex issues and expectations in hospice and palliative care. The application of the Canadian model to research animal robotics allows for an examination of the dynamic issues that influence the end-of-life experience of patients and families. Our hope is that we have offered a valuable framework that will guide empirical studies using animal robotics in hospice and palliative care, enhancing understanding and addressing the multifaceted needs of individuals and families.

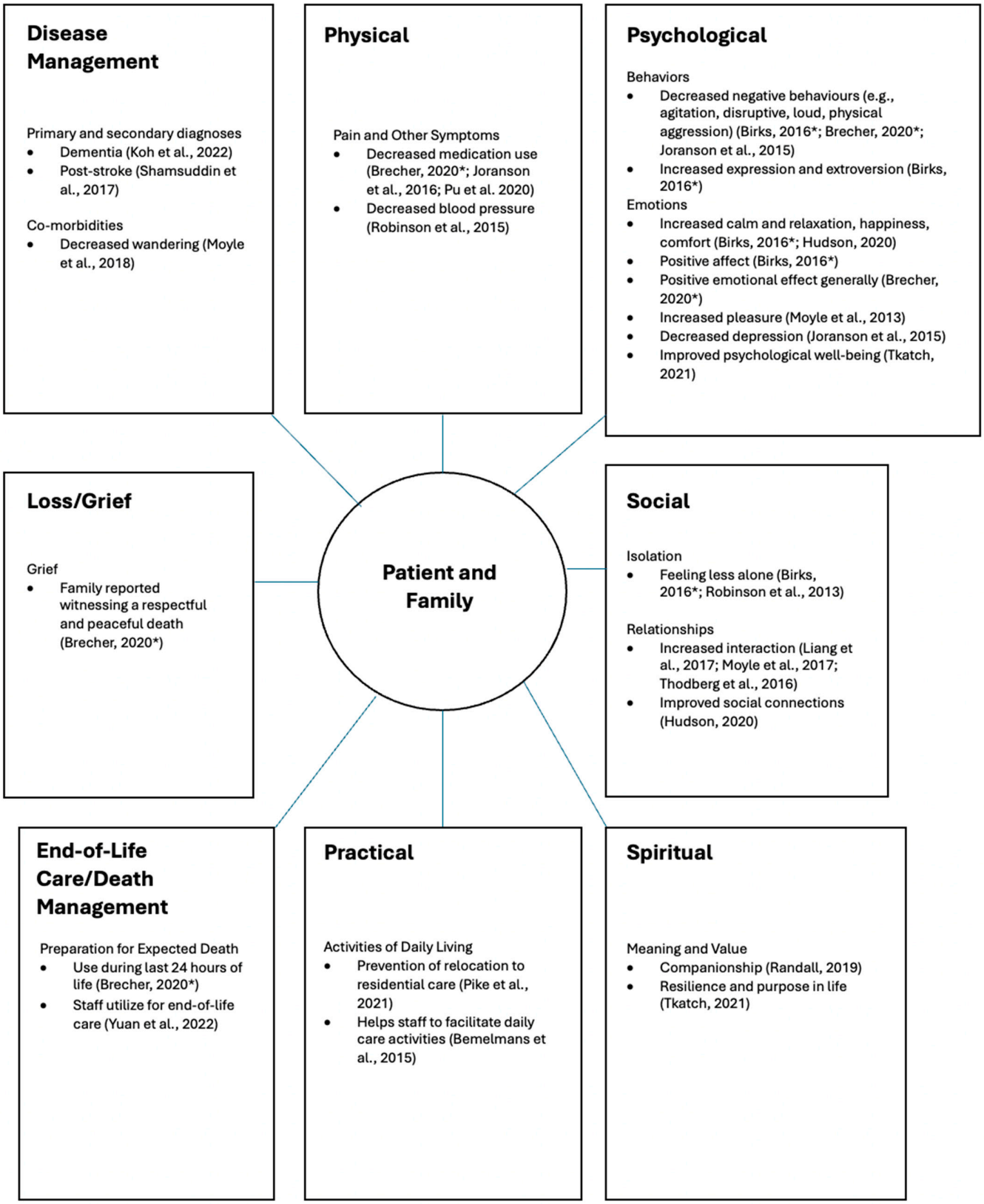

Figure 2. A research framework for robotic animal use among older adults enrolled in hospice or palliative care (adapted from the Domains of Issues Associated with Illness and Bereavement [64]). * Study included in this scoping review. Canadian Hospice Palliative Care Association. A Model to Guide Hospice Palliative Care. Available online: https://www.chpca.ca/wp-content/uploads/2019/12/norms-of-practice-eng-web.pdf (accessed on 1 May 2024).

9. Conclusions

This scoping review included one study from the perspective of individuals receiving care and the other from the perspective of therapists. Despite these seemingly divergent viewpoints, they converge on the promising benefits of robot pets in palliative care settings. Both palliative care and therapeutic care fields where robot pets are used share a focus on comprehensive, compassionate support that extends beyond managing physical pain and symptoms. They aim to improve overall well-being and maximize comfort, dignity, and quality of life despite serious illness. The similarities in values and care delivery, along with positive findings from both therapists and those receiving care, initiate an important dialogue on the use of robot pets in palliative care.

The synergy between palliative care and the ever-advancing technology sector offers a promising future with exciting possibilities to better address the needs of individuals living with a serious illness. Indeed, healthcare in general is on the verge of a new era, where modern technologies will become essential tools in the pursuit of providing improved and more individualized care. Although robotic pets can help meet the psychological and emotional needs of older adults receiving palliative care, additional research is needed to better understand this potential.

The scoping review identified a gap in the empirical literature and shows a need for more research on the use and impact of using robotic pets with older adults receiving hospice or palliative care. The review contributes to the evidence of the potential benefits of robotic pets in end-of-life care; however, more rigorous trials are required to confirm these benefits. Future studies should consider the perception of the robotic pet, not only among the older adult, but also the caregivers, both professional and non-professional, while also taking into consideration the older adults' preferences in type of robot.

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