

Music, social engagement and AD

**Music, social engagement, and Alzheimer's disease: a scoping review**

Final Report  
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## Abstract

Across the globe, researchers, clinicians, and caregivers are continuing to search for solutions to the myriad problems caused by Alzheimer's disease and related dementias. Music is an area of focus receiving considerable attention for its potential benefits to help manage the effects of neuropsychiatric symptoms upon individuals living with Alzheimer's disease and related dementias. However, attention is lacking on the potential social value of music to positively influence quality of life for both individuals living with dementias and their surrounding communities. This scoping review compiles recent reports on this potential, highlighting the social nature of music and its various uses (e.g. listening, making) to change the often tense and reactive atmosphere surrounding both the individuals living with Alzheimer's disease and related dementias and their surrounding communities into comparatively joyous living environments. Databases used included PubMed, EBSCOhost's CINAHL and PsychINFO, Cochrane Library (sub-search conducted using ALOIS, the Specialized Register of the Cochrane Dementia and Cognitive Improvement Group (CDCIG)), ProQuest's Biological Science Collection, the *Journal of Music Therapy* and *Nordic Journal of Music Therapy*, and Google Scholar. After screening for eligibility and inclusion, 26 documents were identified, including review articles, experimental studies, recommendations, pilot studies, conference proceedings, book chapters, and executive summaries. Overall, this review concludes that music can facilitate prosocial engagement between persons living with Alzheimer's disease and related dementias and their surrounding communities, due to a complex interplay of neurobiological mechanisms largely preserved in persons living with Alzheimer's disease and related dementias. More well designed and well controlled empirical studies are necessary to clarify contexts in which music and its various uses may be helpful to improve quality of life for both the individuals suffering from Alzheimer's disease and related dementias and their surrounding communities. Such results would provide further evidence-based support for the use of music to strengthen both formal and informal patient-centered care models.

## 1. Background

Music is interwoven into the autobiographical milieu of people's lives. Music from certain time periods, or associated with personal, idiosyncratic experiences, may elicit vivid recollections of people, feelings, actions, and associated events. For older individuals undergoing neurogenerative changes that affect memory, music may offer a critical connection to self-concept, memories, and cognitive states that allow for better functioning in the moment. That connection may be an important tool in fostering the completion of critical activities of daily living. Indeed, there is growing evidence that music may have value in improving cognition and mood state in people with neurodegenerative diseases, such as Alzheimer's disease. Music may be used as a tool to achieve a stable cognitive state, helping the listener recall intact memories and emotional context. Furthermore, music may aid in reminiscing, and foster comfortable and effective communication for those suffering from Alzheimer's related decline.

### 1.1 Public Health Significance:

Every 65 seconds, an individual in the United States develops Alzheimer's disease, with a projected total of ~14 million people affected by 2050 [1]. Alzheimer's Disease International estimates that the prevalence of AD will increase by 225% by 2050, affecting more than 115 million people globally [2]. Social consequences of the disease include chronic distress for caregivers, families, and loved ones, with an estimated total cost of treatment in 2015 of \$695 billion [3]. Contributors to these social consequences include neuropsychiatric, or behavioral and psychological symptoms of dementia, e.g. agitation, anxiety, and/or depression, among others. These neuropsychiatric symptoms negatively affect quality of life outcomes for both the person living with dementia and their caregivers ([4]; [5]; and [6]).

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Neuropsychiatric symptoms in Alzheimer's disease reflect a dynamic interaction between one's constantly changing environmental demands, changes in functional neuroanatomy and lowered stress tolerance or coping thresholds caused by the disease's progression [7].

Development and expansion of methods of treatment of neuropsychiatric symptoms (e.g. apathy, irritability, disinhibition, hallucinations, elation, and/or delusions), considering their aforementioned economic and psychological impacts upon caregivers, families and loved ones, is direly needed.

### 1.2 Treatment approaches using pharmaceuticals:

Current approaches to treat Alzheimer's disease (AD) and associated neuropsychiatric symptoms include the use of medications (e.g. anti-depressants, anti-psychotics, cognitive enhancers, anxiolytics, and sleep modifiers, among others) and environmental support of increasingly restrictive forms as the disease progresses [8]. Current data on cognitive enhancers such as acetylcholinesterase inhibitors (e.g., donepezil) and glutamatergic agents (e.g., memantine) show small but limited efficiency in delaying disease progression [9]. Furthermore, combined pharmacological approaches are directed at addressing both cognitive decline and mood symptoms [10]. Sahoo et al. ((2018), [10]) discusses this approach as a synergistic method for targeting multiple pathological stages or events in AD and as an alternative to the "one-molecule-one-target" approach, providing a decision matrix for caregivers to assess combinations of drugs towards the treatment of symptoms of AD. These treatment approaches often take place within assisted living facilities, nursing homes, and/or personal residences.

### 1.2.1 Limitations to treatment approaches using pharmaceuticals:

Unfortunately, none of the pharmaceutical treatment options approved by the Food and Drug Administration stop or reverse progression of the disease [1]. The “one-molecule-one-target” approach to the treatment of AD is also proving inadequate considering the combination of factors contributing to progression of the disease [10]. Longevity of effect is a problem for many pharmacological approaches for behavioral symptoms and also frequently have cognitive effects that are undesirable [11]. Further, antipsychotic medications have been associated with increased risk of myocardial infarction [12], stroke [13], and mortality [14], and according to the Centers for Medicare and Medicaid Services (2013, [15]), antipsychotics should only be used when behavioral symptoms present a danger to self or and/or others.

### 1.3 Goals of current treatment approaches

Beyond the goal of a cure, extending independent living and improving quality of life are principal goals for the treatment of AD [1]. Several non-pharmacological treatments including physical exercise [16; 17] and cognitive stimulation [18] provide evidence-based results in reducing the progression of dementia linked to AD, management of mood symptoms, extension of independent living and improvement of quality of life [19]. Active management of the progression of the disease through a coordinated strategy using both pharmacological and non-pharmacological approaches enhances the quality of life of both patients and caregivers [20], including appropriate use of available treatment options, effective management of comorbid conditions, coordination between caregivers and physicians, attending support groups and supportive services for both the patients and caregivers, and participation in personally meaningful/purposive activities [1].



### 1.3.1 Non-pharmacological treatment approaches

Non-pharmacological treatment approaches are affordable means to ecologically address mood and cognitive symptoms ([21]; [5]). Music therapy is an example of such an approach and is defined as “the use of music and/or its musical elements (sound, rhythm, melody and harmony) by a qualified music therapist, with a client or group, in a process designed to facilitate and promote communication, relationships, learning, mobilization, expression, organization and other relevant therapeutic objectives in order to meet physical, emotional, mental, social and cognitive needs” [22]. Music therapy (i.e. receptive and/or participatory) has been reported to elicit reductions in mood symptoms over time [19]. A prior review concluded that long-term music therapy positively influenced anxiety measures in persons living with Alzheimer’s disease [23]. There is some evidence that 1:1 active music therapy reduces agitation, disruptiveness and the need for psychotropic medication [24]. There is also evidence that receptive music therapy reduces anxiety and depression in patients with mild to moderate Alzheimer’s disease (AD) [25].

Prior literature has largely focused on this type of formal use of music as a therapeutic tool, though there are other potential delivery mechanisms. “Music-based therapeutic interventions” have also shown small changes in depressive symptoms and overall behavioral problems [26]. More generally, music is shown to affect mood and behaviors in people living with AD and related dementias. For example, Clark et al. ((1998), [27]) tested the use of preferred recorded music upon aggressive bathing behaviors in 18 persons living with AD. They randomized participants into control (no music) and treatment (preferred recorded music) settings, recording 20 observations for each participant over a period of 1 month. Results indicated decreases in 12 of 15 aggressive behaviors and caregivers reported increased

cooperation during bathing. Implications for the effectiveness in severely cognitively impaired adults are discussed.

Thus far, the data available on music therapies and music-based therapeutic interventions is difficult to interpret. Heterogeneity of studies (i.e. intervention definition and application, follow-up duration, type of outcome measured, and sample sizes), despite multiple reports of positive effects upon mood symptoms over time [19], do not currently support definitive conclusions. Further difficulty in interpreting the heterogeneity of studies arises through the various language used to define types of approaches. This language includes listening to music, active music making, recorded music, live music, selected music, individualized music, patient preferred music, classical/relaxation music, popular/native music and group and individual interventions [28]. Types of approaches include randomized and non-randomized controlled trials, pre-post/before-after designs, and qualitative and mixed-methods studies [29]. Longitudinal designs using music therapy to treat mood symptoms are, thus far, limited [29].

#### 1.4 Individualized music playlists for the treatment of symptoms:

Individualized music is defined by the use of preferential playlists of familiar music by the person living with Alzheimer's disease (AD). Individualized music has some support in improving mood symptoms, particularly agitation and anxiety in persons living with AD [30]. Gerdner and Swanson ((1993), [31]) conducted a longitudinal study of five participants between the ages of 70-99 exhibiting agitation as defined by the modified Cohen-Mansfield and Billig Agitation Inventory (1986) and presence of mental confusion through performance on the Mini Mental State Exam (Folstein, Folstein, and McHugh, 1975) over two weeks. The effects of music on the number of agitated behaviors were assessed during music listening. Through graphic

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display and narrative discussion, the number of agitated behaviors decreased over the two-week period on a patient-by-patient basis when comparing baseline assessments to the music interventions. The results from this experiment led to the development of a theoretical foundation for the use of individualized music as an intervention for the management of agitation in persons with Alzheimer's disease and related dementias [32]. This theoretical foundation highlights Hall and Buckwalter's (1987) linear progression from initial cognitive impairment to an individual's lowered stress threshold, caused by "a decreased ability to receive and process sensory stimuli, resulting in ... a heightened potential for anxiety" [33].

Personalized, or preferential music playlists also improves communication between patients and caregivers, often lessening effects of mood disruption [34]. Long and White ((2018), [34]) designed a person-centered educational program involving nursing students and persons living with dementia. One-hundred ten nursing students created personalized music playlists for 110 persons living with dementia residing in *Music and Memory* certified long-term care facilities, as part of a program with the Texas Department of Aging and Disability to reduce antipsychotic use in persons living with dementia. Students determined music preferences through communication with family members or loved ones of the persons living with dementia. If family or loved ones were not available, students played sections of various music selections to the persons living with dementia and documented their reactions. The students completed weekly journals reflecting upon their interactions with the persons living with dementia, highlighting positive communicative reactions (i.e. head nods, finger taps, smiling, laughing, dancing, and singing) from the persons living with dementia in response to the music choices. Conclusions suggest transfer effects upon the students' abilities to communicate with cognitively

impaired and other neuro-atypical adult populations due to the knowledge gained through this program.

Interactive engagement with personalized music has shown positive benefits upon reduction in mood symptoms and restoration of cognitive and emotional function over time, when compared to a passive listening and non-music control group [35]. Sakamoto et al. ((2013), [35]) studied persons living with severe AD, measuring changes in emotional state and stress using a pre-post design. Short-term and long-term effects were positive in both the passive listening and interactive groups, with caregiver burden ratings reduced in the interactive group. Importantly, this study indicates a significance for the use of music to facilitate prosocial engagement between individuals, which is supported by literature outside of studies in the Alzheimer's disease and related dementias populations focusing on healthy children ([36]; [37]). Sakamoto et al. ((2013), [35]) also indicate a significance for the use of music (both passive listening and interactive) to positively impact short-term distress levels in persons living with severe AD, as confirmed by increases in parasympathetic nervous system activity. Furthermore, long-term effects indicated increased behavioral disturbances after 3-week follow-up in both the passive and interactive groups, but not the control group.

Listening to pleasurable music affects brain regions responsible for reward activation [38]. Due to relative preservation of autobiographical [39] and emotionally-charged memory [40] over the course of disease progression in AD, it is understood that engagement with individualized music elicits outward displays of reward activation (e.g. smiling and/or laughter; [41]). Outward displays of reward activation are emotionally contagious [42], supporting the significance of the use of individualized music to address and treat symptoms in Alzheimer's and related dementias. Furthermore, quality of life indicators specific to persons living with dementia

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and their caregivers are improved via individualized music therapy and interventions, reducing caregiver burden and burnout ([43]; [44]).

In 2014, Dr. Dan Cohen and his team comprising the *Music and Memory* organization released a documentary film called “Alive Inside,” which chronicles the transformational before-and-after effects individualized playlists of recorded music have had upon individuals living with the disease and their surrounding communities. The immediacy of the initial shift in multiple aspects of several of the individuals’ demeanors and outwardly displayed reconnection to their communities is startling and a testament to the power of music to promote prosocial engagement between individuals. This film and the partners involved are significant factors driving the impetus for this project: to provide a scoping review of the literature published internationally and after January 2014 of the effects of individualized music upon the management of mood symptoms for the persons living with dementia and their surrounding communities. Two other significant factors contribute to the impetus for this project: 1) personal life experience caring for a loved one with fronto-temporal dementia; and 2) personal life experience as a professional musician.

## 2. **Methods**

The guiding research question for this scoping review was:

**What role(s) does preferred/individualized music play in the management of behavioral and psychological symptoms for persons living with dementia and their surrounding communities?**

### 2.1 Design:

This scoping review was formatted in line with Classen et al. (2019, [45]). A scoping review was chosen for this project because of the author's lack of awareness of relevant topic matter for the purposes of a systematic review of the literature. Scoping reviews precede systematic reviews to rate study quality and provide evidence-based recommendations for follow-up [46]. This review consisted of four phases: 1) identifying the research question and inclusion criteria based upon the PICOS framework [47]; 2) search strategy development and literature review; 3) study selection and data extraction; 4) documenting study results, implications, and recommendations.

### 2.2 Protocol and Registration:

The above phases defining this study's protocol were guided by the *PRISMA-P 2015 Checklist*. To the author's knowledge to date, no scoping or systematic reviews with the below search criteria or guiding research question are registered with either the *JBIR Database of Systematic Reviews and Implementation Reports* or the *International*

*Prospective Register of Systematic Reviews (PROSPERO)*. Furthermore, this study's protocol was not registered in adherence with PROSPERO's guidelines [48].

### 2.3 Inclusion Criteria:

Studies eligible for inclusion met the PICOS criteria outlined below [47].

#### 2.3.1 Population:

- Studies must have included original research and/or reviews of original research on persons living with Alzheimer's disease or related dementias

#### 2.3.2 Interventions:

- Studies must have included original research and/or reviews of original research on persons living with Alzheimer's disease or related dementias using receptive and/or participatory music therapy, preferential playlists, and/or individualized music (see [33]) for the management of neuropsychiatric symptoms (I.e. Neuropsychiatric symptoms)

#### 2.3.3 Comparators:

- Studies including comparison to pharmacological management of Neuropsychiatric symptoms of dementia were included
  - These criteria were not required for inclusion, but comparison to pharmacological management of Neuropsychiatric symptoms was

discussed below to provide consideration for follow-up research  
(I.e. towards a systematic review)

#### 2.3.4 Outcomes:

- Outcomes included evidence-based changes in Neuropsychiatric symptoms over time using non-pharmacological methods

#### 2.3.5 Further inclusion criteria:

- Published on or after January 1<sup>st</sup>, 2014
  - Seminal studies germane to the topic area of focus published on or before this date were included
    - Studies conducted around the globe
    - Studies including all related content on Alzheimer's disease and related dementias
      - Mild cognitive impairment in addition to AD was included in the review. Further, other dementias included in this review: Lewy Bodies, fronto-temporal, mixed, vascular, and posterior cortical atrophy)
  - Studies published in the English language
    - Studies conducted in both clinical (I.e. hospitals, emergency clinics, supplementary care facilities, hospice care, and



memory care units) and community settings (I.e. stay-at-home family care)

#### 2.4 Search Strategy:

Several databases were used to conduct this review to search for all articles, theses/dissertations, conference proceedings, books, presentations, and recommendations using the below search terms. A gray literature search on Google Scholar was also conducted.

##### 2.4.1 Databases used:

- PubMed;
- EBSCOhost's CINAHL and PsychINFO;
- Cochrane Library (sub-search conducted using ALOIS, the Specialized Register of the Cochrane Dementia and Cognitive Improvement Group (CDCIG));
- ProQuest's Biological Science Collection;
- *The Journal of Music Therapy* and *Nordic Journal of Music Therapy*;
- Google Scholar

##### 2.4.2 Search terms:

(((((((((music OR receptive music therapy OR preferential playlists)) AND (social engagement OR social interaction)) AND (behavioral symptoms OR psychosocial symptoms)) AND (Alzheimer's disease OR dementia)) AND (early onset OR mild cognitive

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impairment)) AND (cognitive OR memory)) AND chronic distress) AND social consequences) AND neuropsychiatric symptoms) AND caregiver distress

- MeSH terms search: (((((((("music"[MeSH Terms] OR "music"[All Fields]) OR (receptive[All Fields] AND ("music therapy"[MeSH Terms] OR ("music"[All Fields] AND "therapy"[All Fields]) OR "music therapy"[All Fields])) OR (preferential[All Fields] AND playlists[All Fields])) AND ((social[All Fields] AND engagement[All Fields]) OR ("interpersonal relations"[MeSH Terms] OR ("interpersonal"[All Fields] AND "relations"[All Fields]) OR "interpersonal relations"[All Fields] OR ("social"[All Fields] AND "interaction"[All Fields]) OR "social interaction"[All Fields]))) AND (("behavioural symptoms"[All Fields] OR "behavioral symptoms"[MeSH Terms] OR ("behavioral"[All Fields] AND "symptoms"[All Fields]) OR "behavioral symptoms"[All Fields]) OR (psychosocial[All Fields] AND ("diagnosis"[Subheading] OR "diagnosis"[All Fields] OR "symptoms"[All Fields] OR "diagnosis"[MeSH Terms] OR "symptoms"[All Fields]))) AND (("Alzheimer disease"[MeSH Terms] OR ("Alzheimer"[All Fields] AND "disease"[All Fields]) OR "Alzheimer disease"[All Fields] OR ("Alzheimer's"[All Fields] AND "disease"[All Fields]) OR "Alzheimer's disease"[All Fields]) OR ("dementia"[MeSH Terms] OR "dementia"[All Fields]))) AND ((early[All Fields] AND ("age of onset"[MeSH Terms] OR ("age"[All Fields] AND "onset"[All Fields]) OR "age of onset"[All Fields] OR "onset"[All Fields])) OR ("cognitive dysfunction"[MeSH Terms] OR ("cognitive"[All Fields] AND "dysfunction"[All Fields]) OR "cognitive

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dysfunction"[All Fields] OR ("mild"[All Fields] AND "cognitive"[All Fields] AND "impairment"[All Fields]) OR "mild cognitive impairment"[All Fields])) AND ("cognitive"[All Fields] OR ("memory"[MeSH Terms] OR "memory"[All Fields])) AND (chronic[All Fields] AND distress[All Fields]) AND (social[All Fields] AND consequences[All Fields]) AND (neuropsychiatric[All Fields] AND ("diagnosis"[Subheading] OR "diagnosis"[All Fields] OR "symptoms"[All Fields] OR "diagnosis"[MeSH Terms] OR "symptoms"[All Fields])) AND (("caregivers"[MeSH Terms] OR "caregivers"[All Fields] OR "caregiver"[All Fields]) AND distress[All Fields]) AND ("2014/07/04"[PDat] : "2019/07/02"[PDat])

### 2.4.3 Stages of search and analysis:

- **Step 1:** Title and abstract identification
  - Acceptance of approved titles and abstracts within search criteria
- **Step 2:** Screening
  - Removal of duplicates across databases and gray literature search
- **Step 3:** Eligibility and inclusion
  - Full texts included for analysis
  - (See Figure 3)
- **Step 4:** Data extraction
  - Followed similar extraction procedures from collaborative work conducted with the University of Florida's Center for Arts in Medicine's scoping review on the arts and public health communication (2019)

- Step 5: Data analysis
  - Extracted data were analyzed using a narrative approach
    - Followed method utilized by [19]

### **Risk of Bias**

The team attempted to mitigate bias [49]. Reviews of drafts of this article were conducted in progress of its completion by several members of the University of Florida community, including: Directors from three separate Centers at the University of Florida and Malcolm Randall VA Medical Center (I.e. Geriatric Research Education and Clinical Center, One Health Center for Excellence, and Brain Rehabilitation Research Center), and supporting staff from the One Health Center for Excellence. Drafts of this article were also provided to staff from the International Arts and Minds Lab of Johns Hopkins University and staff of the University of California School of Medicine's Division of Geriatrics.

### **3. Results**

After screening for eligibility and inclusion, 26 documents were analyzed (see Figure 3). Table 1 displays the types of literature identified in the data extraction process. Table 2 displays results by database. Table 3... Table 4, 5, 6, 7, and 8 ... Table 9 ... Findings per the PICOS framework are presented below.

#### **3.1 Findings per the PICOS Framework:**

##### **3.1.1 Population and Interventions**

From the experimental studies - randomized controlled trials (n = 4) and interventions (n = 3) – and pilot studies (n = 4) included for review, sampled Persons living with dementias presented with mild symptoms ([50]; [51]), mild to moderate symptoms [52], diagnosis of an Alzheimer’s and related dementias ([53]; [54]; [55]; [56]; [57]; [58]) and severe symptoms ([59]; [60]).

Of the experimental studies, three are prospective ([50]; [57]; [58]) and four are completed ([51]; [54]; [56]; [59]). Of the pilot studies, all four are completed ([52]; [53]; [55]; [60]).

### 3.1.2 Comparators and Outcomes

From the included reviews – systematic (n = 1), narrative (n = 4), and scoping (n = 1) - recommendations (n = 1), abstracts from conference proceedings (n = 2), book chapters (n = 1), executive summaries (n = 1), recommendations (n = 1), and reviews and recommendations (n = 4), comparison between pharmacological and non-pharmacological management of Neuropsychiatric symptoms occurred in all results ([3]; [5]; [6]; [19]; [61]; [62]; [63]; [64]; [65]; [66]; [67]; [68]; [69]; [70]).

## 4. Discussion

### 4.1 Primary findings

In response to the research question (i.e. what role(s) does preferred/individualized music play in the management of behavioral and psychological symptoms for persons living with dementia and their surrounding communities?), the primary findings of this review maintain and support current understandings of the positive benefits of the use of preferred/individualized music (i.e. both music therapy and music-based therapeutic interventions/activities) to manage

the progressive effects of behavioral and psychological symptoms upon people living with Alzheimer's and related dementias, and their caregivers over time [19]. Perhaps due to the complexity of the interactions of the search terms used in this review, heterogeneity of results in included studies altered the initial focus on the effects of music alone to include effects of non-pharmacological approaches at large. Effective management of behavioral and psychological symptoms in studies included in this review often involved tailored, systematic approaches utilizing music as only part of the treatment plan ([56]; [72]). However, music-based approaches for the management of these symptoms routinely produced positive results across a spectra of outcome measures [19].

Individualized, person/patient-centered care is an effective methodology to manage behavioral and psychological symptoms in persons living with dementia and other mental health diagnoses, via treatments involving whole health approaches, mindfulness-based stress reduction, and integrative medicine, promoting well-being and improved quality of life [65]. Person/Patient-centered care to manage these symptoms in persons living with dementia involves an intricate understanding of each individual's needs. This includes an agreed-upon comprehensive assessment of how to manage the progressive changes in comorbidities of Alzheimer's and related dementias over time to mitigate reductions in quality of life outcomes for both the person living with dementia and their caregivers ([66]; [72]). In a prospective study in the Netherlands [57], person/patient-centered care will be addressed through caregiver training specific to their routinized maintenance of factors contributing to caregiver burden. Caregiver burden ultimately affects the wellbeing and quality of life for the persons living with dementia over time, highlighting its significant prioritization at the outset of the person/patient-centered care approach ([50]; [69]).

Pain management contributes to person/patient-centered care and maintenance of caregiver burden ([59]; [67]; [70]). Pain perception maintains in persons living with dementias as disease progression ensues, but neuropathological features of disease progression differ between Alzheimer's and related dementias diagnoses, contributing to the difficulties in tailoring pharmaceutical treatments ([59]; [70]). Furthermore, neuropsychiatric symptoms of Alzheimer's and related dementias contribute to challenges in pain management as verbal communication deficits present themselves throughout disease progression [70]. Palliative care is a promising person/patient-centered approach to reduce pain and discomfort in persons living with dementias [57]. The European Association for Palliative Care (EAPC) performed a Delphi study and published a white paper with a list of fifty-seven recommendations comprising eleven domains for structured implementation throughout disease progression [73]. The authors of the EAPC report highlight the challenges of implementing their framework across cultures and the need for tailored strategies towards policymaking. Furthermore, advanced care planning is a challenge to implement when families have difficulty openly discussing death [67].

#### 4.2 Bio-cultural significance of music towards the management of neuropsychiatric symptoms in Alzheimer's and related dementias

Changes in environmental conditions contribute to presenting behavioral and psychological symptoms in Alzheimer's and related dementias [3]. Music therapy improves the presentation of these symptoms via mediation of mood and engagement [53]. Music therapy is also shown to lessen levels of distress in persons living with dementias, as indicated by changes in salivary-cortisol [54]. Music interventions more generally show positive changes in cognitive performance, quality of life, and activities of daily living on an individual-by-individual basis [52].

Regarding the changes in salivary-cortisol reported in [54], positive social interaction – indicated by measurable changes in activity of the oxytocinergic and opioidergic systems - promotes wellbeing and quality of life throughout the lifespan when implemented early in life ([53]). Positive social interaction through music increases empathy ([36]; [37]), a neurobiological substrate of and psychophysiological imperative for the well-being of the species ([74]; [75]). Common pleasurable emotional experiences with music [39] suggests that a species-wide neurophysiological mechanism exists, simultaneously responsible for the shifts in autonomic nervous system activity reported by [54] and positive social interaction via increased empathy reported by [36] and [37].

Peck et al. ((2016), [76]) reviewed anecdotal and empirical evidence of potential underlying mechanisms (i.e. interactions between the default mode network, autonomic nervous system, and dopaminergic systems) for music’s effects upon improved autobiographical memory retrieval/recall in AD. Peck et al. ((2016), [76]) also reviewed case studies, concluding that emotionally salient music linked to autobiographical memories of the person living with dementia activates otherwise deteriorating brain regions caused by the debilitating and progressive effects of AD ([57]; [77]; [78]; [79]). This evidence suggests that interactions between the mechanisms responsible for emotional processing and autobiographical memory consolidation and retrieval/recall are intimately tied to human experience of and with music. In support of [77], evidence from a study using fMRI and FDG-PET on the AD population concluded that brain areas responsible for musical memory are spared due to “substantially limited” cortical atrophy [80].

The effects of the interactions of these mechanisms upon autobiographical memory is supported outside the literature exclusive to Alzheimer’s and related dementias, including



extensive bio-cultural investigations ([81]; [82]; [83]; [84]; [85]; [86]). Taken together, this evidence provides a substantive base to support the findings of [77] and [80] and furthermore, findings from pilot studies, randomized controlled trials, and reviews reporting positive changes in well-being and quality of life indicators for both the Persons living with dementia and their caregivers via social interaction through music ([19]; [23]; [44]; [53]; [54]). Finally, mechanisms arguably responsible for aspects of the beneficial effects of social interaction through music ([87]; [88]) are postulated here as largely maintained throughout disease progression in Alzheimer's and related dementias, though evidence specific to these populations is limited and in need of further investigation [89].

#### 4.3 Primary Limitations:

Of the included studies in this review, 15 provided limitations in consideration of their respective methods, results, and discussions. These limitations were coded, producing 16 codes categorized into types of limitations presented in each study. See Table 3 for the ranking of these codes. See Tables 4, 5, 6, 7, and 8 for this analysis.

The top three limitations ( $N \geq 3$ ) discussed were sample size ([19]; [55]; [59]; [60]; [69]), phase of life considerations, including factors involved with early/late onset of dementia ([5]; [59]; [60]; [63]), and follow-up duration ([19]; [53]; [56]). Other limitations of significance ( $N > 2$ ) included how the intervention was defined and applied ([55]; [19]), type of outcome measured ([55]; [19]), duration of effects in relation to overall duration of treatment and number of sessions ([26]; [69]), and need for person-centered care ([51]; [72]).

Several other limitations are discussed. Kales et al. ((2015), [5]) discuss the need for communities to adopt more proactive, rather than reactive approaches to the management of

neuropsychiatric symptoms in Alzheimer's and related dementias. This includes implementation of more thorough assessment of underlying causes and greater support for implementation of non-pharmacological approaches, including increased access and availability for the training needed to support and educate caregivers. In continuation of [5], Livingston et al. ((2017), [3]) discuss the need for services to be much more readily available to informal and professional caregivers, offering scale and value to their care-routines of the Persons living with dementia at the community level. Furthermore, Livingston et al. ((2017), [3]) reiterate the importance for care-based techniques and strategies to highlight successes on an individual-by-individual basis, encouraging prevention, high-quality and accessible care to the ever-increasing population of persons living with dementia, their families, informal and professional caregivers.

#### 4.4 Limitations to the uses of music

Despite the evidence-base of the effects of the use of music therapy and music-based therapeutic interventions to manage neuropsychiatric symptoms in the Alzheimer's and related dementias populations [19], several studies report ongoing limitations. In response to several of these limitations, Weise et al. ((2018), [58]) propose a randomized-control trial with a relatively large sample size including participants from multiple locations, systematic identification of personalized music for each participant, and continuous examination and adaptation of the personalized music with additional listening time available to the participant when necessary, assessed via careful implementation and evaluation.

Zucchella et al. ((2018), 69]) similarly discuss the issues of sample size and clarity of effects over time as discussed in [58], as well as the lack of quality of studies. Van der Steen et al. ((2018), [26]) came to a similar conclusion regarding quality of studies specific to outcomes for social behavior and anxiety. Between these studies and for the considerations of researchers and practitioners, another ongoing limitation is clarity between how to define interventions using accredited music therapy approaches and music-based therapeutic interventions.

Lawrence et al. ((2012), [43]) and Ueda et al. ((2013), [23]) report the need for greater socially engaging interventions using music therapy and music-based therapeutic interventions, towards improved quality of life and well-being for persons living with dementia and their caregivers. In response to this, studies show that use of music therapy and music-based therapeutic interventions reduced salivary-cortisol levels in the Alzheimer's and related dementias populations [54] and in the cancer population [90], respectively. Another study reports that the use of group singing increased oxytocin levels [91]. Taken together, the

results presented in these studies suggest that whether facilitated by an accredited music therapist or not, musical activities including social engagement are associated with reductions in indicators of fight/flight responses and increases in indicators of rest/digest responses [92].

Further personalization is needed ([51]; [72]) to better understand long-term effects of individualized music therapy and/or music-based therapeutic interventions upon improved/increased social engagement b/w persons living with dementia and their caregivers. In a prospective trial using a music-based therapeutic intervention [93], the authors discuss the priority for social engagement between participants, facilitators, and caregivers, towards a sustainable program led by communal facilitation and encouraging regular close personal contact. Ihara et al, ((2019), [94]) report increased social engagement via a person-centered music playlist-based intervention, indicated by pre/post changes in indicators defining social engagement (I.e. eye contact, talkativeness, and overall joy among others), but lasting effects of the intervention are suggested for follow-up work, including an increase in the dosage of music.

In their critical synthesis, Garrido et al. ((2017), [95]) report numerous limitations of the use of music playlists to contribute to the management of neuropsychiatric symptoms in the Alzheimer's and related dementias populations. Reductions in certain psychosocial quality of life indicators (e.g. social isolation, diminished self-identity and ability to communicate with family members; [96]) are supported by [95], but several factors contribute to discrepancies in results reported across different studies, including differences in disease pathology, severity of disease progression and associated differences in presenting neuropsychiatric symptoms (e.g. Alzheimer's disease, Lewy Body dementia, vascular

dementia, fronto-temporal dementia, etc.), sample sizes, lack of control groups, and heterogeneity of study design.

Distinctions between effects of music therapy led by a certified therapist and non-therapist led music-based therapeutic interventions/activities are another key highlight of [95], as non-therapist led playlist interventions/activities are receiving more and more attention after the release of the documentary film “Alive Inside” [97]. Furthermore, effects of therapist-led and non-therapist led musical interventions/activities involving active and receptive approaches towards the management of neuropsychiatric symptoms remain inconclusive [95]. In partial support of this, a more recent review [98] (alternate citation, Leggieri et al. (2019)) reports that passive music listening has the potential for long-term impact upon relaxation in the persons living with dementia, whereas active music therapy may provide acute benefits, including engagement and social interaction.

#### 4.5 Future directions:

Developing consistent and agreed upon methods to distinguish between active and receptive musical interventions/activities, as well as those musical interventions/activities led by a certified music therapist versus those led by a caregiver and/or healthcare professional either trained by a certified music therapist or not, are significant considerations for future work in the area of the use of music to manage Neuropsychiatric symptoms in the Alzheimer’s and related dementias populations [95]. Personalization of musical interventions/activities is found to have a greater positive effect upon the management of neuropsychiatric symptoms over time, contributing to the need for more of a focus on the value of person/patient-centered care to manage neuropsychiatric symptoms ([51]; [72]).

Considering the above limitations specific to the use of music to manage neuropsychiatric symptoms in the Alzheimer's and related dementias populations, there are several potential directions to move forward. Kales et al. ((2015), [5]) propose three research questions for future work:

- 1) What specific brain areas, receptors, and neurotransmitters are involved in the neurobiology of the behavioral and psychological symptoms of dementia? Such knowledge could be used to improve pharmacologic and non-pharmacologic treatments.
- 2) What are the mechanisms by which behavioral and environmental approaches create benefits, such as stress reduction and increased tolerance of frustration? The results of such research could be used to tailor interventions more accurately.
- 3) How can behavioral and environmental approaches be better integrated into standard clinical care? What would be the cost? Is the cost offset by savings from reducing potentially preventable hospital admissions and early institutionalization?

Prior discussion of the bio-cultural implications for the value of music to contribute to the management of Neuropsychiatric symptoms in the Alzheimer's and related dementias populations (see section 4.2) addresses aspects of the first of Kales et al. ((2015), [5]) research questions. Peck et al. ((2016), [76]) postulates that when stimulated by music, interactions between the default mode network, the autonomic nervous system, and dopaminergic system may be responsible for memory enhancement in persons living with AD. Additionally, Fang et al. ((2017), [99]) review four neural mechanisms potentially responsible for cognitive enhancement in persons living AD, including neuroplasticity, neurogenesis/regeneration and repair, neuroendocrine, and neuropsychiatric. Focusing on the latter in response to Kales et al.

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((2015), [5]) first research question, Fang et al. ((2017), [99]) suggest that reductions in anxiety via musical stimulation may enhance autobiographical memory recall. Furthermore, Slattery et al. (2019, [100]) report the potential value of the use of musical stimulation to map functional networks responsible for musical memory in persons living with AD.

Continuing from the above, Mehr et al. ((2018), [86]) discussion on the similarities of form and function in human song across cultures suggests there are common mechanisms within and across cultures responsible for the production and perception of meaning and/or intention from singing. Primary emotional exclamations via singing (e.g. sadness, happiness, anger, or fear) exhibit perceivable intention presumably spared in the AD population, perhaps due to the relative preservation of musical memory in persons with AD [80]. Perception of primary emotionally salient content via singing may be preserved in certain members of the AD population due to their maintained detection of pitch violations in familiar and unfamiliar melodies, including severely impaired individuals [101].

Phylogenetic arguments on the development of human musicality contribute to and direct further attention towards neurophysiological mechanisms associated with the above paragraphs' content, as well as provision towards substantive response to Kales et al. ((2015), [5]) first research question. Wallin, Merker, and Brown's *The Origins of Music* ((2001), [81]), Mithen's *The singing Neanderthals* ((2006), [82]), Malloch and Trevarthen's *Communicative Musicality* ((2009), [83]), and Tomlinson's *A Million Years of Music* ((2015), [85]) provide fundamental considerations towards the social value of musical interaction from inter and intrapersonal perspectives. These works are hallmarks in the world of bio-cultural musicology and open doors to explore the findings of Jacobsen et al. ((2015), [80]) and Cuddy et al. ((2015), [101]) from multiple angles. Taken together with reviews from [99] and [100], there is potential here to

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enhance existing methods of researchers working to understand disease progression and perhaps even causes of Alzheimer's and related dementias.

Experimental designs involving person/patient-centered care via creation of mutually preferential music playlists between healthcare professionals, family-based caregivers, and Persons living with dementias may facilitate greater and more positive interpersonal interaction between these individuals/groups, as stimulated communication via the Persons living with dementias' reminiscence would be more personally salient to the professional and non-professional caregiver(s). If combined with physical interaction (e.g. synchronized, entrained, and/or temporally coordinated movement to the music), this interaction may promote social bonding between all individuals involved. Furthermore, experimental designs involving detailed assessment of caregivers' and Persons living with dementias' baseline personalities, baseline empathetic dispositions, music preferences, baseline musical skill, and autonomic nervous system activity would contribute to reports of the value of music to promote prosocial interaction between individuals ([36]; [37]).

Experimental designs from applied ethnomusicology are contributing to and facilitating the development of more availability for prosocial interaction between Persons living with dementias and their surrounding communities [102]. In her pilot educational and intergenerationally structured program, Dr. Gubner created a class for university students and Persons living with dementias to document their empowering experiences interacting with one another via film and music. De-stigmatizing neurodiversity and promoting creative aging through experiential filmmaking, ethnography, and personalized music playlists, Dr. Gubner's program attempts to engage students and empower Persons living with dementias, in an effort to develop existing research methods dominated by randomized and non-randomized controlled



trials, in favor of person-centered care. These methods contribute to and build upon the field of medical ethnomusicology [103], which stresses the significance of intercultural communication (i.e. verbal and bodily) through music and musical interaction, as means to comprehend and reflect upon shared life experiences between human beings.

In response to the second and third of the research questions given in this section, Livingston et al. ((2017), [33]) provide extensive coverage from multiple angles towards a comprehensive assessment of both the mechanisms involved with behavioral and environmental treatment approaches contributing to stress reduction, and how these approaches could be integrated into healthcare to offset and in some cases, prevent prohibitive costs. Livingston et al. (2017, [33]) present a model of potentially modifiable behavioral and environmental risk factors that may minimize future diagnoses of Alzheimer's disease and related dementias by 33%. Peripheral hearing loss is highlighted within this model, but the authors caution readers that a/the mechanism associated with cognitive decline and peripheral hearing loss is not yet confirmed. However, they speculate that based upon prior work, hearing loss may add to the cognitive load of an already vulnerable brain and associated changes over time [104], that hearing loss may lead to social isolation and associated depression [105], and accelerated atrophy [106].

## **5. Recommendations**

Recommendations for the management of neuropsychiatric symptoms in Alzheimer's and related dementias using non-pharmacological approaches are plethora, involving specific considerations for post-diagnosis management over time ([3]; [6]; [64]; [66]; [72]) and pain management, palliative care, and advanced care planning ([67]; [70]; [83]).

See Table 9 for a compiled list of recommendations from the references given in the above paragraph, reflecting the order in which these recommendations were presented. See Figure 3 for contributing factors to challenges faced by healthcare professionals and informal caregivers towards the management of neuropsychiatric symptoms. See Figure 4 for the DICE approach to the detection, management, and treatment of neuropsychiatric symptoms [5]. See Figure 5 for recommendations on how to create a personalized music playlist from the *Music and Memory* organization's website.

The *Comfort Matters* organization offers family caregivers and healthcare professionals a thorough list of resources to support their care trajectories, providing website links to both national (e.g. Alzheimer's Association, AARP, NIH, among others) and local organizations. Links to specialized websites for residential care or home services are also provided (e.g. *A Place for Mom*, *Care*, *Caring*, among others).

#### 5.1 Three Key Takeaways from this review:

- 1) Behavioral changes to risk factors may reduce incidences of dementia by ~33%
- 2) Person/Patient-centered care is highly recommended
- 3) Proactive management of presenting symptoms will increase quality of life over time

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### **Conflict of Interest Statement**

The author declares no potential conflict of interest with respect to the authorship, research, or publication of this work.

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**Tables**

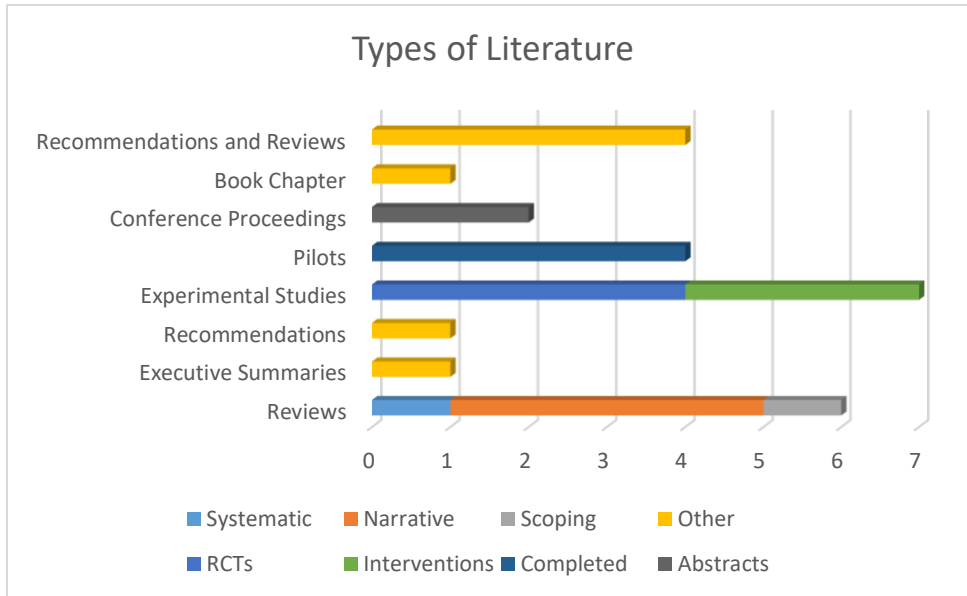


Table 1. Displays the types of all identified and included literature. Experimental studies included randomized controlled trials (n = 4) and interventions (n = 3). Reviews included narrative (n = 4), systematic (n = 1), and scoping (n = 1). Reviews and recommendations (n = 4), conference proceedings (n = 2), executive summaries (n = 1), book chapters (n = 1), recommendations (n = 1) and pilot studies (n = 4) were also identified.

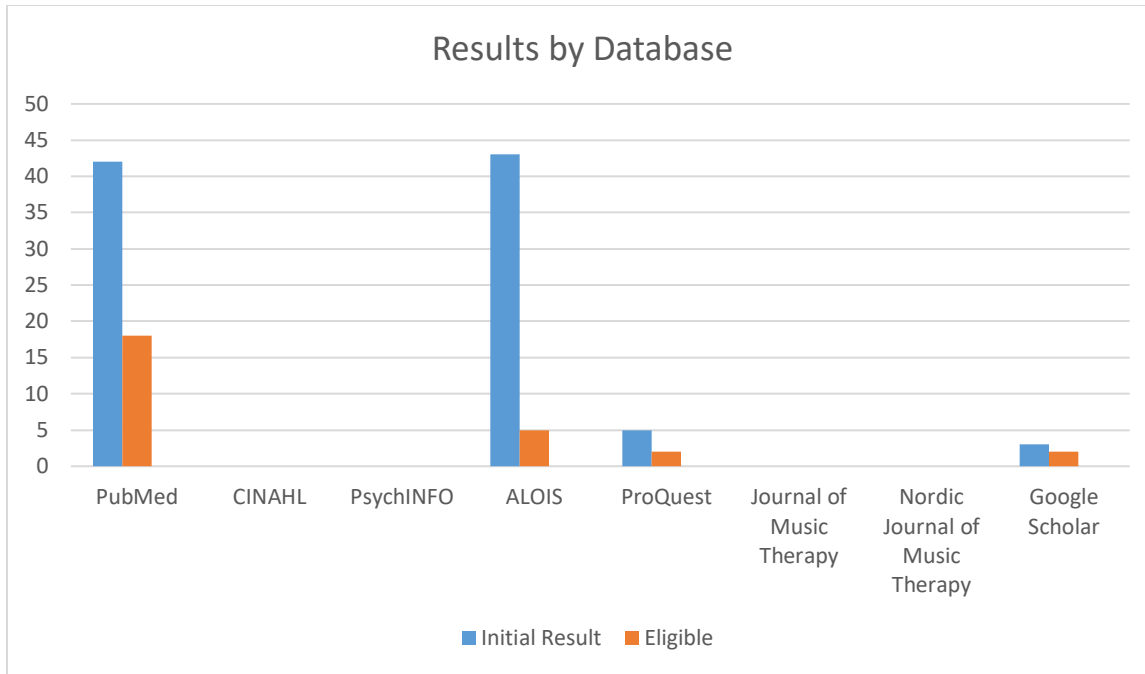


Table 2. Displays the initial and eligible results from each database. PubMed produced the highest number of initial (n = 42) and eligible results (n = 18). Cochrane Library’s ALOIS produced the second highest number of initial (n = 43) and eligible results (n = 5). One result from ALOIS was excluded [88] due to inaccessibility to the full text article. ProQuest’s Biological Science Collection produced the third highest initial (n = 5) and eligible results (n = 2). The *Journal of Music Therapy* nor the *Nordic Journal of Music Therapy* produced any results. Google Scholar produced initial (n = 3) and eligible results (n = 2).

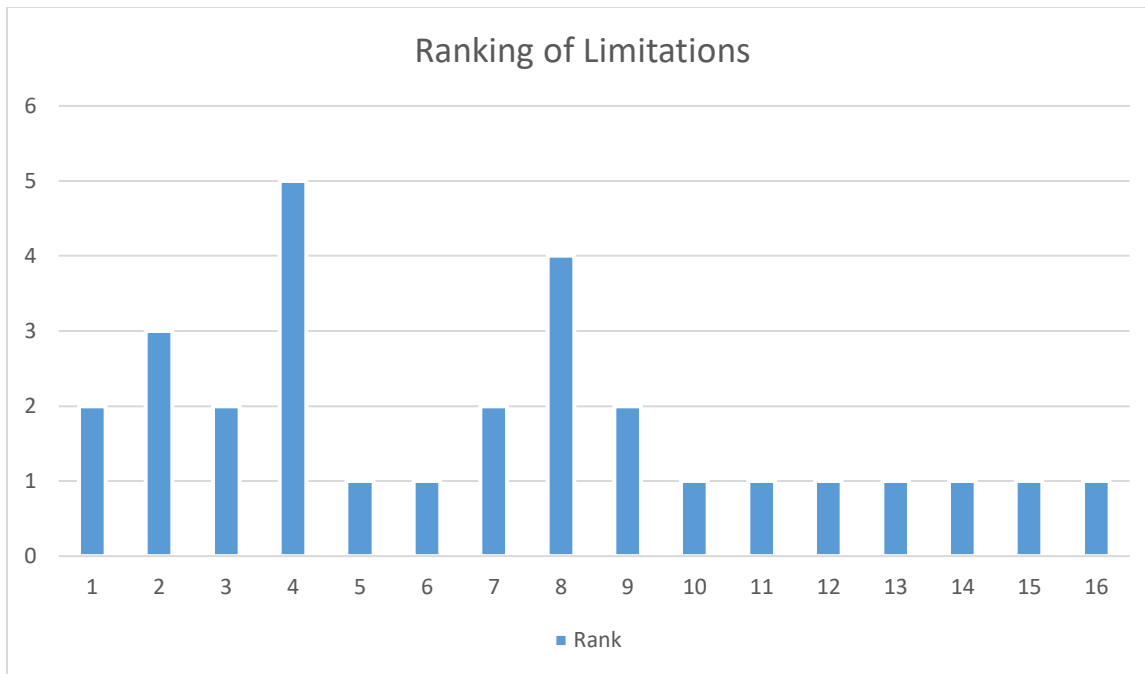


Table 3. Displays the amount of hits for each code. The numbers displayed on the X-axis correspond to each of the codes provided in Tables 4, 5, 6, 7, and 8.

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Author	Limitation	Code Applied
Abraha, I., Rimland, J. M., Trotta, F. M., Dell'Aquila, G., Cruz-Jentoft, A., Petrovic, M., ... Cherubini, A.	The majority of the studies had great variation in how the same type of intervention was defined and applied, the follow-up duration, the type of outcome measured, usually with modest sample size.	1, 2, 3, 4
Austrom, M. G., Boustani, M., & LaMantia, M. A.	N/A	N/A
Birkenhäger-Gillesse, E. G., Kollen, B. J., Zuidema, S. U., & Achterberg, W. P.	N/A	N/A
Cravello, L., Di Santo, S., Varrassi, G., Benincasa, D., Marchettini, P., de Tommaso, M., ... Caltagirone, C.	N/A	N/A
Colonnello, V., Petrocchi, N., Farinelli, M., & Ottaviani, C.	Most studies focus on a specific phase of life (i.e., adulthood). Future studies should focus on the role of opioids and oxytocin in positive social interactions adopting a lifespan perspective.	8
Cummings, J. L., Isaacson, R. S., Schmitt, F. A., & Velting, D. M.	Routinized updates to management of BPSDs and other comorbid health issues contributing to deterioration of an individual with ADRDs is required via personalized, tailored programming across the health care team and family caregivers. Individualization is strongly needed.	9
Demange, M., Lenoir, H., Pino, M., Cantegreil-Kallen, I., Rigaud, A. S., & Cristancho-Lacroix, V.	1) need for larger sample size, participant follow-up, and control group to improve reliability; 2) women were the predominant participant group (80%), potentially skewing results; 3) steps to control for subjective well-being were not taken (e.g. pharma treatment for individual patients was maintained due to pain; 4) assessment of behavioral disorders at short exposure to the robot should be made; 5) exclusion of patients due to diagnosed level of high cognitive impairment limited extent of intervention, as only patients able to respond to the I-PANAS SF scale were included; 6) distinguishing early and late-onset depression is advised to control for confounding variables; 7) assessing and understanding patients' past experiences will mitigate potential for negative reminiscence(s)	4, 8, 10, 11

Table 4.

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<p>Fletcher, P. D., Downey, L. E., Golden, H. L., Clark, C. N., Slattery, C. F., Paterson, R. W., ... Warren, J. D.</p>	<p>1) need for larger sample size and longitudinal assessment; 2) future work should extend to later-onset samples of the AD population, as this one addressed early-onset; 3) binary classification of pain and temperature detection (i.e. presence or absence) should code symptom frequency and intensity for parametric correlation with other disease measures; 4) explore patients' conceptualization of interoceptive signals, as this might yield further signatures of disease. Pain and temperature may constitute a useful model system for investigating abnormalities of sensory salience, homeostatic and self schema processing that are core to the pathophysiology of canonical neurodegenerative diseases (Craig, 2002, 2009; Downey et al., 2014; Zhou and Seeley, 2014).</p>	<p>4, 8</p>
<p>Forstmeier, S., Maercker, A., Savaskan, E., &amp; Roth, T.</p>	<p>N/A</p>	<p>N/A</p>
<p>Gitlin, L. N., Marx, K. A., Alonzi, D., Kvedar, T., Moody, J., Trahan, M., &amp; Van Haitsma, K.</p>	<p>Future efforts should evaluate its effectiveness in reducing inappropriate pharmacologic use and strategies to enhance continued activity use by staff during hospitalization and families following discharge.</p>	<p>1, 2, 3, 12</p>
<p>Goodkind, M. S., Sturm, V. E., Ascher, E. A., Shdo, S. M., Miller, B. L., Rankin, K. P., &amp; Levenson, R. W.</p>	<p>Further development and testing of our new task using larger and more diverse samples is clearly warranted. This should include: (a) expanding the test set with multiple stimuli for the different emotions, (b) carrying out more extensive psychometric testing, (c) evaluating order of presentation effects, and (d) evaluating the effects of prior experience with the particular films used. In addition, the intriguing findings using the MMSE support the value of exploring the influence of more specific cognitive abilities on emotion recognition, similar to our previous work studying specific cognitive correlates of emotion regulation ability (Gyurak, Goodkind, Kramer, Miller, &amp; Levenson, 2012; Gyurak et al., 2009;).</p>	<p>4</p>
<p>Hoppe S.</p>	<p>One important conclusion of this article is that people have different needs. Experience experts or support groups can fulfil certain needs, while a professional or friend can fulfil others. Regardless of the type of relationship, attuning to the needs of the person one wants to understand is crucial. Also the limits of empathy need to be acknowledged. "An empathic stance must include some notion and acceptance of the limits, failure, and even the impossibility of empathy" (Kirmayer 2008:470).</p>	<p>9</p>

Table 5.

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<p>Kales, H. C., Gitlin, L. N., &amp; Lyketsos, C. G.</p>	<p>Specific to prevention of BPSDs: 1) future studies should assess how often mild symptoms progress to more severe ones; whether screening and monitoring for behavioral symptoms can identify behaviors at an early stage and alter their course; whether screening for risk factors for behavioral symptoms and then modifying them can prevent occurrences; 2) Future research is also needed to compare the effectiveness of non-pharmacologic and pharmacologic strategies; understand the underlying biobehavioral mechanisms by which non-pharmacologic strategies work; and identify whether approaches such as the DICE method improve care and reduce costs to families and health systems, hospital admissions, and nursing home placements. A current US National Institutes of Health trial is examining the use of DICE paired with technology in an RCT of care givers</p>	<p>8, 13</p>
<p>Lee, E. E., Chang, B., Huege, S., &amp; Hirst, J.</p>	<p>N/A</p>	<p>N/A</p>
<p>Marx, K. A., Duffort, N., Scerpella, D. L., Samus, Q. M., &amp; Gitlin, L. N.</p>	<p>1) multiple terms were found that referred to ALFs, including “residential care home,” “care and support homes,” “chronic care facilities,” “aged care facility,” “sheltered housing,” and “housing with care”; 2) the regulations and environments of ALFs vary from state to state in the United States</p>	<p>14</p>
<p>Scales, K., Zimmerman, S., &amp; Miller, S. J.</p>	<p>N/A</p>	<p>N/A</p>
<p>Zucchella, C., Sinforiani, E., Tamburin, S., Federico, A., Mantovani, E., Bernini, S., ... Bartolo, M.</p>	<p>1) The main limitation of the present review is its narrative design; 2) Another limitation is the use of two search engines, only (i.e., PubMed and the Cochrane database of systematic reviews); 3) Future studies should employ larger sample sizes, include all important outcomes, in particular positive ones, such as emotional and social well-being, and examine the duration of the effect in relation to the overall duration of the treatment and the number of sessions (as found in van der Steen et al. (2017) and Fusar-Poli et al. (2018))</p>	<p>4, 7, 15, 16</p>

Table 6.

Music, social engagement and AD

Cheong, C., Foong, Y., Koh, H., Chen, D., Tan, A., Tan, J., ... & Yap, L.	"Although the effects of CMT did not seem to extend beyond the period of music engagement, CMT can contribute to the overall well-being of PtDD if it is regularly scheduled into their daily routines or incorporated into other areas of care such as physical rehabilitation and nursing to increase patient compliance and cooperation"		2
Hsiung, G. Y. R., Kirkland, K., Summers, S. G., Beattie, B. L., & Jacova, C.	N/A because access to full text was not found	N/A	
Liesk, J., Hartogh, T., & Kalbe, E.	the presented pilot study does not provide generalizable results on effects of interventions on cognition, quality of life and ADL. However, it provides a good starting point for planning future studies, as currently required in the S-3 Guidelines on Dementia		5
Prieto, C.	N/A because access to full text was not found	N/A	
Weise, L., Jakob, E., Töpfer, N. F., & Wilz, G.	N/A because it's prospective	N/A	

Table 7.



Music, social engagement and AD

Starr, R.	Further research is needed to understand cultural and ethnic differences in mental health concerns, as well as appropriate assessment and treatment in culturally and ethnically diverse aging populations	6
van der Steen, J. T., Smaling, H. J., van der Wouden, J. C., Bruinsma, M. S., Scholten, R. J., & Vink, A. C.	Future studies should examine the duration of effects in relation to the overall duration of treatment and the number of sessions	7

Table 8.

Tables 4, 5, 6, 7, and 8. Display the analysis of coded limitations presented and discussed in each of the included studies from PubMed, Cochrane ALOIS, and Google Scholar. Codes used:

- 1) how the intervention was defined and applied;
- 2) follow-up duration; 3) type of outcome measured; 4) sample size and diversity;
- 5) intervention does not provide generalizable results; 6) appropriate assessment and treatment of mental health issues considering cultural and ethnic differences;
- 7) duration of effects in relation to overall duration of treatment and number of sessions;
- 8) phase of life considerations (e.g. childhood or adulthood) and relationships between early/late-onset to presentation of Neuropsychiatric symptoms; 9) need for person-centered care/tailoring of approaches to care; 10) sex/gender of sample; 11) steps to control for subjective well-being (i.e. pharmacological treatments pre-intervention); 12) effects of patient-centered care in reducing use of pharmaceutical treatments; 13) comparing effectiveness of non-pharmacological and pharmacological treatments to prevent Neuropsychiatric symptoms; 14) clearer distinctions between and methods to identify definitions of assisted living facilities; 15) use of narrative review as a limitation; 16) inclusion of social and well-being outcomes in study design

# Music, social engagement and AD

Author	1	2	3	4	5	6	7	8	9	10	11	12
<p><b>Post-diagnosis management</b></p> <p>Livingston et al. (2017)</p>	<p>Incidence of dementia is increasing globally and needs greater attention.</p>	<p>Be ambitious about prevention: We recommend active treatment of hypertension in middle aged (45–65 years) and older people (aged older than 65 years) without dementia to reduce dementia incidence. Interventions for other risk factors including more childhood education, exercise, maintaining social engagement, reducing smoking, and management of hearing loss, depression, diabetes, and obesity might have the potential to delay or prevent a third of dementia cases.</p>	<p>Treat cognitive symptoms: To maximise cognition, people with Alzheimer's disease or dementia with Lewy bodies should be offered cholinesterase inhibitors at all stages, or memantine for severe dementia. Cholinesterase inhibitors are not effective in mild cognitive impairment.</p>	<p>Individualize dementia care: To maximise cognition, people with Alzheimer's disease or dementia with Lewy bodies should be offered cholinesterase inhibitors at all stages, or memantine for severe dementia. Cholinesterase inhibitors are not effective in mild cognitive impairment.</p>	<p>Care for family carers: Family carers are at high risk of depression. Effective interventions, including STRategies for Relatives (START) or Resources for Enhancing Alzheimer's Caregiver Health intervention (REACH), reduce the risk of depression, treat the symptoms, and should be made available.</p>	<p>Plan for the future: People with dementia and their families value discussions about the future and decisions about possible attorneys to make decisions. Clinicians should consider capacity to make different types of decisions at diagnosis.</p>	<p>Protect people with dementia: People with dementia and society require protection from possible risks of the condition, including self-neglect, vulnerability (including to exploitation), managing money, driving, or using weapons. Risk assessment and management at all stages of the disease is essential, but it should be balanced against the person's right to autonomy.</p>	<p>Manage neuropsychiatric symptoms: Management of the neuropsychiatric symptoms of dementia including agitation, low mood, or psychosis is usually psychological, social, and environmental, with pharmacological management reserved for individuals with more severe symptoms.</p>	<p>Consider end of life: A third of older people die with dementia, so it is essential that professionals working in end-of-life care consider whether a patient has dementia, because they might be unable to make decisions about their care and treatment or express their needs and wishes.</p>	<p>Technology: Technological interventions have the potential to improve care delivery but should not replace social contact.</p>		

# Music, social engagement and AD

	Austrom et al. (2018)	Adopt a person-centered approach to care	Care provider teamwork across all dimensions of the care team is essential for good quality of life for everyone involved	Intricately understand comorbidities of aging and dementia to adequately address changes in disease progression over time	Encourage use of non-pharmacological approaches for the treatment of Neuropsychiatric symptoms first	Understand when pharmacological approaches are warranted for treatment of Neuropsychiatric symptoms	Caregiver teamwork to create a person-centered plan is essential for long-term quality of life considerations when medical/social crises occur	Have end of life conversations early to prepare for changes/transitions in the disease's progression					
	Marx et al. (2017)	Adopt evidence-based or evidence-informed interventions: 1) activities tailored to residents; 2) music tailored to residents	Use tailored activity as a therapeutic modality: 1) Use activity that is based on resident interests and capabilities as a way to interact effectively with residents	Adopt new training approaches for staff: 1) Use principles of adult learning; 2) More hands-on-training; 3) Peer leaders as trainers	Use emerging technologies for training and intervention: 1) Online training allows staff to work at their own pace; 2) Online applications can provide in the moment feedback	Participate in practice based research: 1) Test new interventions or adapt interventions from other settings to the ALF setting; 2) Know the key components of an intervention; 3) Have measurable outcomes; 4) Report outcomes to advance the field							

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	<p>Cummings et al. (2015)</p>	<p>Modifying risk factors for cognitive dysfunction: 1) consider following a Mediterranean-style diet; 2) consider taking supplements containing omega-3; 3) minimize alcohol intake; 4) engage in regular physical activity; 5) maintain leisure and social activities; 6) continue or begin activities that engage the brain e.g. Tai Chi, dancing, puzzles; 7) educate yourself about ALZHEIMER'S AND RELATED DEMENTIASs via available online resources: Alzheimer's Association, Alzheimer's Foundation of America, etc.; 8) include music in daily life - listening to music and/or making music with others; 9) maintain</p>	<p>Lifestyle considerations for patients with AD: 1) taking omega-3s has mixed results upon reduction in cognitive decline; 2) education about psychological effects of symptoms of dementia may prevent depression, anxiety, and other Neuropsychiatric symptoms; 3) pursuing regular engagement in the arts may help sustain sense of identity and improve behavior via enhanced communication; 4) pet therapy reduces agitation and anxiety in some dementia patients; 5) adjusting activities to fit with the patient's abilities may reduce stress for the patient; 6) urge the patient to participate in leisure activities to preserve function and quality of life</p>	<p>Managing comorbidities: 1) assess regularly for medical and neuropsychiatric comorbidities; 2) manage cardiovascular risk factors via lifestyle recommendations and medications to reduce risk of cognitive decline; 3) investigate overlapping factors (i.e. medical, somatic, or medication-related) for potential changes in function or behavior; 4) promptly treat acute medical illness to reduce risk for hospital admission; 5) offer caregiver education and support to manage Neuropsychiatric symptoms; 6) initiate psychoactive medication where necessary and document discussions with patient and/or family caregivers; 7) awareness to drug-drug interactions is paramount for potential adverse effects; 8) simplify medication regimen where possible</p>	<p>Other considerations: 1) health advice involving nutrition, best practices for use of transdermal patches, and regular assessment of patient's clinical/functional state; 2) safety considerations of the patient's home, whether or not the patient or family caregivers have firearms, and the need for the patient to potentially stop driving; 3) legal considerations regarding future incapacitation, state requirements regarding medical fitness to drive a vehicle, awareness to legal obligations if suspected abuse/neglect from caregiver-to-patient occurs; 4) support towards caregiver coping and how to access local support services</p>								
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# Music, social engagement and AD

		regular sleep patterns; 10) manage stress											
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## Music, social engagement and AD

	[15]	<p>Approaches targeting the person with dementia: 1) Reminiscence therapy (discussion of past experiences); 2) Validation therapy (working through unresolved conflicts); 3) Simulated presence therapy (use of audiotaped recordings of family members' voices); 4) Aromatherapy (use of fragrant plant oils); 5) Cognitive training and rehabilitation; 6) Acupuncture; 7) Light therapy</p>	<p>Approaches targeting the family caregivers: 1) Resources for Enhancing Alzheimer's Caregiver Health (REACH II) initiative and REACH-VA; 2) Tailored Activity Program (TAP); 3) Care of Persons with Dementia in their Environments (COPE) study; 4) Advancing Caregiver Training (ACT) study; 5)</p>	<p>Approaches targeting the surrounding environment for the Persons living with dementia and their caregivers: 1) Being overstimulated (for example, excess noise, people, or clutter in the home) or understimulated (for example, lack of anything of interest to look at); 2) Safety problems (for example, access to household chemicals or sharp objects or easy ability to exit the home); 3) Lack of activity and structure (for example, no regular exercise or activities that match interests and capabilities); 4) Lack of established routines (for example, frequent changes in the time, location, or sequence of daily activities)</p>	<p>DICE approach: 1) Describe - elicit a thorough description of the symptoms by accurately characterizing the symptoms and the context in which they occur; 2) Investigate - the next step is for the provider to examine, exclude, and identify possible underlying and modifiable causes; 3) Create - In this step, the provider, care giver, person with dementia (if possible), and team collaborate to create and implement a treatment plan; 4) Evaluate - The final step is to assess whether recommended strategies were attempted and implemented effectively, whether the target symptoms improved, whether the care giver's distress was reduced, and whether there were any unintended side effects or consequences</p>								
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# Music, social engagement and AD

<p><b>Pain management, palliative care and advanced care planning</b></p>	<p>van der Steen et al. (2014)</p>	<p>Applicability of palliative care: 1) anticipation of terminal stages and associated planning; 2) improve quality of life via maintenance of function and comfort; 3) baseline and specialist palliative care considerations; 4) treatment of Neuropsychiatric symptoms, comorbid disease conditions, and inter-health concerns</p>	<p>Person-centered care: 1) view perceived problems from the patient's perspective; 2) shared decision making including the patient and family members; 3) health care team needs to address family and patient information needs throughout course of disease progression; 4) responding to other family/patient needs is essential throughout course of disease progression; 5) place of care considerations should include preferences, but safety and caregiver burden issues must also be taken into account; 6) regular discussion within healthcare and family caregiver team about issues of well-being</p>	<p>Setting care goals and advance planning: 1) prioritizing global care goals early can guide care trajectories; 2) anticipate progress of the disease and be proactive with advance care planning, involving patient perspectives as much as possible; 3) formats for advance care planning can vary, adding to its need for prioritization early in the disease progress; 4) mild dementia patients need support planning for the future; 5) maximizing comfort for severe dementia is a primary goal; 6) revisiting advance care plans is a best practice to update with changes in disease progression; 7) document and store care plans for later review</p>	<p>Continuity of care: 1) continuous care is required; 2) includes care from all disciplines; 3) a central coordinator within care team is best; 4) transferring patient from a setting requires substantial communication between new and old care teams</p>	<p>Prognostication and timely recognition of dying: 1) timely discussion of end of life may prepare families for the future; 2) predicting mortality accurately is impossible, but combinations of judgements and prognoses can provide more accurate direction towards management of symptoms</p>	<p>Avoid overly aggressive treatment: 1) transfer to the hospital considering care goals should be done prudently; 2) medication for comorbid conditions should be reviewed regularly; 3) avoid restraints whenever possible; 4) hydration if the patient is infected or other appropriate situations may be provided subcutaneously (only moderate consensus); 5) skillful hand feeding is preferred to enteral tube nutrition (only moderate consensus); 6) antibiotics may</p>	<p>Provide comfort for optimal treatment of symptoms: 1) holistic approach to treatment of symptoms is paramount due to routine occurrence; 2) sources of discomfort may differ and requires multiple caregiver perspectives; 3) pain, discomfort, and behavioral disturbances require accurate tools to assess severity across stages of disease progression; 4) non-pharmacological and pharmacological treatment of symptoms should be pursued as needed; 5) nursing care ensures comfort in patients near death; 6)</p>	<p>Psychosocial and spiritual support: 1) emotional support is paramount; 2) knowledge of religious affiliation will facilitate another layer of patient satisfaction, well-being and quality of life; 3) recognition of religious ritual may help the patient; 4) comfortable environments are significant</p>	<p>Family care and involvement: 1) provide social support for caregivers to assist with caregiver burden; 2) diagnosis is a significant moment for family caregivers and when they may need the most support; 3) provide education to families regarding progressive stages of dementia and care options - examine family receptiveness to gauge methods for future correspondence; 4) encourage family</p>	<p>Education of the health care team: 1) all members of the team need adequate training in palliative care techniques; 2) domains 1-9 of this list comprise core competencies</p>	<p>Societal and ethical issues: 1) patients with dementia should have access to palliative care on equal terms with patients with other diseases; 2) family caregivers should have access to adequate support; 3) promoting collaboration between dementia and palliative care is encouraged; 4) palliative care education should be made more accessible to curricula for physician and nurse training; 5) adequate motivation and funding are needed for professional caregivers to work in dementia and palliative care; 6) end-of-</p>	
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							<p>help alleviate discomfort via combat of symptoms of infection</p>	<p>specialist palliative care teams help with specific symptoms and continuity of care, but management of Neuropsychiatric symptoms may require other specialist care</p>		<p>involvement in the patient's care; 5) assist families with decision making for their loved one; 6) professional caregivers need to understand families' emotional needs regarding loved ones' decline; 7) offer bereavement support where needed; 8) adequate time for families following death of a loved one is essential</p>		<p>life care for patients with dementia needs greater economic and systemic incentives; 7) more awareness is needed for palliative care in dementia; 8) national strategies and policies need shaping regarding inclusion of palliative care, end-of-life care, and long-term care in dementia and beyond</p>	
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	Lee et al. (2018)	"Five Wishes" document (Aging with Dignity, 2015)	"Go Wish" card game (CODA Alliance, 2005)	<p>When no advanced care directive exists, a conversation is needed between physicians/professional-caregivers and family members. Here are eight recommended steps to employ: 1) Choose a quiet and private place for discussion; 2) Begin with a summary of psychiatric and medical treatments thus far; 3) Inquire what the family knows about the disease process in an open-ended way; 4) Avoid statements that place the burden of decision on loved ones; 5) Use statements that provide empathy and comfort without false hope; 6) Educate family on the research that shows that morbidity and mortality are high in older patients with dementia on whom invasive life-saving measures are performed; 7) Use the concept of "palliative paternalism" when maladaptive coping mechanisms are detected (Roland et al., 2014); 8) Align with other specialists</p>	<p>Other clinical decision making dilemmas to consider in advanced care planning: 1) use of artificial nutrition should be considered from multiple angles, as prolonging life via this method leads to the potential for multiple other challenges after beginning the process of artificial nutrition (e.g. food blockage in the tube, leaks, dislodgement and the possibility for increases in patient's agitation); 2) use of antibiotics in patients without clinical evidence of infection may lead to increases in Neuropsychiatric symptoms due to drug side effects; 3) educating family caregivers as to when withdrawal of medicinal treatments is appropriate for the care of their loved one can lessen their feelings of guilt and shame considering end of life preparations; 4) visitation to emergency departments may be avoided if advanced care directives and long-term care goals are accurately addressed, lessening the potential for further degradation in presenting symptoms of the patient; 5) medical complaints from the</p>									
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# Music, social engagement and AD

				to present a clear picture of clinical outcomes	patient and family members can be avoided if the clinicians and professional caregivers are adequately prepared with understanding of the natural progression of presenting symptoms of dementia (e.g. loss of cognitive function, gait impairment, incontinence, apraxia, anorexia, difficulty eating, and risk to aspiration; 6) neuropsychiatric symptoms must also be considered (e.g. depression, anxiety, psychosis, confusion, among others) due to impact upon caregiver burden and patient quality of life and well-being; 7) referral to hospice may be appropriate when the patient nears end of life								
Cravell et al. (2019)	Make a correct diagnosis of pain in patients with cognitive impairment	Use validated and standardized tools for pain assessment	Self-assessment pain scales are indicated for patients with mild to moderate cognitive impairment and observational scales for those unable to	Consider non-pharmacological interventions for the treatment of chronic pain in elderly with cognitive decline	Avoid using inappropriate and potentially dangerous drugs to treat pain in frail elderly people	In choosing analgesic drugs, consider clinical variables and comorbidity of elderly patient	According to severity of pain, start therapy with non-opioids and, if necessary, consider opioids later	Make a gradual titration of pharmacological treatment for pain (start low, go slow)	Avoid using neuroleptics and benzodiazepines as pain killers	Use antiepileptic drugs with care	Consider SNRI as adjuvants and/or an alternative to NSAIDs and opioids	Consider using natural compounds able to modulate the pain threshold	

Music, social engagement and AD

				understand the scale instructions			with cognitive decline						
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Table 9. Displays the compiled list of recommendations from the sources discussing post-diagnosis treatment and management of neuropsychiatric symptoms, and from the sources discussing pain management, palliative care, and advanced care planning.

**Figures**

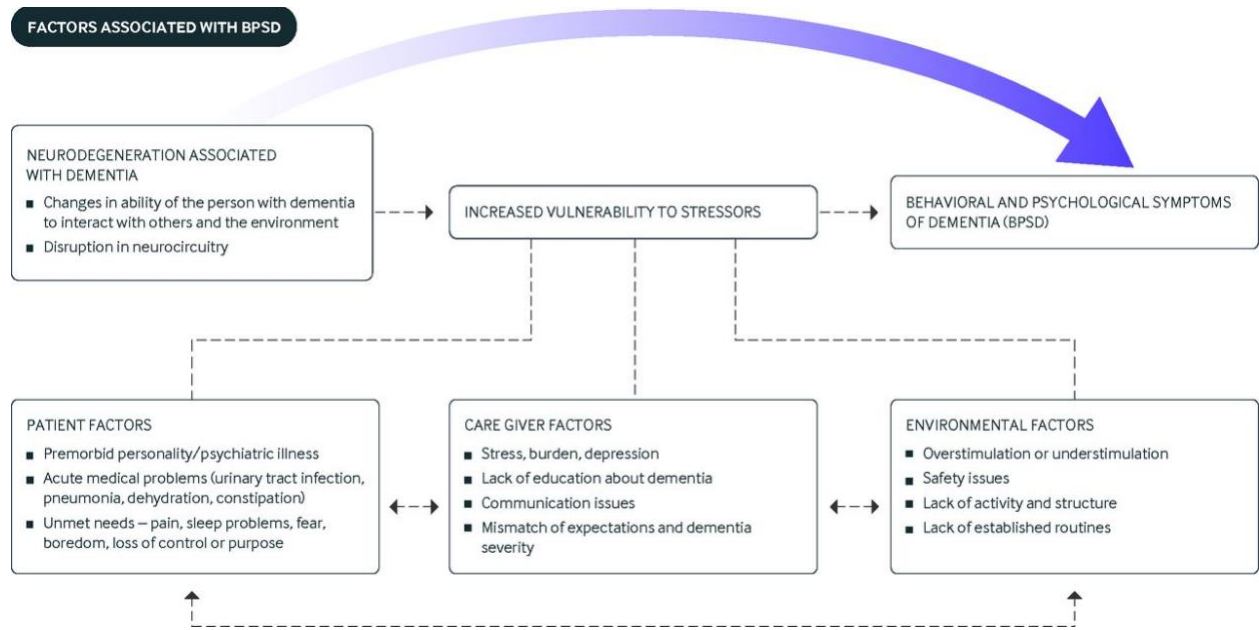


Figure 1. Visual model of factors contributing to neuropsychiatric symptoms of Alzheimer’s and related dementias [15].

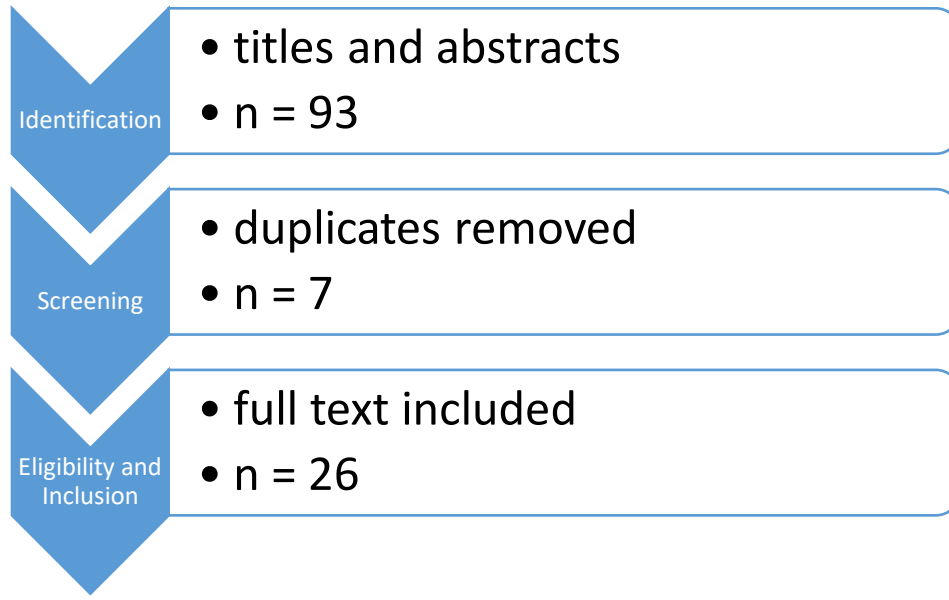


Figure 2. Displays steps 1-3 of the search and analysis process.

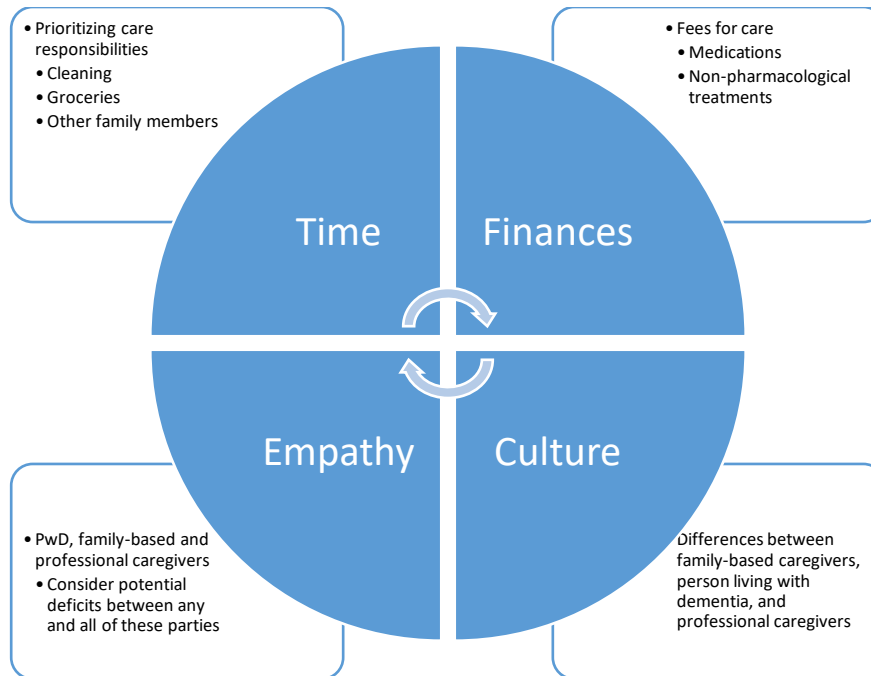


Figure 3. Displays challenges faced by healthcare professionals and informal caregivers towards the management of presenting neuropsychiatric symptoms from their patient/person/loved-one living with dementia. Here is a brief list of some of these considerations: 1) time - health care professionals and caregivers have myriad other responsibilities that may impact the amount of time they have to spend with their patient/person/loved-one living with dementia ([1]; [3]); 2) financial responsibilities – some of the costs associated with health care include fees for pharmacological and non-pharmacological treatments towards the management of Neuropsychiatric symptoms, fees for assessments from medical professionals towards changes in treatment regimen for the Persons living with dementia, fees for assisted living facilities, and fees for caregivers’ health and well-being as the disease progresses ([1]; [3]); 3) empathy deficits – from the Persons living with dementia to their caregiver teams and vice versa [107]; 4) culture/ethnicity - the Persons living with dementia, their formal health care professionals and family-based informal caregivers may all differ, limiting initial intercultural understanding towards any treatment regimen [62].

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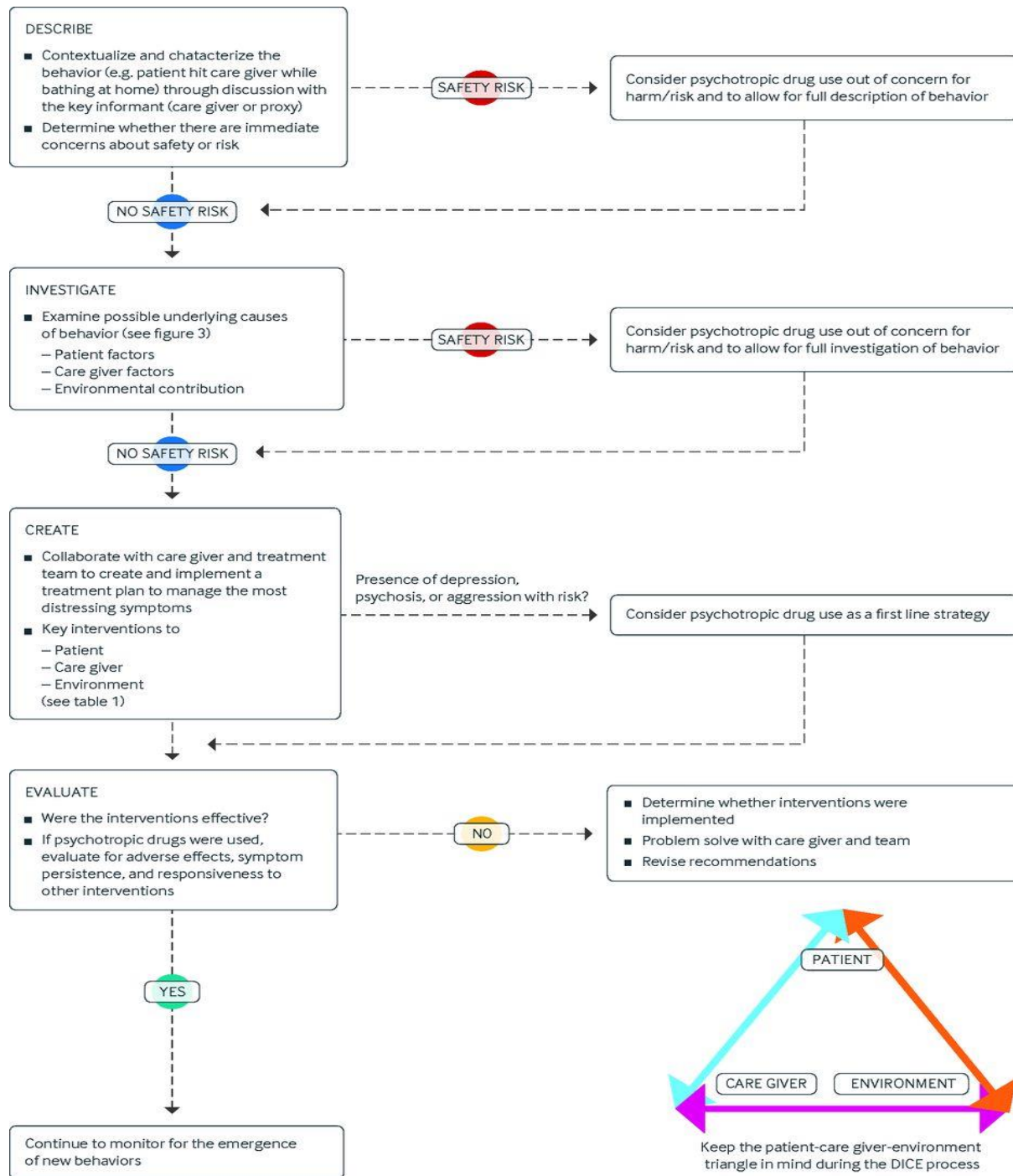


Figure 4. Displays the DICE (Describe, Investigate, Create, and Evaluate) approach towards the detection and management of presenting neuropsychiatric symptoms, considerations of causes, and potential treatments utilizing pharmacological and non-pharmacological options [14].



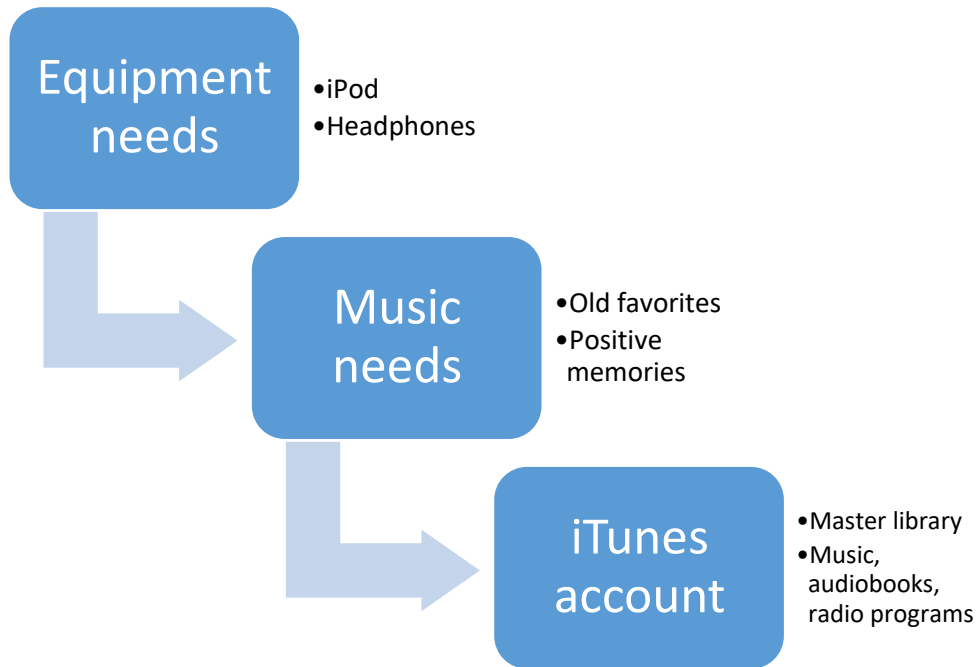


Figure 5. Displays key items in a checklist towards the creation of a personalized music playlist from the *Music and Memory* Organization.