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Effectiveness of Hearing Rehabilitation for Care Home Residents with Dementia: A Systematic Review

Abstract:

Objectives: To report the effectiveness of, and barriers and facilitators to, hearing rehabilitation for care home residents with dementia.

Design: Systematic review.

Setting and Participants: Care home residents with dementia and hearing loss.

Methods: No restrictions on publication date or language were set and grey literature was considered. Eligible studies were critically appraised and presented via a narrative review.

Results: Sixteen studies, most of low-to-moderate quality, were identified. Hearing rehabilitation, including hearing devices, communication techniques and visual aids (e.g., flashcards), were reported to improve residents' communication, quality of life and reduce agitation, with improvements in staff knowledge of hearing loss and job satisfaction. Residents' symptoms of dementia presented barriers, e.g., losing or not tolerating hearing aids. Low staff prioritization of hearing loss due to time-pressures and lack of hearing-related training for staff were further barriers, particularly for residents who required assistance with hearing devices. Adopting a person-centered approach based on residents' capabilities and preferences and involving family members facilitated hearing device use.

Conclusions and Implications: Residents with dementia can benefit from hearing rehabilitation. Identifying and implementing efficient, individualized hearing rehabilitation is necessary for those with complex cognitive needs. Increased funding and support for the social care sector is required to address systemic issues that

- 26 pose barriers to hearing rehabilitation, including time-pressures, lack of training for
- 27 staff and access to audiology services for residents.

28 **Introduction**

29 Approximately 70% of care home residents live with dementia or severe memory
30 impairment¹ and 75% have some degree of hearing loss.² Furthermore, the
31 symptoms of dementia and hearing loss overlap and interact, including
32 communication difficulties,³ loneliness⁴ and poorer quality of life.⁵ Untreated hearing
33 loss increases agitation and confusion for residents with dementia^{6,7} which may
34 result in excess use of antipsychotics and tranquilizers.⁸ Hearing loss is also
35 associated with increased risk of falls,⁹ frailty,¹⁰ other chronic health conditions¹¹ and
36 increased use of health services.¹² Alongside improving communication and quality
37 of life, hearing rehabilitation may therefore offer opportunities to improve
38 pharmacological and health-related outcomes for residents with dementia.

39 In a recent systematic review, Dawes et al.¹³ found hearing aids to be generally
40 effective in ameliorating behavioral and psychological symptoms of dementia
41 (BPSD), hearing-related disabilities and quality of life for people with dementia living
42 in the community. What remains unclear is the effectiveness of hearing rehabilitation
43 for people with – typically more advanced – dementia in care homes and the barriers
44 unique to this population group. Hearing aids are the primary treatment for hearing
45 loss but components of hearing interventions within care homes also include
46 personal sound amplification devices (PSAPs),¹⁴ communication techniques,¹⁵
47 communication aids,¹⁶ environmental modifications¹⁷ and earwax removal.¹⁷

48 Unfortunately, hearing rehabilitation in care homes is inconsistent.¹⁸⁻²⁰ Reliable
49 estimates of the proportion of residents who use hearing aids are lacking due to
50 differences in measuring and reporting hearing loss (self-report vs. audiometric
51 screening) and the range of methods used to determine hearing aid ‘use’. Rates of
52 reported use therefore range between 8% and 70%.^{17,21,22} Lower levels of cognitive

53 functioning are linked to low hearing aid use^{23,24} suggesting additional barriers for
54 people with dementia. Residents with dementia may lack insight into their need for
55 hearing support and may not engage without understanding the benefits.^{5,25,26}
56 Difficulties in using hearing devices due to visual impairment,^{27,28} poorer visuospatial
57 abilities, mobility, manual dexterity and other co-morbidities²⁹ are also likely.
58 Providing hearing rehabilitation in care homes is particularly challenging due to
59 excess background noise levels in communal areas³⁰ and variations in staff
60 knowledge of hearing loss and hearing device maintenance.³⁰⁻³⁴

61 Existing work^{3,4} has systematically reviewed the negative impacts of hearing loss on
62 residents and its barriers to communication, but has not evaluated the outcomes of
63 hearing interventions, alongside the specific barriers and facilitators for residents
64 living with dementia. The present systematic review addresses the following
65 questions: (i) How effective are hearing rehabilitation interventions for care home
66 residents living with hearing loss and dementia in improving communication,
67 cognitive function, functional ability, BPSD, quality of life, caregiver burden, use of
68 pharmacological intervention and health service utilization? (ii) What are the barriers
69 and facilitators to the use of hearing rehabilitation? This review will inform the
70 development of evidence-based hearing interventions that are appropriate for care
71 home settings and inform care practices in improving outcomes for residents living
72 with dementia and hearing loss.

73 **Methods**

74 This systematic review was conducted in accordance with the Preferred Reporting
75 for Systematic Reviews and Meta-Analysis (PRISMA) Statement for acquiring,
76 extracting, assessing and reporting data.³⁵ The protocol was pre-registered on

77 PROSPERO (CRD42020167362). Post-registration, the authors updated the PICOS
78 (Population, Intervention, Comparator, Outcomes, Study design)³⁶: 'Intervention'
79 criteria: 'psychosocial' was changed to 'non-pharmacological' to capture all relevant
80 interventions. No other changes occurred.

81 **Data Sources**

82 The following electronic platforms, databases and trial registries were searched
83 systematically: Ovid MEDLINE, PsycINFO, PubMed, CINAHL Plus, Web of Science,
84 Scopus, British Nursing Index, ComDisDome, The Cochrane Library and Google
85 Scholar (Table S1 includes search terms). Reference lists of eligible articles were
86 hand-searched for potential studies, including research published in peer-reviewed
87 journals and conference papers/proceedings containing research data, book
88 chapters, dissertations and theses. Databases were searched in May 2020. A
89 second search was conducted in January 2021 and no additional eligible studies
90 were identified.

91 The following terms were identified based on free text words, Medical Subject
92 Headings (MeSH) and reviews of relevant literature. These terms were used for the
93 Ovid MEDLINE primary search: (exp Dementia/ OR Alzheimer*.mp. OR Cognitive
94 Impair*.mp.) AND (Deaf*.mp. OR Hearing Disorder*.mp. OR Hearing Impair*.mp. OR
95 Hearing Loss/) AND (Nursing Home*.mp. OR Care Home*.mp. OR Homes for the
96 Aged/ OR Residential Facilit*.mp. OR Residential Aged Care OR Long-Term Care/).

97 All returned searchers were exported into Endnote X9 software³⁷ where duplicates
98 were removed using a built-in function. Titles and abstracts were then exported into
99 a Microsoft Excel spreadsheet³⁸ for study selection.

100 **Eligibility Criteria**

101 Returned searches were screened based on the pre-registered PICOS criteria
102 (Table 1). 'BPSD' is an outcome, so the term has been used at times in this review.
103 However, we acknowledge its caveats; there is no one 'BPSD' and a given
104 intervention will affect individuals differently, therefore we further specify symptoms
105 where possible.

106 (INSERT TABLE 1 HERE)

107 There were no restrictions on publication date or language, providing a title and
108 abstract were available in English. If the article appeared relevant during title and
109 abstract screening, it was translated into English for full screening. Unpublished
110 studies that matched the eligibility criteria were sought out by contacting the
111 author(s) wherever possible.

112 **Study Selection**

113 Titles and abstracts were screened by the primary independent reviewer (HC). A
114 second independent reviewer (EH) screened a randomly selected 10% of these titles
115 and abstracts. Those that did not meet the criteria were eliminated, those that did
116 meet or did not provide enough information at this point were retained.
117 Disagreements were resolved through discussion with a third reviewer (RM).

118 **Data Extraction and Synthesis**

119 Data extraction was performed independently by the primary reviewer (HC) using
120 standardized parameters piloted before data collection (Table S2). All data extraction
121 tables were reviewed by a second reviewer (EH). In three instances, authors were

122 contacted for missing data, and information was provided by one. Data were then
123 synthesized (Table 2) and analyzed using a narrative framework by the primary
124 reviewer. Effect size (Cohen's *d*) was calculated using means, standard deviations
125 and study sample sizes reported in text or in tables.

126 ***Quality Appraisal***

127 Study methodology was evaluated independently by two reviewers (HC, RM) using
128 the Mixed Methods Appraisal Tool (MMAT).³⁹ The MMAT has established reliability
129 and validity for appraising health studies⁴⁰ and is appropriate for qualitative,
130 quantitative and mixed-method studies. The reviewers used the MMAT 27-item
131 checklist, answering "yes", "no" or "can't tell" for each item and compared
132 assessment results through discussion. Any disagreements were discussed with a
133 third reviewer (EH). The MMAT does not provide a score but instead allows for a
134 narrative summary of the research quality (Table S3).

135 Interventions themselves were appraised using the revised Criteria for Reporting the
136 Development and Evaluation of Complex Interventions in healthcare checklist
137 (CReDEC12)⁴¹ to optimize future intervention development. The CReDEC12 is a 13-
138 item checklist intended to appraise the development, feasibility, piloting, and
139 evaluation of complex interventions (Table S4). Two reviewers (HC, RM)
140 independently assessed the included studies, assigning each paper a score out of
141 13 (Table 2).

142 Each included study was assigned a level of evidence⁴² between 1-7 (Table 2).

143 ***Screening Results***

144 Fig.1 shows a flow diagram of the search process. The first systematic search
145 returned 1352 articles after removing duplicates. After initial abstract and title
146 screening ($k=0.61$, substantial agreement between the two independent reviewers),
147 53 articles were retained for full-text assessment. This process resulted in 16 articles
148 eligible for inclusion in this review ($k=0.90$, almost perfect agreement). One
149 Japanese article with an English title and abstract met the criteria during first-level
150 screening. The full article was translated into English using Google Translate, then
151 both copies were sent to a fluent non-native Japanese speaker, who corrected any
152 errors in the translation.

153 (INSERT FIGURE 1 HERE)

154 (INSERT TABLE 2 HERE)

155 **Results**

156 ***Study Characteristics***

157 Studies included in this review were published between 1986 and August 2020, all
158 conducted in high-income countries (Table 2). Studies included controlled trials,
159 single-group pretest-posttest designs, interviews, surveys and single-subject case
160 designs, involving participants with a range of cognitive impairment and hearing
161 levels, indicated in Table 2.

162 ***Quality Appraisal***

163 The MMAT³⁹ (Table S3) and levels of evidence⁴² evaluations (Table 2) illustrate a
164 range of methodological quality across studies. The four case studies^{6,7,25,43} lacked
165 clear research questions and standardized data collection and analysis methods.

166 Reliance on behavioral observations and self-report limits their reliability, along with
167 a limited number of participant quotes to support the authors' interpretations. The
168 results from these case studies provide low-level evidence for the benefits of hearing
169 rehabilitation for residents with dementia. Most pretest-posttest studies were judged
170 to be of moderate quality because of incomplete outcome data and high participant
171 attrition, caused by participant illness, death, resistance to participation and
172 difficulties completing measurements.^{14,17,44,45,46,47} Only Hopper et al.⁴⁸ reported the
173 use of a power analysis to determine sample size.

174 The CReDECI2⁴¹ evaluation identified several interventions that included clear
175 descriptions of the intervention components, materials and tools used, and
176 standardized outcome measurements.^{15,17,44,46,48} Almost all studies considered the
177 care home characteristics when designing the intervention, e.g., the type and size of
178 facility and staff involvement. However, the lack of control groups or randomization
179 was a limitation in almost all studies, excluding McCallion et al.¹⁵ and Suzuki et al.⁴⁶
180 Only two studies piloted any part of their intervention.^{43,44}

181 ***Hearing Rehabilitation***

182 ***Hearing Devices***

183 Ten studies discussed sound amplification with hearing aids or
184 PSAPs.^{6,7,14,21,24,43,46,47,48,49} Both hearing aids and PSAPs amplify sound, but PSAPs
185 are simpler to use, sold over the counter at a lower cost and do not require fitting by
186 an audiologist.⁵⁰ Low rates of hearing aid use were found across studies, particularly
187 for residents with severe cognitive impairment compared to mild impairment or
188 normal cognition.^{17,24,44} Residents with dementia required additional support from

189 caregivers to use and manage hearing devices.^{7,24,46,49} PSAPs were used as a
190 stepping-stone to hearing aid use for some residents with dementia.^{7,14}

191 Several studies exploring amplification reported improvements in
192 communication,^{7,43,46,49} reductions in anxiety, agitation and hallucinations,^{6,7,43,49}
193 improvements in speech recognition,^{46,47,48} and quality of life and wellbeing.^{6,7,43,49}

194 PSAP use did not improve quality of life in Jupiter's¹⁴ pilot study. Weinstein and
195 Amsel⁴⁷ found improvements in Mental Status Questionnaire scores⁵¹ when using
196 PSAPs. No other study found improvements in cognitive measures.^{14,46,49} Two
197 amplification intervention case studies resulted in reductions in anti-anxiety and
198 tranquilizer medication for residents who were very agitated.^{6,43} Other case
199 studies^{7,43} described improvements in staff skillset and confidence using
200 amplification devices after training and practice. Care staff acknowledged the
201 benefits of hearing devices for communication but did not refer residents to
202 audiologists.⁴⁹ Instead, staff relied on improvised communication techniques, as
203 hearing was deemed to be a lower priority than other aspects of care. The multi-
204 component intervention used by Looi et al.¹⁷ included wax removal for 5/15
205 participants. High participant attrition was reported (46%) and whether these
206 participants completed post-testing was unclear. The authors did not report the
207 effectiveness of wax removal in their study.

208 **Visual Aids**

209 Two studies investigated flashcard (displaying phrases or pictures) use by care staff,
210 which were utilized when hearing-impaired residents with dementia experienced
211 difficulties using hearing devices.^{25,52} These interventions were well received by both
212 staff and residents due to their ease and simplicity. One case study reported

213 improved communication between staff and residents and decreased resident
214 aggression and agitation.²⁵ However, no change in the larger, although lower quality,
215 study was noted,⁵² despite staff becoming more aware of residents' communication
216 difficulties. As part of an exploratory interview study, staff reported the benefits of
217 visual aids⁴⁹ but emphasized that they were rarely provided within care homes.

218 ***Communication Strategies***

219 Verbal and non-verbal communication strategies were also employed, often in
220 addition to hearing aids or PSAPs.^{7,15,17,25,44,45,49} Communication strategies included
221 repeating and rephrasing and conversing in quiet areas,²⁵ talking face-to-face with
222 residents,⁷ using 'yes/no' questions and ensuring there was adequate lighting.¹⁵

223 Staff reported knowing of communication difficulties that accompany dementia and
224 hearing loss during interviews, therefore adapted their communication techniques by
225 facing the resident and speaking slowly.⁴⁹ The unavailability of amplification devices
226 within care homes may influence staff preference for using communication
227 techniques.⁴⁹ One communication training program was praised by staff due to its
228 adaptability to the needs of each resident.⁴⁵ Furthermore, individualized care plans
229 that documented residents' individual abilities and communication preferences were
230 valued by staff and improved their confidence in providing hearing support^{17,45} and
231 resident quality of life.⁴⁵

232 ***Barriers to Hearing Rehabilitation***

233 Barriers and facilitators related to individual, facility and social context were reported
234 across studies.

235 Residents commonly declined hearing aids for reasons including discomfort,
236 perceived benefit or lack of interest.^{7,17,21,24,25,43,46,49} Furthermore, PSAPs were
237 generally unfamiliar to staff and residents and sometimes disliked, due to their
238 'heaviness'.^{14,43,49} Residents needed time to adapt to PSAPs.^{7,43} Personalising
239 PSAPs e.g. by changing the headphone type, may increase acceptance.⁴³ Many
240 studies found residents with advanced dementia encountered intractable barriers to
241 using hearing devices such as the inability to use devices themselves or forgetting,
242 losing or breaking them.^{7,14,21,24,43,46,49} Cognitive impairment also prevented residents
243 from engaging in communication training⁴⁴ and completing outcome
244 measurements.¹⁷

245 Staff reported a low-level of knowledge of amplification devices.^{6,7,17,21,24,49} Staff
246 reported the ability to carry out basic hearing aid management in one study, despite
247 having no formal training.²¹ However, they were interested in developing hearing
248 support skills.^{17,21,46} Hearing device management was not prioritized⁴⁹ or
249 incorporated into care routines.^{6,7} Residents were sometimes not referred to
250 audiology services for hearing assessment and hearing aid fitting.⁴⁹ When residents
251 did receive audiology services, they waited several months for their hearing aids, for
252 which there was no reported follow-up.^{17,21} Staff reported difficulties with finding the
253 time to participate in training sessions,^{17,45} a challenge with more complex and time-
254 consuming interventions.

255 ***Facilitators of Hearing Rehabilitation***

256 Involvement of family members in hearing aid management (e.g., changing batteries)
257 was a facilitator.^{6,7,21,49} Absence of family visitors and involvement may contribute to

258 poor uptake and use of hearing devices.¹⁴ Alongside care staff, family involvement
259 was recommended in future research of this kind.¹⁷

260 A well-managed care home, including staff delegation, interdisciplinary collaboration,
261 staff knowledge and skill also facilitated hearing rehabilitation.^{7,17,21,48} Finally, the
262 importance of individual management plans was strongly emphasized across
263 studies,^{17,45,49} alongside a ‘trial and error’ approach to finding what suited individual
264 residents best.^{7,14,43} Care plans that took residents’ cognitive and physical abilities
265 and support needs into account when determining appropriate hearing rehabilitation
266 improved communication and quality of life.⁴⁵

267 **Discussion**

268 ***Effectiveness of Hearing Rehabilitation for Care Home Residents with*** 269 ***Dementia***

270 Amplification helped improve communication, and reduced residents’ agitation and
271 restlessness^{6,7,25,43} and ‘socially inappropriate’ behaviors.^{43,46} Two case studies also
272 reported reduced use of anti-anxiety medication and major tranquilizers.^{6,43} Reducing
273 unnecessary pharmacological intervention is a goal within care homes⁵³ and should
274 be considered as an outcome for future care home hearing interventions. Quality of
275 life, wellbeing and mood improvements were also reported via interviews or informal
276 feedback from staff.^{6,7,25,43,49}

277 There was no consistent evidence for improvements in cognition with hearing aids or
278 PSAPs.^{14,46,48} Weinstein and Amsel⁴⁷ reported immediate improvements in
279 performance on a cognitive screening with PSAP use. However, practice effects may
280 have influenced results, as pretest-posttest were carried out in quick succession.

281 Only Hopper et al.⁴⁸ reported a sample size calculation, highlighting a risk of bias in
282 the included studies. To determine whether hearing device use reduces cognitive
283 decline in residents with dementia, adequately powered, controlled longitudinal
284 studies are desirable.

285 Where hearing devices were rejected by residents, flashcards were occasionally
286 utilized instead. The reported benefits of visual aids for communicating with residents
287 with dementia and hearing loss were inconsistent.^{49,52} One case study reported their
288 use improved communication between staff and residents and decreased resident
289 aggression and agitation.²⁵ These studies did not report participants' visual abilities.
290 Around 1/3 of residents have dual-sensory impairment,²⁷ which may make sensory
291 rehabilitation difficult because individuals cannot compensate with the other sense.⁵⁴
292 Dual-sensory impairment may limit the effectiveness of visual aid interventions.

293 Communication training for residents with dementia was ineffective because
294 residents were unable to remember and apply the training.⁴⁴ However, when staff
295 utilized communication techniques, this resulted in improvements in residents'
296 participation in activities,⁷ interactions with others⁴⁸ and enabled discussion with
297 residents during assistance with care.²⁵ Residents' mood,^{15,45,49} quality of life⁴⁵ and
298 aggression¹⁵ also improved after staff adapted their communication.

299 Following care staff training in hearing device management and communication
300 techniques, improvements in staff turnover,¹⁵ 'caregiver burden',^{25,43,45} mood,⁴⁵
301 knowledge and confidence^{7,17,45,52} were detailed. Reduced turnover and burden may
302 be attributed to improved communication with residents, reducing the likelihood of
303 encountering 'challenging' situations, e.g., resident aggression.

304 ***Barriers to Hearing Rehabilitation for Residents with Dementia***

305 Individual-level barriers identified are similar to those reported for people with
306 dementia living in the community.^{55,56} Residents had difficulties with losing, refusing
307 and inappropriately using hearing devices.^{7,14,17,21,25,46,49} Reported 'heaviness' of
308 PSAPs^{14,43,49} could be overcome with lighter, newer models. Furthermore, there
309 were no interventions using modern mobile apps e.g., Speech-to-Text or Amplifier
310 apps, the effectiveness of which is yet to be determined in care homes.

311 Fluctuating mental capacity presented barriers to engaging with and remembering
312 training.⁴⁴ Given the level of advanced dementia and other co-morbidities,^{29,57} and
313 difficulties in recognizing and reporting hearing difficulties, barriers may be more
314 challenging for care home residents versus the general community. Previous
315 guidelines on managing hearing in care homes do not fully account for dementia-
316 related difficulties.^{2,58} This review highlights the need for adaptations for residents
317 with dementia.

318 Lack of recognition of hearing needs was a barrier; hearing was not routinely
319 checked.²⁴ Recently published recommendations on sensory screening in people
320 with dementia emphasise alternative approaches (e.g., more time, having family
321 present)⁵⁹, which should be implemented in care homes where residents require
322 individualised hearing care. In addition to these general guidelines, Dawes et al.⁶⁰
323 offers specific advice on identification of hearing difficulties for people with dementia.

324 Earwax removal is an easy and effective means of improving hearing. Regular
325 screening for wax occlusion and removal would be desirable; up to 44% of residents
326 with dementia had earwax impaction in this review.^{21,46,48} This may lead to device

327 rejection and staff scepticism of the benefits of amplification devices,^{7,17,21,46} as
328 devices may be of limited effectiveness unless earwax is removed.

329 Despite residents with dementia needing assistance with their hearing devices, staff
330 knowledge in this tended to be low.^{7,15,17,21,25,45,46,49} Numerous recommendations to
331 improve care staffs' knowledge of hearing rehabilitation have been published,²⁻⁵ but
332 these are not yet widely implemented,^{23,31,32} and there remains no mandatory
333 training on hearing nor regulated standards set for hearing care in the UK or USA.

334 Systemic barriers to hearing rehabilitation in care homes are substantial. Hearing
335 screening, referrals and device management were isolated events within care
336 homes, rather than part of a standard care routine.^{17,21,24,49} Staff lacked the time to
337 engage in interventions due to high workload and prioritization of urgent care
338 needs.^{17,45} Looi et al.¹⁷ described care homes as 'sensory-unfriendly'. Previous
339 studies reported loud communal areas.^{30,33} The 'room environment' is one of the
340 lowest staff priorities.⁶¹ Residents' urgent clinical/nursing needs and pain
341 management are priorities,⁶¹ with psychosocial domains – including communication
342 – becoming 'unfinished care'.^{62,63} Hearing interventions for care homes should be co-
343 developed with residents and staff, e.g., using the Behavior Change Wheel's
344 APEASE criteria⁶⁴, to identify what is feasible within care settings. However, until
345 underfunding, low staffing levels and high turnover^{65,66} are addressed, hearing
346 healthcare may continue to be a low priority within care homes.

347 ***Facilitators of Hearing Rehabilitation for Residents with Dementia***

348 Personalization and adaptability facilitated use and effectiveness of
349 interventions.^{7,15,17,43,45} Adaptations included changing headphone type⁴³ and trialing

350 alternative hearing devices.^{7,14} Personalized communication plans helped staff
351 understand resident preferences, ability to communicate and level of assistance
352 needed, improving their confidence.^{17,45}

353 Communication difficulties arise from hearing and cognitive deficits,^{3,45} thus
354 interventions to support communication should consider both hearing and fluctuating
355 cognitive needs. Amplification alone may not be enough to address cognitive-
356 communication impairments.⁴⁸ Rather, interventions could include environmental
357 adaptations, visual aids and communication training for staff and family members.
358 Multi-component interventions are in line with a large body of work arguing that
359 person-centered care for residents is the gold-standard.^{67,68} The international drive to
360 move from task-centered to person-centered care is integrated in policy and
361 regulation.^{69,70} Care homes must ensure that hearing rehabilitation is person-
362 centered, in line with the World Health Organization report on hearing.⁷¹

363 Assistance from family facilitated hearing device use for residents with
364 dementia.^{6,7,21,49} Family involvement with care improves resident wellbeing,⁷² and
365 their knowledge informs 'shared-decision making' and 'family-centered dementia
366 care',^{73,74} which includes decisions about hearing rehabilitation. One challenge is the
367 ambiguous role of family members as caregivers within care homes,⁷² and the extent
368 to which care homes should be responsible for addressing the hearing needs of
369 residents, as residents without family may then be disadvantaged. Future research
370 should further explore the perspectives and perceived responsibilities of family
371 members in providing hearing rehabilitation for their relatives.

372 ***Strengths and Limitations***

373 Our systematically conducted narrative review provides an exploration of existing
374 research including studies varying in intervention type and outcome measure,
375 precluding a meta-analysis.

376 Inclusion of grey literature reduced potential for publication bias and facilitated a
377 broader understanding of practices across multiple countries. Both grey literature
378 and peer-reviewed studies varied in quality, and the lack of sample size justifications
379 and high attrition rates undermine the reliability of some results. Gold standard
380 randomized-controlled designs are desirable but potentially unfeasible for care home
381 residents with complex health needs and fluctuating mental capacity. Future
382 research addressing the hearing needs of residents with dementia may need to
383 adopt pragmatic and efficient designs (e.g., n-of-1 trials,⁷⁵ or quasi-experimental
384 pretest-posttest designs⁷⁶).

385 Quality of life was systematically measured in only one study,⁴⁵ possibly due to
386 difficulties in conceptualization and measurement in people with severe dementia.⁷⁷
387 Interviews and observational measurements may be more appropriate for residents
388 with dementia, as they may struggle with formal measurements that rely on
389 retrospective reflection and clear communication abilities.⁷⁷

390 Hearing technologies have advanced over the time-span in which the included
391 papers were published. Most of the included studies did not report the make and/or
392 model of the hearing devices used, making it difficult to compare the effectiveness of
393 older vs. newer hearing devices for residents with dementia.

394 Addressing communication may impact on functional independence, although
395 studies tended not to assess functional outcomes. Attention to the benefits of

396 hearing interventions would address needs for 're-enablement' and promoting
397 independence and involvement of residents within care settings.^{70,78} Furthermore,
398 hearing loss is associated with falls⁹ and numerous chronic health conditions^{10,11}
399 which lead to hospitalization and medical care. Hearing rehabilitation may offer a
400 low-cost opportunity to improve residents' health outcomes and reduce healthcare
401 costs. However, no study reported the impact of hearing rehabilitation on health
402 service utilization.

403 **Conclusions and Implications**

404 Hearing rehabilitation provides benefits to residents' communication, BPSD and
405 quality of life. Benefits for staff mood, 'burden' and turnover were also evident. Less
406 clear was the impact on residents' cognition, functional independence and
407 pharmacological intervention. Hearing device use was low, and staff relied on
408 improvised communication tactics, rather than formal training. Care home
409 environments are typically noisy and environmental modifications are needed to
410 facilitate communication. Barriers to hearing rehabilitation included rejection of
411 hearing aids, inadequate staff knowledge surrounding hearing devices and low
412 prioritization of hearing care within care homes. There are also systemic barriers,
413 under-funded social care, low staffing levels and limited access to training in hearing
414 healthcare. Person-centered approaches that considered residents' physical and
415 cognitive abilities and preferences facilitated hearing rehabilitation use. Family input
416 may lead to more successful hearing interventions. Residents' communication needs
417 are complex, consisting of both hearing and cognitive difficulties, therefore,
418 interventions should be multi-component i.e., including hearing devices, other
419 communication aids and environmental adaptations within care homes.

420

421 **Conflicts of Interest:**

422 None

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634 **Table and Figure Legends:**

635

636 **Table 1. *PICOS Eligibility Criteria***

637

638 **Figure 1. PRISMA Flow Diagram**

639

640 *Fig 1. PRISMA flow chart of literature search showing the identification, screening,*
641 *eligibility, and inclusion phases of the searches.*

642 **Table 2. Data Synthesis Including Characteristics and Critical Appraisal of Included Studies.**

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647 *Key: ACF – Aged Care Facility, ADL - Activities of Daily Living, ADQoL - Alzheimer’s Disease related Quality of Life, BCRS - Brief*
648 *Cognitive Rating Scale, BPSD – Behavioral and Psychological Symptoms of Dementia, CEAPG - Communication Environment*
649 *Assessment and Planning Guide, CETI - Modified Communication Effectiveness Index for Residential Elderly, CIQ - Communication*
650 *Impairment Questionnaire, CMAI - Cohen-Mansfield Agitation Inventory, CSDD - Cornell’s Scale for Depression in Dementia, Dx –*
651 *diagnosis, FLCI - Functional Linguistic Communication Inventory, ICS - Interactional Comfort Survey, IIADL - Index of Independence*
652 *in Activities of Daily Living, KAT - Knowledge of Alzheimer’s Test, MDS – Minimum Data Set, MDS-COGS – Minimum Date Set*
653 *Cognition Scale, MMSE – Mini Mental State Examination, MOSES - Multidimensional Observation Scale for the Elderly subjects,*
654 *MSQ - Mental Status Questionnaire, NCAS - Nursing Care Assessment Scale, NHHHI – Nursing Home Hearing Handicap Index,*
655 *PCI - Profile of Communicative Interactions, PSAP – Personal Sound Amplification Product, PSMHQ - Penn State Mental Health*
656 *Questionnaire, PTA – Pure Tone Average, QoC - Questionnaire of Communication, SII - Speech Intelligibility Index, SWRD -*
657 *Satisfaction Working With Residents With Dementia*

658

659 *Note: Full CReDEC12 and MMAT checklists are shown in the supplementary materials (Tables S3 and S4). Cohen’s d effect sizes*
660 *are reported wherever possible. It was not appropriate to appraise Bott et al. (2020) or Cohen-Mansfield and Taylor (2004a; 2004b)*
661 *using the CReDEC12 as they were not intervention studies.*

662

663