



Improving the Provision of Hearing Care to Long-Term Care Home Residents with Dementia: Developing a Behaviour Change Intervention for Care Staff

RESEARCH

HANNAH CROSS

CHRISTOPHER J. ARMITAGE

PIERS DAWES

IRACEMA LEROI

REBECCA E. MILLMAN

*Author affiliations can be found in the back matter of this article



ABSTRACT

Context: Hearing loss disproportionately affects long-term care home (LTCH) residents with dementia, impacting their quality of life. Most residents with dementia rely on LTCH staff to provide hearing care. However, previous research shows provision is inconsistent. The Behaviour Change Wheel (BCW) can be used for developing behaviour-change interventions.

Objective: To describe the structured, multistage development of an intervention to help LTCH staff provide hearing care to residents with dementia.

Method: Using results from qualitative and quantitative studies and patient and public involvement sessions, we outlined problems associated with hearing care and determined the changes that should be made using the Capabilities, Opportunities, and Motivation-Behaviour Change Model. We then selected and specified five target behaviours for intervention, and identified relevant intervention functions, behaviour change techniques (BCTs), and modes of delivery.

Findings: The multi-component intervention is designed to boost the psychological capability, reflective motivation, and physical opportunity of care assistants. The intervention functions deemed most appropriate were education, modelling, incentivisation, and environmental restructuring, alongside several specific BCTs.

Limitations: Some of the larger-scale issues relating to hearing care, such as collaborations between LTCHs and audiology services and the costs of hearing devices, were not able to be addressed in this intervention.

Conclusions: This study is the first to use the BCW to develop an intervention targeting the staff's provision of hearing care to LTCH residents with dementia. This intervention addresses the wide-ranging barriers that staff experience when providing hearing care. Trialling this intervention will provide insight into its effectiveness and acceptability for residents and staff.

CORRESPONDING AUTHOR:

Hannah Cross

A3.16 Ellen-Wilkinson Building, Manchester Centre for Audiology and Deafness, University of Manchester, Oxford Road, Manchester, M13 9PL, United Kingdom

Hannah.cross-2@manchester.ac.uk

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INTRODUCTION

Dementia and hearing loss disproportionately affect the people living in long-term care homes (LTCHs) (Hoffmann et al., 2014; Prince et al., 2014). Over 70% of LTCH residents have dementia (Echalier, 2014), and approximately three-quarters have hearing loss (Hoffman et al., 2014). Comorbid hearing loss and dementia can impair communication abilities, exacerbate confusion, and cause loneliness (Crosbie et al., 2019; White et al., 2021). Most residents rely on LTCH staff to meet their hearing needs (Punch & Horstmanshof, 2019). When staff address the hearing needs of residents with dementia effectively, this can minimise agitation and social isolation and improve communication (Cross et al., 2022).

Despite the high prevalence of hearing loss in residents with dementia, many residents do not receive adequate hearing care (Andrusjak et al., 2020; Cross et al., 2022; Cross et al., 2023a; Cross et al., 2023b; Cross et al., 2023c). Hearing care may include hearing aids, personal sound amplification products (PSAPs), environmental adjustments, communication techniques, and more (Cross et al., 2022). However, the use of hearing aid is low for residents with dementia (Andrusjak et al., 2020; Cross et al., 2022), supplementary communication aids are not always provided (Bott et al., 2022), and excess noise in communal areas often disrupts communication (Pryce & Goberman-Hill, 2012). Several barriers contribute to the inconsistent hearing care provided by staff, including limited knowledge about hearing loss, time constraints, and low prioritisation of hearing within the care sector

(Andrusjak et al., 2020; Crosbie et al., 2019; Cross et al., 2022; Cross et al., 2023a). The absence of official guidelines compounds the issue, as residents with dementia often struggle with hearing aids and require additional support from care staff for their hearing (Cross et al., 2022; Cross et al., 2023a; Cross et al., 2023b; Leroi et al., 2021; Punch & Horstmanshof, 2019). Because many residents with dementia rely completely on care staff to meet their hearing needs (Cohen-Mansfield & Taylor, 2004; Punch & Horstmanshof, 2019), it is necessary to change staff behaviour by equipping them with the adequate abilities in order to ensure that residents receive hearing care.

The Behaviour Change Wheel (BCW) (Michie et al., 2014) is a framework designed to understand and change behaviour. The BCW outlines a step-by-step systematic approach to understanding problems surrounding behaviours and identifying interventions that may bring about behaviour change in the target group (e.g., the provision of hearing care to residents with dementia by LTCH staff). Researchers can use the three stages, including the eight steps of the BCW, to develop an intervention (Figures 1 and 2). Stage 1 of the BCW involves understanding people’s behaviour and what requires change. The Capabilities, Opportunities, and Motivations Model of Behaviour Change (COM-B) lies at the centre of the BCW and aids in understanding drivers of the target behaviour. The COM-B model hypothesises that a person’s capabilities (e.g., skills), opportunities (e.g., finances), and motivations (e.g., goals), drive behaviour. Identifying the domain(s) in which change is needed through intervention is the first stage. Stage 2 involves identifying intervention functions (e.g., Training

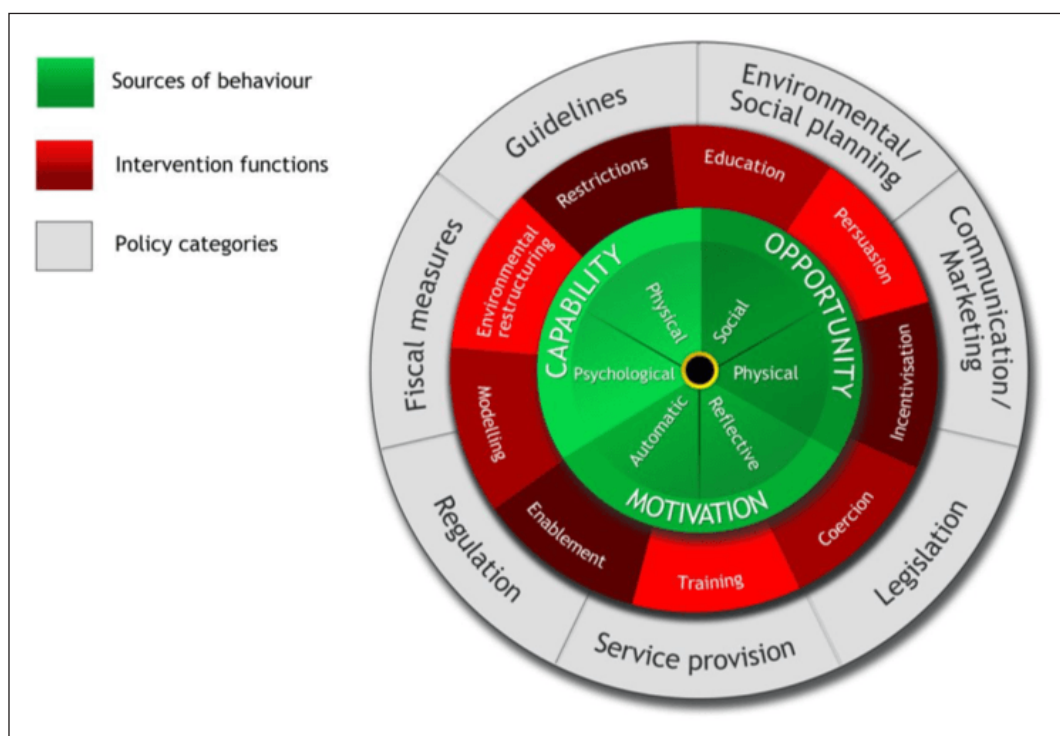


Figure 1 The Behaviour Change Wheel (Michie et al., 2014).

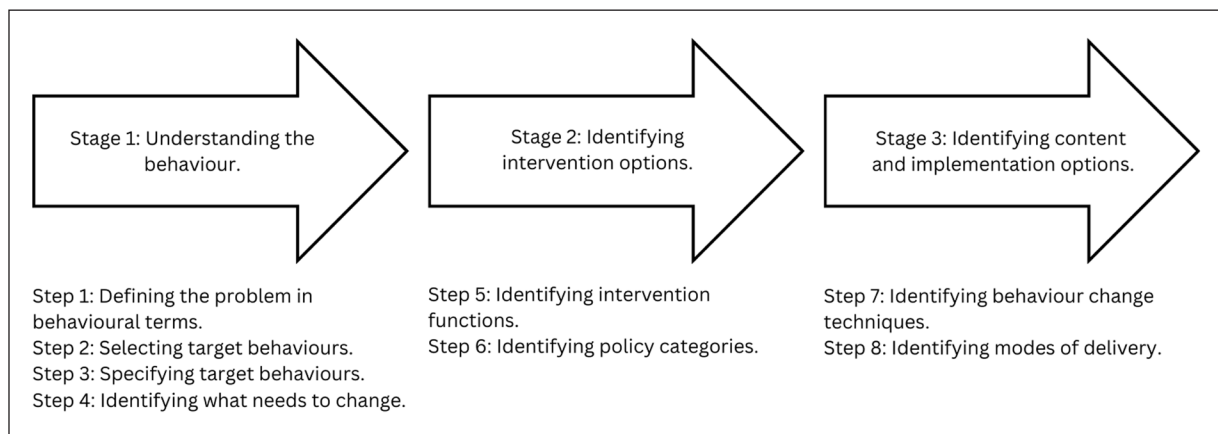


Figure 2 The 3 stages of the Behaviour Change Wheel, which are used to understand behaviour and subsequently identify intervention options and content to change behaviour.

or Environmental Restructuring) and policy categories (e.g., Regulation or Guidelines) from the BCW that may bring about this specific change in the necessary domain(s). Stage 3 includes selecting behaviour change techniques (BCTs) and modes of delivery for intervention. The APEASE criteria (Michie et al., 2014) can be used to guide researchers' decisions during these stages on what is affordable, practical, effective and cost-effective, acceptable, safe, and equitable within the context of the intervention.

The aim of this paper is to outline how we used the stages of the BCW to develop a behaviour change intervention to improve the hearing care provided to LTCH residents with dementia by LTCH staff. We have previously conducted primary research on the topic of hearing care within LTCHs (Cross et al., 2022; Cross et al., 2023a; Cross et al., 2023b). We have now used the results of these studies – a systematic review, surveys and interviews with staff and family carers, and additional Public and Patient Involvement (PPI) sessions – to design our intervention. The focus of the current paper is to describe the detailed, step-by-step development of our intervention.

Developing interventions using evidence guided by theory is beneficial for explicitly determining the cause of behaviour and practically selecting interventions most likely to change behaviour (Bartholomew & Mullen, 2011). Here, the three stages of the BCW are used to outline a transparent, evidence-based intervention. As hearing care in LTCHs is a complex issue with wide-ranging barriers, multi-component interventions are recommended for improving hearing care provided to people with dementia (e.g., Cross et al., 2022; Regan et al., 2019) and are more appropriate for complex settings.

METHODS

The BCW (see Figure 2) includes three stages (understanding behaviour, identifying implementation

options, and identifying intervention content) that are further divided into eight steps (defining the problem, selecting target behaviours, specifying target behaviours, identifying what needs to change, identifying intervention functions, identifying policy categories, identifying BCTs, and identifying modes of delivery).

PATIENT AND PUBLIC INVOLVEMENT (PPI)

PPI refers to research conducted *with* the public; not on or to them. PPI contributors are co-researchers; not study participants. Four PPI contributors were consulted to share their opinions on various aspects and the proposed delivery of the intervention. Contributors included an LTCH nurse, an assistant occupational therapist working across several LTCHs, an LTCH resident with hearing loss and dementia, and their family carer. All contributors, apart from the resident, took part in their own virtual informal discussion session lasting approximately one and a half hours with HC and REM on Zoom. The resident with dementia and hearing loss completed an adapted online questionnaire on the same subjects with the help of a caregiver, as the use of Zoom was not possible due to hearing and memory difficulties. All contributors lived and worked across England and Wales and were reimbursed with £30 cash or a voucher for their time. The PPI sessions focused on the contributors' perceived importance of the intervention, the acceptability and practicability of hearing aids and PSAPs within LTCHs, the acceptability and practicability of the hearing champion role (who is most appropriate for this role, what incentives might be appropriate for this person), meaningful outcomes and outcome measures, effective and practical recruitment and retention of staff and residents to the intervention, and acceptable reimbursement for intervention engagement.

STAGE 1: UNDERSTANDING THE BEHAVIOUR

Step 1: Defining the problem in behavioural terms

We first identified the problems with hearing care provision within LTCHs. To do this, we (Cross et al., 2022) conducted a systematic review of 16 studies to aid our understanding of the barriers (problems) and facilitators associated with providing hearing care to residents with dementia. We also conducted cross-sectional surveys with staff (N = 163) (outlined in Cross et al., 2023a) and family caregivers (N = 87) (outlined in Cross et al., 2023c) to further explore the problems and enablers. We then conducted follow-up semi-structured interviews with staff (N = 10) (outlined in Cross et al., 2023b) and family carers (N = 6) (outlined in Cross et al., 2023c).

Step 2: Selecting target behaviours

We then selected the behaviours related to hearing care provision that we will aim to change through intervention. Results from our systematic review (Cross et al., 2022) aided the selection of target behaviours based on how effective they are in improving outcomes for residents and staff. The primary research question of the systematic review was: How effective are hearing rehabilitation interventions for LTCH residents living with hearing loss and dementia? Public and Patient Involvement (PPI) sessions (N = 4) were conducted to discuss behaviours. Cost-effectiveness and practicality were considered as well.

Step 3: Specifying target behaviours

Target behaviours identified in Step 2 were then specified in greater detail regarding who, when, where, how, and with whom they would be performed. Our survey with care staff (Cross et al., 2023a) aided the specification of the target behaviour by identifying who would best benefit from intervention. This was also discussed with PPI contributors.

Step 4: Identifying what needs to change

The COM-B model (detailed within Figure 1) was used to develop a theoretical understanding of target behaviours and what needs to change for care staff to engage with these behaviours. Participants (Cross et al., 2023a) self-reported their physical and psychological capabilities, physical and social opportunities, and reflective and automatic motivation to provide hearing care to residents with dementia (behaviour). Using a brief, validated, universal COM-B measure (Keyworth et al., 2020), survey participants responded on “Strongly Disagree-Strongly Agree” 11-point Likert scales for each COM-B domain. Data were analysed descriptively and quantitatively to determine statistically significant differences between domain scores. Multiple linear regression was used to explore domains as predictors of behaviour (providing hearing care to residents with dementia and hearing loss).

To explore COM-B domains further, semi-structured interviews (Cross et al., 2023b) with care staff were analysed deductively by coding instances of the Theoretical Domains Framework (TDF) domains (Atkins et al., 2017). The TDF is a holistic 14-domain framework that can supplement the COM-B model, also used to explore determinants of behaviour. Relevant TDF domains identified via interviews with care staff were mapped onto corresponding COM-B domains (Cane et al., 2012) to understand what needs to change (outlined in Cross et al., 2023b). Pre-mapped matrices between COM-B domains and TDF are included in Appendix A. For example, the TDF domain “knowledge” maps to the COM-B domain “psychological capability”.

STAGE 2: IDENTIFYING INTERVENTION OPTIONS

Step 5: Identifying intervention functions

Included in the BCW are nine intervention functions (Figure 1) that map to each of the COM-B domains (mapping and definitions are displayed in Appendix B). Intervention functions are selected by evaluation of which would be most likely to affect behaviour change in the intervention in question. As a research team, we used the APEASE criteria (Michie et al., 2014) to select intervention functions (Appendix C). Using the BCW’s APEASE criteria helps to guide researchers in their discussions and decisions on which intervention function would be most appropriate for its intervention context (is it affordable, practical, effective and cost-effective, acceptable, safe, or equitable? Definitions of these criteria can be seen in Appendix C). There is a subjective element to using the APEASE criteria; we discussed each of the nine intervention functions in relation to our target domains, previous literature, and consultation with our PPI group. For example, we asked PPI contributors for their opinions on whether the function “modelling” would practically fit into the LTCH working culture and whether the function “incentivisation” would be appropriate. Intervention functions that did not meet the APEASE criteria checklist (Appendix C) were subsequently not incorporated into the intervention.

Step 6: Identifying policy categories

The BCW includes seven policy interventions, pre-mapped to each COM-B domain. As this intervention was not concerned with changing policy, we did not undertake this stage.

STAGE 3: IDENTIFY CONTENT AND IMPLEMENTATION OPTIONS

Step 7: Identifying BCTs

While intervention functions provide a broad approach to achieving behaviour change, Behaviour Change Techniques (BCTs) can be selected to plan the intervention in more detail. The BCT Taxonomy V.1 (Michie et al., 2013)

includes 93 BCTs. As there are links drawn previously between intervention functions and BCTs (Cane et al., 2012), and TDF domains and BCTs (Cane et al., 2015), we used these to guide our selection. The APEASE criteria (Appendix D) were used to make decisions on BCTs through conversations within our research team and in consultation with our PPI group.

Step 8: Identifying modes of delivery

Modes of delivery refer to the way in which the intervention will be delivered, such as face-to-face or over the phone. We developed the intervention delivery based on discussions with PPI contributors. PPI contributors were asked their opinions on which modes would be optimal for participants working and living in LTCHs, such as how they would like to receive training and their preferred options for participant reimbursement, among others.

RESULTS

STAGE 1: UNDERSTANDING THE BEHAVIOUR

Step 1: Defining the problem in behavioural terms

Our systematic review (Cross et al., 2022) identified the following behaviours as part of providing hearing care within LTCHs: managing hearing aids, PSAPs, visual aids, and using communication techniques. Barriers to effective hearing care, identified via systematic review (Cross et al., 2022) included: residents with dementia losing or rejecting hearing aids; finding PSAPs heavy; time pressures and lack of knowledge about hearing loss/hearing devices amongst staff; no staff delegation or routine for hearing care; excess noise in LTCHs; poor collaborations between LTCHs and audiologists resulting in inconsistent screening, check-ups, and earwax removal; and cost of hearing aids. The systematic search did not identify appropriate guidelines for supporting hearing loss for residents with dementia.

Survey results (Cross et al., 2023a) revealed that staff provide hearing care to only 50% of residents they believed would benefit and only 24.6% test or check residents' hearing aids. Barriers (problems) experienced by staff identified via survey and interview (Cross et al., 2023a; Cross et al., 2023b) included: poor training and knowledge on hearing loss/care; no delegated staff members for hearing care; difficulties when residents refuse, remove, or lose their hearing aids; and poor collaborations between LTCHs and audiology services.

For family caregivers of residents with dementia (Cross et al., 2023c), only 60% check resident's hearing devices and 50% use communication techniques when speaking to residents. Barriers (problems) for family

carers included (Cross et al., 2023c): lacking knowledge of hearing care; challenges when residents refuse, forget to use, lose, or break hearing aids; face masks hindering communication; costs of non-NHS hearing aids; poor collaborations between LTCHs and audiology services; and low priority of hearing loss in LTCHs and lack of clearly defined responsibilities for hearing care.

PPI feedback included: difficulties identifying hearing loss in residents with dementia; untreated hearing loss causing agitation, aggression, and loneliness in residents; apprehensions about hearing devices being uncomfortable for residents; residents forgetting, removing, and losing hearing aids; poor links between LTCHs and audiology services being worse for residents with dementia (inability to complete standard hearing tests or attend external appointments); no training on hearing loss/care; limited information on hearing loss in residents' care plans; no resources in the LTCH to facilitate communication (e.g., PSAPs); face masks impeding communication; background noise amplified by hearing aids; and no accountability for hearing loss amongst staff and high staff turnover making ownership for hearing care difficult.

Step 2: Selecting target behaviours

Table 1 outlines five target behaviours for this intervention. Many residents with dementia reject hearing aids (Cross et al., 2022). PSAPs that sit over the ears and are larger than hearing aids may offer an alternative or additional source of amplification that mitigates some difficulties with hearing aids. For residents who reject their hearing aid, a PSAP will be provided instead, in line with the American Speech-Language-Hearing Association (1997) guidelines for audiology service delivery in nursing homes. Residents will be given the chance to switch to a PSAP or use a PSAP alongside their hearing aid(s), after a two-week adjustment period to their hearing aid(s).

Step 3: Specifying target behaviours

Care staff were chosen as the target individuals, as residents with dementia are often unable to manage their hearing by themselves (Cross et al., 2023a; Punch & Horstmanshof, 2019). Survey results (Cross et al., 2023a) showed that working as a care assistant, compared to a registered nurse, was a significant predictor of providing hearing care to fewer residents with dementia. Therefore, care assistants (responsible for providing personal care to residents) will be the target group of LTCH staff. Working in a privately-owned LTCH (large company or chain), compared to a local authority-owned LTCH (UK local district, borough, council), also predicted lower engagement with behaviour (Cross et al., 2023a). Therefore, privately-owned LTCHs are the target setting. Most UK LTCHs are privately-funded, and most staff are care assistants (Skills for Care, 2022). Cross et al. (2023a)

TARGET BEHAVIOUR (WHAT?)	MANAGING AND CHECKING RESIDENTS' HEARING AIDS.	MANAGING AND CHECKING RESIDENTS' SOUND AMPLIFICATION DEVICES (PSAPS).	USING COMMUNICATION TECHNIQUES WHEN TALKING TO RESIDENTS.	WEARING A TRANSPARENT FACE MASK.	IMPROVING THE COMMUNICATION ENVIRONMENT.
Who?	Care assistants.				
When?	Inserting and checking hearing aids every morning during personal care. Re-inserting them throughout day if removed by the resident. Checking if the resident seems unable to hear. Removing hearing aids when assisting resident to bed.	Helping the resident put on their PSAP every morning during personal care. Assisting residents throughout the day when they would benefit, such as during a family visit. Checking if the resident seems unable to hear. Removing PSAPs when assisting residents to bed.	These target behaviours should be used in every interaction with residents with dementia and hearing loss.		
Where?	Privately-owned LTCHs.				
How?	Cleaning hearing aids daily by wiping/brushing the earmold and device, removing debris. Removing wax from the earmold using a pick. Testing the hearing aids daily. Soaking the earmold in warm water weekly. Changing batteries weekly. Sending the hearing aid to audiologist if repairs are needed.	Cleaning and testing the hearing device daily, wiping it down. Changing the batteries when required.	Maintaining eye contact, speaking clearly, slowly, and loudly, not shouting. Using short sentences and hand gestures. Giving time for the resident to respond. Rephrase questions if needed. Writing things down on the whiteboard or using flashcards if needed.	Putting a transparent mask on before interacting with the resident, changing the mask after personal care. Following Personal Protective Equipment guidance.	Turning down television and radio volume, finding a quiet area to talk to resident.
With whom?	Residents with dementia (hearing aid accepted).	Residents with dementia (hearing aid rejected or required alongside hearing aid).	Residents with dementia.		

Table 1 Target behaviours selected and specified for this intervention (Step 3).

found no differences between type (nursing or residential) or size of LTCH relating to hearing care provision.

Family members are not the targets for this intervention as their visits to LTCHs and hands-on care can be intermittent (Cross et al., 2023c). Overall, we did not have enough evidence to incorporate family into the intervention at this time.

Step 4: Identifying what needs to change

Survey results (Cross et al., 2023a) showed that the physical capability scores of care staff were significantly higher than those of reflective motivation, physical opportunity, and social opportunity. Psychological capability scores were also significantly higher than physical opportunity scores. Physical opportunity was a significant predictor of behaviour; staff who perceived themselves as having fewer physical opportunities to provide hearing care did so for fewer residents with dementia. The following domains were identified as barriers for care staff via semi-structured interviews (Cross et al., 2023b): psychological capability (knowledge), physical opportunity (environmental context and resources), and reflective motivation (optimism and social/professional role and identity). Facilitators related to reflective motivation (beliefs about consequences and social/professional role and identity). Specific barriers/problems and facilitators are outlined in Table 2 under these COM domains.

STAGE 2: IDENTIFYING INTERVENTION OPTIONS

Step 5: Identifying intervention functions

Appendix C shows our assessment of each intervention function against the APEASE criteria (Michie et al., 2014). Selected intervention functions are Education, Training, Incentivization, Modelling, and Environmental Restructuring.

Step 6: Identifying policy categories

Policy categories were not selected.

STAGE 3: IDENTIFY CONTENT AND IMPLEMENTATION OPTIONS

Step 7: Identifying BCTs

BCTs are outlined in Table 2.

Step 8: Identifying modes of delivery

Face-to-face was chosen as the mode of delivery for group-level Education and Training, which would be delivered by a member of the research team addressing psychological capability at the start of the intervention. All staff involved in the intervention will have protected time to attend a paid one-off 2-hour interactive session

(Table 2), deemed acceptable and preferable by PPI contributors. A PowerPoint presentation and printed training booklet will be provided to staff. Hearing Champions (Table 2) will receive an additional 1-hour training session on their responsibilities. An additional purpose of this training session is to help staff build confidence to take accountability for the intervention. This will be supported by telephone, email, and video calls from the research team on an individual basis where necessary. In PPI sessions, care staff expressed the desire for links with and support from researchers leading the intervention. Free-to-access online videos and step-by-step printed material will be provided to staff to access when they feel the need to refresh their knowledge. *Environmental restructuring* (Table 2) will be delivered face-to-face at the start of the intervention, providing staff with the necessary resources. All staff will be incentivised with a monetary or voucher payment to facilitate training and intervention engagement, deemed necessary by PPI contributors. Hearing Champions will be incentivised monthly during the intervention due to the role and increased workload. *Incentivisation* will be provided face-to-face or remotely, depending on the participants' preferences. The Hearing Champions will perform *Modelling* independently.

DISCUSSION

This paper describes the structured development of an intervention designed to improve hearing care provided by LTCH staff to residents with dementia. The components of this intervention were identified using the results of four studies and PPI with key stakeholders. The intervention aims to engage staff in five target behaviours, which can theoretically be engaged in via five intervention functions: *Education*, *Training*, *Incentivization*, *Modelling*, and *Environmental Restructuring*, as well as several additional specific BCTs. The selection of these intervention functions was guided by our previous studies (Cross et al., 2023a; Cross et al., 2023b) using the COM-B model, where *psychological capability*, *reflective motivation*, and *physical opportunity* were the areas in which care staff required change.

Research has highlighted a growing need for improvements in hearing care within LTCH settings; particularly for residents with dementia (Cross et al., 2022; Punch & Horstmanshof, 2019). However, to date, few high-quality interventions have been developed to improve practice. Previous assessments conducted by two independent reviewers about hearing care interventions using the Mixed Methods Appraisal Tool, the Criteria for Reporting the Development and Evaluation of Complex Interventions in healthcare, and Level of Evidence tools, found study quality to be of low-to-moderate

COM DOMAIN	TDF DOMAIN	THE PROBLEM	IDENTIFIED OR SUPPORTED VIA	INTERVENTION FUNCTIONS	BCTs	INTERVENTION STRATEGY
Psychological Capability	Knowledge	Lack of knowledge about hearing loss: identifying hearing loss in residents with dementia, hearing aid management, and hearing care.	Systematic review Interviews PPI	Education Training	Instruction on how to perform a behaviour. Demonstration of the behaviour. Feedback on behaviour. Behavioural/ practice rehearsal. Material reward (behaviour).	Provide verbal instructions and demonstrations during the training workshop on hearing aids and PSAPs management (cleaning, battery change, retubing, inserting, and removing PSAPs). Allow for physical practice and verbal feedback. Provide written and online step-by-step instructions. Demonstrate communication techniques during the workshop and provide written information in the training pack. Allow for physical practice and provide verbal feedback. Provide verbal information on the signs of hearing loss in residents with dementia and written information in the training pack. Info pack to be kept on the nurses' station for easy access. Participants to receive remuneration for attending workshop.
Physical Opportunity	Environmental context and resources.	Time pressures. High staff turnover. Excess noise in the LTCH.	Systematic review PPI Systematic review PPI	Not practical Not practical Education Environmental restructuring	Information on emotional consequences. Information on social and environmental consequences. Instruction on how to perform a behaviour. Restructuring the physical environment.	Provide verbal information on the impact of excessive noise in LTCH for residents (confusion, social isolation, etc.) during the workshop. Provide verbal information on techniques to reduce noise in LTCH (turning down television/ radio volume in communal areas, moving into a quiet area to communicate, using communication techniques; intervention as above).
		Poor collaborations between LTCHs and audiologists. Cost of hearing aids.	Systematic review Interviews PPI Systematic review (non-UK)	Not practical Not practical		
		Low physical opportunity (overall) to provide hearing care to residents with dementia, predicting behaviour.	Survey	Environmental restructuring	Adding objects to the environment.	Provide hearing aid(s) and/or PSAPs to residents with dementia and hearing loss who take part in the intervention. Provide the training pack for staff to access when needed. Provide flashcards, whiteboards, and other supplementary materials to use alongside hearing devices.

(Contd.)

COM DOMAIN	TDF DOMAIN	THE PROBLEM	IDENTIFIED OR SUPPORTED VIA	INTERVENTION FUNCTIONS	BCTs	INTERVENTION STRATEGY
Reflective Motivation	Optimism	Difficulties supporting residents with hearing aids (refusing, losing, removing them often).	Systematic review Survey Interviews PPI	Education Environmental restructuring	Adding objects to the environment. Focus on past success.	Provide residents with named cases for hearing aids and PSAPs. Hearing aids and PSAPs to be labelled. Encourage staff to focus on times that residents have benefitted from hearing devices and how this was achieved, despite difficulties.
		Despondency about appropriateness of audiology services for residents with dementia.	Interviews PPI	Not practical		
	Social/professional role & identity	No staff delegation for hearing care	Systematic review Survey Interviews PPI	Modelling Incentivisation	Identification of self as a role model. Identity associated with changed behaviour. Material incentive (behaviour). Material reward (behaviour).	Hearing Champions to take ownership of managing residents' hearing devices and the LTCH noise levels where possible. Hearing champions to be responsible for assisting other staff with hearing care. Hearing champions to be the point of contact for researchers. Researcher to inform Champion of material reward, acting as an incentive (money or voucher) to be given each month and at the end of the intervention to boost motivation and engagement, reducing potential attrition.
	Beliefs about consequences	Motivated by the consequences of providing hearing care to residents with dementia.	Interviews PPI	Education	Information about health consequences. Information about social and environmental consequences. Information about emotional consequences. Sallience of consequences.	Provide verbal and written information on the consequences of untreated and undertreated hearing loss in residents with dementia (increased risk of falls, confusion, loneliness, etc.) during the workshop and in the training pack. Inform the impact that these symptoms have on residents, staff, and family (knock-on effect to other residents and caregivers, increased reliance on caregivers, and increased paperwork for staff following a potentially avoidable incident/ fall). Following education on the impact of untreated hearing loss, staff are to know these signs to check hearing devices/noise levels if resident displays these symptoms.

Table 2 Overview of intervention development using the BCW. The first four columns (COM domain, TDF domain, The problem, Identified via) display BCW Steps 1-4 using findings from our previous studies. The final three columns (Intervention functions, BCTs, Intervention Strategy) display BCW Steps 5-8.

quality (Cross et al., 2022). High-quality interventions were person-centred, involved randomisation and a control group, and piloted the intervention (McCallion et al., 1999; McGilton et al., 2017). Additionally, most previous interventions were either not dementia-specific (e.g., Looi et al., 2004; Suzuki et al., 2018) or excluded residents with dementia from participating (Goorabi et al., 2008). We propose that an evidence-based intervention developed specifically to help staff with dementia is required. Additionally, previous interventions have almost exclusively been implemented in the USA or Canada (Cross et al., 2022), where health- and social-care infrastructures can differ greatly from the UK’s health- and social-care systems.

STRENGTHS AND LIMITATIONS

The use of the BCW is a strength of this intervention development. No prior intervention aimed at improving the ability of care staff to provide hearing care was, to our knowledge, developed using a behavioural theory. For example, educational interventions aimed at improving care staff knowledge and skills surrounding dementia and hearing loss can be beneficial (McCallion et al., 1999; McGilton et al., 2017). However, the potential benefits of addressing motivation alongside training for long-term behaviour change is unknown. This may be the reason for the variable engagement and adherence to previous interventions designed for LTCHs, where competing demands are high and motivation may be low (McCallion et al., 1999; Jupiter et al., 2016; McGilton et al., 2017). The multi-component aspect of the proposed intervention, addressing the capabilities, opportunities, and motivation may therefore be more successful than a single-component intervention. In addition, PPI in implementation and intervention research can lead to higher-quality, more ethical research that has a greater chance of being accepted and integrated into contexts unfamiliar with research (e.g., LTCHs) (Gray-Burrows et al., 2018).

However, our intervention will not address some of the larger-scale issues. For example, improving the collaborative relationship between LTCHs and audiology services did not pass the APEASE criteria. Such an issue goes beyond our scope but does remain a prevalent issue for staff and family carers (Cross et al., 2023b; Cross et al., 2023c; Höbler et al., 2018; Punch & Horstmanshof, 2019). Additionally, our own studies that informed the development of this intervention focused on caregivers only. It would have been beneficial to include audiologists to further understand the suitability of hearing devices for residents with dementia and to provide guidance on how to improve the working relationships between UK LTCHs and UK

audiology services. The inclusion of both stakeholder groups should be considered in future.

CONCLUSION

The aim of this paper was to detail how we used each stage of the BCW to develop a hearing care intervention for use within LTCH settings. Piloting this intervention is the next stage. The outcome of a pilot study would inform the potential for a larger trial and determine the intervention’s effectiveness and acceptability. The negative impacts caused by unsupported hearing loss and dementia (Cross et al., 2023b; White et al., 2021) make an intervention such as this important. While the provision of hearing care to residents with dementia can be complex, the structural approach taken here identifies and targets multi-level barriers and has the potential to improve communication and hearing-related outcomes such as social engagement, mood, and behaviour of residents with dementia and hearing loss (Cross et al., 2022).

APPENDIX

COM-B DOMAIN		TDF DOMAIN
Capability	Psychological	Knowledge
		Skills
	Physical	Memory, attention, and decision processes
		Behavioural regulation
Opportunity	Social	Social influences
	Physical	Environmental context and resources
Motivation	Reflective	Social/professional role and identity
		Beliefs about capabilities
		Optimism
		Beliefs about consequences
	Automatic	Intentions
		Goals
		Social/professional role and identity
		Optimism
		Reinforcement
		Emotions

Appendix A Guidance for mapping the COM-B and TDF domains (Cane et al., 2012).

INTERVENTION FUNCTION										
COM-B DOMAIN	EDUCATION	PERSUASION	INCENTIVISATION	COERCION	TRAINING	RESTRICTION	ENVIRONMENTAL RESTRUCTURING	MODELLING	ENABLEMENT	
Physical capability					X					X
Psychological capability	X				X					X
Reflective motivation	X	X	X	X						
Automatic motivation	X		X	X			X	X		X
Physical opportunity						X	X			X
Social opportunity						X	X			X

Appendix B Intervention functions that can be used to bring about change for the COM-B domains. (Michie et al., 2014).

Education: Increasing knowledge or understanding.

Persuasion: Using communication to induce positive or negative feelings or stimulate action.

Incentivisation: Creating expectation of reward.

Coercion: Creating expectation of punishment or cost.

Training: Imparting skills.

Restriction: Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours).

Environmental restructuring: Changing the physical or social context.

Modelling: Providing an example for people to aspire to or imitate.

Enablement: Increasing means/ reducing barriers to increase capability or opportunity.

INTERVENTION FUNCTIONS	DOES THE INTERVENTION FUNCTION MEET THE APEASE CRITERIA (AFFORDABILITY, PRACTICABILITY, EFFECTIVENESS/COST-EFFECTIVENESS, ACCEPTABILITY, SIDE-EFFECTS/SAFETY, EQUITY) IN THE CONTEXT OF HEARING CARE?
Education	Yes.
Persuasion	Not likely to be effective as staff already appear motivated to provide this care generally.
Incentivisation	Yes.
Coercion	Not acceptable for care staff.
Training	Yes.
Restriction	Not safe or practical as restricting staffs' engagement with other care may result in unsafe consequences for residents.
Environmental restructuring	Yes (Small environmental changes).
Modelling	Yes.
Enablement	No.
Selected intervention functions:	Education, Incentivisation, Training, Environmental Restructuring, and Modelling.

Appendix C APEASE judgement for intervention function selection.

APEASE definitions (Michie et al., 2014):

Acceptability: Acceptability refers to the extent to which an intervention is judged to be appropriate by relevant stakeholders (public, professional, and political). Acceptability may differ for different stakeholders. For example, the general public may favour an intervention that restricts marketing of alcohol or tobacco, but politicians considering legislation on this may take a different view.

Practicability: An intervention is practicable to the extent that it can be delivered as designed through the means intended to the target population. For example, an intervention may be effective when delivered by highly selected and trained staff and extensive resources but in routine clinical practice this may not be achievable.

Effectiveness: Effectiveness refers to the effect size of the intervention in relation to the desired objectives in a real-world context. It is distinct from efficacy, which refers to the effect size of the intervention when delivered under optimal conditions in comparative evaluations.

Affordability: Interventions often have an implicit or explicit budget. It does not matter how effective, or even cost-effective it may be if it cannot be afforded. An intervention is affordable if within an acceptable budget it can be delivered to, or accessed by, all those for whom it would be relevant or of benefit.

Side-effects: An intervention may be effective and practicable, but have unwanted side-effects or unintended consequences. These need to be considered when deciding whether or not to proceed.

Equity: An important consideration is the extent to which an intervention may reduce or increase the disparities in standard of living, wellbeing or health between different sectors of society.

RELEVANT TDF DOMAIN	BCT ASSOCIATED WITH TDF DOMAIN	DOES THE BCT MEET THE APEASE CRITERIA (AFFORDABILITY, PRACTICABILITY, EFFECTIVENESS/COST-EFFECTIVENESS, ACCEPTABILITY, SIDE-EFFECTS/SAFETY, EQUITY) IN THE CONTEXT OF HEARING CARE?
<i>Lack of knowledge of hearing loss, hearing aids, hearing care generally, identifying hearing loss in residents with dementia, and Excess noise in the LTCH.</i>	Feedback on behaviour	Yes
	Biofeedback	Not effective
	Information on antecedents	Not effective for this domain
	Information on health consequences	Not effective for this domain
	Information on emotional consequences	Yes
	Instruction on how to perform a behaviour	Yes
	Demonstration of the behaviour	Yes
	Behavioural/ practice rehearsal	Yes
	Reattribution	Not effective
	Behavioural experiments	Not effective

RELEVANT TDF DOMAIN	BCT ASSOCIATED WITH TDF DOMAIN	DOES THE BCT MEET THE APEASE CRITERIA (AFFORDABILITY, PRACTICABILITY, EFFECTIVENESS/COST-EFFECTIVENESS, ACCEPTABILITY, SIDE-EFFECTS/SAFETY, EQUITY) IN THE CONTEXT OF HEARING CARE?
	Information on social and environmental consequences	Yes
Social/professional role & identity: <i>No staff delegation/responsibility for hearing care.</i>	Identification of self as a role model	Yes
	Self-affirmation/valued self-identity	Not effective
	Identity associated with changed behaviour	Yes
	Framing/Reframing	Not effective
	Incompatible beliefs/Cognitive dissonance	Not effective
	Credible source	Not practical
	Social support (unspecified)	Not effective
	Social comparison	Not acceptable
	Material incentive (behaviour)	Yes
	Material reward (behaviour)	Yes
	Non-specific reward	Not practical
	Social reward	Not practical
	Social incentive	Not effective
	Non-specific incentive	Not acceptable/practical
	Incentive (outcome)	Yes
	Reward (outcome)	Yes
	Self-reward	Not acceptable/practical
	Reward (outcome)	Not acceptable/practical
Punishment	Not acceptable	
Optimism: <i>Difficulties supporting residents with hearing aids (refusing, losing, removing often).</i>	Focus on past success	Yes
	Verbal persuasion to boost self-efficacy	Not effective
	Review outcome goal	Not effective
Beliefs about consequences: <i>Motivated by the consequences of providing hearing care to residents with dementia.</i>	Information about health consequences	Yes
	Salience of consequences	Yes
	Information on social and environmental consequences	Yes
	Anticipated regret	Not appropriate
	Information on emotional consequences	Yes
	Pros and cons	Not effective
	Prompts/cues	Not effective
	Comparative imagining of future outcomes	Not effective
	Material incentive (behaviour)	Not appropriate for this domain
	Incentive (outcome)	Not appropriate for this domain
	Material reward (outcome)	Not appropriate for this domain
	Threat/future punishment	Not appropriate
Vicarious consequences	Not effective	

RELEVANT TDF DOMAIN	BCT ASSOCIATED WITH TDF DOMAIN	DOES THE BCT MEET THE APEASE CRITERIA (AFFORDABILITY, PRACTICABILITY, EFFECTIVENESS/COST-EFFECTIVENESS, ACCEPTABILITY, SIDE-EFFECTS/SAFETY, EQUITY) IN THE CONTEXT OF HEARING CARE?
	Covert sensitisation/imaginary punishment	Not effective
	Covert conditioning/imaginary reward	Not effective
Environmental context and resources: <i>Excess noise in the LTCH and Low physical opportunity (overall) to provide hearing care to residents with dementia, predicting behaviour.</i>	Social support (practical)	Not effective
	Prompts/cues	Not effective
	Discriminative (Learned) Cue	Not effective
	Remove aversive stimulus	Not effective
	Restructuring the physical environment	Yes (small changes)
	Restructuring the social environment	Not effective
	Avoidance/reducing exposure to cues for the behaviour	Not effective
	Adding objects to the environment	Yes
	Discriminative (learned) cue/cue signalling reward	Not effective

Appendix D APEASE judgement for BCT selection.

APEASE definitions (Michie et al., 2014):

Acceptability: Acceptability refers to the extent to which an intervention is judged to be appropriate by relevant stakeholders (public, professional, and political). Acceptability may differ for different stakeholders. For example, the general public may favour an intervention that restricts marketing of alcohol or tobacco, but politicians considering legislation on this may take a different view.

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ETHICS AND CONSENT

This is not a primary research study; therefore, ethical approval was not required. However, all primary research studies that informed the development of this intervention received favourable ethical review from the University of Manchester Research Ethics Committee (2021-11502-18581 and 2020-10261-16439). All participants provided informed consent prior to taking part in these studies.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

HC, RM, CJA, IL, and PD designed the studies that informed the development of this intervention. HC collected and analysed the data associated with these studies. HC, CJA and RM made substantial contributions to the conception and design of the current paper. RM co-analysed the qualitative data associated with the studies that informed the development of this intervention. All authors (HC, RM, CJA, PD, and IL) drafted or substantially revised the work used to develop the current intervention paper. All authors read and approved the final manuscript of this intervention development and have agreed to be accountable for their own contributions to the work.

AUTHOR AFFILIATIONS

Hannah Cross  orcid.org/0000-0002-9153-1135

Manchester Centre for Audiology and Deafness, School of Health Sciences, University of Manchester, Manchester, United Kingdom

Christopher J. Armitage  orcid.org/0000-0003-2365-1765

Manchester Centre for Health Psychology, University of Manchester, Manchester, United Kingdom; Manchester University NHS Foundation Trust, Manchester Academic Health Science Centre, Manchester, United Kingdom; NIHR Greater Manchester Patient Safety Translational Research Centre, University of Manchester, Manchester, United Kingdom; NIHR Manchester Biomedical Research Centre, Manchester University Hospitals NHS Foundation Trust, Manchester Academic Health Science Centre, Manchester, United Kingdom

Piers Dawes  orcid.org/0000-0003-3180-9884

Manchester Centre for Audiology and Deafness, School of Health Sciences, University of Manchester, Manchester, United Kingdom; NIHR Manchester Biomedical Research Centre, Manchester University Hospitals NHS Foundation Trust, Manchester Academic Health Science Centre, Manchester, United Kingdom; Centre for Hearing Research (CHEAR), School of Health and Rehabilitation Sciences, University of Queensland, Australia

Iracema Leroi  orcid.org/0000-0003-1822-3643

Global Brain Health Institute and School of Medicine, Trinity College Dublin, Dublin, Ireland

Rebecca E. Millman  orcid.org/0000-0001-8606-0167

Manchester Centre for Audiology and Deafness, School of Health Sciences, University of Manchester, Manchester, United Kingdom; NIHR Manchester Biomedical Research Centre, Manchester University Hospitals NHS Foundation Trust, Manchester Academic Health Science Centre, Manchester, United Kingdom

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