

### Using mHealth technologies to increase the three I's: individualisation, interactivity and inclusivity

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## MMHL research programme



Aim: to seek new knowledge and clinical strategies to overcome social activity and participation restrictions arising from difficulties in hearing  $\rightarrow$  improve quality of life





## What is mhealth?



- Delivers healthcare by mobile technologies
- A subgroup of telehealth, ehealth and telemedicine

## Mobile technology use is increasing in older adults



#### Smartphone ownership in 55+ year olds





(Deloitte, 2017)

## Smartphone mode of delivery (mhealth): benefits

Overcome barriers time, mobility, geography

Easy access and convenience

Personalised tailored information to meet individual's needs

Interactive, enabling selfmonitoring and self-evaluation

Social network opportunities

Limited healthcare resources

Training healthcare workers







Empowerment

Better knowledge and understanding

Greater engagement and self-management

Increase social support

Low cost, high volume, new service delivery models



Increase awareness of hearing loss

and more.....

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National Institute for

Health Research









(ENT and Audiology News, special issue on mhealth, Ferguson guest editor, 2017)

## mHealth for hearing care and self-management





(ENT and Audiology News, special issue on mhealth, Ferguson guest editor, 2017)

#### mHealth enables National Institute for self-management of long-term conditions

- Provision of education to improve knowledge
- Strategies to support adherence to treatment
- Tailoring of practical support
- Psychological strategies adjustment to life with LTC
- Social support as appropriate
  - Communication partners
  - Peers
  - Professional
  - Online support



(Taylor et al, 2014)

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(Taylor et al, 2014)

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to life with LTC



### **Listening devices**





### Hearing aids are effective





"The evidence is compatible with the widespread provision of hearing aids as the first-line clinical management in those seeking help for hearing difficulties"

(Ferguson et al, Cochrane Review: Hearing aids for adults with mild to moderate hearing loss, 2017)



• Majority (2/3) who would benefit from hearing aids do not have them

(Davis et al. HTA, 2007)

• Hearing aid non-use variable: 3-24%

(Ferguson et al, 2017)

Implement a new FDA device category for over-the-counter (OTC)
 wearable hearing devices separate from hearing aids
 (National Academies of Sciences, Engineering, and Medicine, 2016)

 "Can new technologies replace hearing aids?" ranked as the 5<sup>th</sup> research priority by patients and audiologists



(Henshaw et al. Lancet, 2015)

#### National Institute for Accessibility and use Health Research Majority (2/3) who would benefit from hearing aids dre them HTA, 2007) ies imp Hearing aid non-use variable: 3-24% A technolog (Ferguson et al, 2017) Implement a new FDA over-the-counter (OTC) wearable hearing from hearing aids *Temies of Sciences, Engineering, and Medicine, 2016)* Connologies replace hearing aids?" as the 5<sup>th</sup> research priority by patients ra and audiologists (Henshaw et al. Lancet, 2015)

# Smartphone-connectivity:





Self-fitting



**User-adjustment** 



**Remote delivery** 

#### Usability of alternatives in 'real-world'. NHS National Institute for Health Research

➢Q: Views on alternative listening devices: usability, acceptability and adherence?





(Maidment & Ferguson, 2017)

Factors that affect a particular health **behaviour**  $\rightarrow$  use of alternative listening device to manage hearing loss



Guiding Principles



**COM-B** health behaviour change model

(Michie et al, 2011; 2014; Coulson et al, 2016)

## Differences between alternative devices



		Capability	Opportunity	Motivation
Smartphone hearing aid	<ul> <li>Easy to use and adjust</li> <li>Improved listening</li> <li>Control and confidence</li> </ul>			
PSAP	<ul> <li>Difficult to use</li> <li>Sound quality mixed</li> <li>Discrete/less noticeable</li> </ul>	×	?	
Hearable	<ul> <li>Difficult to use</li> <li>Delay intolerable</li> <li>'Young' and 'trendy'</li> </ul>	×		?
Smartphone app	<ul> <li>Straight forward to use</li> <li>Helpful in quiet</li> <li>Self-conscious</li> </ul>		?	×

## Capability Knowledge and skills



• The devices should be simple and intuitive to use

"You want something you take out of the box and it's ready to go."

• Online support was preferred for troubleshooting

"YouTube videos would be the first place that I would look to get support. [...] If a video shows me, that's just as good as someone sat in front of me showing me."

## **Opportunity** Social & environmental



• User-control to make fine-tune adjustments had an impact on participation

"[the app] gave me a higher possibility of being able to hear what's being said and join in."

 Concern about the views of others when using devices not typically associated with hearing loss

"People think that you're listening to something, and that you're being rude, but you're not, you're listening to them."

## Motivation Identity, beliefs, emotions



• **User-control** to make fine-tune adjustments elicited **positive emotions** 

"It gives me that bit of control, and it's not other people running my life, it's me."

• The devices were viewed as potentially less stigmatising

"If I just look as if I've got ear buds in, people will just treat me normally."

Greater sense of autonomy and empowerment, less frustration, greater device use

# General lack of awareness of alternative devices





- **116** adults with self-reported hearing difficulties
- Little awareness/experience
- 'Very interested'
- Highest ranking features user-controllability:
  - 1. volume
  - 2. sound quality
  - 3. directionality

(Maidment & Ferguson, 2018)

## mtech innovations: evaluation of the 3xls



#### eAdjust application

- Benefits of user-set conditions compared to factory presets
- To explore and identify patient preferences and usability
- N=44 new and existing users
- Android vs iPhone!

PHONAK



#### **NHS** National Institute for Health Research

#### **Remote access delivery model**



'How-to' toolkit

 $\rightarrow$  new service model





## Take home message

- New and emerging listening devices alongside mobile technologies enables greater
  - opportunities for new service delivery models
  - choice of device
    - different pros and cons may be dependent on individual needs



The potential for improved patient outcomes is evident and could transform adult audiology services



## eHealth and self-management









If you are an audiologist

- How confident are you that the information and advice you offer your first-time hearing aid patients is
  - understood
  - absorbed
  - and then acted upon

once they leave the comfort of your clinic room?



### Question to audiologists:

I am confident that the information given is remembered and acted upon by my hearing aid patients





# Knowledge of all things hearing is poor



- Patients, public, practitioners
  - Experienced hearing aid users
    - hearing aids and how to use them poor to excellent
    - 60-80% did not know how to use the telephone

(Desjardin & Doherty, 2009)

(Goggins & Day, 2003)

Hearing aid non-use

Costs: financial - individual and healthcare systems person with hearing loss = communication difficulties → reduced social interaction → poorer QoL

- Health context
  - better knowledge increases patient satisfaction and treatment compliance

(Murray et al, 2005)

- Hearing aid users have a desire for additional information
  - both before and after the fitting appointments

(Laplante Levesque et al, 2013; Kelly et al, 2013)

## **HEAR-IT** study



Q: Do video tutorials (or RLOs) *supplement* advice and information provided by audiologists and result in enhanced benefit and use for hearing aid users?

- 1. To *develop a* series of reusable learning objects (RLOs)
  - range of auditory rehabilitation subjects
  - accessible to hearing aid users and their families
- 2. To evaluate the benefits and cost-effectiveness of the RLOs



#### Research for Patient Benefit

inspired by patients and practice

## **Re-usable learning objects**



Commonly used in elearning environments



- Participatory approach  $\rightarrow$  high quality materials aligned to the user's needs
- Improve motivation and compliance with health treatments

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# Participatory design: to identify content





Consensus n=33 hearing healthcare professionals

n=33 hearing aid users n=11 audiologists







(Ferguson et al, Int J Audiol, 2018)

## Participatory design: to develop RLOs





(: e.g.e.e., ..., ...e., ..., ..., ...,

## The end-product: interactive multimedia RLOs for HA users

**NHS** National Institute for Health Research





(Ferguson et al, Ear Hear, 2016)

## Evaluation: Clinically registered RCT (N=203)



Take-up and adherence

Self-management

HA knowledge & skills



Take-up = 78% 94.3% watched all RLOs

2+ times = 49.9% Re-use suggested selfmanagement Better knowledge on HAs and communication & HA handling skills

HA use



Greater use (GHABP) suboptimal users



Valued by users



Rated RLOs as highly useful (9/10) Improved confidence Preferable to written info **Health economics** 



RLOs were a very effective and cheap healthcare intervention

(Ferguson et al, Am J Aud 2015; Ear Hear, 2016)

## 'Active ingredients' of C2Hear



Identified which aspects of the Theoretical Domains Framework (TDF) are present • in each RLO  $\rightarrow$  mapped onto the COM-B model



What to expect when wearing hearing aids

<sup>(</sup>Maidment et al., in prep)

## Underlying processes



#### **Contextual factors**

External factors that inform
 WHY the intervention works

## Greater hearing aid self-efficacy predicted:

- Greater use
- Reduced emotional consequences of hearing loss (e.g. anxiety)
- Greater hearing aid handling skills and knowledge

#### **Causal mechanisms**

Mechanisms of impact - HOW
 the intervention works

#### Improved hearing aid handling skills and knowledge led to:

- Greater use, benefit and satisfaction
- Reduced emotional consequences of hearing loss (e.g. anxiety)
- Increased patient activation

(Process evaluation of complex interventions: Medical Research Council guidance. Moore et al. BMJ, 2015 (Maidment et al, Int J Audiol, in prep)

# Early delivery of C2Hear improves self-efficacy



Measure of Audiological Rehabilitation for Self-efficacy for Hearing Aids (MARS-HA):



Early delivery of C2Hear 'primes' patients for their hearing aid fitting (Gomez & Ferguson, in prep)

### Question to audiologists:

I am confident that the information given is remembered and acted upon by my hearing aid patients





• Vast majority were more confident





#### Research into practice





You

## Getting C2Hear out there: impact



Just google 'C2Hear Online YouTube' NIHR Nottingham Biomedical Research Centre

- 4x increase in second year, ~6000/month
- Views from >50 countries: 38% UK 38% N America
- Used in UK audiology departments, on ~30 websites
- Included in national guideline documents
- Research Impact awards; REF potential 4\*



British Society of Audiology

KNOWLEDGE | LEARNING | PRACTICE | IMPACT

National Institute for Health and Care Excellence

## Towards an mhealth self-management system



- Knowledge
- Individualised
- Interactive
- Inclusive
- Shared decision-making •
- Monitoring
- Self-evaluation
- Peer support



**Patients** 

**Non-audiological HCP** 



## mRLOs tailored for hearing aid users (m2Hear)



## Individualised - tailored to meet National Institute for user's specific needs (m2Hear)



## Greater interactivity



Mel - You have selected information on Getting used to your hearing aids. Back What can I expect when wearing hearing aids for the first time? How do I get used to wearing my hearing aids? OCT How can I get used to wearing my hearing aids? You may wish to become familiar and comfortable 0:42 / 2:01 • 🖸 : with the sounds in your own home at first

## Greater interactivity



#### Drag and drop

How do I work with others to help me take part in conversations?

#### Hearing problems and solutions activity

Here are some situations you might recognise with suggested solutions.

Activity: Drag which solution you think would be best to each problem.



#### More activities

## Self-efficacy for hearing aids and National Institute for hearing handicap significantly improved

40

Self-efficacy for hearing aids (MARS-HA)

Hearing handicap (HHIE)







## What the patients said



• Provides reminders

"[m2Hear] started to change my life. I had... a prop basically... something to fall back onto if there was a problem."

Convenient to re-visit

It's more convenient to use, wherever you are. You just get your phone out.

Comprehensive content

"I knew which section to go to and there were details in there that would gave me what I needed."

#### Mational Institute for Mational Institute for Mational Institute for Mealth Research

Mohi	ile Application Rating Scale — us			
			m2Hear	C2Hear
	uMARS Overall quality		4.23	3.60
	uMARS Engagement		3.61	3.13
	uMARS Functionality		4.46	3.75
	uMARS Aesthetics		4.22	3.00
	uMARS Information		4.65	4.50
	uMARS Subjective quality		3.60	3.25





## Including others





#### National Institute for Including communication partners Health Research

• Support and involvement from others improved outcomes

(Scarinci et al, 2008)

 Aligned coping strategies between people with hearing loss and their family and friends → positive effect and improved outcomes

(Barker et al, Int J Audiol, 2017)

- Focus groups suggested that CPs would value information relevant to them (Ferguson et al, Ear Hear, 2016)
- Communication Tactics RLO for 'others'
  - designed specifically for mobile-technologies (e.g. smartphones, tablets)
  - added more activities





## **Restaurant activity**



#### Choose the best location to hear conversation as well as possible

## Communication tactics for CPs: <sub>Nati</sub> "active ingredients"



Greater emphasis on the environment





## Inclusive: involving others





Think aloud and video analysis

(Ferguson et al, ASHA Perspectives SIG7 In press)

### Greatest impact for joint-working

• Increased CP's hearing-related knowledge, and highlighted difficulties faced by the PHL





CPs would change their behaviour to help improve communication based on their learning

"That's what we shall look for [a quiet restaurant table]" (CP)

"We are both on the same wavelength, we can look for it now" (PHL)

Prompted novel discussions about challenging everyday communication situations

(Ferguson et al, ASHA Perspectives SIG7 In press; Henshaw et al, BSA, 2017)





### residential carehome staff



• 84% thought correct use of hearing aids was extremely important

72% assisted all residents with hearing aids and maintenance
20% " half or more
8% " half or less

None of the carehomes had sought or reported ever provided any training

**OUD** Getting more from your hearing just got easy





(Rocks & Ferguson, 2013)





#### National Institute for Training residential carehome staff

n = 25 care home staff n = 3 homes



#### Knowledge of hearing aids and communication

Significant pre-post improvement p < .001 d = 3.6

"This should be made mandatory at induction with annual refresher sessions"



Health Research



Practical hearing aid skills

Significant pre-post improvement p < .001 d = 3.3

"Awareness of hearing aids has definitely gone up with all of us"

## Take home messages





- Knowledge is power and a mechanism of impact leading to: better hearing aid outcomes, reduced psychosocial effects (e.g. anxiety), and greater patient activation
- The future is the three I's individualisation, interactivity and inclusivity
- Involving partners in 'joint-working' with C2Hear prompts novel discussions about challenging communication leading to behaviour change in partners

"technology works best when it brings people together"

(Matt Mullenweg)

National Institute for

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C<sub>2</sub>Hear

### Thanks to .....





Patient panels



Mild-moderate hearing loss team David Maidment Rachel Gomez Nottingham University Hospitals



#### Clinical and academic colleagues





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