

1 **Telehealth rehabilitation for adults with cochlear implants in response**  
2 **to the Covid-19 pandemic: Platform selection and case studies**

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25 **Telehealth rehabilitation for adults with cochlear implants in response**  
26 **to the Covid-19 pandemic: Platform selection and case studies**

27 **Abstract**

28 **Background:** Effective information giving and goal setting prior to cochlear  
29 implantation and individualised rehabilitation following implantation are crucial  
30 for shaping adult patients' expectations and optimising their outcomes. Usually  
31 provided face-to-face in a clinic setting, the Covid-19 pandemic resulted in the  
32 cessation of clinic appointments for an indeterminate time. This is a description  
33 of one rehabilitation team's response to the limitations imposed during the  
34 Covid-19 pandemic.

35 **Aims:** Our first objective was to assess commercially available video call and  
36 dedicated health tools for suitability to provide online rehabilitation services. Our  
37 second objective was to describe how the chosen tool was used in the  
38 implementation of our online rehabilitation service, including pilot sessions and  
39 written support materials, and present three case studies of telehealth  
40 rehabilitation.

41 **Method:** Video conferencing and telehealth tools were assessed in terms of  
42 their security, accessibility and functionality. Appointment types that could be  
43 carried out via telehealth were identified. Appointment content was amended  
44 where needed for telehealth delivery. Three case studies have been selected to  
45 show users' experiences in different appointment types. Feedback was collected  
46 from patients and staff.

47 **Outcomes & results:** A video call platform was identified that was supported  
48 by the host National Health Service Trust's Information Technology (IT)  
49 Department and met the needs of the rehabilitation service. A rehabilitation  
50 telehealth service for patients pre- and post-cochlear implantation was  
51 successfully implemented, ensuring that patients continued to receive appropriate  
52 care in the context of lockdown measures. We share the framework we used to  
53 select the platform, practical lessons learned, and materials developed to support  
54 patients with the implementation of the service.

55           **Conclusion:** Telehealth rehabilitation appointments are a method of maintaining  
56           a high quality, effective service for adult patients pre- and post-cochlear  
57           implantation. It is predicted that the benefits of telehealth will last beyond the  
58           lockdown restrictions posed by Covid-19 for this regional service and its patients.

59           Keywords: cochlear implant; adults; rehabilitation; Covid-19; telehealth;  
60           telemedicine; speech and language therapy

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81 **Background**

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83 The Yorkshire Auditory Implant Service (YAIS) is part of the National Health Service  
84 (NHS) for England and Wales. We assess children and adult patients with severe-to-  
85 profound hearing impairment who are being considered for cochlear implantation, also  
86 providing audiology support and rehabilitation to those patients who have undergone  
87 the procedure. The team consists of administration staff, audiologists, consultant ear  
88 nose and throat surgeons, speech & language therapists (SLTs), teachers of the deaf, a  
89 rehabilitation support worker (RSW) and technicians. Based at the Listening for Life  
90 Centre (LFLC), Bradford Royal Infirmary, the service accepts patients from a wide  
91 geographical area, across Yorkshire and its surrounding regions. The population we  
92 serve is culturally diverse and represents a wide range of socio-economic backgrounds.

93

94 YAIS's adult rehabilitation team, comprising two SLTs and a RSW, offers  
95 appointments pre- and post-implant (Table 1). Counselling, listening rehabilitation, and  
96 communication training can be crucial in optimising outcomes for adults receiving  
97 cochlear implants (CIs). Our service's model includes information giving and goal  
98 setting prior to cochlear implantation, and rehabilitation following implantation. These  
99 appointments have traditionally been provided in-person, either one-to-one or in group  
100 therapy sessions, by SLTs. Our service had no prior experience in delivering these  
101 services via telehealth.

102

103 In March 2020, the UK's cases of Covid-19 were growing and national lockdown  
104 measures were put in place, restricting the movement of people outside of their own  
105 homes as much as possible. Employers were asked to allow staff to work from home  
106 wherever practicable and only essential travel was allowed. People with health  
107 conditions putting them at higher risk of being severely affected by Covid-19 were  
108 advised to stay at home ('shield'). The advice to healthcare services at this time was to  
109 instigate, '*...a principle of "digital first" in primary care and with out-patients: unless  
110 there are clinical or practical reasons, all consultations should be done by  
111 telemedicine*' (Great Britain, House of Commons 2020).

112

113 All YAIS patients were contacted and advised that appointments would not be offered  
114 until further notice and most scheduled appointments were postponed. Patients who had

115 recently been implanted were prioritised and offered their initial audiology &  
116 rehabilitation implant activation appointments at LFLC.

117 The impact of lockdown on YAIS patient rehabilitation included:

- 118 • Patients being unable to attend face to face appointments, either due to restrictions on  
119 travel or shielding
- 120 • As lockdown lifted and prioritised patients were offered face to face appointments  
121 (those needing audiological review or urgently requiring support with their implant),  
122 staff were required to wear Personal Protective Equipment (PPE) according to national  
123 guidance, including face masks and visors (in addition to aprons and gloves) and to  
124 observe social distancing of 2 metres

125 Patient support and therapy groups would not be offered for the foreseeable future due  
126 to social distancing measures and to reduce virus transmission risk to patients and staff.

127

128 To minimise disruption to patient care while adhering to health and safety measures, the  
129 adult rehabilitation team sought to establish whether any face to face appointments  
130 could be successfully delivered via telehealth, pre-operatively to provide adequate  
131 preparation for implantation and guide expectations, and post-operatively to deliver  
132 effective rehabilitation.

133

134 Studies have been published over several years on the feasibility of carrying out speech  
135 processor programming, CI function testing, and speech perception assessments with  
136 adults online (Ramos et al., 2009; Kuzovkov et al., 2014; Cullington et al., 2018;  
137 Schepers et al., 2019). However, to our knowledge, and in line with a systematic review  
138 from 2016 (Bush et al.), no previous studies have addressed online listening  
139 rehabilitation for adults under the care of CI services.

140

141 Telehealth has been used for other client groups within speech and language therapy,  
142 including those with dysfluency (O'Brian et al, 2008), dysphagia (Burns et al, 2019),  
143 and acquired communication impairment (Pitt et al, 2019). However, adults with  
144 severe-to-profound hearing impairment experience unique communication challenges.  
145 These can include increased reliance on lip-reading, greater dependence on good sound  
146 quality, in some cases a need for sign-language support, and access to written material  
147 to supplement spoken conversation. Therefore methods used for telehealth in typically-  
148 hearing client groups may not be directly applicable to CI service users. It is also

149 important to consider the technical limitations of telehealth platforms, as these can  
150 affect the accessibility of online interventions for elderly and hearing-impaired adults  
151 (Meyer et al., 2019). Finally, the delivery of any healthcare intervention online must  
152 comply with information governance guidance, ensuring online security and patient  
153 confidentiality.

154 Telehealth solutions could become a long-term feature of CI care, regardless of the  
155 time-course of coronavirus-related restrictions. Prior to the pandemic they had been  
156 successfully implemented to increase accessibility to CIs for those who are distributed  
157 over a wide geographical area and / or whose age or health makes travel burdensome  
158 (Hughes et al 2012). Telehealth brings time and cost-savings for patients, who have  
159 reported satisfaction in receiving interventions without needing to pay for transport to a  
160 hospital (Wilson & Wells, 2009). The option for therapists to provide rehabilitation  
161 from their homes might also reduce the number of times they commute to the CI  
162 department per week. If telehealth services can be introduced and maintained across the  
163 healthcare sector, the reduction in travel for patients and professionals could have wider  
164 health benefits for the whole community (Schembari et al., 2015, Khreis et al., 2019).

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168 In summary, the Covid-19 pandemic has led to a need for the rapid roll-out of telehealth  
169 for CI rehabilitation services internationally. There are good reasons why CI telehealth  
170 services could remain for the long-term, and it is worth careful planning to ensure that  
171 they run smoothly and effectively. However, there is little published evidence to support  
172 clinics in making this transition for CI therapy services. This means there is an urgent  
173 need within the field to share our experiences of telehealth service development,  
174 including successes, challenges faced, and best practice. Toward that aim, we developed  
175 the following objectives:

- 176 (1) To assess available video call and dedicated health tools for suitability to  
177 provide online rehabilitation services.
- 178 (2) To describe how the chosen tool was used in the implementation of our online  
179 rehabilitation service, including pilot sessions and written support materials, and  
180 present three case studies of telehealth rehabilitation.

181

182 ***Materials and Methods***

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185

186 The adult rehabilitation team explored alternative options for service delivery. NHSX  
187 (a joint unit bringing together teams from the Department of Health & Social Care,  
188 NHS England and NHS Improvement to drive the digital transformation of care)  
189 published guidance to clinicians as part of their Covid-19 response:

190       ‘We encourage the use of video conferencing to carry out consultations with  
191 patients and service users. This could help to reduce the spread of COVID 19. It is  
192 fine to use video conferencing tools such as Skype, WhatsApp, Facetime as well as  
193 commercial products designed specifically for this purpose.’ (NHSX, March 2020)

194 The following appointments were identified as deliverable via telehealth:

- 195       • *CI information session*: delivered to prospective CI patients following their  
196 initial audiological and rehabilitation assessments. This session gives the patient  
197 information on how the CI works, explains the difference in hearing with an  
198 implant compared to normal hearing and aims to guide realistic expectations of  
199 the rehabilitation they will need to carry out post-operatively to achieve optimal  
200 outcomes with their implant. Patients cannot advance on the CI pathway without  
201 having attended this appointment. Although CI surgery was suspended over the  
202 initial lockdown period, there were a number of patients at the appropriate stage  
203 in the pathway to receive this session remotely.
- 204       • *Goal setting session*: following the information session, the patient is given time  
205 to consider their aims with the implant. This session is a discussion of their  
206 goals with the SLT to ensure they are realistic prior to having the operation.
- 207       • *Six and twelve week follow up appointments*: these post-operative appointments  
208 are in place to ensure that the patient is progressing with their implant in line  
209 with their goals and to provide support and rehabilitation materials as needed.

210

211 ***Telehealth platform selection***

212

213 The SLTs developed a framework to assess the suitability of available platforms. This  
214 was based on three key qualities, each broken down into several specific criteria.. Other  
215 videoconferencing platforms (e.g. Google Meet) and dedicated telehealth systems (e.g.  
216 AccuRx) were not supported by the host Trust's IT department and were therefore not  
217 assessed.

218

219 Security: Sessions must have the capability to be confidential and comply with the  
220 hospital's information governance guidance. This required software endorsement by the  
221 host hospital, and the availability of IT department support.

222

223 Accessibility: We considered the accessibility of each platform from the perspective of  
224 the patient and service provider. This included whether the patient could join an online  
225 session direct from an email link without downloading software; compatibility with  
226 hospital devices and network; and accessibility to staff via a hospital email account.

227

228 Functionality: These considerations were to achieve as high quality experience for the  
229 patients as possible. They included the best possible image quality, so that patients  
230 could access lip-reading; the ability for the host to share their screen allowing patients  
231 to view presentations, rehabilitation resources etc; the option for live captions; access to  
232 a 'chat' function, to allow real-time typed text support of spoken content; and the option  
233 for session delivery to multiple patients by more than one staff member. This last  
234 criterion means that sessions could continue to be provided by more than one staff  
235 member where necessary, and / or a sign-language interpreter could be included in the  
236 appointment.

237

238 Because of the need for lip-reading and sign-language interpreting, only video-based  
239 platforms were assessed against the framework. These included: Cisco Webex,  
240 Microsoft Teams, and NHS Attend Anywhere. Other platforms were not considered as  
241 they were not endorsed by the IT department.

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245 ***Results***

246

247 ***Telehealth platform selection***

248 The three platforms were trialled by the SLTs, who assessed their performance against  
249 the assessment framework shown in Table 2. Cisco Webex performed well in all three  
250 categories of security, accessibility and functionality, although it lacked the capability  
251 for live captions at the time of our assessment. Microsoft Teams met all of the  
252 functionality criteria. Unfortunately, in terms of security, Microsoft Teams was not  
253 endorsed by our institution or supported by the IT department, nor was it accessible  
254 using our hospital email addresses. We were therefore unable to guarantee compliance  
255 with information governance policies and decided it was not a viable option. NHS  
256 Attend Anywhere met our security and accessibility criteria and was used widely and  
257 successfully in the Trust when used by staff on site. However its connectivity was  
258 suboptimal in the home setting of the SLT, with the screen freezing on occasion. In  
259 addition, the ‘share screen’ facility was disabled on hospital devices. We therefore  
260 selected Cisco Webex as the preferred platform for sessions conducted from the SLT’s  
261 home and those with a component involving screen sharing. Attend Anywhere has been  
262 used for appointments not requiring screen sharing.

263

264 Access to the chosen platform was granted to the SLTs by the IT department. This  
265 allowed the staff to become familiar with the platform including setting up  
266 appointments (‘meetings’), establishing how the email invites would look to patients,  
267 and exploring the ‘screenshare’ and ‘chat’ functions. Pilot testing was carried out using  
268 lay volunteers in their late 60s / early 70s, with similar technological experience  
269 (frequent tablet or laptop users for internet access rather than for accessing documents)  
270 to a large proportion of the Y AIS adult caseload. Pilot testing provided a valuable  
271 opportunity for the SLTs to familiarise themselves with the software in a real-time  
272 interaction situation. ‘Chat’ was found to be an effective written tool to supplement the  
273 spoken content of the telehealth session if participants were unable to hear. When  
274 giving information, muting the listener’s microphone enabled the best sound quality to  
275 be achieved.

276

277 The SLTs wrote patient information leaflets describing how to access the telehealth  
278 platform (Appendix 1 & 2). These were sent to patients at the point of arranging a  
279 telehealth appointment to help them prepare. Telehealth session feedback forms  
280 (Appendix 3) were written to collect information on the patient experience and to guide  
281 improvements to the telehealth service. Both the information sheet and the feedback  
282 form could be sent electronically or by post. If sent electronically, the feedback form  
283 was designed to be sent in the body of an email rather than as an attachment (e.g.  
284 Microsoft Word document) that may or may not be easy to edit on the patient's device.  
285 Any presentations usually given face-to-face to groups were amended by the therapists  
286 to suit telehealth delivery, by incorporating textual explanation of the 'chat' function  
287 and microphone muting at the beginning of the session and including frequent, visually  
288 prompted opportunities for the patient to ask questions.

289

290 Notes on the telehealth rehabilitation sessions were taken by the participating SLT, and  
291 user feedback was collected via the telehealth feedback forms. Three representative and  
292 informative clinical appointments were chosen to be case studies and the results of  
293 professional and participant feedback was summarised.

294

295 As telehealth was a new way of working there was limited access to hospital computers  
296 with webcams and speakers initially. However, these were quickly provided by the IT  
297 department. It was necessary to find a computer with a webcam and speakers in a quiet  
298 room for telehealth appointments to be carried out successfully.

299

### 300 ***Case studies***

301

#### 302 *Case 1: Information session (individual patient)*

303 *Pre-Covid session provision:* Individual information sessions were offered if it was felt  
304 that the patient wouldn't cope with a group setting – e.g. needed extra support due to a  
305 learning disability, or needed a British Sign Language (BSL) interpreter. The session  
306 consisted of a Powerpoint presentation delivered by a SLT with on-screen text support  
307 where needed.

308 *Post-Covid session provision:* Patients receive the information session individually  
309 either at LFLC or remotely, according to patient preference.

310 *Patient:* P1 was a 70 year old female with severe-to-profound deafness. She was a  
311 hearing aid user being assessed for cochlear implantation. She had previous experience  
312 of using videoconferencing platforms to maintain contact with family during the  
313 lockdown period, with limited success at hearing speech in online calls. She was  
314 offered and consented to a telehealth information session. The session was arranged on  
315 Cisco Webex and the patient was emailed with the link to the session and the patient  
316 information sheet. A text reminder was sent to the patient the day before the  
317 appointment.

318 *Session:* The telehealth session was attended by the 2 SLTs (one working from LFLC,  
319 one from home), P1 and her partner. The therapists ensured that the chat feature could  
320 be used by the patient at the beginning of the session. One therapist controlled the  
321 screen share of the Powerpoint presentation whilst the other managed the 'chat' feature,  
322 typing up responses to any questions to ensure that P1 could access the information.  
323 There were no issues with connectivity throughout the appointment.

324 *Learning points for therapists:*

- 325 • Following the session, the telehealth version of the presentation was amended to  
326 remove a video which could not successfully be seen by the patient during playback on  
327 Cisco Webex. The video's content was to consolidate points previously explained in  
328 the presentation so it was not necessary to replace it with additional material.
- 329 • Muting the typing therapist's microphone was necessary to prevent keyboard noise  
330 from disrupting the session.

331 *Patient feedback following session:* P1 reported verbally at the end of the appointment  
332 that she was pleased that she had been able to hear the therapists during the session at  
333 times but was appreciative of the text back-up to spoken conversation via the chat  
334 feature. P1 and her partner both expressed that they had had sufficient opportunity to  
335 ask questions and that they were grateful that they had been able to access the session  
336 from their own home removing the need to travel; they had had some anxiety around  
337 attending a hospital setting during lockdown so a telehealth appointment solved this  
338 problem for them..

339 P1 gave this written feedback following the appointment:

340 "It was nice to see your faces again on screen, but nothing like face-to-face. It saved us  
341 about 3 hours travelling time. Although I heard most of what was said, it was  
342 reassuring to have subtitles on the presentation and for (therapist) to type out answers to  
343 questions."

344 “One advantage is the necessity to retain a defined structure and the muting during the  
345 presentation certainly aids the focus.”

346 A negative aspect to the telehealth appointment was described as, “My initial  
347 worry/panic that I couldn’t connect to the Video call!” In practice she was able to make  
348 the call with no difficulty.

349

350 *Case 2: Six week post-operative follow up*

351 *Pre-Covid session provision:* patients attended LFLC for a face-to-face clinical session  
352 to discuss their progress with listening via the implant, areas of success and difficulty,  
353 and to receive further guidance on optimising their listening. This appointment is  
354 tailored to the patient, their level of progress with the implant and current needs and  
355 goals.

356 *Post-Covid session provision:* this session is now delivered either in person at LFLC or  
357 remotely.

358 *Patient:* P2 was a 52 year old female who had her CI operation in March 2020 and had  
359 CI initial activation during lockdown. She was offered and consented to a telehealth  
360 rehabilitation appointment. The Cisco Webex appointment and information sheet was  
361 sent to the patient via email. P2 had used video conference platforms (particularly  
362 Google Meet which has the benefit of live captions) with family and friends throughout  
363 the lockdown period and was confident that she would benefit from input via telehealth.  
364 P2 had successfully used the speech-to-text smartphone app ‘Live Transcribe’ during  
365 some conversations and planned to have this as support during the session if it was  
366 required.

367 *Session:* The session was attended by the patient and one therapist working from home.  
368 P2 was able to hear the therapist throughout the session without needing to use Live  
369 Transcribe. Screen share was used when appropriate to show rehabilitation exercises to  
370 the patient. There were no problems with connectivity throughout the appointment.

371 *Learning points for therapist:* the session was positively reviewed by both the patient  
372 and the therapist. P2 had undertaken a significant amount of listening practice and had  
373 progressed well with her implant. Had this not been the case it is plausible that a  
374 telehealth appointment would not have been as successful.

375 *Patient feedback following session:* P2’s immediate verbal feedback of the session was  
376 favourable; she was particularly pleased that she had been able to hear the therapist.

377 Following the appointment she provided this written feedback:

378 “I have to say that I have been quite opposed to remote appointments in the past as I  
379 saw it as a way to push out the user/patient; but I found it very useful and convenient  
380 indeed when we did it (or the quality of the interlocutor made it so enjoyable).”

381

382 *Case 3: Information session (delivered to two patients simultaneously)*

383 *Pre-Covid session provision:* The CI information session was delivered at LFLC to a  
384 small group of patients at the same stage in the CI assessment pathway. Each patient  
385 was able to bring a family member or friend. The session was delivered by 2 SLTs or a  
386 SLT and a RSW, using voice recognition software/ text support on screen when needed,  
387 i.e. for the question and answer section. Current CI users also attended to talk about  
388 their experiences and to answer questions from the group.

389 *Post-Covid session provision:* Cisco Webex provides the facility for the session to be  
390 delivered remotely to more than one patient simultaneously.

391 *Patients:* Two pre-implant patients were invited to join the same telehealth information  
392 session. P3 was a 32 year old male hearing aid user with profound hearing loss. P4 was  
393 a 57 year old female hearing aid user with profound hearing loss. It was made clear to  
394 both that another patient would be present on the screen at their appointment, and both  
395 consented to this. The Cisco Webex information sheet was amended to include points  
396 specific to group sessions, namely that it is crucial that confidentiality is respected and  
397 that patient details are not discussed outside of the session.

398 Two therapists, P3 and P4 attended the session. P3 managed well with hearing aids in  
399 the session whilst P4 relied heavily on the ‘chat’ feature to support her access to the  
400 spoken content.

401 P4’s internet connection was lost part way through the session, returning approximately  
402 5 minutes later. This affected the flow of the session for P3 and the therapists. The  
403 missed section was repeated for P4 at the end of the session to ensure that she had been  
404 given all the necessary information.

405 *Learning points for therapists:* telehealth delivery to more than one patient  
406 simultaneously presented more challenges. The connectivity issues of P4 impacted on  
407 the continuity of the session for P3. The SLTs felt that individual telehealth sessions  
408 were more reliably successful. Whilst there is a clear advantage to delivering a group  
409 telehealth session with respect to time efficiency, the potential for one patient’s internet  
410 connection to impact on other patients’ experience needs to be considered.

411

412 *Patient feedback following the session:* P3 provided the following written feedback  
413 after the session:

- 414 • “Positive: still face to face
- 415 • Negative: screen froze a few times made it a bit difficult.”

416 P4 did not provide any feedback.

417

## 418 ***Discussion***

419

420 Our implementation of telehealth appointments was driven by the pandemic and the  
421 associated need to consider alternative service delivery options. Being a regional  
422 service we found that, similar to O’Brian et al (2008) and Burns et al (2019), telehealth  
423 appointments were a preferable option for patients travelling a distance to the service at  
424 a time when national guidance was to ‘stay home’. People with severe-profound  
425 hearing loss are unlikely to be able to use the telephone, the contact method used by  
426 O’Brian et al (2008), resulting in the need for a video call platform. When comparing  
427 the available platforms (Table 2) we considered what facilities were necessary to  
428 support our client group to successfully access the telehealth appointments, for example  
429 live captions or a facility for the clinician to type out any spoken information that our  
430 patients were unable to hear or lipread during the session. We were accustomed to  
431 providing written support in face to face appointments for our patients and a number of  
432 routine appointments were already in written presentation format for this reason. These  
433 sessions were adapted for telehealth delivery, with written explanations of the telehealth  
434 format included, for example inserting slides indicating when microphones would be  
435 muted to allow better sound quality during the session. As previous studies have also  
436 identified we recognised that some of our patients using video calls for the first time  
437 may need support in accessing the telehealth platform. However due to the restrictions  
438 imposed by the pandemic we did not have the option of providing this support in person  
439 (Burns et al, 2019; Pitt et al, 2019) and instead wrote detailed support sheets on how to  
440 access the video call platforms that were sent to the patients with their invitation to the  
441 telehealth appointment (Appendices 1 & 2). Pitt et al (2019) provided  
442 patients/adults/service users with the technology necessary (computer, webcam, WiFi  
443 Hotspot, etc) to access telehealth appointments to patients who did not have their own,  
444 which we are not able to do due to lack of funding. We are aware that poor access to

445 technology and lack of technological ability are precluding factors to some of our  
446 patients being able to access telehealth appointments and that for those patients, face to  
447 face sessions at the department will continue to be necessary. Although Pitt et al (2019)  
448 had good outcomes with group intervention via telehealth appointments, to date we  
449 have found that individual sessions are more reliably successful with the telehealth  
450 platforms we use with our patients.

451

452 Measures to slow the spread of Covid-19 have included the need to wear PPE and to  
453 socially distance, both of which impact on the successful delivery of face to face clinical  
454 sessions to people with severe to profound hearing impairment. We established a  
455 telehealth service for adult rehabilitation has ensured continuity of care for our CI  
456 patients. By considering the security, accessibility and functionality of the available  
457 platforms, we delivered successful sessions, despite our clients being severe-to-  
458 profoundly deaf hearing aid users, or recently implanted CI users beginning to adjust to  
459 the sound provided.

460

461 Some advantages to telehealth sessions as perceived by the patients were predictable  
462 and will reach beyond the lifespan of the pandemic. Similar to Hughes et al's (2012)  
463 findings, travel time for the patient is eliminated as acknowledged in P1's feedback: "It  
464 saved us about 3 hours travelling time." Being a regional service, the travel time in  
465 addition to the number and length of appointments can be onerous for patients who do  
466 not live nearby. For patients who have commitments such as work or dependents, the  
467 time saved travelling will be valuable. If a significant number of appointments shift to  
468 telehealth, there will be an environmental benefit, with fewer healthcare appointment-  
469 related car emissions in the local area as per Schembari et al (2015) and Khreis et al  
470 (2019), in addition to a financial benefit to patients by eliminating the need to pay for  
471 transport, or fuel and car parking, as previously identified by Wilson & Wells (2009).

472

473 We are mindful that not all patients will have access to equipment that will enable them  
474 to access telehealth sessions, either due to personal preference or financial reasons  
475 ('digital poverty'). Depending on the lockdown restrictions that clinics and patients are  
476 working within, some patients may be able to use equipment loaned by friends or  
477 family. There is a need to ensure that patients are not prevented from accessing  
478 rehabilitation if they are not able to participate in telehealth sessions. Face-to-face

479 appointments could continue for these patients, or measures taken for the clinic to  
480 provide the necessary equipment and support to people in their homes, to ensure  
481 equitable service delivery.

482

483 This record of our rapid roll-out of telehealth rehabilitation for adults at a CI service has  
484 some limitations. As the service is new, we have experience with only a small number  
485 of clients. This work has demonstrated that currently available platforms can enable  
486 successful rehabilitation for patients with severe-profound hearing impairment. These  
487 encouraging findings indicate that CI rehabilitation services for adults can be developed  
488 in parallel with remote programming (Cullington et al, 2018; Kuzovkov et al, 2014;  
489 Ramos et al, 2009; Schepers et al, 2019). More studies are needed to report outcomes  
490 for larger patient populations, and to validate telehealth rehabilitation in comparison to  
491 traditional face-to-face service delivery. Also, the technology available for telehealth is  
492 likely to evolve rapidly, and so the selection of platforms is a process that may need to  
493 be regularly reviewed.

494

495 Whilst telehealth is not new, its use since the onset of the Covid-19 pandemic has  
496 increased considerably around the world. It is possible that telehealth platforms will  
497 continue to evolve and improve and meet the needs of this client group better. Our own  
498 use of telehealth has evolved since March 2020 and we have changed our service  
499 delivery to reflect this (see Table 3). It is our aim to reintroduce group sessions at  
500 LFLC when Covid guidelines allow this.

501

502 To our knowledge, this is the first report that provides information on the  
503 implementation and initial results of a telehealth service for CI rehabilitation for adults.  
504 This study adds to the existing knowledge base for online speech and language therapy  
505 by describing how adults with severe to profound hearing loss can be supported to  
506 access telehealth appointments if appropriate adjustments are made such as providing  
507 detailed written information and adapting session content and delivery. The framework  
508 we developed to assess potential telehealth applications informed our decision to use  
509 Cisco Webex. It could also be used by other clinics internationally, alongside  
510 consideration of their own legal regulations, to guide the selection of whichever is the  
511 most appropriate platform for them. We hope that the patient information and feedback  
512 sheets we have developed might also be useful to other services, along with the



513 experience we have gained in our implementation of clinical telehealth rehabilitation for  
514 this unique population.

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517 **References**

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