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The initial evaluation of an Internet-based support system for audiologists and first-time hearing aid clients ☆

K. Jonas Brännström [a,b,*], Marie Öberg [b,c], Elisabeth Ingo [b], Kristoffer N.T. Månsson [b], Gerhard Andersson [b,d,e], Thomas Lunner [b,e], Ariane Laplante-Lévesque [b,e]

[a] Department of Logopedics, Phoniatrics and Audiology, Lund University, Sweden
[b] Department of Behavioural Sciences and Learning, Linköping University, Sweden
[c] Technical Audiology, Department of Clinical and Experimental Medicine, Faculty of Health Sciences, Linköping University, Department of Otorhinolaryngology in Linköping, Anaesthetics, Operations and Specialty Surgery Center, County Council of Östergötland, Sweden
[d] Department of Clinical Neuroscience, Karolinska Institutet, Sweden
[e] Eriksholm Research Centre, Oticon A/S, Denmark

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ABSTRACT

Objectives: Audiologists provide professional contact and support between appointments to clients with hearing impairment using telephone and e-mail, but more advanced and flexible technological platforms are also possible. The present study aimed to evaluate the clinical application of an Internet-based support system for audiologists and their first-time hearing aid clients.
Design: An Internet-based support system developed by Månsson et al. (2013) for psychologists and their clients was adapted for audiologic purposes. Three audiologic clinics in Sweden tested the support system with their clients.
Study sample: Twenty-three clients managed by four audiologists used and evaluated the support system. In addition, five of the clients and all four audiologists were interviewed and their responses were analyzed using content analysis.
Results: The clients and the audiologists reported positive experiences and overall satisfaction but audiologists reported that the support system did not address the needs of all clients. More positive experiences and greater satisfaction with the support system were associated with reductions on self-reported consequences of hearing loss and positive hearing aids outcomes.
Conclusions: An Internet-based support system can be used in audiologic rehabilitation. Both audiologists and clients recognized the system's potential value to offer an online support to the provision of audiologic services.

1. Introduction

Disabling hearing loss affects approximately 5% of the global population (WHO, 2015) and becomes more prevalent with age, affecting about 1/3 of the population aged over 65. Hearing loss affects both the individual's and significant others' physical and psychological health negatively which incurs costs for the individual and the society in general (Hjalte et al., 2012). Audiologic rehabilitation is the most common way to alleviate the effects of hearing loss. The rehabilitation process requires several visits including hearing and hearing needs assessment, counseling, client education, and fitting of hearing aids. Audiologist contact and support between appointments could provide more continuous and timely care, improve information exchange, and facilitate the audiologic rehabilitation. With optimal accessibility in mind, such audiologist contact and support has been offered in a telephone format (Cherry and Rubinstein, 1994) and in an electronic mail format (Laplante-Lévesque et al., 2006). Other technological platforms are now available to offer this service. The present study reports on the clinical application of an Internet-based support system for audiologists and first-time hearing aid clients.

1.1. Tele-health

Tele-health adoption depends on technical as well as human factors: both clients and clinicians must be able and willing to use such applications. Research has focused largely on client- and clinician-specific predictors of adoption, rather than on social, organizational, or environmental factors (Or and Karsh, 2009). Theories of technology adoption have been used to explain tele-health adoption and inform the design

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* Corresponding author at: Department of Logopedics, Phoniatrics, and Audiology, Clinical Sciences Lund, Lund University, SE-221 85 Lund, Sweden.
E-mail address: jonas.brannstrom@med.lu.se (K.J. Brännström).

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and implementation of tele-health applications, both for clients and clinicians (e.g., Gagnon et al., 2003; Sun et al., 2013). Clinicians' opinions towards tele-health are central as they typically act as gate-keepers for tele-health adoption (Whitten and Mackert, 2005). Clients tend to be more satisfied with tele-health services than their clinicians (Kairy et al., 2009). Tele-health has been used to empower clients in various areas of health including chronic diseases where the client is encouraged to engage actively in their health and its management (Calvillo et al., 2014). Tele-health could also be applied to support the problem-solving process that is audiologic rehabilitation.

1.2. Tele-audiology

Internet use is prevalent among people with hearing impairment: independent studies from Canada, the United Kingdom, and Sweden all point towards greater Internet use in people with hearing impairment than in the general population of corresponding age (Gonsalves and Pichora-Fuller, 2008; Henshaw et al., 2012; Thorén et al., 2013). Several tele-audiology applications exist: for a systematic review, see Swanepoel and Hall (2010). Examples of tele-audiology applications of particular interest for audiologic rehabilitation include educational program with telephone consultations for hearing aid users (Lundberg et al., 2011a, 2011b; Malmberg et al., 2015), hearing information search on the Internet (Laplante-Lévesque et al., 2012), Internet-based audiologic rehabilitation (Thorén et al., 2011; Kaldo et al., 2013; Thorén et al., 2014), and Internet-based peer support groups (Cummings et al., 2002). However, the combination of Internet-delivered support and face-to-face appointment has not been tested.

Limited information on audiology clients' experiences of tele-audiology is currently available, except for Eikelboom and Atlas (2005) who found that the majority of Australian audiology clients did not know about tele-medicine. However, clients were interested in tele-audiology to reduce waiting times and costs, but a common barrier for using it was that they preferred face-to-face appointments (Eikelboom and Atlas, 2005). Also, hearing aid users with severe forms of hearing loss cannot easily use the telephone but can do better if using video chat programs instead of the telephone (Mantokoudis et al., 2012). The client attitudes towards and interest in tele-audiology applications suggest that a combination of tele-audiology and face-to-face appointments may increase client satisfaction with the audiologic rehabilitation. Also, tele-audiology accessible through so-called smart mobile phones has the potential to improve accessibility even more by removing geographical and temporal barriers (Silva et al., 2015). The perceptions and experiences of audiologists regarding tele-audiology are also largely unknown (Swanepoel and Hall, 2010). However, Singh et al. (2014) surveyed hearing health care practitioners in Canada. They reported that a majority of audiologists and hearing instrument specialists had contact with both clients and colleagues through electronic mail but less than 4% had used videoconferencing services. Also, Singh et al. (2014) reported that the attitudes towards tele-audiology were overall neutral and the majority of the sample thought it would not have large impact on professional practice or improve the quality of the services provided. Based on these findings together, it would be of value to evaluate the implementation of tele-audiology applications in clinical practice from both the client and the audiologist point of views as many clients believe that they could benefit and the fact that audiologists experience more custom-made tele-audiology applications in clinical practice seems negligible.

1.3. Internet-based support system for audiologists and first-time hearing aid clients

Car et al. (2012) listed considerations for the effective development of tele-health interventions for people with chronic health conditions. This includes being grounded in a disease management strategy, addressing client needs, and using a technological platform that is suitable for the application aims. In line with these considerations, Månsson et al. (2013) developed an Internet-based support system for face-to-face cognitive behavior therapy (CBT) for patients with common anxiety and depression disorders. The system included components of CBT such as a library of interventions gathered from existing Internet-delivered CBT interventions (Andersson et al., 2002; Andersson et al., 2005; Andersson et al., 2006). As tailored interventions seems to be more effective than standardized interventions (Johansson et al., 2012), the support system content was tailored for each client. The system was tested with 15 clients and found to be effective in reducing anxiety and depressive symptoms. In the present study, the Internet-based platform (support system) of Månsson et al. (2013) was adapted for audiologic purposes and the concept of Internet-delivered support in combination with face-to-face appointment was tested at the clinic.

1.4. Research aims

The present study aims to evaluate the clinical application of an Internet-based support system for audiologists and their first-time hearing aid clients. This is done in two steps: First, it examines the associations between the usage of an Internet-based support system for audiologists and first-time hearing aid clients and a hypothesized reduction in self-reported consequences of hearing loss, improvement in hearing aid self-efficacy, and hearing aid outcomes commonly seen after hearing aid fitting. Second, it describes how both audiologists and clients used and experienced the support system.

2. Materials and methods

Using the framework and fundamental functions of the Internet-based platform by Månsson et al. (2013), four research audiologists adapted the content of the support system for audiologic purposes. The audiologists tested the system and revised its content and functions in an iterative process. The development process, functions, and content of the support system are described elsewhere (Brännström et al., 2015). In the present study, four clinical audiologists used and evaluated the final version in three audiologic clinics in Sweden.

The four clinical audiologists worked in three public tax-funded Swedish hospitals: Linköping University Hospital, Norrköping Hospital, and Värnamo Hospital. These clinical audiologists were those who agreed to participate after informal contacts. In Sweden, hearing assessments and hearing aid fittings are provided by audiologists. Swedish audiologists have a bachelor degree in audiology and are licensed by the National Board of Health and Welfare to practice audiology. Swedish audiologic services have historically been a public service provided by tax-funded hospitals. Also today most audiologic services in Sweden are provided through the public sector. There are some regional differences where private practitioners may receive some financial compensation for the fitting of hearing aids. These private practitioners are also allowed to sell hearing aids to clients as a private company. Generally, a client needs to pay about USD100 for the access to services, hearing aids included, when utilizing the publicly funded system. When a client seeks help for hearing problems they usually attend about three or four appointments lasting approximately 1 h each. Hearing assessments are made at the first visit. At the second visit, a rehabilitation plan is made by the audiologist based on a discussion with the client on the specific needs and goals of the client. Commonly hearing aids are fitted, information on user expectations and instructions are provided often along with information on communication strategies. At the third and fourth visits fine tuning of the hearing aids is made if required and additional support is provided if warranted. Details on the Swedish hearing health care services are available in Brännström et al. (2013).

2.1. Participants

The participants were four clinical audiologists who used an Internet-based support system and 23 of their first-time hearing aid clients. The inclusion criteria for the clients were to be an adult first time hearing aid user (>18 years of age), be able to read and write in Swedish, to use the Internet at least weekly, and to own a mobile phone capable of receiving short message service (SMS, to receive temporary code required for login). Potential participants seeking audiologic rehabilitation were informed of the study. Initially, 39 clients were recruited, but seven clients discontinued the rehabilitation and rejected hearing aids and were therefore excluded. Furthermore, nine clients dropped out from the study but completed their rehabilitation. Of these nine, seven announced they were no longer interested to use the Internet-based support system and two never logged in to the support system. The reasons for drop out were login problems (n = 5) and unknown (no reason provided, n = 4). After these exclusions, the final sample presented here consisted of 23 clients. Demographic data for the final client sample are listed in Table 1. Clients varied in age from 47 to 81 years (mean age of 64.4 years; 8.5 SD). As seen in Table 1, a male predominance was seen in the sample (15 men and 8 women). Nineteen of the 23 clients were living with a husband/wife/partner. Four of the 23 clients had completed 9 years in school, 10 clients had completed 12 years, and eight had additional education at college or university level. Four received one hearing aid and 19 received two hearing aids.

The study was approved by the regional ethics committee (ID: 2011/433-31). Informed consent was collected electronically when the client entered the support system for the first time. The clients received no remuneration for their participation.

Table 1
Demographic data for the included clients (n = 23).

Variable				
Age (years)		Mean	64.4	
		SD	8.5	
		Range	47–81	
Gender		Female	34.8%	n = 8
		Male	65.2%	n = 15
PTA (dB HL)	Right ear	Mean	35.7	
		SD	17.1	
		Range	13–100	
	Left ear	Mean	31.4	
		SD	12.0	
		Range	8–53	
	Best ear	Mean	29.2	
		SD	12.0	
		Range	8–53	
Living conditions	Living alone		8.7%	n = 2
	Living with husband/wife/partner		82.6%	n = 19
	Other		4.3%	n = 1
	Missing		4.3%	n = 1
Education	Elementary school (7–15 years of age)		17.4%	n = 4
	Secondary school (16–18 years of age)		43.5%	n = 10
	Post secondary school/college (≥18 years of age)		8.7%	n = 2
	University (≥18 years of age)		26.1%	n = 6
	Missing		4.3%	n = 1
Computer use	Every day		78.3%	n = 18
	At least once every week		21.7%	n = 5
	At least once every month		0%	n = 0
	More seldom		0%	n = 0
Hearing aid fitting	Monaural		17.4%	n = 4
	Binaural		82.6%	n = 19

PTA was calculated as the average in dB HL for frequencies 0.5, 1, 2, and 4 kHz.

2.2. Materials

Open-source code language PHP and MySQL were used to construct the Internet-based support system, which was accessible through an encrypted secure sockets layer (SSL) connection to the Internet. The system was accessed via a computer or a mobile device (e.g., tablet) from any location. All study participants (audiologists and clients) received a personal login ID via email. Supplementary login security was implemented to comply with national privacy laws. Each time a user attempted to log on, they received a SMS containing a temporary six-digit code which they entered on the system site. Inactivity within the system for 15 min closed the user login session by signing the SSL connection out.

The clients and the audiologists had access to slightly different content in the Internet-based support system. The audiologists were able to tailor the material made available to each client. The following sections were included in the support system: agenda (to record the content of appointments), messaging (to facilitate communication between appointments), tasks (e.g., results of audiologic assessment), memos (to write notes), library (to store predetermined text files/videos), and a personal library (to upload specific material for a certain client). The clients had a similar main screen with an additional section which contained the recently shared documents and videos sent from the audiologists but without the agenda and memos sections. The clients were also able to provide written feedback on completed tasks (documents/videos) in the library. The audiologists, but not the clients, had the opportunity to send SMS via the support system.

The clients completed several questionnaires. A brief questionnaire collected demographic information such as age and gender. The self-perceived emotional and social consequences of hearing loss were measured both before and after the rehabilitation with the Hearing Handicap Inventory for the Elderly (HHIE; Ventry and Weinstein, 1982). The HHIE consists of 25 items divided into two subscales: 1) emotional consequences (E) and 2) social and situational effects (S) of hearing impairment. There are three response options for each item: yes (score of 4), sometimes (2), or no (0). Higher scores represent greater self-perceived emotional and social consequences of hearing loss. The Swedish version of the HHIE has been shown to be reliable with good internal consistency and has been used in several Swedish studies (Öberg et al., 2007; Öberg et al., 2008; Öberg et al., 2009; Thorén et al., 2011; Thorén et al., 2014).

The Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA) assesses the confidence that clients have in their beliefs to care for and use hearing aids (West and Smith, 2007). The questionnaire consists of 24 items divided into the four subscales: (1) aided listening skills, (2) basic handling, (3) adjustment to hearing aids, and (4) advanced handling. An overall score is calculated as the mean of all items included in the subscales. The items ask the respondents to rate the certainty they have towards their ability to specific tasks related to hearing aids. The clients judge the strength of certainty on a 0–100 interval scale, where 0 represents no certainty and 100 represents complete certainty. The questionnaire was translated to Swedish by the authors and in this study only the items for the subscales basic handling, adjustment to hearing aids and advanced handling were included (15 items). The rationale for excluding the first subscale (aided listening) was that these items assess performance in listening situations with hearing aids, tasks which the support system did not target.

The International Outcome Inventory for Hearing Aids (IOI-HA) is a 7-item questionnaire evaluating the efficacy of the hearing aid rehabilitation (Cox et al., 2000; Cox et al., 2002). Each item focuses on a different topic: 1) daily use, 2) benefit, 3) residual activity limitation, 4) satisfaction, 5) residual participation restriction, 6) impact on others, and 7) quality of life. Each item has five potential responses, which range from the worst (1) to the best outcome (5). A higher score indicates a better outcome. Scores are reported as a global score (sum of all items) and two subscales; the introspection (items 1, 2, 4, and

7) and interaction (items, 3, 5, and 6) subscales. The Swedish version of the IOI-HA has been psychometrically evaluated and used in several Swedish studies (Öberg et al., 2007; Öberg et al., 2008; Öberg et al., 2009; Brännström and Wennerström, 2010; Thorén et al., 2011; Thorén et al., 2014).

A Visual Analogue Scale (VAS) questionnaire, with four items was constructed to measure satisfaction, experiences of the functions and documents in the Internet-based support system, and the clients' opinion of using the system in future hearing aid fittings. The effects were assessed using a VAS with rating from 0 (negative) to 10 (positive). The audiologists also completed this questionnaire from their perspective. The separate items are shown in Table 2.

A feedback questionnaire with nine open items evaluated the clients' overall experiences of the support system in terms of the pros and cons, functionality, and satisfaction with the support system (i.e., "How difficult did you find the different texts and functions?"). In total, 18 of the 23 clients completed the feedback questionnaire. It is not known why not all completed this questionnaire.

In addition, to investigate clients' and audiologists' experiences with the Internet-based support system, the feedback questionnaire was supplemented by telephone interviews with five clients and face-to-face interviews with all four audiologists.

2.3. Procedures

The audiologists were instructed to perform the audiologic rehabilitation as usual in accordance with their clinic guidelines. At the first appointment, the audiologists instructed each client on how to use the support system, using a computer or tablet (according to the client's preference) for demonstration purposes. The clients were typically scheduled for one to three follow-up appointments where the first follow-up appointment normally was within the first month after the hearing aid fitting. The audiologists and clients used the support system during the period from the fitting appointment to the last follow-up appointment. Fig. 1 presents a flowchart of the client pathways and assessments.

In the present study, the library section of the support system was prepopulated with learning material related to hearing impairment, hearing aids, and communication strategies. During the appointments, the audiologists and the clients decided together if additional documents/videos would be shared via the support system. When the audiologist shared a file with the client, it became accessible in the client's view. The shared file appeared in the client's recently shared files section. When the client had engaged in the files, he or she was instructed to tick a box to confirm their engagement and, if relevant, to provide written feedback related to the material.

Three of the questionnaires (HHIE, MARS-HA, and demographic questionnaire) were sent by mail to the clients and returned before the first appointment. Three weeks after the last follow-up appointment, five questionnaires were sent by mail to the participants: HHIE, MARS-HA, IOI-HA, the VAS questionnaire, and the feedback questionnaire with nine open-ended items. Clients were to complete the questionnaires and send them to the research team (not their clinical audiologist).

Clients from each of the different clinics were randomly invited for a telephone interview until 20% of the clients from each clinic accepted an interview, in total five interviews. The telephone interviews, held by one of the authors (MÖ), were based on the same nine open ended questions used in the feedback questionnaire. The interviews were recorded. The interview was held 1–3 months after the last follow-up appointment.

Audiologists' experiences with the support system were investigated through face-to-face interviews, held by an independent researcher not involved in the present study and conducted at the audiologists' respective clinics. The interviews were held after the audiologist completed the rehabilitation for all their clients in the present study. The face-to-face interviews were based on 17 open ended questions (e.g., "How user friendly do you think the support system is for

Table 2
Descriptive use and VAS-ratings of experiences and satisfaction with the Internet-based support system for the audiologists and the clients. Note that all clients who agreed initially to participate were demonstrated the support system and thus provided some log data. Therefore, to account for the fact that each audiologist managed a different number of clients, the number of logins, sent and read messages, and sent SMS per client was calculated by dividing the sum with the initial number of clients enrolled in the study (n = 39).

Variable			Audiologists		Clients	
Number of logins		Mean	81.8	n = 4	7.5	n = 23
		SD	43.1		6.5	
		Range	39–141		1–24	
Number of sent messages		Mean	25.3	n = 4	1.7	n = 23
		SD	29.2		1.8	
		Range	9–69		0–6	
Number of read messages		Mean	10.0	n = 4	2.8	n = 23
		SD	6.4		2.0	
		Range	5–19		0–7	
Number of sent SMS		Mean	21.3	n = 4	n/a	
		SD	26.7		n/a	
		Range	5–61		n/a	
Number of logins per client			8.4	n = 4	n/a	
Number of sent messages per client			2.6	n = 4	n/a	
Number of read messages per client			1.0	n = 4	n/a	
Number of sent SMS per client			2.2	n = 4	n/a	
Feedback given in library	Provided feedback		n/a		47.8%	n = 11
	Did not provide feedback		n/a		52.2%	n = 12
How satisfied are you with the Internet based support system?	0 = Not satisfied at all; 10 = very satisfied	Mean	6.7	n = 3	6.8	n = 16
		SD	2.5		2.3	
		Range	4–9		2–10	
I experienced the documents available in the Internet based support system as:	0 = Not useful at all; 10 = very useful	Mean	7.0	n = 3	7.2	n = 16
		SD	1.7		1.8	
		Range	5–8		4–10	
I experienced the functions (for example to send messages, read documents) in the Internet based support system as:	0 = Not easy to use at all; 10 = very easy to use	Mean	8.0	n = 3	7.2	n = 16
		SD	1.0		2.4	
		Range	7–9		3–10	
What is your opinion on using the Internet based support system during your next hearing aid fitting?	0 = Prefer not to use it; 10 = Would definitely use it	Mean	6.7	n = 3	7.3	n = 16
		SD	3.1		1.9	
		Range	4–10		4–10	

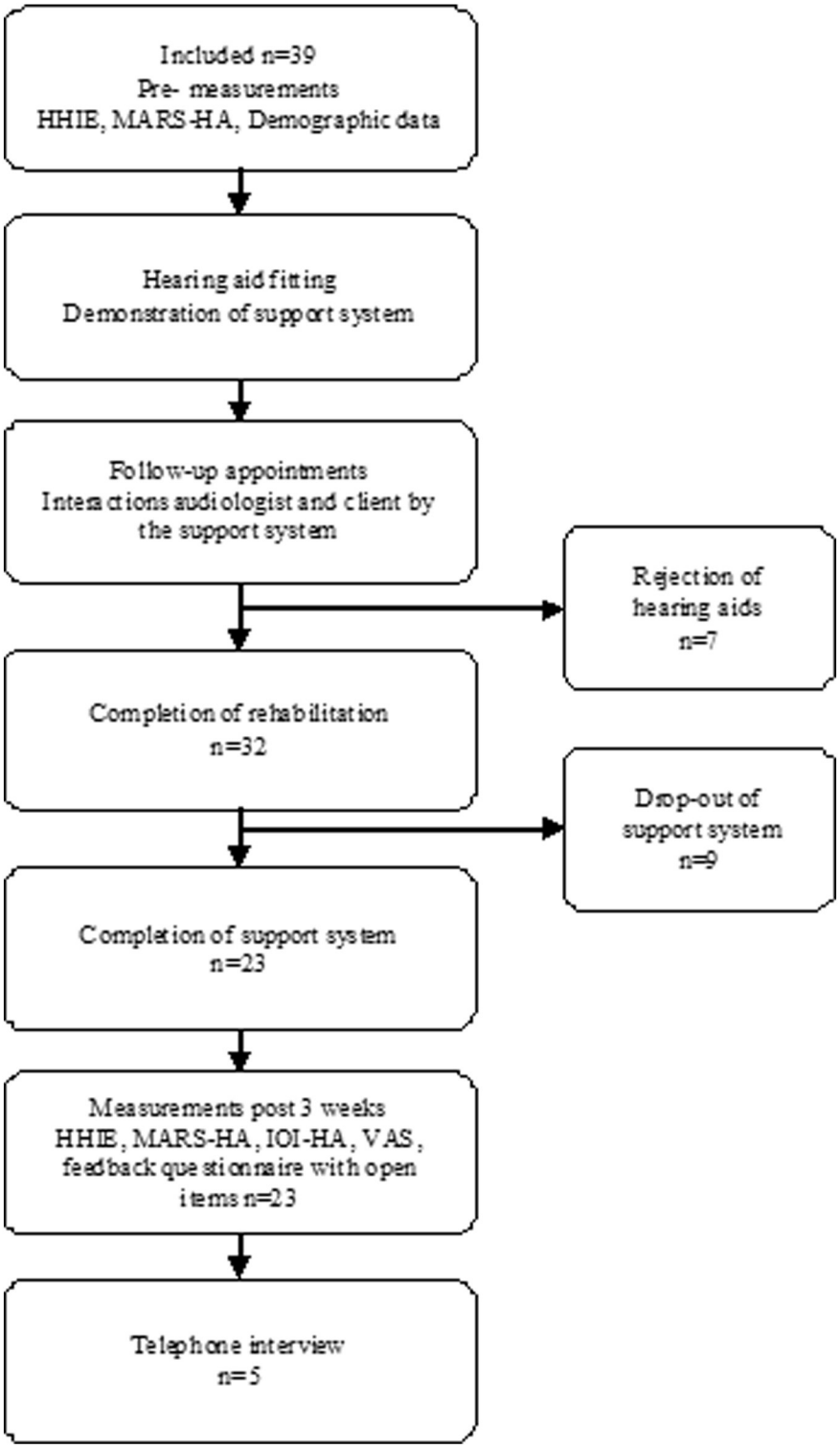

Fig. 1. Flowchart of the client pathways and assessments.

audiologists?" or "Something that should be changed?"). All four audiologists consented to the interviews. Recordings were successfully obtained for three of the four interviews; the included data from the fourth interview consisted of written notes made by the interviewer.

The interviews, both with clients and audiologists, had a duration of approximately 20 min. All recorded interviews were transcribed verbatim. The clients and the audiologists' interviews were analyzed separately using qualitative content analysis (Graneheim and Lundman, 2004; Knudsen et al., 2012). Interview excerpts pertaining to the support system were divided into units of meaning, coded, and assembled into categories and themes. The analysis was conducted by one of the authors (EI) in active communication with two of the other authors (MÖ and ALL). Codes and the organization of categories and themes were agreed upon. No qualitative analysis software was used. As data gathered in the feedback questionnaires were in agreement with the interviews regarding their content, the two sources of data were merged.

2.4. Statistical analyses

Statistical analyses were performed using IBM SPSS Statistics version 21.0. Repeated measures analyses of variance (ANOVA) were used to evaluate the effects of the rehabilitation with the Internet-based support system on HHIE and MARS-HA scores. In each analysis, the within-subject effects were tested from pre-fitting of hearing aids (Pre-HA) to post-fitting of hearing aids (Post-HA). Pearson product–moment correlations (r) were calculated between variables to investigate associations. For dichotomous demographic variables independent-samples t-tests were used to evaluate their effect on support system usage and assessment. However, this analysis was only conducted when the number of participants in each group was higher than five and this criterion was only met for gender. Parametric tests were used as almost all data were normally distributed using the Kolmogorov–Smirnov test for normality. In all analyses, probability values of $p < 0.05$ were considered statistically significant.

3. Results

3.1. Descriptive use of the Internet-based support system — audiologists

Table 2 shows the descriptive use and VAS-ratings of the audiologists' experiences and satisfaction with the Internet-based support system. The large ranges of logins, sent messages, read messages, and sent SMS messages indicated differences in how the four audiologists used the support system. All clients who agreed initially to participate were demonstrated the support system and thus provided some log data. Also, this analysis did not account for the fact that each audiologist managed a different number of clients. To account for this, the number of logins, sent and read messages, and sent SMS per client was calculated by dividing the sum with the initial number of clients enrolled in the study ($n = 39$). This provided a conservative estimate of audiologist usage per client, but the support system did not log the audiologist's actions regarding an individual client. However, these numbers give an indication of the audiologists' total use of the support system. The average satisfaction and experiences with the system are about two to three points above the middle of the VAS, indicating both satisfaction and positive experiences with the support system.

3.2. Descriptive use of the Internet-based support system — clients

Table 2 also shows the descriptive use and VAS-ratings of the clients' experiences and satisfaction with the Internet-based support system. Clients accessed the support system on average 7–8 times during the study period, sending about two messages to the audiologist and reading about three messages from the audiologist. A large range of logins to the support system and also number of sent and read messages were seen for the clients. About half of the clients provided feedback at least once on information (documents/videos) in the support system library. The average VAS-ratings of satisfaction and experiences with the support system were placed in the higher end of the scale (towards 10) indicating overall satisfaction with the support system and generally positive experiences with the system, although some clients seem to report less satisfaction and had less positive experiences as indicated by the lower end of the ranges.

3.3. Outcome measures and associations

Table 3 shows the mean scores and standard deviations (SD) for HHIE and MARS-HA measured Pre-HA and Post-HA along with the within-subject effects (W). Also seen in Table 3 are the IOI-HA global and subscale scores obtained only Post-HA. Significant improvement was seen for HHIE global score and both subscale scores. No significant change was seen for MARS-HA and subscales.

Associations between Internet-based support system use (i.e., number of logins) VAS-ratings of satisfaction and experiences with the support system, HHIE change (i.e. from pre-HA to post-HA), and IOI-HA were evaluated. The results are presented in Table 4. A positive association was seen between the number of logins and the VAS rating for "I experienced the documents available in the Internet-based support system as …" ($r = 0.523$, $p = 0.038$). This suggests that clients with increasing number of logins also reported that the documents in the support system were more positive to them. Positive associations were seen between VAS ratings for "How satisfied are you with the Internet-based support system?" and "I experienced the documents available in the Internet-based support system as …", and between "How satisfied are you with the Internet-based support system?" and "I experienced the functions (for example to send messages, read documents) in the Internet-based support system as …" ($r \geq 0.652$, $p < 0.01$) suggesting that the clients who were more satisfied with the system also had experienced the documents as more useful and the functions as easier to use. Positive associations were seen between VAS ratings for "How satisfied are you with the Internet-based support system?" and the IOI-HA global score, the improvement in HHIE global score, and the improvement in scores on the two HHIE subscales E and S ($r \geq 0.502$, $p < 0.05$). This suggests that as satisfaction with the support system increased the hearing aid fitting outcome improved and self-reported consequences of hearing loss decreased.

Positive associations were seen between VAS question "I experienced the documents available in the Internet-based support system as …" and the improvement in HHIE global score and scores on both subscales ($r \geq 0.501$, $p < 0.05$) indicating that clients who experienced the documents as more positive also had greater reduction in their self-reported consequences of hearing loss. In about two thirds of the cases, significant associations were seen between the different outcome

Table 3
Mean and standard deviations (SD) for HHIE, MARS-HA, and IOI-HA for the clients.

			Pre HA		Post HA				
Questionnaire	Scale	n	Mean	SD	Mean	SD	F-value	p	η^2
HHIE	Global	20	29.1	14.4	20.5	12.5	11.036	0.004**	0.367
	Emotional	20	13.6	8.7	8.9	6.2	7.219	0.015*	0.275
	Social	20	15.5	7.0	11.6	6.8	14.571	0.001**	0.434
MARS-HA	Basic handling subscale	19	93.7	8.6	96.7	5.9	2.341	0.143	0.115
	Adjustment subscale	21	79.3	16.8	84.6	20.0	1.774	0.200	0.090
	Advanced handling	21	79.5	20.6	69.4	24.2	3.720	0.07	0.171
IOI-HA	Global	20	n/a	n/a	28.9	4.0			
	Introspection subscale	20	n/a	n/a	15.7	2.8			
	Interaction subscale	20	n/a	n/a	13.1	1.9			

HHIE: Hearing Handicap Inventory for the Elderly.
MARS-HA: Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids.
IOI-HA: International Outcome Inventory for Hearing Aids.
* The effect is significant at the 0.05 level.
** The effect is significant at the 0.01 level.

Table 4
Correlation coefficients (r) between Internet-based support system use and experiences, and outcome measures (n = 15–23). Note that for the HHIE global and subscales the score indicate change from pre- to post-HA.

		USE	VAS-ratings			IOI-HA			HHIE	
		Logins	1	2	3	Global	Intro	Inter	Global	E
VAS-ratings	1. How satisfied are you with the Internet based support system?	.224								
	2. I experienced the documents available in the Internet based support system as…	.523*	.709**							
	3. I experienced the functions (for example to send messages, read documents) in the Internet-based support system as…	.242	.652**	.470						
IOI-HA	Global	.137	.502*	.198	.071					
	Intro	−.075	.475	.077	.081	.908**				
	Inter	.408	.161	.337	−.011	.772**	.435			
HHIE	Global	.194	.599*	.573*	.296	.485*	.495*	.292		
	E	.188	.527*	.501*	.247	.447*	.450*	.279	.963**	
	S	.171	.607*	.585*	.323	.467*	.486*	.266	.895**	.741**

USE: Internet based support system use; Logins: number of logins.
IOI-HA: International Outcome Inventory for Hearing Aids; Global: Sum of all items; Intro: Introspection subscale; Inter: Interaction subscale.
HHIE: Hearing Handicap Inventory for the Elderly; E: Emotional subscale; S: Social subscale.
* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

measures (IOI-HA and HHIE improvement) showing that improvement in one outcome was correlated to improvement in another ($r \geq 0.447$, $p < 0.05$; details are available in Table 4).

No association was seen between demographic variables and Internet-based support system use (i.e. number of logins) and VAS-ratings of satisfaction and experiences with the support system with one exception: A positive association was seen between age and the VAS rating for "I experienced the documents available in the Internet-based support system as …" ($r = 0.532$, $p = 0.028$) indicating that older subjects reported that the documents were more valuable. Overall no gender differences were seen but male users provided significantly more feedback than female users (male mean = 1.7, SD = 0.5; female mean = 1.2, SD = 0.4; $t(21) = 2.512$, $p = 0.02$). No other significant gender differences were found.

3.4. Audiologist experiences

In the qualitative content analysis, three themes and six categories emerged from the interviews with the audiologists and their feedback questionnaires. The themes and the connection between themes and categories are presented in Table 5.

3.4.1. Content

The audiologists appreciated the material and described it as appropriate for the clients, but noted that it should be kept up to date (e.g., use instructions showing currently available hearing aids). The material used had mainly been the predetermined material in the library with occasional additions for individual clients (e.g., material on tinnitus for clients who reported problems). An example comment was "For the right patient, that is a patient with need of this, it could be of use".

Table 5
Result of content analysis, with three themes (*content*, *navigation*, and *potential gain*) and categories for the clients (n = 18) and audiologists (n = 4).

	Clients (n = 18)	Audiologists (n = 4)
Content	Materials available	
Navigation	Technology (clients' experiences only)	Technology (clients and audiologists' experiences)
	Design and layout	
Potential gain	Target of individual client needs	
	Additional client-audiologist communication channel	
		Role in relation to clinical time and appointments

3.4.2. Navigation

The audiologists reported no problems with navigating within the support system, although the support system was occasionally not reliable and perceived as requiring further development. One concrete idea for development was to send automatic notification to the audiologist when a client had accessed a file in the library or sent a message, therefore removing the need for the audiologist to log in to monitor the clients' use of the support system. The audiologists described the login process as the most common issue for clients. Audiologists made comments such as "The program is structured easily and pedagogically, so there has been no problem working with it for my part" and "I feel that it has to have greater appeal, so that both the patient and the audiologist would want to work with it".

3.4.3. Potential gain

The audiologists' opinions of the Internet-based support system were positive, if it was used with clients who would benefit from it. Clients participating in the present study were not perceived as being in great need of the additional help the support system offered. Benefits frequently mentioned were the easy way of communicating with the client, the possibility for the client to ask questions without having to wait, the information available for the client, and the possibility for the client to repeat given instructions and information. For example, one audiologist stated "It could be a safety function for the audiologist as well, if there is a long delay until the follow-up appointment, the patient is able to get in contact with the audiologist faster. You are not limited to telephone hours, and you may return with a quick response message". All four audiologists recognized the benefit of the support system as an optional rehabilitation tool, and would recommend it to their colleagues when meeting with a client who would benefit from using the support system. It is not stated who these may be.

Furthermore, the audiologists reported that the support system required extra time during and between appointments. One audiologist said that "Well, I have spent an added time of 15 min on the [first] appointments as a maximum". However, two of the audiologists believed that experience and routine with the support system would, in the future, decrease the number of appointments needed for each client.

3.5. Client experiences

In the content analysis, three themes in five categories emerged from the open ended items and interviews with the clients (see Table 5). The client experiences are summarized below according to the three themes.

3.5.1. Content

In general, the clients were positive regarding the material available in the support system. The level of detail and difficulty was adequate to the clients. Two examples of comments were "Some information was really basic, and that I thought it did not benefit me, but other information [was adequate] … Well, there were both kinds [of information] "and "All the information is collected there [in the support system], so there is no need to keep a lot of paper based information at home".

3.5.2. Navigation

Many clients experienced technical difficulties with the login process: having to enter the temporary code obtained via SMS was described as unnecessarily complicated and cumbersome. Some clients also reported difficulties navigating within the support system and using its different functions, stating that more than basic computer experience was needed. To this effect one client said "I am experienced with computers, so in my case there was no problem, but I am thinking that … Well, this [support system] is also meant to be used by people that are a lot older [than me]". Further development of the support system, especially in terms of design and layout, was also mentioned as desirable. For example, one client stated "Well it is like: you are so used to different types of computer systems that contain a lot more [than this one]".

3.5.3. Potential gain

The majority of the clients had a positive opinion on the Internet-based support system in general, though one third of the sample explicitly reported little or no personal need for the support system. Most clients reported that they did not use the support system extensively, mainly because they did not have any problems or questions, felt satisfied with the information gained at the clinic, and had not felt the need of extra support or as one client stated "If I had, [felt the need] I am sure I would have used this program a lot more". The most frequently mentioned benefit were the easy way of communication with one's audiologist (e.g., be able to ask questions at any time without having to call or to wait for an appointment). A comment was "The feeling that you do not need to have to remember a question for a long time or to wait; "I am not meeting her [the audiologist] for a whole month" or something like that. Whenever you have a question you may ask it and receive a response message". Clients recognized the support system as being a good complement to the appointments if needed, and the usefulness in the possibility to read and watch the material to facilitate information retention. The majority of the clients stated that they would recommend the support system to friends and family members who would undergo a hearing aid fitting.

4. Discussion

The present study reported on the clinical application of an Internet-based support system for audiologists and first-time hearing aid clients. The purpose was to implement the system in clinical setting. The findings show that the clients and the audiologists reported overall satisfaction and positive experiences but both audiologists and clients reported that the support system did not address the needs of all clients. Also, some clients expressed that they did not need the additional support that the support system was thought to provide. Furthermore, the findings indicated that self-reported consequences of hearing loss and hearing aid outcome improved with increasing satisfaction and more positive experiences with the support system. Both clients and audiologists recognized the potential value of including a support system in audiologic rehabilitation.

Positive experiences and overall satisfaction were found in relation to the Internet-based support system. The data point to large individual differences in user behavior of the support system, both between clients and between audiologists. This is a similar finding to previous findings (Ruland et al., 2013; Manchaiah et al., 2014). Client and audiologist experiences with the support system showed that some of the considerations for the effective development of tele-health interventions for people with chronic health conditions (Car et al., 2012) were not adequately addressed in this study. For example, in the qualitative interviews both audiologists and clients reported that the support system did not address the needs of all clients. This could suggest that the participants using the Internet to some extent on regular basis already felt they had access to the support system information through the regular Internet and that the support system did not provide additional or sufficient new information to motivate the use as suggested previously (Manchaiah et al., 2014; Weymann et al., 2015). It could also suggest that some participants were satisfied with the information they received during the appointments at the clinic as have been reported in other fields (Frøisland et al., 2012; Cook et al., 2014). Usability and design expertise would have been beneficial to the development process (Brännström et al., 2015).

Still, clients did not need to use the support system extensively to find it helpful. For some, having access to a specific video showing hearing aid maintenance could be meeting needs and therefore being seen as of value. Also, based on the descriptive use of the support system, it is reasonable to assume that clients used the support system according to their individual needs or preferences for information and contact with the audiologist between appointments. The audiologists suggested an improvement to the system to save audiologist time: the support system could send a notification automatically to the audiologist when a client had accessed a file or sent a message.

The HHIE was used to measure reduction in self-reported consequences of hearing loss from pre- to post-hearing aid fitting (Ventry and Weinstein, 1982). The global score and subscale scores improved significantly from pre- to post-hearing aid fitting. This is in accordance with previous studies indicating that audiologic rehabilitation with hearing aid fitting improves self-reported consequences of hearing loss post fitting (e.g., Öberg et al., 2008; Öberg et al., 2009). The present findings suggest that the use of the support system does not alter this pattern. The effect of the Internet-based support system use on hearing aid self-efficacy was measured with the MARS-HA (West and Smith, 2007). No significant changes from pre- to post- hearing aid fitting were seen. The post-fitting scores for the Basic handling and Adjustment subscales were very similar to those reported by West and Smith (2007) for first-time hearing aid users (less than 6 months experience of use) indicating that the clients were confident in their belief to care handling and adjusting the hearing aids after rehabilitation in combination with support system use. The IOI-HA was used to evaluate the efficacy of the hearing aid rehabilitation (Cox et al., 2000; Cox et al., 2002). The average global and subscale scores were slightly higher in the present study than in other studies using the same Swedish IOI-HA version. The shorter time interval between the conclusion of the rehabilitation and the administration of the IOI-HA used in the present study (three weeks compared to 6 to 12 months) may have influenced the outcomes, but generally the IOI-HA global and subscale scores are similar to those from previous reports (e.g., Öberg et al., 2009; Brännström and Wennerström, 2010).

Associations between the Internet-based support system use and ratings of satisfaction and experiences with the support system, reduction in self-reported consequences of hearing loss, and hearing aid outcomes were investigated. Clients that had more positive experiences and that were more satisfied with the support system had a greater reduction in self-reported consequences of hearing loss and reported better hearing aid outcomes. However, the actual use of the Internet-based support system assessed as the number of logins to the support system were not associated with reduction in self-reported consequences of hearing loss nor with the hearing aid outcomes. If the support system had worked in a dose/effect manner we would have expected such a relationship emerging. The observed pattern of results would be expected from a sample that provided socially desirable answers, i.e. the tendency to consciously or unconsciously overly describe

oneself or put forward one's opinions in a more positive way when, for example, responding on a questionnaire (Paulhus, 2002; Sjöström and Holst, 2002). The participants were instructed to send their completed questionnaires to the research team (instead of their clinical audiologist), but this might not have been enough to remove the effect of social desirability bias on the results (Tourangeau and Yan, 2007). On the other hand, there was a positive association between the number of logins and the reported satisfaction with the documents provided in the support system. This could indicate that those who reported less satisfaction with the documents were less inclined to log on the support system as they experienced the documents as less relevant for them. It is therefore possible that using material in the support system tailored for each client would increase the satisfaction and perhaps the benefit of the information. The latter may prove important as tailored interventions seem to be more effective than standardized interventions in other fields (Johansson et al., 2012). However, causal relationships cannot be revealed from the present data and corrections could have been applied given the multiple comparisons. In addition, age seems to be a confounding factor as older subjects reported that the documents were more valuable. Future studies are required to elucidate these matters.

To the best of the authors' knowledge, this is the first study of an Internet-based support system for audiologic services: a support system that may allow audiologists to tailor the content of the support system to the needs of each client. The support system logging data obtained gave an overall picture of support system usage, but more sophisticated logging (e.g., time logging, content of mail correspondence) could provide information on how to customize the content of the support system to best answer client needs. In addition, further functionality could also be added to the support system. For example, the power of Internet-based peer support is also known in the general health literature and in audiologic rehabilitation (Leibert et al., 2008; Thorén et al., 2011; Thorén et al., 2014) and a peer support dimension could be added to the current support system.

Four audiologists in three Swedish hospitals tested the support system. Both clients and audiologists were included as research participants, and both quantitative and qualitative data was collected. Whilst 39 clients were enrolled, only 23 clients completed the study. This is a major limitation of the study. Problems with drop-outs in studies utilizing Internet-based treatments have been previously reported. For example, Manchaiah et al. (2014) reported both recruitment difficulties and excessive drop-out rates in a clinical trial of the "patient journey model" which aims to improve counseling of individuals with hearing disabilities. They found that the counseling material based on self-reflection most likely did not attract all participants. This could suggest that the amount of personalization provided in the present Internet-based support system was not extensive enough. Thus, the present drop-outs can perhaps be due to the experience that their own needs did not require the support system. In the view of a customized and individualized audiologic rehabilitation, it is possible that the support system should be viewed as a tool among many selected only when relevant. Also, the system was developed by four research audiologists (Brännström et al., 2015). In the future, system development with closer user involvement (i.e., both clients and audiologists) is strongly recommended. Another cause for the drop-outs could be the encountered login problems as stated in the interviews with the audiologists and clients. The login procedure proved too complicated for many clients. The supplementary login security implementation (a six-digit code sent via SMS at each login attempt) required by national privacy laws was too cumbersome for some. This has been reported for studies in other fields (e.g. Frøisland et al., 2012). Future studies need to directly assess the reasons for drop-outs. Also, the research design does not allow to directly measure the benefits of the support system (e.g., information retention or hearing aid outcomes) compared to a control group. Future research could compare the benefits of the support system to usual care or placebo group.

5. Conclusions

As part of this study, audiologists and first-time hearing aid clients tested an Internet-based support system. It is possible to implement a support system for use in audiologic rehabilitation in combination with face-to-face appointments. Easy login procedures are necessary for facilitating usage and more sophisticated logging of user behavior is required to gather information on possible ways to customize the content of a support system to best answer audiologists and clients' needs. In addition, direct assessment is needed to explore whether the manner of providing or the content of the support is the cause of non-use among clients. Both clients and audiologists recognized the system's potential value to offer an online support to the provision of audiologic service.

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