The internet is unquestionably a phenomenal platform for health information, research, rehabilitation programmes, and self-management programmes. There is evidence too that internet-based treatments can lead to improvements in psychological distress, health behaviour, and disease control [1]. Interestingly, Henshaw et al found that in adults aged 50-74, hearing loss was associated with greater computer skills and internet use than having no hearing loss [2]. So, internet-based treatments might be particularly suited to those with hearing problems, as is the case for most people who have tinnitus.

In the field of audiology interest and investment in internet-based assessments and treatment programmes is on the increase, so much so that the international ‘Internet and Audiology’ conference will be in its third annual meeting later this year. There is a clear sense in the field that the internet represents new opportunity to better use clinical expertise for the benefit of people with hearing difficulties and related conditions such as tinnitus [3].

Internet-based treatment for tinnitus might include, for example, asynchronous clinician contact, interactive homework, or the provision for use of audio, video, or text files [4]. Eight research papers on this topic were published during 2016. Two papers describe work so far on different tinnitus self-management programmes. Three papers considered effectiveness of internet-based treatments: one randomised controlled trial (RCT), one observational study, and one systematic review. A further three papers consider how internet-based treatments for tinnitus might work.

Newly-developed internet-based treatments

Internet-based treatments for tinnitus that are on the horizon are described in Greenwell et al [5] and Beukes et al [6] both of whom are UK-based authors.

Greenwell et al describe their protocol for a mixed-methods process evaluation of how people use and interact with the Tinnitus E-Programme [7]. This 10-week internet-based self-management programme provides
downloadable educational materials, relaxation exercises and training, brief cognitive restructuring skills training, optional social support in the form of a moderated online discussion forum, and information about books and other websites that might be useful.

The programme is self-completed over 6 weeks followed by a 4-week ‘maintenance’ period where individuals continue to practice the skills they have learned. People can self-monitor their progress by completing a tinnitus questionnaire [8].

The purpose of a process evaluation is to develop a deep understanding of how people experience a treatment, an essential first step when evaluating treatments that are complex. To do this Greenwell et al outline two parallel mixed-methods studies. Study 1 is an online survey to gather views from people who already have experience of the programme. Study 2 involved new users who completed the 10-week programme before taking part in an in-depth interview, and reported their use of the skills learned and how well they were able to implement the skills in their everyday lives. The findings from both studies will be used to optimise the Tinnitus E-Programme before effectiveness is tested in a clinical trial. At the time of publication Study 1 was still open to recruitment and Study 2 was completed.

In their study the iCBT was first evaluated in the development stage by a group consisting of specialist audiologists, a hearing rehabilitationist, and two members of a tinnitus support group. iCBT was then tested in a group of 29 adults with significant tinnitus distress. All participants completed a satisfaction questionnaire developed specifically for the study rating various aspects of the programme including usability, suitability of content, presentation, suitability of iCBT for people who have tinnitus, and the appropriateness and clarity of the exercises involved.

In the second paper, Beukes et al describe the development process of their treatment, a clinician-guided internet-based cognitive behavioural therapy (iCBT), and the technical functionality testing they went through to identify any areas for improvement. The express aim of the treatment is to “maximise behavioural change by offering various techniques within a comprehensive intervention that focuses on addressing the physical, emotional and daily effects of experiencing tinnitus” (p.7). The treatment comprises compulsory modules on progressive relaxation, cognitive restructuring, use of positive imagery, reinterpretation of tinnitus, exposure therapy, focus exercises, and planning for the future. There are also optional modules on sound enrichment, hearing tactics, and sleep, concentration, and sound sensitivity problems.

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Overall, satisfaction was high and the main refinements indicated related to technical functionality. This treatment is subject to an ongoing randomised controlled trial (clinicaltrials.gov: NCT02370810). Importantly, the studies described by both Greenwell et al and Beukes et al were guided by the Medical Research Council guideline on developing and evaluating a complex intervention [9]. This guideline...
urges careful and iterative development and feasibility testing of new complex treatments before they can be considered ready to evaluate in a clinical trial. In addition, publication of the process of development and feasibility testing such as was done by Greenwell et al. and Beukes et al. is important for transparency and to promote best practice in the field of internet-based treatment development.

Do internet-based treatments work?

Measures of effectiveness of internet-based treatments for tinnitus were reported in two clinical studies and one systematic review published in 2016. In the first clinical study, Kim et al. describe a treatment using individualised ‘notched’ music delivered from a smartphone app, combined with the herb Ginkgo biloba [10]. Twenty-six patients reporting persistent bothersome tinnitus were recruited to the study and were instructed to (1) listen to the notched music for 30–60 minutes per day, and (2) take Ginkgo biloba (Ginexin-F 80-mg tablets) twice a day, for 3 months. The effects of the combined treatment were measured using the Tinnitus Handicap Inventory (THI) questionnaire [11]. Various demographic data were also collected using clinical questionnaires that measure depression, anxiety, and sleep quality, to examine whether these factors affected treatment success. After treatment, there was a modest reduction in tinnitus questionnaire scores overall (34 points before treatment and 23 after) which does not equate to a clinically meaningful change.

There are a number of issues to highlight with the study by Kim et al. Not least is that the study involved two different treatments combined and no ‘control’ group. As such it cannot be determined if any improvements in individuals might be associated with one or other part of the treatment, or indeed if any improvement was simply due to spontaneous improvements in tinnitus that happened over the three month course of the study. It is also unclear why these authors used Ginkgo biloba in their study. They provide no rationale for it and in discussing limitations of the study refer to one of their own studies as evidence of it having no beneficial effect on tinnitus. Rather, its use clinically is recommended against as it is associated with no tinnitus benefit and some negative side effects and common drug interactions [12].

The only RCT of an internet-based tinnitus treatment to be published in 2016 came from Weise et al. who compared the effectiveness of iCBT to participation in a moderated online discussion forum [13]. iCBT was delivered as described earlier for Beukes et al. with the exception that the clinicians guiding the treatment were CBT therapists or clinical psychologists. They used the discussion forum to control for non-specific effects of treatments such as treatment expectancy effects. Participants were randomly allocated to the two different conditions with 62 people in each study group, and assessed for tinnitus severity and associated symptoms before and after treatment. For the iCBT group they also measured symptoms at six and 12-month follow-up. On their main measure of effect, the THI, they found a significant and clinically meaningful improvement in scores for the iCBT group (53 points before treatment and 33 after) compared to the discussion forum group which had a small reduction in tinnitus score (52 points before treatment and 46 points after). Improvements in the iCBT group were maintained at six and 12 months after treatment (35 points before treatment and 29 after). Based on this and previous evidence of effectiveness they conclude that the implementation of iCBT for tinnitus into routine health care is an important next step to improving access to treatment for patients with tinnitus.

The combined evidence for the benefits of self-help interventions for tinnitus was systematically reviewed by Greenwell et al. [14]. In this paper, the authors reviewed controlled clinical trials and reported on measures of tinnitus distress, functional management, anxiety, depression, and quality of life. They also used a behaviour change techniques taxonomy and the PRISMS taxonomy of self-management components to systematically describe the interventions. Just five studies were included in the review, and only two evaluated internet-based treatments (iCBT) for tinnitus. Those studies showed that

iCBT led to a reduction in tinnitus distress but not depression, and

iCBT that is guided by a therapist may be more effective than unguided iCBT.

Taken together with the more recent study from Weise et al. it can be concluded that iCBT is an important avenue of further development.

How internet-based treatments might work?

To optimise the benefit that might be had from internet-based treatment it is important to consider at all stages how they might work. Effectiveness may be as much about the way the treatment is delivered as it is about
treatment content for example. So how do internet-based treatment components, and a user’s interactions with them, lead to the desired beneficial effects? Greenwell and Hoare explored the presence of four key interactive design features (social context and support, contacts with the intervention, tailoring, and self-management) across internet-based audiology rehabilitation and self-management interventions including those for tinnitus [15]. The review also asked whether there is evidence of these design features being important to the effects of the intervention. Five treatments were identified as representative examples of work in the field, two of which were treatments for tinnitus (iCBT and the Tinnitus E-Programme, as described earlier). Interestingly, both treatments were found to use social context and support and contacts with the intervention (e.g. therapist contact, email/phone contact) and self-management (e.g. homework assignments, self-completing and scoring clinical questionnaires) and neither treatment use any form of tailoring. Tailoring involves the provision of individualised information based on certain characteristics, e.g. only providing information on sleep management to those people who report their tinnitus impacts on their ability to sleep well. This review concluded that future studies should explore the role of tailoring as a potential mediator of more benefit from internet-based treatments, and the amount and combinations of design features that lead to maximum benefit. As the two tinnitus treatments in this review used the same design features they cannot be contrasted on that basis.

A mixed methods approach was used by Heinrich et al who explored what makes people who have tinnitus seek help, and what motivates them while they undertake iCBT [16]. These are important questions as studies of internet-based treatments often report high attrition after initial engagement, and some patients prefer face-to-face therapy to iCBT. Heinrich et al explored these issues with an open ended questionnaire sent to 112 tinnitus patients before and after completing iCBT for tinnitus. Patients reported six factors that would motivate them to continue with treatment, namely potential for success, training/learning something new, personal disposition, prospect of success, evidence of it being effective for others, and support from the study team or their social environment. Naming specific tinnitus-related problems as a reason for engaging with iCBT was associated with greater improvement after, as was describing an active involvement in the treatment. These authors conclude the need for further hypothesis driven testing to confirm their exploratory results.

Predicting benefit
The final paper reported here came from Lindner et al who asked whether cognitive flexibility (how well we can switch between thinking about two different concepts) predicts the benefit that people report after completing internet-based psychological treatments for tinnitus or other disorders [17]. Fifty-three people took part in the tinnitus trial and completed the Wisconsin Card Sorting Test (used to measure cognitive flexibility) [18] before treatment with iCBT. The authors hypothesised that if a person has greater cognitive flexibility then they are more able to learn and use the cognitive restructuring techniques that are part of iCBT, and so would report more improvement in their tinnitus. However, they found no significant relationship between treatment gains and scores on the Wisconsin Card Sorting Test, concluding that lower cognitive flexibility, as measured by this test at least, should not reflect the likelihood of benefit from iCBT.

Conclusion
Educational and psychological treatments are not always readily accessible yet are acknowledged as beneficial to people with tinnitus. As such, internet-based treatments with their global reach provide an alternative to those unable or indeed unwilling to access traditional clinical services. They may also represent useful additions to clinical services either complementing what treatment is currently given, or providing resources that can be accessed as needed between clinic appointments. Internet-based treatment is viable and likely desirable to clinicians and people with tinnitus. However, care is needed if treatments are to be delivered in the most effective way. Whilst the content of an intervention might be excellent, if the intervention lacks key design features then its potential effectiveness may never be realised. There is every indication to continue and drive forward this line of research and treatment.
References


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