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ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Telescopic otology referrals: Evaluation of feasibility and acceptability

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Abstract

Objective: A remote telemedical otology referral and advice service was introduced to interested general practices. General practitioners (GPs) were given a new device, "endoscope-i" that combines an optimized smartphone high definition video app with an otoendoscope. They were specifically trained to examine and capture images of patients' eardrums, which were sent electronically with a summary of clinical information and an in-app hearing testing (if required), for specialist advice to two ear, nose, and throat (ENT) consultants. We describe the findings from an evaluation of the first 6 months of this service to establish the feasibility and acceptability of an otology telemedical referral and advice service.

Methods: The new service was advertised to GP practices in Northern Staffordshire. All interested GPs were provided with training and equipment to deliver the remote referral service. Data were collected from GPs at baseline, informal feedback in response to referral outcomes and end of service feedback. Referral data were collected routinely during the service delivery.

Results: Fifteen GP leads from 15 practices received training and equipment. One quickly lost the equipment. Of the remaining 14 practices, eight sent a total of 53 remote referrals using this technology over 6 months. The most common reason for referral was an uncertainty of what could be seen in or around the eardrum. The primary barrier for implementation was lack of wireless internet connections within practices. GPs reported that they used this technology to share examination findings with patients.

Conclusions: GPs were positive about the technology, from initial engagement with training and after advice were given. Some GPs expanded the role of the technology to a consultation aid. Referral volume was manageable. Commissioners should consider tariffs structures for such services; empirical cost-effectiveness and workload-impact evaluation would inform this.

KEYWORDS

eardrum, endoscopy, referral, service evaluation, telemedicine

1 | BACKGROUND

Ear, nose, and throat (ENT) problems are common but heterogeneous in general practice. Although many primary care ENT presentations are for acute self-limiting conditions, severe, function-threatening, and chronic conditions are often associated with delayed diagnosis and multiple presentations.[1] General practitioner (GP) training does not require formal ENT training, with learning often being experiential and supervised by GP trainers rather than ENT surgeons. Specialist advice is therefore commonly sought.[2] Hospital Episode Statistics (HES) data demonstrates that in 2016/17 there were 2.9 million outpatient ENT attendances in England of which around 40% were first face-to-face appointments[3] and <0.5% were teleconsultations.[3] Locally, approximately half of all ENT referrals are otological.

Referrals are undertaken by GPs for a wide range of reasons,[4] thus not all patients with ear problems requiring specialist input require a face-to-face ENT clinic and may be managed in a more timely and efficient way using remote technology. Although telephone or video consultations may be cost-effective and feasible,[5] they lack the ability to examine patients' ears—a fundamental aspect of an otology consultation. Newer technologies, such as endoscopes with recording devices allowing the capturing and sharing of images with ENT specialists,[6] may enrich information transferred to specialists. This in turn may widen the scope of patients suitable for remote management and may help to refine referrals[7] and chronic condition monitoring. Reduced travel time[8] and faster diagnoses are potential benefits for patients. However, within primary care, capturing and using endoscopic ear images to supplement referrals for specialist advice is relatively new, the technologies and associated services are variable and there is very little evidence relating to these approaches. Despite the theoretical benefits, evidence from over 10 years ago suggested higher rates of follow-up among virtual clinics when compared to face-to-face,[9] and the place of this technology within existing service models remains undefined. This evaluation is aimed to assess the feasibility and acceptability of a new telescopic eardrum referral system for primary care.

2 | METHODS

2.1 | The endoscope-i service

In one health economy, funding was provided for practices to receive the endoscope-i equipment[6] and training for use within a service redesign The components of the endoscope-i advice and referral service were: (a) endoscope-i equipment, (b) GP training, (c) app for iPod and iPad, (d) transmission of referral data to Consultant ENT surgeons, (e) face-to-face in-practice support, and (f) online resources. Each is described further below. In addition, provision of local hotspots for data connectivity to those practices that required it was provided.

1. Endoscope-i equipment: GPs were given the otoendoscope (4 mm diameter, 0°, 70 mm length), endoscope-i adapter, iOS device (iPod touch), and a light wand (see Figure 1). This enables users to capture and record high definition endoscopic images (see Figure 2).[6] The endoscope is cleaned between patients with a detergent based wipe.
2. GP training: three training sessions over 6 weeks. The first was an online video module outlining endoscope-i technology, anatomy of the ear as visualized using an endoscope and a clinical revision of common otology conditions. The second and third sessions were face-to-face group sessions delivered on two different mid-week evenings. GPs were given the endoscope-i equipment at the second session, which addressed safe use of endoscope-i, practical ear endoscopy and the app. The third session provided instruction on hearing tests and sending referrals using the app and troubleshooted equipment problems. At the end of the third session, GPs' use of endoscope-i was assessed by the ENT consultants and, where appropriate, GPs were certified as competent in its use.

FIGURE 1 Light wand fitted with adapter and endoscope to iOS device

FIGURE 2 High-definition endoscopic ear picture from endoscope-i

3. The CE marked *e-i Pro CCG* App[10]: had two components. The first enabled clinicians to record endoscopic images and videos and had the facility for a brief typed or dictated history. The second component was on the GP iPad and iPod touch and enabled the clinician to provide a structured history and perform a hearing test.
4. Transmission of referral data: to the two consultant ENT specialists service via nhs.uk email or via Box, a secure platform which enabled file sharing. Each consultant gave their individual opinion, consulted together and provided a unified response. The advice was sent back to the referrer via NHS.uk email.
5. Face-to-face in-practice support: prior to rolling out the service face-to-face support was provided to GPs, by one of the ENT specialists visiting the practice. During this visit, they undertook an equipment check and ensured the practice IT infrastructure would allow for the referrals to take place. Following the rollout of the new service, a further face-to-face in-practice visit was conducted to troubleshoot and gain evaluation feedback.
6. Online resources[11]: in addition to the first training session, delivered online, further online resources were developed over the course of the service rollout. This public facing information was designed to provide refresher information for clinicians, details of the service for newly engaged clinicians and information for interested patients.

The Clinical Commissioning Group commissioners were supportive of the service redesign and for the potential, it offered to switch from face-to-face to remote specialty ENT consultations.

2.2 | Ethical considerations

Ethical approval was not required to undertake this evaluation of a service redesign. Endoscope-i equipment, use and processes have been developed in line with regulatory and legal requirements.[12]

2.3 | Participants and setting

The forthcoming service redesign was advertised to GPs in Northern Staffordshire after an update workshop for general practice teams. This event focused on technology enabled care services in primary care and endoscope-i—was demonstrated by one of the consultants (AG). All interested GPs were accepted to deliver the service. Training commenced in June 2016 and referrals using the new service commenced from September 2016. Any patient deemed appropriate for the service was included, no inclusion/exclusion criteria were provided. Predicted activity was up to 20 new referrals per month with the expectation that two thirds would be managed with telescopic referral alone.

2.4 | Costs

The specialist referral service was provided free-of-charge during the evaluation period. Training costs were £2000 in total, the endoscope-i kit costed £1500 each, iPods were £133 each, the iPads were already in the practices and the headphones for the audiogram were £50.

2.5 | Evaluation data collection

Data regarding acceptability and feasibility of the service was planned a priori, using a suite of strategies; however, iterations were required and are discussed below.

Baseline questionnaire of GPs: designed to establish what attracted GPs to the service and the ease of use of the equipment. It was administered by one of the ENT specialists (AG) and was administered post-training but before referrals to the service began. Twelve baseline surveys were returned.

ENT specialist feedback: designed to capture information about appropriateness of referred cases, adequacy of information provided for clinical decision-making, whether diagnoses could be made, frequency with which face-to-face assessment following telescopic referral was necessary, and technology process issues.

Quantitative assessment of uptake of training and use of the service: details of the number of GPs who completed the full training, undertook telescopic referrals and secondary care referrals to response times were recorded routinely.

Formal feedback from GPs after service use: although originally planned 1 and 6 months after service rollout, this was delayed, and feedback was sought on one occasion and accepted until project end (August 2017).

A priori patient feedback data was planned, however no feasible solution was identified to approach and securely transmitting patient details to the team, so this element of the evaluation had to be omitted.

2.6 | Data analysis

Descriptive analyses were undertaken. Practice referral numbers were converted into referral rates per 1000 registered patients using data relating to list sizes in October 2016.[13] Interpretation of the data was structured according to Lau et al's conceptual framework, which describes key elements influencing implementation of change.[14]

3 | RESULTS

3.1 | Intervention

3.1.1 | Use of the service

Fifteen GPs from 15 practices expressed an interest in delivering this service. One quickly lost their equipment, so this evaluation relates to 14 practices. By the end of the first 6 months of the service, eight practices had referred 53 patients using endoscope-i. Forty-four referrals (83%) were managed with remote advice alone. The remaining nine patients needed onwards referral for microsuction (n = 3), likely surgery (n = 2), computed tomography scan before face-to-face review (n = 2), face-to-face review before advice could be given (n = 1), and alternative source of advice (problem unrelated to the ear). Figures 3 and 4 demonstrate the reasons for referral and frequency of diagnosing different pathologies. The information received through the remote referral enabled the clinicians to optimize the referral pathway for these nine patients—eg, arranging imaging prior outpatient appointment, and ensuring the patient is seen in the correct clinic. Referral rates between practices varied, among the eight practices who had referred the median referral rate was 0.65/1000 registered patients (range 0.13, 4.10). The median ENT specialist response time to remote referrals was 48 minutes (IQR 22 minutes, 2 hours 28 minutes). The longest response time recorded was 15 hours 55 minutes.

3.1.2 | GP opinion

Initial feedback about the service

At service initiation, 10 baseline survey respondents had used endoscope-i with at least one patient. Of these, six stated that, compared to usual equipment, the quality of ear examination was better (including one who said "generally better but sometimes worse"), and four stated it was the same. At this time, 10 GPs stated they would recommend endoscope-i to other GPs, one had not used it and the other was "unsure." Free-text comments offered by GPs about why they would recommend the technology, referenced the "better quality of pictures," the "ability to save images," and capability to "review and follow-up after treatment."

Real-time GP feedback

GP feedback was not routinely collected; however, anecdotal comments reflected gratitude for the "explanation and advice," changes to referral approach prompted by the service (either not to refer or refer to different destination), specialist support for a particular

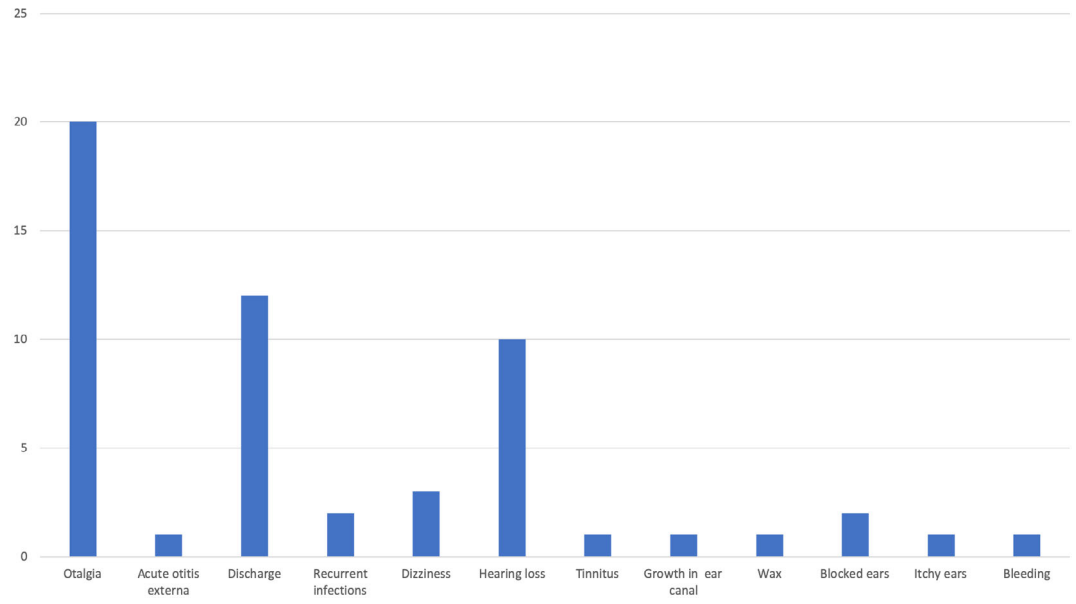

FIGURE 3 Bar chart demonstrating reasons for referral

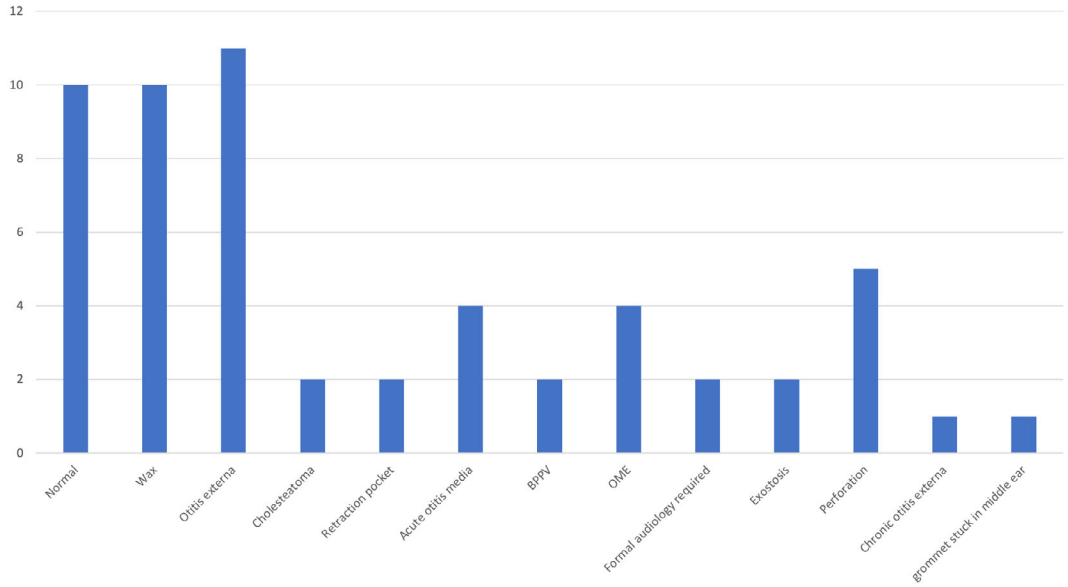

FIGURE 4 Bar chart showing diagnosed pathologies in the ear

pharmacological treatment approach, or more efficient use of eventual face-to-face appointment (eg, when imaging had been recommended first).

Reflections at service end

At service end, GPs were informed and five provided formal feedback, while one provided an ambivalent reaction, the remaining GPs were "sad" (n = 3) and "disappointed" (n = 1) that the service had ended. GPs reflected it had been "useful" and helped them to "improve patient care," through the educational value of using the technology. Educational value was for both GPs (n = 1) and patients (n = 1). One GP was concerned about now managing patient expectations in its absence, and another reported they would continue using it "for my own diagnostics." Finally, one GP reported it had helped in their Care Quality Commission (CQC) inspection.

3.1.3 | Specialist perspectives

The specialists delivering the service found referrals to be manageable, and advice could be given in all but one case without providing face-to-face review. The specialists also reflected an enhanced educational value as they provided advice about the clinical diagnosis and management, the GPs' imaging technique (eg, feeding back if they were too close to the tympanic membrane) and refinement of referred videos (eg, advice about trimming clips). Both specialists were pleasantly surprised at the ease with which a definitive diagnosis and management strategy could be provided, often with very little history. When little history was received, the answers provided were broader, for example, "if they have this, then you need to do X, if they have that, then you need to do Y." When referrals were accompanied by detailed histories and hearing screen, the diagnosis and management could be very specific, essentially the same as seeing the patient in secondary care clinics.

3.2 | Professional

The most common reason GPs gave for taking part in the service was to improve referrals (easier, better quality, and/or quicker; n = 7). Other reasons were to acquire a new skill (or learn about a new "gadget"; n = 3), obtain improved quality images of the ear (n = 3) or specialist diagnostic support (n = 2), to enable GPs to look back at images again (n = 1) or show them to patients (n = 1), to improve ENT service (n = 1), to make it convenient for patients (n = 1) and out of "curiosity" (n = 1). One GP reported that they were keen to be involved as they saw a high number of ENT patients in their practice as part of usual care.

3.3 | Organization

Only half of the GPs responding to the baseline survey had watched the training video. Among these, all reported the quality as "OK" or "excellent" and key take-home messages were how to use the endoscope (n = 4) and learning from seeing the endoscopic pictures (n = 1) and pathologies (n = 1). One GP valued the videos being available to watch a "number of times and reinforce understanding." Most respondents reported having attended face-to-face training (n = 10), although one did not attend the group sessions and was trained at their own practice by the endoscope-i team. Of those who did attend face-to-face training, all stated it was "excellent."

3.4 | External context

A key barrier to implementation arose from the limited technology infrastructure in primary care practices. None had Wi-Fi access suitable for data transmission (three had guest Wi-Fi) which prevented direct use of

the app. COIN practices presented a particular difficulty. Without internet connectivity, GPs had to download PDFs to email to the specialists. Significant extra investment was undertaken for Wi-Fi dongles (£280 per practice for 1 year of data) to facilitate easier remote referrals.

4 | DISCUSSION

A review of the literature on teleotology shows a sparsity of randomized controlled trials. Historically, the focus of such programs has been on the provision of service support for geographically remote areas.[15-18] Otolaryngology as a whole lends itself to utilizing e-technology with almost a 90% uptake.[19] This is because 62% of pathologies within otolaryngology have been deemed suitable to manage via a telemedical pathway.[20] The emphasis of success is strongly dependent on image quality and a number of Tele otoscopy systems have been developed over the last 5 years. Totterman et al[21] used a Visual Analogue Scale to compare the efficacy of four different digital otoscopes to diagnose three specific ear findings (normal, perforation, exostosis) in a Finnish medical setting. Within the same health care system, Erkkola-Anttinen et al[22] analyzed the efficacy of one of the top-rated digital otoscopes from the previous study in the context of parental examinations. They concluded that parents were able to reliably perform video otoscopy for diagnosing otitis media with effusion in children aged 6-35 months emphasizing the value of video over still images to improve diagnostic accuracy by the receiving clinician. Conversely, Shah et al[23] demonstrated a large interoperator variability of agreement for diagnosis of ear examinations between a trained professional against a parent who had watched a video tutorial on examining the ear. They stress caution in relying on parents to provide diagnostic video information despite the high rated quality of the images some of these devices may provide.

Overall it seems logical that each device available on the market should be used in a responsible a fixed protocol to minimize misdiagnosis. Each device should be individually assessed with a number of outcome measures beyond just images quality including ease of use and overall acceptability. Our study is the first of its kind to assess a digital otoscope device in a real-world setting assessing a multitude of both qualitative and quantitative outcome measures. We found that endoscope-i telemedical otology referrals appear to be feasible and acceptable among engaged primary care and secondary care clinicians. Half of practices who were initially interested in delivering the service had undertaken referrals by 6 months and positive feedback was obtained at project end. Although far fewer referrals were sent than expected, the extension of the technology into an educational tool was perceived as valuable. This educational role was wider than that expected prior to service rollout. It had been thought that educational would come from the ability to store and later refer to images. However, it was the individual advice and feedback that was most valued. The hook of learning a new skill and training to use a new "gadget" did appear to be a significant carrot for engagement. Indeed, GPs did not refer to the external context within their feedback, rather they were more focused on the benefits to them and their patients.

Information technology infrastructure within primary care was a significant barrier to its easy use. The need for GPs to download images and email them may have served as a barrier to referral; however, the was no direct evidence of this. Although most referred patients could be managed remotely, it is not known what effect this service had on the GP's personal threshold for seeking advice. However, the referrals were below the number expected prior to the service start.

4.1 | Strengths and limitations

This service evaluation includes data from all GPs in the local area who expressed an interest in this service redesign. The service was supported to a gold-standard level, with the ENT specialists (and developers of endoscope-i) visiting practices individually immediately prior to service rollout, delivering missed training on a one-to-one basis and troubleshooting problems. Although this evaluation demonstrates use in a best-case scenario, this level of support is unlikely to be scalable. We used data collected from a variety of sources to provide a wider perspective; however, it was unfortunate that the patient voice could not be obtained, as planned. Finally, GP feedback was collected by the ENT specialists thus risking desirability bias among the responses.

4.2 | Implications for future practice

Important lessons for further rollout of this, or other novel, technologies were gained. This technology is acceptable in primary care and its value could be extended further by: (a) providing microsuction training as this was required for many referrals received and, locally, there are significant waiting times for this procedure; (b) providing long-term follow-up of chronic ear conditions; (c) training non-GP clinicians to use the equipment; and (d) to visualize other areas of the body. Although scale-out to visualizing nasal cavities, throats and even the female cervix have been suggested, examining these mucosal lined cavities comes with additional infection control logistics. Recognizing the value seen from being able to record, store, and play back clinical findings which usually patients are not party suggests that the value of other similar technologies may be expanded (eg, use of electronic stethoscopes as a patient education or communication tool). When used, the video training was acceptable and useful; however, only half of GPs utilized this form of training. Despite GPs commonly citing a lack of time and the flexibility offered by online learning platforms, in this case, the face-to-face training was better utilized and better received. In this service, a significant extra investment was required to provide the internet infrastructure for practices to be able to send the referrals more easily. This would not be an option for many service rollouts. If remote, online technologies are going to be maximized in primary care, the Wi-Fi infrastructure across the community needs to be established to remove this barrier. Finally, as technology such as this is emerging more frequently, commissioners should develop updated tariff structures to accommodate them.

4.3 | Implications for future research

To formally assess the value and role of the technology in the health economy, to ensure that work is not generated, that patient safety is not adversely impacted and that patients find this an acceptable service delivery method, empirical patient acceptability, cost-effectiveness and workload-impact evaluation should be undertaken. This requires testing among wider audiences, in which estimates of patient and (likely less engaged) clinician acceptability will be more representative and to ensure any adverse events (which are likely to be rare) are detected. Empirical work should also consider the more difficult to measure outcomes of using this technology, for example, continued professional development arising through experiential learning and feedback, and improved patient understanding though demonstration of images as part of an explanation.

5 | CONCLUSIONS

ENT telescopic remote referrals appear to be feasible and acceptable to engaged primary care and secondary care clinicians, and patients. Evidence of extended use of the technology into a consultation aid, suggests potential educational benefits to patients. Non-GP clinicians could be trained to use the technology to more widely improve primary care ENT assessment. Engagement of all interested parties is key to success, those GPs who were keen and determined to use the system got the most out if it and asking GPs with a limited interest will certainly lead to limited use. Although service delivery appears promising, implementation and data collection were undertaken by the consultants who designed and developed endoscope-i. Larger-scale, empirical, cost- and clinical-effectiveness, and workload-impact evaluation are required to establish its position and impact within the health economy.

CONFLICT OF INTEREST

Both A.G. and C.C. are directors of endoscope-i Ltd.

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