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RESEARCH ARTICLE

REVISED Understanding the implementation of telepractice in speech and language services using a mixed-methods approach [version 2; peer review: 2 approved]

Previously titled: 'Understanding the implementation of telepractice in speech and language services for children and adults using a mixed-methods approach'

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Abstract

Background: Telepractice emerged as a solution to overcome the challenges of access issues in the delivery of healthcare. Telepractice in speech language pathology (SLP) has existed for nearly a decade yet there is a significant knowledge gap with respect to the factors influencing the implementation of telepractice as a routine or long-term, sustained effort. This mixed-methods study aimed to identify implementation factors that influence the provision of telepractice in SLP services.

Method: A mixed-methods study consisting of a scoping review and semi-structured interviews (SSI) was carried out. Articles that described telepractice in SLP were included based on an operational definition of implementation and a set of inclusion criteria.

Results: Data was extracted from 11 studies that were mapped to nine projects in telepractice in SLP. The broad focus areas identified included diagnostics and evaluation, therapeutics and comprehensive assessment, management and follow-up care services. Synchronous/real-time telepractice methods were always used for the provision of diagnostic testing or when providing therapy services using video conferencing. The '*professional-facilitator-patient*' model was used most commonly followed by the '*professional-patient*' model. Barriers for long-term sustainability included inadequate initial capital investment, lack of reimbursement and payment options, low internet speed and bandwidth, resistance and hesitancy to use telepractice from the patient's end, lack of organizational policies and uniform regulations. Sustainable source of funding, having a dedicated team of professionals and technicians with clear roles and responsibilities, and inclusion of systematic planning facilitated implementation.

Open Peer Review

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Any reports and responses or comments on the article can be found at the end of the article.

Conclusion: In general, telepractice in SLP was not explicitly guided by implementation science or framework. The use of implementation frameworks ensures systematic planning and feasibility assessment to inform the scale-up of implementation. Therefore, it would be worthwhile for program implementers to consider these aspects when exploring telepractice services.

Keywords
Implementation, telepractice, speech language pathology, qualitative, scoping review, semi-structured interviews, barriers, facilitators

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Introduction

Telepractice-based service delivery has been used as a solution to overcome the challenges of service inadequacies by speech language pathologists (SLPs). In general, rehabilitation services are time intensive resulting in a higher demand for professionals. Follow-up testing and repeated visits for assessment/therapy/rehabilitation are required as a part of the diagnosis and intervention plan for persons with SLP. The lack of consistent access to these services results in irregular follow-up visits with haphazard schedules, resulting in significant treatment deficits. The availability and accessibility to these services is particularly limited in Low and Middle Income Countries (LMICs), where the majority of the global population live (Gallego *et al.*, 2017). Even in high- income countries (HICs) having relatively well funded health systems, there exists a shortage in the rural SLP workforce (Fairweather *et al.*, 2016)

Although it was initially explored in the context of rural/remote regions, its applications in semi-urban and urban regions to overcome scheduling challenges and for issues of convenience have contributed to its appeal. Though few, impact evaluations suggests that telepractice is also advantageous in terms of cost-effectiveness. For example, Burns *et al.*, 2017 found synchronous telepractice service by an SLP for head and neck cancer intervention resulted in 12% average cost savings for the health service and a AUD 40.05 savings per patient per referral. Further, in the context of the COVID-19 pandemic, telepractice based services acted as a catalyst in its widespread use, with a market growth of 135.20% (Kollia & Tsiamtsiouris, 2021).

Systematic and scoping reviews have reported studies in telepractice in SLP (Hall *et al.*, 2013; Weidner & Lowman, 2020). The purpose of these reviews have primarily been to examine evidence regarding telepractice applications with respect to services delivered for various disorders and details regarding patient-site facilitators. In spite of the benefits of telepractice services, the long-term success of these services is questionable

given the lack of data (van Dyk, 2014). Many telepractice explorations do not last beyond the pilot or experimental phase. There is a significant knowledge gap with respect to use of implementation science and factors influencing the implementation of telepractice service delivery in speech and language services as a routine or long-term, sustained effort.

Implementation science frameworks are useful in contextualizing and systematically planning the implementation of new interventions (like telepractice services) post-experimental or feasibility assessment phases. A holistic implementation approach identifies stakeholder readiness, organizational readiness, and feasibility outcomes to guide implementation. Lack of a systematic approach can lead to implementation errors which in turn result in significant wastage of resources, namely time, human resources and cost. Campbell *et al.* (2020) reported that implementation frameworks were not commonly used to guide the implementation of telepractice services in allied health sciences and there is a failure to employ available robust theoretical models to understand telepractice implementation.

This mixed-methods study aimed to identify implementation factors that influence the provision of telepractice in SLP services. A broad focus was taken for SLP services, including those that cater to all age groups, irrespective of rural or urban regions, implemented on a sustained or routine basis (operationally defined in the methods section). Specific objectives were to 1. identify projects that have an implementation focus and map their geographical distribution through a scoping review 2. understand the focus area, the methods and models of telepractice used in these projects and 3. identify barriers and facilitators that influenced the implementation of telepractice services using a mixed-methods approach consisting of a scoping review and qualitative semi-structured interviews (SSIs).

Methods

This study received ethical clearance from the Institutional Ethics Committee (Reference Number: CSP/20/NOV/87/191 of Sri Ramachandra Institute of Higher Education and Research (deemed to be University))

Scoping review

Development of a scoping review protocol. A scoping review protocol was developed based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews guidelines (Tricco *et al.*, 2018). The eligibility criteria were based on the Population-Context-Concept framework (Hannes & Macaitis, 2012). This included search terms, strategies, quality appraisal criteria and extraction methods, as described below.

Development of search strategy. An initial pilot search was carried out using PubMed and Google Scholar. This was used to fine-tune the keywords and the index terms (subject headings) used to identify the articles. The search strategy was iterative as reviewers became more familiar with the evidence base; additional keywords and sources, and potentially useful search terms were discovered and incorporated into the search

strategy (available in the Extended data). An initial decision profile (available in the Extended data) was designed to document the selection of articles based on the pilot search.

Database search. PubMed, Cochrane Library, Web of Science, and Scopus electronic databases were searched and grey literature was identified using Google Scholar and ProQuest. The search was conducted between January 2021-April 2021. The articles were screened by title, abstract and then full text against the aforementioned criteria. The citations included in articles were manually screened as a secondary source for articles. Search results were imported into Rayyan QCRI software (Qatar Computing Research Institute, Doha, Qatar) for duplicate removal. This entire process included two reviewers and any disagreements between the two reviewers were discussed until a consensus was reached. The articles were coded based on a coding format developed by the reviewers and a spread-sheet was prepared to extract data from the included studies.

Inclusion criteria. For this study, implementation of telepractice for SLP services was operationally defined as "*a sustained model of service delivery using telepractice based on prior feasibility and validation studies*". Any telepractice project implemented for two or more years, providing screening, diagnostic or rehabilitative services to individuals of all age groups with speech and language difficulties across the world, was of interest. Even if the word "implementation" was not used in the articles, words such as "on-going" or the long-term nature of the service implementation described using the number of years was considered. All telepractice modalities, such as the use of video conferencing, web-based, mobile applications and remote computing were included. Literature from January 2010 – April 2021 published in the English language were considered. Quasi-experimental trials, community or field trials, studies describing implementation or feasibility of implementation and fulfilling the operational definition of implementation were included.

Exclusion criteria. Studies involving the comparison of in-person and telepractice measures without long-term implementation were excluded. Also, studies that only reported validation of tests or tools were excluded. Attempts were made to obtain full texts of the articles by writing emails to the corresponding authors or sending full-text requests via ResearchGate. However, articles were excluded when full texts were not available. Studies in languages other than English were also excluded.

Analysis The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram was used to summarize the search results. Data from studies was extracted on: project description, geographical distribution, the focus area of service delivery, method and model of telepractice service delivery. Barriers and facilitators were identified and grouped under five domains (*technical aspects, organizational aspects, patient perspectives, economical aspects, and ethical-legal aspects*). These domains were identified from telemedicine implementation frameworks (Kidholm *et al.*, 2012; Tanriverdi & Iacono, 1999; van Dyk, 2014). Barriers and facilitators were explicitly reported in some studies based on what they experienced; else suggestions were provided on what was likely to improve the overall implementation. These suggestions were categorized as either barriers or facilitators based on the context of the statement (available in the Extended data). Suggestions, as a quality improvement were considered as facilitators and suggestions as a fundamental requirement that was not available, were considered as barriers.

Semi-structured interviews (SSI)

e-Consent. Informed e-consent for publication of the participant's details was obtained from the participants before the semi-structured interview.

Development of interview guide. SSI guides were developed to obtain a detailed understanding of the barriers and facilitators from the perspective of program implementers/investigators of the projects described in the scoping review. The domains on implementation barriers and facilitators identified in the scoping review served as the framework for the development of the interview guides. The interview guide was initially pilot tested with one project implementer for further refinements and finalization of the guides. A copy of the interview guide can be found in the Extended data.

Participants. The primary and corresponding authors of the studies identified in the scoping review were contacted through email along with a link to an online consent form. Other authors were contacted when responses could not be obtained from the primary and corresponding authors. In a few instances, the investigators were directed to another team member by the primary or corresponding authors themselves. Periodic bi-monthly reminders were provided for scheduling the interview; the consent form was kept open for three months.

Data collection. The SSIs were conducted for five authors who provided consent, via an encrypted online video-conferencing platform at a mutually convenient time. The duration of each interview was approximately 30 to 45 minutes and was carried out in English by the investigators who were trained in conducting qualitative interviews. Interviews were carried out between March 2021 and August 2021.

Analysis. All the audio and video recorded interviews were transcribed verbatim. The transcripts were uploaded into NVivo 12 (QDA Miner Lite is a basic software that is available as a free alternative software). Data were analysed using a hybrid approach of qualitative thematic analysis (Swain, 2018), which included i) a deductive template of codes and themes derived from our scoping review and ii) a data-driven inductive approach that was carried out following data collection. We then applied the principles of thematic analysis as described by Clarke & Braun (2012) which involved six stages.

In the first stage, we became familiar with our data through repeated readings of the interview transcripts. Next, we coded two transcripts which was done independently by two coders (1st and 2nd author). After independently coding these transcripts we expanded on the existing codebook and added codes inductively derived from the interviews. Any differences in coding were discussed and resolved. The remaining transcripts were coded using this codebook; new issues identified in these interviews relevant to our study were given a new code and inserted into the codebook. We then began to cluster the codes according to similarity and regularity, thereby facilitating the development of categories.

In the third stage, we reviewed these categories and began to search for meaningful patterns in the data relevant to our research questions. Hence, we collated all the coded data relevant to each theme. In the fourth stage, we began to review the themes and to reflect on whether these themes related to our data and were convincing and credible. In the fifth stage, we started to label and define each theme, describing in detail what it signified in the context of our study and the framework derived from the scoping review. Finally, in the 6th stage, we brought forth an explanation of our study findings and supported them with quotes that were placed under the respective themes.

Results

This scoping review identified 11 articles that fulfilled the criteria of having an implementation focus for SLP as operationally defined for the purpose of this study (Figure 1).

Project mapping

The literature reviewed based on the inclusion criteria of the scoping review has been summarized (available in the Extended data). The data extracted from these studies is tabulated for the purpose of analysis of this scoping review. Table 1a in Extended data includes the study code, study title, authors, countries and focus area. The settings, participants, personnel, and type of services are described in Table 1b in Extended data.

There were several research articles published based on a single large project; to factor this in and make a realistic assessment of implementation focus, project mapping was done. Articles describing common background information in the introduction section of the article, common sites of implementation, broad aims and an overlapping group of investigators were mapped as a single project. Studies that could not be mapped were considered independent projects. Nine projects were identified based on the mapping exercise (Table 1). Each project was coded for ease of reference as follows:
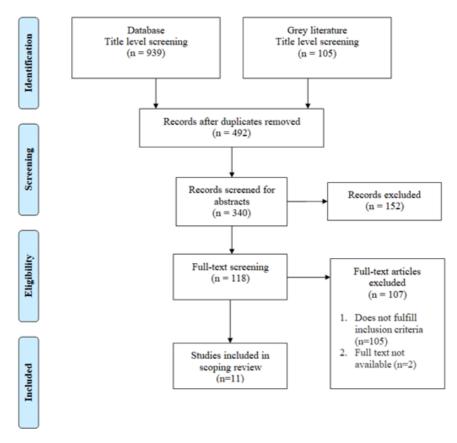

Figure 1. PRISMA flow diagram representing the study's search process.

Table 1. Summary of project mapping in telepractice in speech language pathology.

Focus area	Country	Research articles	Project code
Diagnostics and evaluation	United States of America	Malandraki et al. (2011) Malandraki et al. (2012)	P1
	Australia	Burns et al. (2019)	P2
Therapeutics	United States of America	Grogan-Johnson (2012) Alvares (2013)	P3
		Boisvert & Hall (2019)	P4
		Short et al. (2016)	P5
		Clark et al. (2019)	P6
	Australia	Pitt et al. (2018)	P7
	Norway	Øra et al. (2020)	P8
Comprehensive services	Canada	Haynes & Langevin (2010)	P9

P (project) and serial number. The rest of the findings will be reported using the project codes.

Geographical distribution of projects
Telepractice in SLP was implemented in five projects from the USA; two in Australia; and one each in Norway and Canada. Projects implemented were predominantly to overcome access barriers for individuals in rural areas and/or remote locations (P2, P3, P5 and P6). Two projects in the US (P1) (P4), one project each in Australia (P7) and Norway (P8) catered to people in both semi-urban and metropolitan areas. None were from LMIC settings.

Focus area of service delivery
Telepractice based service delivery included; assessment of swallowing disorders for adults and geriatric populations (P1, P2), speech and language therapy services in schools (P3, P4, P5), pediatric feeding therapy (P6), individual and group rehabilitation services for adults with post-stroke aphasia (P7, P8). In one project comprehensive assessment, management and follow-up care services were provided to individuals with stuttering across different age groups using telepractice (P9).

Method of telepractice
Use of synchronous/real-time, asynchronous/store and forward, or a combination/ hybrid method for providing telepractice services in SLP was identified from the scoping review.

We found that only *synchronous/ real-time methods* were used for telepractice based assessment and therapy services. These include swallowing assessments using real-time video fluoroscopy and clinical swallowing examinations (P1, P2). Therapy services for various speech, swallowing and language disorders were provided real-time using desktop-based video-conferencing software (P3, P4, P5, P6, P7, and P8). Assessment, management and follow up care for individuals with stuttering were also provided using real-time video conferencing (P9).

Model of telepractice service delivery
Models of service delivery were categorized as: '*professional – facilitator – patient*' where a trained e-helper/telepractice assistant/ support staff supports patient care; '*professional – patient*' wherein the professional delivers the service directly to the patient without intermediary personnel involved; and '*professional-professional*' wherein a second speech-language pathologist is involved at the patient site.

The '*professional-facilitator-patient*' model was used commonly irrespective of whether services were provided to rural or urban areas. A facilitator/e-helper/paraprofessional supported the service delivery of clinical swallowing assessment (P2) and speech and language therapy services (P3, P4, P5, P9). The '*professional-patient*' model was used to empower the patient's family member/ caregiver to enable the delivery of therapeutic services for speech and language disorders (P6, P7, P8). The '*professional-professional*' model was reported where an SLP was required for dysphagia assessment, to minimize the risk of aspiration and penetration related incidents (P1).

Implementation barriers and facilitators
Five of the nine projects reported service delivery to be on-going or routine. The rest, even though long-term, were still only research studies. Feasibility and validation trials within a clinical practice framework were found to be useful in transitioning from the evidence-based research phase to routine implementation (quote 1 in Table 2; all following quotes are also presented in Table 2).

These sustained implementation efforts included clinical swallowing evaluation conducted within a public health service in

Table 2. Reference quotes from the semi-structured interviews.

	Implementation barriers and facilitators
1.	"We did a number of trials initially to be able to validate the safety, reliability and validity of the model. That was randomized controlled trials…we actually did those trials within a clinical practice framework … within a hospital environment. They weren't in an academic or a lab based environment… We've also had a really good evidence base to drive our telehealth services and have that quality of care too. And that's been something that's really pushed our service development and the management have really supported that knowing that we have the models that are evidence-based to deliver high quality care. So it's not that we've just come up with it and said, Oh, let's give this a go. We've actually got good rigor in evidence-based practice for that. So that's been another key driver I think, in supporting and expanding our teleservices." - Project implementer of an on-going telepractice service delivery from Australia

	Patient perspectives
2.	"Some people, some families did not want to do it. They wanted to come in, but then we gradually got them to do some sessions face to face and maybe another session or two online. So they do a hybrid approach and people become more used to doing it that way." - Project implementer from Australia
3.	"We did find that wearing a lapel microphone was important to be able to hear the patient's throat clearing and coughing as if we were sitting with them in an in-person environment." - Project implementer of an on-going telepractice service delivery from Australia.
4.	"It's a lot more than just a tabletop, desktop, computer, a laptop, or even a phone. We will help support them. We want to make sure technology isn't the barrier. We will always furnish devices for them. If they have a device that's too old to sustain or just can't function effectively, we'll send them a device essentially to lend them while they're participating in the services. We'll send them like a pre-addressed box. They can send it back to us when we're done. And typically when we send folks those, we're sending the iPod touches, which are a little bit cheaper than the iPads or a tablet and they're smaller. And so if anything was to happen to them, we of course have them insured through the university, but it's a low-cost item compared to a $300 tablet or something like that. It's still a cost, but we've had pretty good success rates of getting them back." - Project implementer of an on-going multidisciplinary telepractice service delivery from USA
5.	"We encourage First Peoples to engage in telepractice. We are very keen to have family members involved and cultural liaison offices who come into the sessions as well to provide support. We've done sessions with interpreters via telehealth, to support people who are from a non-English speaking background. If they're not at the same site, we can link in with them to provide that support. So we try to be very accommodating with whatever the needs are of the person that we're seeing." - Project implementer of an on-going telepractice service delivery from Australia.
6.	"I think during the past year, many people were fine with it. Towards the end, towards the spring of last year, we had some people who were starting to get antsy that could go back in person." - Project implementer of an on-going multidisciplinary telepractice service delivery from the USA

	Organizational aspects
7.	"It's not a monetary benefit, but an educational benefit. And as we've seen, it's an extremely important part of the curriculum now for speech pathology students, to be able to use technology and to be able to do telepractice, because I think what we're going to see post-COVID is that, people are going to continue to demand to have telepractice. And it's not going to be unusual, it's going to be like normal practice." - Project implementer from Australia

	Funding
8.	"We have funding coming from different sources. One source of funding is through the clinic that our feeding clinic is housed at, which is a program for individuals across their lifespan, who are on the autism spectrum, who have developmental disabilities. What happens in Utah, the state gives this group money, here's X amount of millions of dollars, and you will be the payer and the provider…….. So that's where one source of funding comes from for the clients we see. Funding comes from others - other spaces that we have through my lab, as well as we have a small grant from the Autism Council of Utah." - Project implementer of an on-going multidisciplinary telepractice service delivery from the USA
9.	"We only meet once per week. So that really helps cut down costs. We probably could meet five days a week if we had the financial capacity, but with what we received now, one day a week allows us to do one to two assessments per week and then treat about five client sessions…… The reason that we were sort of limited now is just that we don't like to practice outside of our capacity, so we're just like one day a week feels good. But if we had, let's say a grant for $50,000, we could fund two graduate students to work 20 hours a week each to do this work. And then that would open up the clinic to more time. We could probably hire on, the fee for service for our speech and language and nutritionist they'll do hourly type work. And then our team typically does more of the intervention type services. So that's where I think we can get a lot more. The problem is finding more funding for, for our graduate students in our training program as part of their practice." - Project implementer of an on-going multidisciplinary telepractice service delivery from the USA
10.	"We were fortunate here that we have a state-wide telehealth service. So, we actually have a government-funded telehealth network, which has resources and equipment attached to it. So no one really needed to purchase any equipment per se, as part of the implementation, because it's already supplied by the state." - Project implementer of an on-going telepractice service delivery from Australia

Organizational administration
11. "An issue is the type of on-site support that our clients have. So depending on the type and severity of the communication disorder, that's going to – and age of the student, that's going to impact the type of onsite support that's needed. The onsite support is not sufficient. And the student cannot access the services as a result of the lack of onsite support." - Project implementer of a telepractice service delivery to a school district in the USA
12. "So we have telehealth coordinators across the different health services who meet with clinicians to try and engage and build and develop their telehealth services. They want people to be able to access services more flexibly, but there's also a reimbursement incentive for the service to do that [telehealth] too. We have administration offices who are very supportive of telehealth and are part of the process. They contact the patients to do test calls prior to the appointment, and they check off their ID, and anything that they would normally do if they were coming in person. So they schedule as part of that too. So it's a new skill set that they've built. And I think that's been a really good thing in terms of getting the admin staff on board to support our services as well. We have a telehealth portfolio leader, which is me in the department. If we have a new platform that comes in or upgrading equipment, or there's new paperwork that comes in about patient appointments, then I get that and I need to then disseminate that out to our admin staff and our clinical staff." - Project implementer of an on-going telepractice service delivery from Australia
Equipment and infrastructure
13. "We have a very large state. I think the connection in more of the really rural areas can sometimes be a bit challenging. But it just depends on where they are at and the [internet] traffic and that sort of thing. I know in our own service, we have had sometimes, a variable bandwidth, even in a metropolitan city because of the volume of people that are using it. So I think that's just standard everywhere. If we had increased bandwidth to be able to stabilise connections between sites and a system of consistent high-speed network coverage, then that would take away a lot of challenges." - Project implementer of an on-going telepractice service delivery from Australia
14. "So our actual project doesn't really experience that (drop in the internet) because we're providing telepractice to a school district. So the students are in the school building, the school district provides the services and in the state of Ohio, all of our public instruction has a shared infrastructure for the internet. So we have very good internet for that." - Project implementer of an on-going telepractice service delivery from USA
15. "From the clinician point of view, I actually have two laptops and both are connected to the same zoom meeting. One is dedicated to audio and video, and the other is dedicated to content. And the reason why I like to do that is sometimes when we share screens in video conferencing, it changes the configuration of the screen. And especially for clinicians who are newer to telepractice, that kind of throws them off a little bit. So having one system that's dedicated just for the audio-video, we have found to be very helpful. And then one system that is just doing the screen sharing for the material works well." - Project implementer of a telepractice service delivery to a school district in the USA
16. "The software we use back then .....can now be on an iPad. And we are in the process at the moment of trying to calibrate with the software. It looks as though it's going to work well for us, but we need to do some calibrations with different versions of iPads. The iPads change and then your microphones change. So, it's a matter of trying to get some calibration done now on a number of different versions of the iPad so that we can confidently say that calibration is correct." - Project implementer from Australia
Provider's acceptance of telepractice
17. "When it's thrust upon you like it was during the pandemic - Everybody hated it. Nobody wanted it, but it also was a pandemic. Everything was wrong! And I think it gave telepractice a bit of a black eye, at least when you read the blog posts; some of the speech pathologists are like, I'm not planning for this. I hate this. Why are you making me do this and so I think attitude and how you approach it, it is one very important factor. I think some people are better suited to being a telepractice speech pathologist and it goes to that attitude and that willingness to try, and even if you fail, be a good problem solver and figure it out, I think that does matter." - Project implementer of an on-going telepractice service delivery from the USA
18. "Having a good team. So if you have a really strong implementation team of the essential, like stakeholders who are aware of the need for telepractice and are able to just be creative in troubleshooting issues. If you have the people invested and involved, I feel like anything can happen. Like anything positive can happen. We can find ways to access the technology. We can find ways even if it's not synchronous telepractice, if we're saying we're going to have to shift to asynchronous telepractice, having people who value this type of service makes the program. That's very, very important. One can use technology in a host of different ways if you're strategic about it. And if the team really has a strong understanding of the benefits and also the limitations of it. But yeah, I absolutely feel that almost anything is possible if you have the right people involved." - Project implementer of an on-going telepractice service delivery to a school district in the USA
19. "Where do you see the barrier to it is more the clinicians because it's a new way of delivering services. And if they have not been prepared properly or trained properly, you will find resistance from clinicians. One of the key barriers is training and preparation - time to have the training have the, to be able to build up their confidence and the knowledge that this will still work for their clients. So they need to see the evidence. And in the training, you have to give them practical skills. The hard part was getting the clinical educators and people to come on board with it and to come into the clinic and learn how to do a session in that way. They were really nervous about it and all that, but, and some were very sceptical that you couldn't do it and that it wouldn't work, but by the time they've done their sessions, of course, they're like they were really into it. The students in fact became very innovative about how they did sessions and how they dealt with the particular clients." - Project implementer from Australia

	Ethical-Legal aspects
20.	"As part of our government-funded standard telehealth network - the telehealth platform that they use allows integration into the facility and also into the home as well. So we actually have a portal that we utilize for patients to use wherever they are on whatever device they're using. So it doesn't really change at all in relation to where the patient is. It still has that support." - Project implementer of an on-going telepractice service delivery from Australia
21.	"The fact that the government has seen value in this and supported that has been really important. They've set up a reimbursement schedule for telehealth so that there is an incentive for people to use telehealth services. That's paid through the state government. The fact that they've put in a network of resources and equipment for people to use and the telehealth network, both within facilities and in patient's homes." - Project implementer of an on-going telepractice service delivery from Australia

Australia (P2), school-based speech and language therapy services provided for children in the USA (P3), and home-based stuttering therapy services provided in Canada (P9).

The results of the scoping review and the thematic analysis of the SSI were combined to report the factors that influenced implementation positively (facilitators) and negatively (barriers). While we began with five domains during the analysis of the scoping review, from the thematic analysis of the SSI, all the data could be identified under the three domains of; *patient/ caregiver related aspects, organizational aspects, and ethical-legal aspects.*

Patient/Caregiver related aspects. Patient/caregivers' acceptance and perceived benefits and challenges of the services appeared to influence implementation. Perceptions of improved accessibility (less or no travel) to services, reduced wait time, increased consistency and regularity of sessions, reduced cancellations and thereby completion of testing with minimal visits among patients or caregivers were key facilitators to implementation (P2, P6, P7, P8).

Sometimes parents of children undergoing therapy resisted switching over to telepractice services as they perceived it as a hindrance to their child's performance (P3). When options such as a combination of telepractice and in-person service delivery were provided, it eased their fear and enabled acceptance (refer to quote 2).

Another important facilitator was the availability of devices (e.g. patient/ caregiver laptop, tablets or phones) with necessary adaptations for optimal telepractice services, including swallowing and feeding evaluations (refer to quote 3). In some examples, devices were loaned to the patients for the telepractice sessions so they were not required to procure any new equipment to engage in the service (refer to quote 4).

Patient preparation and orientation to the processes involved in using telepractice entailed intensive counseling sessions, handing out information resources and providing them with assistance for technical issues (P7, P8), all of which were found to be helpful. This smooth transition was reported to create ease and better adoption of telepractice. Attention to socio-cultural aspects was reported to enhance acceptance of telepractice and enable accessibility (refer to quote 5).

While COVID-19 acted as a catalyst in the widespread use of telepractice, after a point when patients/ caregivers had reached saturation, they looked forward to reverting to traditional in-person services (refer to quote 6).

Organizational aspects. Organizations tend to provide economic, human resource, and infrastructural support for sustained implementation of telepractice, when such services in turn result in monetary profits or non-monetary benefits (e.g. student training opportunities). Some institutions supported telepractice ventures due to the educational benefit associated with it for the students enrolled in their graduate programs (refer to quote 7).

Funding: Predominantly, services were funded through research grants obtained from charitable donations and governmental organizations (P1, P3, P9) (refer to quote 8). When services were not initiated through research grants, then the higher initial capital investment required to support telepractice was a challenge (P1, P2). Also, obtaining funding to hire more personnel to support the expansion of telepractice services was another key challenge (refer to quote 9). Prior assessment of the availability of internal resources (infrastructure, funding, equipment, human resources) was beneficial in optimizing implementation (P3). Program implementers reported that using and optimizing existing equipment proved to be facilitatory as it minimized any additional costs (refer to quote 10).

Organizational administration: Inconsistencies in billing codes, services covered by insurance companies, and a variety of administrative steps, negatively impacted telepractice service delivery (P6). Reimbursements from insurance companies as well as non-availability of digital payment portals were also reported to be barriers (P3). Self-sustaining, billable implementations of telepractice in SLP were very few (P6, P9).

Lack of onsite support affected service delivery (P1, P3) (refer to quote 11). A dedicated administrative and technical support team supported successful implementation (P5). Telepractice was more successful when roles and responsibilities of the e-helper/facilitator were clearly described. Incentivizing providers for telepractice adoption was considered a useful measure to promote provider satisfaction that could enhance the sustainability of such services (refer to quote 12).

Equipment and infrastructure: Drops in internet speeds were reported especially during peak usage times (P9) affecting service delivery. Poor internet bandwidth affected image quality or intermittency in audio and video transmission. Variable bandwidth made it challenging for off-site clinicians to perform necessary assessments or provide therapy (P1, P5, P7 and P8) (refer to quote 13).

The use of virtual private networks (VPN) and Internet Protocol Wide Area Network (IPWAN) facilitated seamless delivery of telepractice services due to the increased bandwidth availability and more reliable and stable internet connectivity (P5) (refer to quote 14). The use of high quality dedicated video-conferencing equipment was recommended for quality enhancement in the transmission of video and audio (P5). Video-conferencing systems with closed captioning were an advantage in telepractice services (refer to quote 15).

Periodic upgradation of software and technology interfaces with constant advancements were incorporated (refer to quote 16)

Provider's acceptance of telepractice: Adoption of telepractice seemed to evoke negative feelings and apprehensions initially and this was more evident during the start of the COVID-19 pandemic (refer to quote 17). Providers felt inadequately trained and sceptical to use technology, and were apprehensive of these changes/new methods of providing services.

Training additional personnel as telepractice assistants helped bring about a smooth transition in the event any of the assistants took a day off or else quit the job. Systematic training using a variety of materials and methods were considered useful. Tele-supervision helped facilitate strong relationships between the personnel. In addition to clinical strategies, an understanding of the technology used, the ability to troubleshoot, and basic orientation of security measures had to be dealt with during training sessions (P4). Team building, coordination and communication between all providers involved in service delivery resulted in reliable patient outcomes (P3) (refer quote 18).

Upon seeing positive outcomes in patients, providers felt satisfied (P4) (refer to quote 19). Some providers also began to appreciate their ability to adapt to telepractice service delivery and serve as key facilitators in sustaining services (P3, P4).

Ethical-Legal aspects

In some countries lack of national regulations, or differential regulations in each state or province posed restrictions on telepractice services (P6, P9). Having the technical infrastructure for secured transmission of patient data was an essential requirement and helped in the implementation of telepractice services (P1) (refer to quote 20). Interview participants also reported that when data security, privacy and confidentiality were honoured, patients felt secure (refer to quote 21).

Discussion

The current mixed methods study suggests that telepractice is considered as an alternative/ supplementary service delivery to primarily cater to remote rural areas or when there are other practicality issues in accessing services in-person. This may be due to the regulatory guidelines existing in various countries or an overall preference for in-person services for health-related consultations (Cason & Cohn, 2014; Swanepoel *et al.*, 2010). Though, there is a change in this situation post COVID-19 pandemic, yet it appears that there is an 'online fatigue' and the sudden increase of telepractice services during COVID-19 may be a temporary phenomenon (Jaffar & Ali, 2021).

Studies included in the scoping review provided adequate details of the type of disorder, age of beneficiaries and the methods and models used to provide services using telepractice in specific delivery settings. This information is likely to be useful to program planners across countries. However, impact evaluations were limited with only one study reporting cost-outcomes, yet these findings are not generalizable to other contexts.

Although, we came across studies that reported telepractice service delivery in SLP in LMICs, they did not fit the inclusion criteria as they were predominantly pilot studies or validity trials (e.g. Chan *et al.*, 2021; Pamplona & Ysunza, 2020; Raman *et al.*, 2019). Telepractice service delivery was not reported in the context of long-term implementation. It is also plausible that feasibility and priority of publishing implementation efforts in LMICs may be low. Considering the higher disparity in demand versus capacity the need for telepractice in LMICs, addressing the research gap in outcomes and impact evaluations of sustained implementation in LMICs is pertinent (Khoza-Shangase *et al.*, 2021).

In telepractice applications in SLP, only *synchronous/real-time methods* were used for both assessment and therapy. There was a preference for this method as real-time judgment of the SLP was considered critical. Telepractice services were provided to adults in hospitals, or in community clinics or even homes, and for children it was provided in their school or home setting.

The '*professional-facilitator-patient*' model was used commonly irrespective of whether services were provided to rural or urban areas. Real-time video conferencing eliminated the need for the presence of a remote professional or support staff in the '*professional-patient*' model. In these cases, the parent/caregiver served as a facilitator. Some level of patient preparation was involved in this model. Only when simple technologies were required or when the assessment did not require high level of skills, was it possible to provide telepractice services at homes. The '*professional-professional*' model was generally less used, since predominantly telepractice services were implemented to overcome limitations in professional resources, especially in the rural context.

In general, implementation frameworks were not used to guide the planning, provision or outcome evaluations of telepractice services in SLP. While only one project used an implementation framework - the Consolidated Framework for Advancing Implementation Research (Damschroder *et al.,* 2009) - to guide their work (P2), others 'learnt-on-the-go' by making adaptations along the way.

Organisational aspects had substantial influence on implementation. Funding, administrative and infrastructure support were key elements that emerged as a part of organisational support from this study. We found that telepractice services that received public-funding reported better sustainability. Such public-funding support is possible when policy makers consider telepractice as one essential arm of service delivery. Availability of critical infrastructure such as internet also depends on political will of administrators. For example; with COVID-19, efforts were made to improve internet access and speed, yet, not much changed in rural/remote areas where telepractice needs were the most (Lai & Widmar, 2021).

Telepractice services in SLP were implemented with simple video-conferencing technologies that could be directly delivered to the patient in their homes (Boisvert *et al.,* 2012). Only when services required instrumentation, complex intervention, or skilled assistant, a larger scale of implementation was reported. Even when transitions had to be made in the interfacing software or hardware due to technological advancements, such adaptations were made as and when required.

Finally, policies, guidelines, laws are required to ensure that services are provided within ethical and legal boundaries. Wherever national or state laws are not available, individual organizations may evolve their practice guidelines to protect the interest of patients, providers (Cason & Brannon, 2011) and program implementers thereby enabling them to take confident steps towards telepractice implementation.

The strength of the current study lies in the unique method of using a mixed-methods approach (combining a scoping review and semi-structured interviews) to get a deeper understanding of the barriers and facilitators influencing the provision of telepractice services in SLP. Considering the small number of studies with implementation focus, quality appraisal was not carried out, yet this is a limitation of the study. Another limitation is with respect to the restricted context of the views that were obtained from the qualitative SSIs, as all participants belonged to only two countries.

Conclusion

In general, telepractice in SLP was not explicitly guided by implementation science or framework. Only one project used an implementation framework to guide their work. Factors such as initial capital investment, lack of reimbursement and payment options, reduced internet speed and bandwidth, resistance and hesitancy to use telepractice from the patient's end, lack of organizational policies and uniform regulations were found to be barriers for long-term sustainability. Sustainable

source of funding, having a dedicated team of professionals and technicians with clear roles and responsibilities, and inclusion of systematic planning facilitated implementation.

The findings from this study can guide the planning of future telepractice based services in SLP. Telepractice implementation research and reporting in the LMIC context will be valuable considering the demand for such services. And finally, all program planners may consider the use of implementation frameworks for robust and systematic planning, feasibility assessment, adaptations before full-scale implementation.

Data availability
Underlying data
The data underlying this study consists of transcripts of the qualitative interviews that identify the participants and cannot be sufficiently de-identified. To ensure confidentiality and data protection, we have only included relevant excerpts from the interviews with 'no objections' from the participants. Any specific qualitative data set underlying this study can be made available on request to the corresponding author. We will only provide the transcripts to researchers/those that provide a proposal of how the data will be used by them. The corresponding author will ensure to remove identifiers from the particular data set and obtain 'no objections' from the participants before sharing the same.

Extended data
Open Science Framework: Understanding the implementation of telepractice in speech and language services for children and adults using a mixed-methods approach

https://doi.org/10.17605/OSF.IO/C7GRX (Shankar *et al.*, 2022).

This project contains the following extended data:
- Search terms used for the article selection
- Initial Decision Profile
- Barriers and facilitators reported in SLP projects
- A copy of the questionnaire
- Table 1a and 1b: Summary of articles identified in telepractice in speech language pathology

Data are available under the terms of the Creative Commons Zero "No rights reserved" data waiver (CC0 1.0 Public domain dedication).

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Open Peer Review

Current Peer Review Status: ✓ ✓

Version 2

Reviewer Report 20 September 2022

https://doi.org/10.21956/wellcomeopenres.19853.r52218

✓   **Mark Krumm** (iD)

Department of Hearing Sciences, Kent State University, Kent, OH, USA

I very much enjoyed reading "Understanding the implementation of telepractice in speech and language services using a mixed-methods approach".

This article provides an important contribution to telepractice patterns and issues provided by speech and language pathologists today. This article details common models and barriers of telepractice and attempts to determine if a framework is consistently used in successful long-term telepractice programs. In turn, the authors identify practices building toward a best practice framework that others may follow when considering the provision of telepractice. The authors make a clear case that a guiding framework is not often used to achieve best practice or to develop strategies for overcoming barriers. Literature-based research is provided by the authors in this paper which are key to a successful telepractice service regarding equipment, funding, personnel, client needs, and planning. The authors believe a data-based framework is indicated for today's practitioners, and given the evidence they describe in this article, it is hard to argue against them.

It may seem difficult to realize that after all of these years telepractice in speech and language pathology still is struggling with issues identified in this article. I feel this article also correctly identifies issues that are critical, but perhaps not considered seriously or in-depth, such as service sustainability, legal practices, technology, and personnel/client resistance to telepractice. I liked this article because the barriers and best practices associated with telepractice are rarely addressed holistically, and therefore, not easily generalized to other telepractice environments. This article provides that holistic view that can be used to guide individuals attempting to develop a telepractice program. Because of the holistic nature of this paper, it is also a substantial contribution to the literature for clinicians and researchers alike. Yes, some of the barriers have been known for a long time (e.g. telepractice projects not sustained beyond grant funding), but these problems still persist today and should be recognized before implementing a telepractice program.

In summary, I feel this article provides an excellent article for both best practices and the need to

plan strategically for barriers in order to ensure valuable and sustained telepractice services. I think there is much to be learned from this article which extends beyond speech and language pathology telepractice into other health care professions, including audiology. I think this is a must-read paper for clinicians and investigators alike contemplating a telepractice program startup or enhancement.

In the section below are some edits to the text that I think might be helpful:

In the results of the abstract, the authors wrote:
"resistance and hesitancy to use telepractice from the patient's end,"
- ○ **Change recommended:** patient resistance and hesitancy to use telepractice.

In the second paragraph of the Introduction, the authors wrote:
"and a AUD 40.05 savings per patient per referral."
- ○ **Change recommended:** Provide the term or phrase for AUD and place AUD in parenthesis following the term or phrase.

In the third paragraph of page 10 of 20 the authors wrote:
"Periodic upgradation of software and technology interfaces with constant advancements were incorporated"
- ○ **Change recommended**: Substitute upgradation with "upgrades".

On page 10, first paragraph under conclusions, the authors wrote:
"The current mixed methods study suggests that telepractice is considered as an alternative/ supplementary service delivery to primarily cater to remote rural areas or when there are other practicality issues in accessing services in-person."
- ○ **Change recommended:** Delete the phrase: "to primarily cater to", add the phrase: "primarily employed for applications in".

- ○ **Change recommended:** Delete the phrase: "practicality issues", add the phrase: "barriers".

On page 10, first paragraph under conclusions section, the authors wrote:
"Though, there is a change in this situation post COVID-19 pandemic, **yet** it appears that there is an 'online fatigue' and the sudden increase of telepractice services during COVID-19 may be a temporary phenomenon (Jaffar & Ali, 2021)"
- ○ **Change recommended:** Delete: "yet" in the paragraph above, no word insertion in lieu of "yet".

On page 10, second paragraph under conclusions section, the authors wrote:
"However, impact evaluations were limited with only one study reporting cost-outcomes, yet these findings are not generalizable to other contexts"
- ○ **Change recommended:** Remove comma after "cost-outcomes" and insert a "." (period) instead to make this sentence two sentences.

- ○ **Change recommended:** Remove "yet" and insert "Unfortunately,"

On page 10, last paragraph on the page, the authors wrote:

"Only when simple technologies were required or when the assessment did not require high level of skills, was it possible to provide teleprac[1]tice services at home"

- ○ **Change recommended:** Home telepractice services were conducted at home, but only when basic technology configurations were required, or when the assessment protocol did not require a high degree of clinician telepractice skill levels.

  (Note: The reviewer is with the above sentence that it is the clinician who did not need a high skill level in telepractice, but did this statement also mean that the client did not need to have high skill levels with telepractice technology in addition to the clinician?)

On page 10, last paragraph on the page, the authors wrote:
"The 'professional-professional' model was generally less used, since predominantly telepractice serv[1]ices were implemented to overcome limitations in professional resources, especially in the rural context"

- ○ **Change recommended:** Generally, the 'professional-professional' model was the least frequently model. This is not surprising given the key rationale for implementing telepractice services was to overcome limitations in professional resources (especially in rural settings).

On page 11, second paragraph, the authors wrote:
"We found that telepractice services that received public-funding reported better sustainability"

- ○ **Change recommended:** Delete the second "that received" in the sentence and replace it with "which was supported by".

On page 11, paragraph 3, the authors wrote:
Only when services required instrumentation, complex intervention, or skilled assistant, a larger scale of implementation was reported. Even when transitions had to be made in the interfacing software or hardware due to technological advancements, such adaptations were made as and when required

- ○ **Change recommended:** A larger scale of implementation was reported only when services required instrumentation, complex intervention, or skilled assistant became necessary.

- ○ **I think you also eliminate the following sentence as it seems redundant:** "Even when transitions had to be made in the interfacing software or hardware due to technological advancements, such adaptations were made as and when required"

On page 11, paragraph 4, the authors wrote:
"Considering the small number of studies with implementation focus, quality appraisal was not carried out, yet this is a limitation of the study."

- ○ **Change recommended:** Eliminate the comma after "out" and eliminate the word "yet" and insert "and therefore this issue" before "is a limitation of the study".

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Telehealth in the speech and hearing sciences.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 08 April 2022

https://doi.org/10.21956/wellcomeopenres.19494.r49293

K. Ganapathy
Apollo Telemedicine Networking Foundation, Chennai, Tamil Nadu, India

The authors are to be complimented for doing an in-depth analysis of a subject not usually given the importance it deserves, namely studying factors influencing the **actual *implementation* of telepractice.** The authors being domain experts in speech and language pathology (SLP) have rightfully confined themselves to the study of the implementation of technology-enabled remote SLP services. An analysis of scoping reviews and semi-structured interviews has been meticulously carried out. Deploying standard accepted procedures (inclusion, exclusion, PRISMA criteria, data collection, analysis), a thorough scientific study of 11 shortlisted publications has been done. Inadequate initial capital investment, lack of reimbursement and payment options, low internet speed, resistance and hesitancy to use telepractice from the patient's end, lack of organizational policies, and uniform regulations were the identified barriers to implementation. A sustainable source of funding, having a dedicated team of professionals and technicians with clear roles and responsibilities, and inclusion of systematic planning facilitated implementation. The authors have stressed that in the papers studied telepractice implementation in SLP was not guided by

Management Science. The lack of a systematic approach led to implementation errors. The authors have quoted verbatim responses from those interviewed. This approach gives the reader a clearer perspective than using routine mundane emotionless terminology, a hallmark of scientific communication! The reader now has actual views of those who have rolled up their sleeves and made their hands dirty! Areas covered in this review paper include implementation barriers and facilitators, patient perspectives, organisational aspects, funding, equipment and infrastructure, providers' acceptance of telepractice, and ethical and legal aspects. The authors discuss the differences between the *professional-facilitator-patient*, *professional-patient,* and *professional-professional* groups.

Discussion regarding sustainability, more information on the business model, cost-effectiveness, some data on the market for telepractice, and some info on the acute shortage of trained audiologists and speech experts would be useful. Some statistics from a few countries in different income brackets (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) would convince the reader that this gap in SLP management is unlikely to be redressed without virtually extending the reach of the limited domain experts available. While the primary intent of this study is to summarise the current world literature (choosing articles fulfilling very rigid criteria), it perhaps may not be irrelevant to include interviews with others deploying telepractice in SLP in India, including the authors themselves (assuming that the quotes could be subsumed under Personal Communication). This addendum may add to the perspective. The low availability and accessibility of SLP services in low and middle-income countries (LMICs) can also be discussed.

Authors have pointed out that none of the papers studied in deploying telepractice in SLP were from LMICs. It needs to be pointed out that even if such projects were being executed in LMICs, the priority for publishing would be low. Publishing is a time-consuming, labor incentive process, particularly in a non-academic milieu. Though implied, the authors need to reiterate that their conclusions are entirely a synopsis of the 11 studies shortlisted. Five projects from the USA, two from Australia, one each from Norway and Canada do not represent the world. Even guidelines published for the implementation of telehealth, whether it be for SLP or any other clinical domain, are not fixed. It could vary based on changing technology, perceptions, behavioural modifications, reimbursement policies, and a myriad other factors. Success lies in identifying these variables, giving proper weightage to each of them, and being willing to take a relook periodically. One or two paragraphs highlighting the limitations of the methodology used in this study would add value to the paper. Reliable information available in the public domain, though not in indexed journals, could also be mentioned

Telehealth is a major innovation at the technological, social, and cultural levels. Telehealth projects are complex, innovative, and continually evolving. All responses cannot be anticipated. Telehealth generally has a poor record of long-term sustenance. Few organisations have succeeded in reaching large-scale, enterprise-wide adoption. The reviewer, though not an SLP expert, has been actively involved in the management of scores of small and mega telehealth projects over the last 22 years (https://www.youtube.com/watch?v=Wc__mhGDpEE[1])[2] and therefore **now** clearly understands the importance of deploying Management Science. Operational, technical, and clinical challenges in virtually reaching the unreached are dependent on geography, time, and socio-economic environment. Principles of Management Science need to be customised, tailor-made, and adapted as and when required. Publications need to stress organisational, regulatory, and cultural issues *vis a vis* its deployment in initiating, sustaining, and making viable telehealth

activities. The WHO framework for the implementation of Telemedicine Services gives some guidelines[3]. Self-sustaining telehealth projects need to be revenue-generating. The reviewer while initiating telehealth projects across India and a few overseas had to fall back upon discussions with a passionate, street-smart team. Interestingly, it was realised that lessons learnt in the field actually complied with the dicta of management gurus enunciated years later! A detailed need assessment study was the first step. Risks in program implementation, challenges in providing specialists, the necessity for training, retraining, learning, relearning, and unlearning were emphasised. Identifying champions in the community and the team was critical. Future-ready access to cost-effective, need-based, appropriate technology including a robust perspective of telemedicine quality must be considered. Measurable, reproducible, objective parameters to quantify success needs to be defined. Barriers need to be foreseen and addressed. Legal, regulatory, and security issues have to be complied with. The cultural transformation of the beneficiary, health care provider, and the local society is critical. Political will and support go a long way in implementing a telehealth project, particularly when it involves rehabilitation among the young as in SLP projects, where the benefits are not immediate or dramatic. Urban specialists need to be sensitized to community interactions while deploying cutting-edge technology. Programme Managers need to be transparent, accountable, responsible, and open to external third-party audits. Quality of service through feedback needs to be measured. Key Performance Indicators need to be defined. Channels of communication and grievance redressal mechanisms are required, as are escalation and evaluation matrices.

Technology acceptance is always a concern. A detailed customised Standard Operating Procedure is necessary. Evidence of cost-effectiveness is necessary for widespread telemedicine adoption[4,5,6], ensuring funding and sustainability are necessary[7]. Donors, governments, cross-subsidy, for-profit companies, and rarely venture capitalists have been sources of funding. Successful telehealth applications are often run by local telemedicine champions with *ad hoc* funding. Emphasizing personal user advantage and incentivization is as important as advocating general societal advantages.

Barriers to the adoption of telemedicine include difficulties in technology integration, interoperability, standardization, security, time constraints, and financing. Technology can be provided, but health professionals need to use it. Their perceptions, legal issues, technical difficulties, time, convenience, and cost are critical. Hurdles relate to reimbursement, policies governing telecommunication and information technologies, development, and licensure. Acceptance by clinicians and beneficiaries, demonstrable savings, improved access to healthcare, reduced effort, travel time, and adoption into daily practice leads to successful telemedicine applications. Adoption of telemedicine, patient satisfaction, and doctor-patient interactions depend considerably on utilisation of Human Management principles. The latter is intuitive. If patients perceive that telemedicine will save time/money and increase comfort, they may adopt telemedicine. Perceptions before the teleconsult shape decision to (a) sample telemedicine services and (b) use telehealth services regularly. The greater the perceived advantage and perceived compatibility, the greater the intent. To ensure effective operation, skillful planning and implementation are as essential as system design, software functionality, and technical prowess. Optimization of work processes is important. Operations need to be re-invented to use newly available information. Identifying significant pain points results in new innovative solutions.

There are several mega ongoing telehealth projects in India that have stood the test of time, are self-sustaining, and are revenue-generating. Most of these are from non-academic institutions

with little or no resources for publishing. The "tricks of the trade" may also be considered confidential and may not be made available in the public domain and hence would not come under the purview of a rigorous scoping review (https://www.youtube.com/watch?v=yxeuCWBOExM[8]). Interestingly, the authors of this publication are from India. With 63 million having hearing impairment[9], 14 to 20% of pre-school children having delayed or disordered speech and language, if any country needs to understand the dos and don'ts in the implementation of telepractice in speech and language services, it is India. Hopefully, the authors' stringent analysis will help commence the much-needed awareness. Biraj Bhattarai[10] in a study of 118 participants from India, found that only 16% were properly trained to provide teleservices. Mohan *et al.*[11] analysing responses of 205 SLP practitioners, noted that only 12.19% used telepractice. Considering that in 2015, as per the Indian Speech and Hearing Association, there were only 2500 SLP practitioners, telepractice appears to be the only way to virtually extend *their* reach.

Reviewer's additional comments

MAJOR:
  ○ **Is the work clearly and accurately presented and does it cite the current literature?**

The work is clearly and accurately presented. Due to the stringent measures adopted and rightly so, the literature cited is ultra-focused based on search strategy, inclusion, exclusion criteria, PRISMA method, etc. However for the reader to get the "Big Picture", references to the literature dealing with the **business** of telehealth, Management Science in telehealth, and factors directly involved in the deployment of telehealth can be added.
  ○ **Is the study design appropriate and is the work technically sound?**

Yes.
  ○ **Are sufficient details of methods and analysis provided to allow replication by others?**

Yes, details have been provided though numbers are so small and this being a recent topic may not be much scope for immediate replication. The authors define implementation as a sustained model of service. It is desirable that the reader understands the duration of the viability of each of the projects analysed (minimum, maximum, info not available, etc with reference to sustenance).
  ○ **If applicable, is the statistical analysis and its interpretation appropriate?**

Formal statistical analysis is not really relevant. Extrapolating observations made from a very small number of published papers to inferences has many limitations, particularly as all papers originate from a few countries. Papers from India dealing with telehealth and SLP are conspicuous by their absence (refs 10, 11). These need to be discussed and have been elaborated on in the reviewer's main report.
  ○ **Are all the source data underlying the results available to ensure full reproducibility?**

The extended data and additional information are available as supplemental files.
  ○ **Are the conclusions drawn adequately supported by the results?**

Conclusions drawn can be considered to be reasonably supported so far as it refers to the data from the papers analysed. The reviewer has pointed out that in the real world there are many success stories of implementation of telehealth in LMICs that have not been formally published due to various reasons. The authors would do well to add a paragraph on limitations and even dangers of drawing conclusions going only by published material (even if "if it is not published it does not exist"). Implementing telepractice in SLP is not the same as implementing telepractice in other clinical domains. Discussion on commonalities and dissimilarities would be useful

particularly if numbers are furnished from LMICs and other countries to show that virtual remote delivery of SLP is not a luxury but a necessity.

MINOR:
- ○ **Title:** 'Understanding the implementation of telepractice in speech and language services for children and adults using a mixed-methods approach' - adding the words *children and adults* do not give additional meaning and may be dropped.

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Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Not applicable

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Telemedicine, Telehealth, Neurosurgery

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 18 May 2022

Vidya Ramkumar, Sri Ramachandra Institute of Higher Education and Research, Chennai, India

We thank the reviewer for his valuable comments and have provided our responses and clarifications for each of them in the section below. Edits have been made using track changes and existing information pertaining to certain comments by the reviewer has been highlighted in yellow for ease of reference.

Comment 1: Discussion regarding sustainability, more information on the business model, cost-effectiveness, some data on the market for telepractice, and some info on the acute shortage of trained audiologists and speech experts would be useful. Some statistics from a few countries in different income brackets (
https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups) would convince the reader that this gap in SLP management is unlikely to be redressed without virtually extending the reach of the limited domain experts available.

Response 1: We have added information on available literature that describes cost-effectiveness (page 3 - line 15). While there was no data available on the business model, sustainability aspects were captured in this study and have been reported as implementation barriers and facilitators. We agree that information regarding the shortage of trained speech and language pathologists across the world will shed more light on the need and advantages of telepractice. This information has been added in the introduction section of the article (page 3 - line 10).

Comment 2: While the primary intent of this study is to summarise the current world literature (choosing articles fulfilling very rigid criteria), it perhaps may not be irrelevant to include interviews with others deploying telepractice in SLP in India, including the authors

themselves (assuming that the quotes could be subsumed under Personal Communication). This addendum may add to the perspective.

Response 2: While anecdotal evidence suggests that tele-speech and language pathology is in practice in India, there is limited literature available. Even the available literature did not fit the inclusion criteria of being long-term sustained efforts of implementation and therefore none from India could be included in the interview. This information has been mentioned in the discussion section of the article (page 19 - line 18).

Comment 3: The low availability and accessibility of SLP services in low and middle-income countries (LMICs) can be discussed. Authors have pointed out that none of the papers studied in deploying telepractice in SLP was from LMICs. It needs to be pointed out that even if such projects were being executed in LMICs, the priority for publishing would be low. Publishing is a time-consuming, labour incentive process, particularly in a non-academic milieu.

Response 3: General information regarding the low availability and accessibility of SLP services in LMICs has been mentioned in the introduction section of the article (page 3 - line 8). We agree that the priority and feasibility of publishing in LMICs might be considered low and have added this as a point to consider in the discussion section (page 19 - line 22).

Comment 4: Though implied, the authors need to reiterate that their conclusions are entirely a synopsis of the 11 studies shortlisted. Five projects from the USA, two from Australia, and one each from Norway and Canada do not represent the world.

Response 4: Although this has been mentioned in the article (page 11 - line 2), we have reiterated the same in the discussion section (page 20 - line 33) to add emphasis to the restricted context of views obtained from the semi-structured interviews.

Comment 5: One or two paragraphs highlighting the limitations of the methodology used in this study would add value to the paper.

Response 5: We used the standard guidelines recommended for scoping review and semi-structured interviews. However, the quality appraisal could not be performed due to the limited number of studies and has been mentioned on page 20 (line 32). The restricted context of the views obtained from the interview has also been included in the discussion section (page 20 - line 33).

Comment 6: Reliable information available in the public domain, though not in indexed journals, could also be mentioned.

Response 6: In order to accommodate for non-indexed publications, grey literature was included in the review process by searching databases such as Google Scholar and PubMed, as described in the method section (page 4 - line 33). Therefore, we believe we have considered all reliable information available in the public domain.

Reviewer's additional comments

MAJOR:
  ○ **If applicable, is the statistical analysis and its interpretation appropriate?**

Formal statistical analysis is not really relevant. Extrapolating observations made from a very small number of published papers to inferences has many limitations, particularly as all papers originate from a few countries. Papers from India dealing with telehealth and SLP are conspicuous by their absence (refs 10, 11). These need to be discussed and have been elaborated on in the reviewer's main report.

Response: For this study, implementation of telepractice for SLP services was operationally defined as "a sustained model of service delivery using telepractice based on prior feasibility and validation studies". Any telepractice project implemented for two or more years, providing screening, diagnostic or rehabilitative services to individuals of all age groups with speech and language difficulties across the world, was of interest. Even if the word "implementation" was not used in the articles, words such as "on-going" or the long-term nature of the service implementation described using the number of years were considered.

While we did not exclude any studies deliberately, the articles mentioned by the reviewer do not fit the study's inclusion criteria and therefore were excluded.
  ○ **Are the conclusions drawn adequately supported by the results?**

Conclusions drawn can be considered to be reasonably supported so far as it refers to the data from the papers analysed. The reviewer has pointed out that in the real world there are many success stories of implementation of telehealth in LMICs that have not been formally published due to various reasons. The authors would do well to add a paragraph on limitations and even dangers of drawing conclusions going only by published material (even if "if it is not published it does not exist"). Implementing telepractice in SLP is not the same as implementing telepractice in other clinical domains. Discussion on commonalities and dissimilarities would be useful particularly if numbers are furnished from LMICs and other countries to show that virtual remote delivery of SLP is not a luxury but a necessity.

Response: Our results are based on scientific publications in journals as well as grey literature such as detailed reports, unpublished dissertations or thesis. We recognise that this will still not capture information that is not available in the public domain or known only anecdotally. We have mentioned this in our discussion section (page 19 - line 22)

MINOR:
  ○ **Title:** 'Understanding the implementation of telepractice in speech and language services for children and adults using a mixed-methods approach' - adding the words *children and adults* do not give additional meaning and may be dropped.
We agree with the reviewer to modify the title as follows:
'Understanding the implementation of telepractice in speech and language services using a mixed-methods approach.' (Page 1 - line 1)

Competing Interests: None to declare