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Awareness, Acceptance and Viability of Mobile Teleaudiology among Patients with Hearing Concerns in Negros Occidental, Philippines

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Abstract. The Covid pandemic in March 2020 has frightened patients from seeking face to face hearing test consultation. This study introduced a novel approach using smartphone mobile teleaudiology in doing remote screening hearing test. It assessed three aspects namely, awareness, acceptance, and viability of mobile teleaudiology for patients in Negros Occidental. The descriptive research design was used in a researcher made survey questionnaires thru convenient sampling of 40 patients. The study revealed that the awareness level was low in terms of its use, results comparable to the standard audiometry, and usage by medical practitioners. The acceptance level was high. Lastly, it was viable in terms of its marketing and financial characteristics. The most significant challenge was the unstable or absence of an internet connection. The conclusion showed that the awareness and acceptance remained high in all the demographic categories and likewise showed viability in using this new technology.

Keywords. Smartphone Mobile Teleaudiology, Acceptance, Awareness, Marketing and Financial Viability, Descriptive Research, Private Hearing Center, Negros Occidental.

1. Introduction

Telehealth is the broadcasting of health-related services and information through telecommunications technologies (Ballachanda, 2017). Teleaudiology is the use of telehealth to give audiological services thru electronic information and telecommunications technologies to render remote and distance clinical hearing healthcare, as well public education on health matters (Northern, 2012).

In the advent of the COVID 19 pandemic, major changes were seen in the audiological service delivery. Because of the lockdowns, face-to-face audiological services were suspended, and significant changes occurred when teleaudiology was included. Several schemes have enabled hearing center providers to continue by encouraging the use of teleaudiology services wherever clinically appropriate and safe. Face-to-face standard audiology can also be conducted through teleaudiology, regardless of whether they be clinician-led, facilitator-assisted, or patient-led (Eikelboom et al., 2021).

To increase the awareness of mobile teleaudiology, there must be conduct of professional and public information campaigns to patronize the benefits of this new technology

(Eikelboom et al., 2016). A smartphone-based hearing test can be performed at home, thus greatly promoting access to screening (Abu-Ghanem et al., 2016). The results of the proposed smartphone-based hearing test concur with the results likewise of the conventional pure tone audiometric evaluation (Chu et al., 2019). In the consultation service, telehealth can be self-led management, especially when monitoring for and responding to changes in hearing condition severity. They take an active part in clinical decision-making. Synchronous testing is advantageous because it gives the clinician real-time feedback aside from the rapport established (Eikelboom et al., 2016).

To show the acceptance level for mobile teleaudiology, a study was done by audiologists around the world, including Australian audiologists, between June and August 2020, which showed 57% (n=74) used some form of teleaudiology before the COVID pandemic but increased to 75% during the time of the survey. Post-COVID, 83% indicated that they would use teleaudiology. Moreover, there was also a growing willingness among Australian hearing professionals to utilize teleaudiology regardless of whether the patients live in remote and rural areas or in urban areas (Eikelboom et al., 2016). Technology correlates hearing healthcare trends in terms of the rising consumerism, widespread adoption of mobile smart devices, and increasing acceptance of telehealth (Stender et al., 2017).

With the efficiency in scheduling patients even in remote areas or when travel concerns become an important barrier to a face-to-face hearing test, the ease in performing the test and the cost may increase sales and profitability (e3 Diagnostics, 2018).

All studies in mobile teleaudiology were foreign studies that focused on smartphone self-hearing test downloadable applications, as mentioned earlier. Notably, Renda et.al. (2016) determined that the smartphone hearing application test results on both normal the hearing and hearing-impaired participants corresponded with the pure-tone audiogram results. The study of Bright and Pallawela (2016) differentiated the features, operating systems of smartphone applications and their substantial validated results for the screen hearing tests. Unfortunately, there is a lack of local studies in mobile teleaudiology both in Negros Occidental in particular and in the Philippines in general because face-to-face consultation remains the standard of care before the pandemic. Identifying this lack of information to be the gap in the literature, it would then be interesting to find out how teleaudiology will be received by patients with hearing concerns as a new experience in the local setting.

Hence, the study assessed the awareness and acceptance of the patients of mobile teleaudiology as a diagnostic modality and determine its marketing and financial viability of putting up this business in a private hearing center. The results were utilized as the basis for a strategic marketing plan for mobile teleaudiology.

2. Framework of the Study

The theoretical assumption of this study claims that awareness and acceptance will increase the utilization of mobile teleaudiology as a technological innovation in health care for the benefit of both health care professionals and patients during the diagnosis and treatment process. Although there may be perceived benefits in the technological innovations from the point of view of the health care professional, ease of use is the biggest importance experienced by the patients. Furthermore, technological innovations, particularly in mobile teleaudiology will show the business to be viable by bringing in profits for the hearing center.

There are recent models using constructs of different theories and proposing comprehensive models to explain technology behavior. Venkatesh et al. (2003) have created the Unified Theory of Acceptance and Use of Technology, which covers various theories. This model proposes four basic factors affecting the individual's acceptance and usage of the newly encountered technology. These factors are performance expectancy, effort expectancy, social

influence, and facilitating conditions. While the performance expectancy is the expected increase of performance, the effort expectancy is the ease of use related to the accepted technology. Social influence is the perception of self-reflected by people who are important for the individual. Facilitating conditions are beliefs about the existence of personal or institutional support encouraging technology acceptance (Venkatesh et al., 2003).

Another theory is Schumpeter's Innovation Theory of Profit (1943) that states that economic profits arise because of successful innovations introduced by the entrepreneurs. It has been held that the main function of the entrepreneur is to introduce innovations in the economy, and profits are the reward for his performing this function (Megha, 2016). Innovations can be divided into two categories, namely: First, an innovation that reduces the cost of production; Second, an innovation that increases the demand for the product like the introduction of a new product, a new variety, or design of the product, etc.

The unified theory is relevant in this study because it predisposes the assumptions that because of technology, the patients will start to recognize and use it. The factors mentioned in theory may be applicable since the expectation of the patient will be met, especially in the performance of the mobile hearing test application with little effort. Social acceptance and 16 influence will be manifested by the hearing test application thru the patient experiences, which will lead to conditions that will encourage technology compliance.

Schumpeter's Innovation Theory of Profit for viability is also relevant as defined because innovations if effectively managed, can be rewarded with profits in performance of its function. Mobile teleaudiology will reduce the cost of production because it is a free application downloaded on the internet. Likewise, because of the ease of use of this technology, the demand for the product will increase, leading to increase profits for the hearing center.

3. Methods

The study used a descriptive research design to determine the awareness and acceptance of the respondent to this novel diagnostic tool. It was used to explore on the awareness and acceptance of hearing concern patients with regards to this novel approach using smartphone self-hearing test application downloaded on the internet for free. It also determined both the marketing and financial viability of this new technology application.

The respondents of this study were 40 patients who visited the hearing center within the three weeks study period manifesting hearing-related concerns and was determined using the convenience sampling method.

The researcher utilized researcher-made questionnaires that showed the level of awareness and acceptance of the patient to this new technology, viability to start this business as an adjunct to the traditional hearing test service and presented the challenges both the patient and the hearing center will encounter. The researcher-made questionnaires underwent a Content Validity Ratio by Lawshe, which was conducted by ENT practitioners. The validity of the instrument resulted in a 0.9722 content validity index, which makes the instrument considered valid. On the other hand, Kuder-Richardson Formula 20 was used to determine the reliability test of the instrument for dichotomous answers. The reliability test was conducted among 30 patients who were not included in the study. The result of the reliability test yielded a score of 0.77, making the instrument likewise reliable. In addition, the secondary data were utilized for the financial viability, which was computed using profitability, liquidity, and solvency ratios.

After the researcher-made survey questionnaires have been considered valid and reliable, permission was sought from management to conduct the study using the patients of the hearing center to be the respondent by means of the convenience sampling method. They were oriented as to the purpose of the study, how to download the application as well as how to use it. An informed consent form was then filled up by the respondents once they agree to undergo

the study. The privacy and confidentiality of the respondent was observed throughout the study process. The questionnaires were distributed to 19 the respondents and collected afterward by the enumerator and given to the statistician for tallying and statistical analysis. As to the secondary data, the study looked for the assumptions using existing hearing center data in terms of its cash flow, income statement, and balance sheet and made a 3-year projection financial impact analysis. The data was accessed and retrieved after prior approval by management was granted to make a financial ratio study with the help of the company’s accountant staff. The activity of these projections was measured using different financial ratios, namely, liquidity, solvency, and profitability ratios.

Descriptive analysis was used for the profiling of the respondents and for the assessment of their awareness, acceptance, marketing viability, and challenges of mobile teleaudiology. Frequency count, percentage distribution, and ranking were used as statistical tools. For the financial viability, the secondary data taken from the hearing center were used to compute specific financial ratios, namely, profitability, liquidity, and solvency ratios.

4. Results and Discussion

The study used a descriptive research methodology to determine awareness, acceptability, and viability both for the marketing and financial aspect of mobile teleaudiology in a private hearing center. From the study obtained, it has been shown that in terms of awareness, most of the patients were not familiar with the use of this new technology, regardless of age, sex, occupation, nor income level. However, in the other aspects of awareness like the feature, purpose, and consultation services, the study showed awareness throughout the demographic profile. In contrast, the study revealed an overwhelming acceptance of the new mobile teleaudiology technology. With regards to marketing viability, most of the criteria used, such as the 7Ps of the marketing tools, the findings showed a positive response in all categories, except only in the cost of hearing aid which was unaffordable. In terms of the financial viability, the assumptions and three years projection showed a positive and healthy financial outlook, thus making this new technology viable as an added diagnostic tool for the present hearing center. Lastly, the challenges to using mobile teleaudiology ranked unstable internet connection and preference to do face-to-face consultations as the top two concerns.

4.1 Profile of the Respondents

After the survey questionnaires were gathered, the descriptive statistical tools of frequency, percentage, and ranking were used. The questionnaire was designed to have four major concerns – awareness, acceptance, marketing viability, and the challenges in performing mobile teleaudiology. Table 1 shows the demographic information of the respondents. Based on age, there were younger respondents (ages 20-32 years old) at 63%, and the older respondents (ages 33-45 years old) at 45%. The significance of age would be that the younger age group was assumed to be more technologically update, especially with the new applications in the smartphone. It also shows more females (60%) than males 40%). The reason was that there were more females who accepted the questionnaires. Most of the respondents have no noise-related occupation nor exposure to noise (65%), which meant that there were fewer noise-induced hearing loss patients. Lastly, most of the respondents have a high-income level (P36,000.00-70,000.00 per month income) at 70% and lower-income (P0-35,000.00 per month income which showed that they had the means to buy good quality smartphones.

Table 1. Demographic Presentation of Patients Sample

Variables	Frequency	Percentage
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Age		
Younger	25	63
Older	15	37
Total	40	100
Sex		
Female	24	60
Male	16	40
Total	40	100
Exposure to noise		
No	26	65
Yes	8	20
No Answer	6	15
Total	40	100
Income		
Low	12	30
High	28	70
Total	40	100

4.2 Level of Awareness of Mobile Teleaudiology

In Table 2, with regards to the survey on awareness taken as a whole, what is significant to observe is in the question on the use and familiarity of the mobile application, as high as 93% of the respondents have not tried nor experienced using mobile teleaudiology application. This is because the standard hearing test procedure is to do it face to face with the patients. Mobile teleaudiology gain prominence during the start of the pandemic to avoid transmission of the virus both for the patient and the medical personnel. In the study in Australia of 116 patients, 75% of the respondents have not previously heard of teleaudiology (Eikelboom, 2005).

As to the purpose that the hearing screening test results by the mobile application can be compared to the standard audiometer, 73% claimed they are not aware it can be compared. Also, 80% of respondents are unaware of doctors referring patients for mobile teleaudiology. Around 90% of respondents are aware that the mobile application can be downloaded for free, results can be transmitted to the doctor, and it is cost-saving and easy to use. In the consultation with doctors for follow-up, 63% chose face-to-face consultation, 90% preferred online conference or telephone consultation, 85% wanted thru email or text messages.

Table 2. Awareness on Mobile Teleaudiology among Patients, when taken as a whole

Awareness of Mobile Teleaudiology	Yes		No	
	f	%	f	%
Use of Mobile Teleaudiology				
Tried mobile teleaudiology and its use	3	7	37	93
Experienced using mobile teleaudiology	3	7	37	93
Downloaded a hearing test application from smartphone	8	20	32	80
Purpose of Mobile Teleaudiology				
Aware that the purpose of this mobile application is for screening hearing test.	24	60	16	40

Awareness of Mobile Teleaudiology	Yes		No	
	f	%	f	%
Aware that hearing screening test results can be comparable to a standard audiometer machine result	11	27	29	73
Have heard a doctor or medical practitioner who referred someone to use mobile teleaudiology application	8	20	32	80
Features				
Downloadable and for free.	36	90	4	10
Readily transmissible data for your doctor to interpret the results.	36	90	4	10
Cost-savings in terms of transportation and Ease of use	36	90	4	10
Consultation Services				
Face-to-Face Consultation	25	63	15	37
Online conference or Telephone consultation	36	90	4	10
Email or SMS Test message application	34	85	6	15

Overall, there is awareness of mobile teleaudiology by the respondents; however, they were unaware of the usage because they were not told by the medical practitioner to use it, neither were they aware that it can be compared to a standard audiometer. A review study highlighted the need among audiologists to adapt to telehealth applications. These professionals should be familiar and aware about the use of telehealth for diagnostic and therapeutic purposes 25 as well as for professional development activities (Molini et al., 2015 as cited in Ravi et al., 2018).

4.3 Level of Acceptance of Mobile Teleaudiology

In Table 3, the survey regarding acceptance taken as a whole showed overwhelming results that the respondents would intend to use (85%), accept the results (93%), and accept the technical limitations (90%). The reasons why the respondents had a high acceptance level were because of the safety from transmitting the virus since there was no face-to-face consultation done, the ease of use in mobile teleaudiology, and the convenience in performing the hearing test remotely in their locality, as was explained to them by the audiometrician during the orientation of the study before the survey was conducted. This was also noted in the Australian study that 70% of their respondents were willing to use teleaudiology (Eikelboom, 2005).

Table 3. Acceptance on Mobile Teleaudiology among Patients, when taken as a whole

Acceptance of Mobile Teleaudiology	Yes		No	
	f	%	f	%
Do you intend to use the hearing test application through mobile phone?	34	85	6	15
Will you accept the results of the test?	37	93	3	7
Will you accept the technical limitations (e.g., noise, internet connection, etc.) in the conduct of the screening hearing test application?	36	90	4	10

4.4 Marketing Viability of Mobile Teleaudiology

In Table 4, the survey regarding marketing viability taken as a whole showed overwhelming support of mobile teleaudiology in terms of the product willing to purchase hearing aid (73%), avail of the hearing center professional services (85%) and getting a medical certificate after the test and consultation (88%). In terms of price, the results showed the P500.00 hearing test fee (80%) and the professional fee after consultation (90%) acceptable.

However, with regards to the price of hearing aid sold after the hearing test to be affordable, the results showed it to be unacceptable at P10,000.00 (53%). In terms of the place and location of the mobile teleaudiology, the respondents will perform the remote hearing test in the comfort of their homes or offices (83%) but likewise would do it also in a hospital setting (60%). Doing the hearing test in a hearing center had a higher acceptance rate (78%). In terms of promotional activities, the respondents preferred to avail of promotional discounts on selected products (80%), accept any loyalty card by the hearing center (78%), and be informed of the latest promotions thru messaging, online promotions, and telemarketing (75%).

With regards to the personnel, the respondents were satisfied with the service rendered by the hearing center (90%), the promptness in answering inquires (88%), and the professionalism and courteousness (88%). The satisfaction level was also high in the process of the service, with hearing test results given promptly (90%), the confidentiality of the medical certification (88%), 32 and the willingness to pay hearing test fees online thru debit cards (83%). The physical evidence of the hearing test business with regards to customer experience revealed that respondents are willing to give suggestion feedback (90%), willing to receive informational brochures (90%), and would accept membership to the hearing center social media platform (88%).

Table 4. Marketing Viability on Mobile Teleaudiology among Patients, when taken as a whole

Marketing Viability of Mobile Teleaudiology	Yes		No	
	f	%	f	%
PRODUCT				
Purchase a hearing aid if prescribed?	29	73	11	27
Avail of the hearing center professional services and consultation?	34	85	6	15
Get a medical certificate after the test and consultation?	35	88	5	12
PRICE				
the price of the hearing test reasonable (at least PhP500.00)?	32	80	8	20
the professional fee rendered acceptable (consultation)?	36	90	4	10
the price of the hearing aid sold affordable (at least PhP10,000.00)?	19	47	21	53
PLACE				
Would you perform it remotely (<i>meaning doing the test in your house or in your office</i>)?	33	83	7	17
Would you prefer to do the hearing test in a hospital?	24	60	16	40
Would you prefer to do the hearing test in a hearing center?	21	78	9	22



Marketing Viability of Mobile Teleaudiology	Yes		No	
	f	%	f	%
PROMOTION				
Would you want to avail of promotional discounts of selected products?	32	80	8	20
Would you want to avail of a loyalty card for discounts of products and services of the hearing center?	31	78	9	22
Would you want to be informed of the latest gadgets the hearing center can offer thru SMS messaging, online promotions and telemarketing?	30	75	10	25
PEOPLE				
Are you satisfied with the hearing center staff in rendering service to you?	36	90	4	10
Are the hearing center staff prompt in answering your inquiries?	35	88	5	12
Are the hearing center staff and doctors maintain professionalism and courtesy to you?	35	88	5	12
PROCESS				
Are your hearing test results given promptly?	36	90	4	10
Is your hearing test certification given in a confidential manner?	35	88	5	12
Are you willing to pay thru debit cards or other online payment methods your hearing test fees?	33	83	7	17
PHYSICAL EVIDENCE				
Would you be willing to accomplish a feedback or suggestion form to improve services?	36	90	4	10
Would you want hearing center informational brochures sent to you?	36	90	4	10
Will you accept being a member of the hearing center social media platform?	35	88	5	12

The overall interpretation of the marketing survey revealed that the respondents were willing to perform mobile teleaudiology since the level of acceptance to it was high and the price of the hearing test was reasonable for them to pay. Therefore, mobile teleaudiology showed high marketing viability. Performing the test, these factors might increase sales and profitability (e3 Diagnostics, 2018).

In another study by a global telemedicine market research report from Market Research Future, the global telemedicine market is expected to grow at an astonishing compound annual growth rate of 16.5% through 2023, equivalent to around \$15 million. The cost of the hearing aid was the only thing unacceptable to the respondents.

4.5 Challenges in the Use of Mobile Teleaudiology

The respondents were also surveyed with regards to the challenges patients face during the pandemic by means of the frequency and percentage count. From that data, the ranking was also determined.

In Table 5, the results showed that the unstable internet connection was ranked number one at 60%, followed by a preference for doing face-to-face consultation after the pandemic at 32.5%. The reason why unstable internet connection remained the top challenge in the use of mobile teleaudiology was because of the lack of cell sites outside the capital city of Negros Occidental aside from several dead spots causing poor internet signal mainly due to the position of the existing cell sites.

The second rank challenge was the preference of the patients to do face-to-face consultation after the pandemic. The reason being that the audiometer machine gives a more comprehensive diagnostic evaluation of the patient's hearing concerns.

Table 5. Challenges in the use of Mobile Teleaudiology

Challenges	Frequency	%	Ranking
I have unstable to no internet connection.	24	60	1
I prefer to have a face-to-face consultation after the pandemic.	13	32.5	2
I am not comfortable to release any personal/medical data through internet.	12	30	3
In case I am required to buy hearing aid, I do not have enough cash to buy the hearing aid immediately.	11	27.5	4
This medical application process is not covered by my insurance.	10	25	5
I am afraid to find out the result of hearing test by myself.	4	10	6
My mobile phone/gadget is not capable of downloading the application.	1	2.5	7.5
Other than my mobile phone, the required additional gadget, such as earphone is not compatible for hearing test.	1	2.5	7.5
I am not comfortable of hearing test mobile application.	0	0	9

The Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003) proposes four basic factors affecting the individual's acceptance and usage of the newly encountered technology. These factors are performance expectancy, effort expectancy, social influence, and facilitating conditions. In the overall analysis, this theory holds true in the study as it was shown that there was performance expectancy by the respondents in that there was an intention to use the mobile application, acceptance in the results, and acceptance in the technical limitations.

For the effort expectancy, the respondents claimed it is a free and downloadable application and easy to use. Likewise, there was also a positive response to the social influence of mobile teleaudiology as they were satisfied with the service, professionalism, and courtesy of the hearing center staff and doctors. Lastly, the facilitating conditions were also present as they gave an affirmative response to features, consultative services, promotions, and physical evidence of mobile teleaudiology in encouraging support for the acceptance of technology.

Schumpeter's Innovation Theory of Profit (Megha, 2018) states that economic profits arise because of successful innovations introduced by entrepreneurs. In the overall analysis, this theory likewise was true in the study. Mobile teleaudiology in the island of Negros was unknown until the pandemic started. This study, being the first of its kind, was an innovation in doing a local audiometric screening test without using the standard face-to-face consultation.

It also has been shown that the 3-years financial projections in terms of the business aspect of mobile teleaudiology were profitable and viable.

5. Conclusion

The study concluded that mobile teleaudiology is a viable business. It was shown that there was a strong marketing impact of patronage by the patients. Likewise, it was also presented that financially, the financial ratios pointed to a sustainable business despite the challenges it was facing in the implementation. Mobile teleaudiology is a viable business.

Furthermore, it was also the conclusion of this study that the respondents were not aware of the usage of this new technology, mobile teleaudiology, although they have knowledge and awareness of its purpose, features, and consultation services. In contrast, however, the study concluded a high acceptance level of this new technology.

The hearing center management should incorporate mobile teleaudiology as a new diagnostic tool to the present hearing center as it has shown awareness and acceptance by the patients as well as being viable from the point of view of the business.

The medical practitioners must conduct an aggressive information campaign to introduce this new technology for the purpose of public awareness. Likewise, from the challenges gathered, especially the lack of internet connection, patients must be informed of the importance of a good internet connection for this new technology to be useful. Moreover, this test could be done in any location with a strong internet signal with a quiet environment.

Future researchers can conduct this study to investigate the field of mobile teleaudiology, not only for screening hearing tests but also using a smartphone for audiometric diagnostic tests, hearing aid programming and fine-tuning, and controlling hearing aid output using adaptive programming that can modify based upon a specific location or listening environment.

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