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Surveying the Role of Telemedicine in Physiotherapy: Barriers and Opportunities in Remote Care Delivery

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ABSTRACT

The purpose of this work is to review the state of the art of telemedicine within the context of physiotherapy, guided by an interest in uncovering advantages, drawbacks, and further prospects for use. This research sought to evaluate the impact of telemedicine on physiotherapy services by focusing on distance care delivery and to determine the difficulties observed by telemedicine utilizing healthcare professions and patients in physiotherapy. The study also explored the role of technology and training in enhancement of telemedicine based physiotherapy and prospects for telemedicine in future to enhance patient care. Some of the conclusions that were made include; telemedicine increases access to physiotherapy, improves patient participation and provides discretion. Nonetheless, there were some disadvantages which include; poor internet connection and quality; technology; opposition from the professionals; and data protection issues. The study also went further and pointed that, with technological enhancements coupled with artificial intelligence, real time data analysis and integration of healthcare givers and practitioners, telemedicine in physiotherapy could be enhanced. The results of the study imply that overcoming the currently standing technological and training challenges coupled with the integration of latest technologies can unlock telemedicine's full potential in physiotherapy.

Keywords: *Telemedicine, Physiotherapy, Barriers, Opportunities, Remote Care Delivery*

1. INTRODUCTION

Over time, remote delivery of healthcare has seen increasing relevance and application in clinical practice with advances in technology, particularly in the aspects around teletherapy. The practice of telemedicine is broadly known as the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. [1]

With respect to physiotherapy, potential synonyms for telemedicine used include "telerehabilitation." The multi-faceted definitions and practice variations surrounding telemedicine have been summarized and reported in a study which reveals factors including the genericity of the term for the vast array of teleprofessionals. These terms do compete, although the scope of the related practices largely spans the spectrum from preventative to direct healthcare delivery. [2]

Globally, the telemedicine industry is burgeoning, particularly with respect to physiotherapy services, and several studies have examined its historical perspective. Early evidence for telemedicine was first reported in the Australian outback in 1929, where the possibilities of a radio being used for consultations to gain access to specialist opinion for procedures and for in-patient referrals were being considered. Later, the development of interactive electronic consultations was charted, with one of the first using a closed-loop television circuit back in 1950. Telemedicine programming has grown significantly in the military. [3]

In the UK, there have been moves towards the implementation of telemedicine strategies for many years. There have been statements that the government was to implement telemedicine services right to the homes of the working people, so they do not have to attend hospital for treatment and rehabilitation services. More modern reports in the media also promote the use of telemedicine because patients' mobility can be limited by traffic congestion, distance from therapists, or the requirement to travel to the hospital to see the therapists with a long waiting time. Clearly, history has shown a place for alternative consultations other than the face-to-face model, and this paper aims to examine the influence of barriers and enablers within the health profession. [4]

1.1 Statement of Problem

The issue of the research focuses on the use of telemedicine in disease treatment by physical therapy and possible challenges for implementation of such remote care. The research proposal seeks to explore the feasibility of accessing PT through telemedicine, the issues that may limit the delivery of appropriate care from a distance, which may be due to technical hitches, lack of training or lack of access to appropriate tools. The research also focuses on the prospects to enhance the delivery of this service in the future and how to commend the challenges.

1.2 Questions of Study

1 What is the role of telemedicine in Physiotherapy delivery?

2 What are the main challenges facing telemedicine implementation in Physiotherapy?

3 How does access to technology and training impact the effectiveness of Physiotherapy delivery?

4 What are the future opportunities for improving patient care in physiotherapy using telemedicine?

2. LITERATURE REVIEW

2.1 Barriers to Implementing Telemedicine in Physiotherapy Practice

To fully benefit from the numerous advantages that telemedicine offers for physiotherapists, several significant barriers need to be systematically addressed before teletherapy can be optimally implemented in practice. These barriers can be conveniently categorized into three main areas: technological, organizational, and user-related factors. The existing insufficient infrastructure, varying levels of software mastery among practitioners, and the considerable time and financial costs associated with training are all critical issues that might hamper the effective technological implementation of telemedicine solutions. [5]

Additionally, the lack of adequate knowledge for troubleshooting common issues can further complicate the situation. Furthermore, it is essential to establish a comprehensive telehealth policy within the organization, along with evaluating the level of managerial support available for fully integrating telehealth services into the current care process. These elements are crucial for ensuring that telemedicine can transition from being a novel idea to a routine practice that is embraced and utilized effectively by practitioners in the field. [6]

Resistance to change presents significant challenges that could affect the combination of existing physiotherapy practices with teleconsultations. In some organizations, there is a strict rule against providing remote care to patients unless they have first visited their primary caregiver in person, which could seriously hamper the implementation of teleconsultations. With regard to the user experience, apprehension and hesitance towards remote care have been recognized as potential barriers that could hinder patient engagement. [7]

The skepticism and doubts that some patients may feel are likely to reduce not only the uptake of e-consultations but also their adherence to prescribed therapy regimes. Finally, it is important to acknowledge that not all patients have reliable access to the necessary technology, which could potentially exacerbate existing health inequalities and issues of access to care that are already present in the healthcare system. [8]

It has indeed been argued that the ongoing struggle to adapt to new methods of care delivery implies a significant failure to obtain a full return on investment, as well as an increased return period that many providers find challenging to accept. [9] Nevertheless, innovative strategies to successfully overcome the barriers to teleconsultations are absolutely essential since the potential gains from remote care are known to be exceptionally promising, significantly enhancing the accessibility, efficiency, and quality of patient care experiences. Empirical evidence can provide timely and critically important insights into this evolving field, as the current widespread adoption of teleconsultations has created a unique opportunity to thoroughly gauge the development and effectiveness of these virtual care strategies. [10]

Specifically, technological hurdles, personnel-related issues, and organizational aspects that require careful consideration and attention will be looked into if teletherapy services are to be effectively facilitated amid the ongoing challenges presented by the COVID-19 pandemic. [11] Moreover, professional barriers, including but not limited to clinical reasoning in remote physiotherapy assessments, varying levels of accessibility, and evolving referral standards, have been thoroughly discussed in the context of this research. This study ultimately provides valuable insights into the numerous barriers that are known to significantly hamper the successful implementation of teletherapy practices across diverse clinical settings. [12]

2.2 Exploring Exciting Opportunities and Innovations in the Field of Remote Care Delivery Services

While there are still some significant barriers that exist to facilitate telemedicine's full integration into physiotherapy practices, there are also numerous opportunities presented by this increasingly important slice of remote care delivery. [13] Innovations in patient monitoring are emerging rapidly, particularly through advancements in wearable technologies, such as exoskeletons specifically designed for gait retraining. These technologies are invaluable as they provide clinicians with more granular and detailed information about patient progress and mobility issues, greatly aiding in the therapeutic process. [14]

Additional innovations include functional electrical stimulation (FES) devices and sophisticated joint motion capture systems, which have the potential to revolutionize how therapists treat conditions remotely. [15] Furthermore, telemedicine not only provides a critical bridge for long-term, effective remote follow-up care, but the overall efficacy of remote care can be significantly enhanced through the strategic use of wearable devices paired with mobile health applications. Such integrations can greatly heighten patient monitoring capabilities and boost patient engagement levels, leading to better

outcomes overall. [16]

The potential for telemedicine tools could significantly enhance therapeutic collaboration in cases that require diverse interdisciplinary approaches. [17] The recent advancements in virtual reality and mobile technology have enabled such innovative and effective interactions to take place across various health disciplines. In the field of physiotherapy, for example, tools that empower therapists to adjust the level and difficulty of rehabilitation exercises create a future where individualized therapy can take place with minimal teacher input. [18]

This paradigm shift in therapy methods opens up the possibility of low-cost treatment options that might be accessible to a broader range of patients. Innovations currently taking place within virtual reality programming can produce a remarkably realistic physiological response to external stimuli when patients are fully engaged in the immersive experience. [19] Moreover, the increased portability and affordability of new headsets dramatically augment their potential to be effectively utilized in clinical settings, leading to transformative changes in how rehabilitation and patient care are delivered. [20]

Patients engage with mobile health apps for nearly three times longer than their interactions with wearables or other forms of portable health technology. This trend likely stems from the fact that individuals typically keep their smartphones within an arm's reach, making them more accessible. [20] Additionally, artificial intelligence offers the capacity to track and customize rehabilitation efforts through detailed movement analysis, which represents a crucial component of a physiotherapist's toolkit, especially for individuals suffering from conditions such as whiplash. [21]

Rehabilitative health care fundamentally revolves around an intervention that is delivered either directly by a qualified clinician or, in some specific scenarios, through self-management once initial guidance has been provided to the patient. The findings surrounding telehealth interventions reveal no significant differences in patient outcomes, suggesting that despite the considerable potential telehealth applications may hold, effective treatment or rehabilitation often necessitates an initial face-to-face interaction during some phase of care. This approach ensures that patients receive comprehensive support tailored to their individual needs, which can enhance the overall effectiveness of their treatment journey. [22]

Consequently, a comprehensive model of care, with telemedicine effectively providing the necessary support to both the patient and the entire healthcare system, may serve as a vital part of the answer to current healthcare challenges. The outcome of such a model could lead treatment teams to focus more on measuring interactions with patients, rather than solely counting appointments, as a way to better assess the effectiveness of the model itself. [23]

Telemedicine has the potential to significantly extend the reach of healthcare professionals, including physiotherapists, far beyond the traditional boundaries and constraints imposed by a conventional data measurement framework that values only the time spent in a clinical setting [24]. The evaluation of these innovative concepts will require not only a fundamentally different toolset for the analysis of telemedicine interactions but may also necessitate a radical evolution of how outcome measurements are defined and assessed in the context of remote healthcare delivery. This transformation could pave the way for more inclusive and comprehensive healthcare solutions that truly prioritize patient engagement and outcomes, regardless of geographical limitations. [25]

3. METHODOLOGY OF THE STUDY

The study will therefore follow a quantitative research method through completion of questionnaires that will be administered to the health care professionals who are involved in telemedicine based physiotherapy services. The study will, therefore, seek to find out the challenges and possibilities of the delivery of physiotherapy through tele-rehabilitation. These findings will help identify self-perceived barriers and experiences of professionals, as well as revealing opportunities for enhancing telemedicine for physiotherapy services. The study will also evaluate the outcomes and usability of telemedicine in such setting.

3.1 Study Population and Sample

The participants in the study will be drawn from a study population of physiotherapists and telemedicine practitioners drawn from healthcare centers that are providing tele-rehabilitation services. One hundred participants will be chosen for the study through the random sampling method this is to increase the variation of the participants' response and to increase the extent to which the results obtained can be generalized. Thus, the number of participants allows us to establish the necessary grounds for collecting reliable data for further analysis and to develop adequate techniques to fit the studied research questions adequately.

3.2 Study Tool

Structured questionnaires will be adopted as the main data collection instrument in this study. This questioner will be both close-end to capture perception and experiences while being used in tandem with open-end to capture other relevant information. The questions will include questions like role of telemedicine in physiotherapy, problems encountered during remote care, and potential improvements in the existing and future telemedicine involved physiotherapy services.

3.3 Statistical Treatment

The data collected from the questionnaire will be analyzed beneficially by using SPSS (Statistical Package for the Social Sciences). The second research design method involves the descriptive statistics which will be used with a view of determining the means and standard deviations of the responses that different questions garnered. It will make it easy to look for trends or cycles in the data besides determining the middle and spread of the participants' response data. The findings shall be presented in tables as well as graphs in order to enhance comprehension of the conclusions that shall be arrived at.

4. DATA ANALYSIS

4.1 Role of Telemedicine in Physiotherapy Delivery

Table 1 Role of Telemedicine in Physiotherapy Delivery

	Item	Mean	Standard Deviation
1	Telemedicine provides an alternative method for delivering physiotherapy services to patients remotely.	3.66	1.35
2	Telemedicine allows physiotherapists to monitor patients' progress and provide consultations without physical visits.	4.12	1.02
3	It offers increased access to physiotherapy services for individuals in remote or underserved areas.	4.31	0.93
4	Telemedicine can enhance patient engagement and adherence to prescribed rehabilitation exercises.	3.80	1.07
5	The integration of telemedicine in physiotherapy offers flexibility and convenience for both patients and healthcare providers.	4.24	0.90

Table 1 shows some of the telemedicine strategies in the physiotherapy delivery and the importance of each of the below statements with the mean score and standard deviation. The highest mean score is obtained for the statement, "It provides greater opportunity to access physiotherapy to individuals who are in the rural areas or hard to reach areas."

There is, therefore, understanding that telemedicine enhances the issue of physiotherapy accessibility among the patients. Moreover, the statement, telemedicine as physiotherapists can track the patient's progress or for consultation without home visits, received a high mean (4.12) suggesting that telemedicine is relevant for distant patient care. Telemedicine in physiotherapy that brings the option of convenience nearly equal to the traditional physiotherapy practices received the score 4.24 as both patients and health care professionals regard it as advantageous.

Alternatively, the statements about patient engagement (mean, 3.80) and telemedicine as another modality for delivering care (mean, 3.66) were slightly less favorable and had SDs varying from 0.90 to 1.35, more especially for the original item and the engagement-related items.

This variation indicates that although most participants had a positive perception of telemedicine when applied to enhance access and convenience, perceptions on how telemedicine is applicable in physiotherapy delivery might shade in and out depending on specific application or experience.

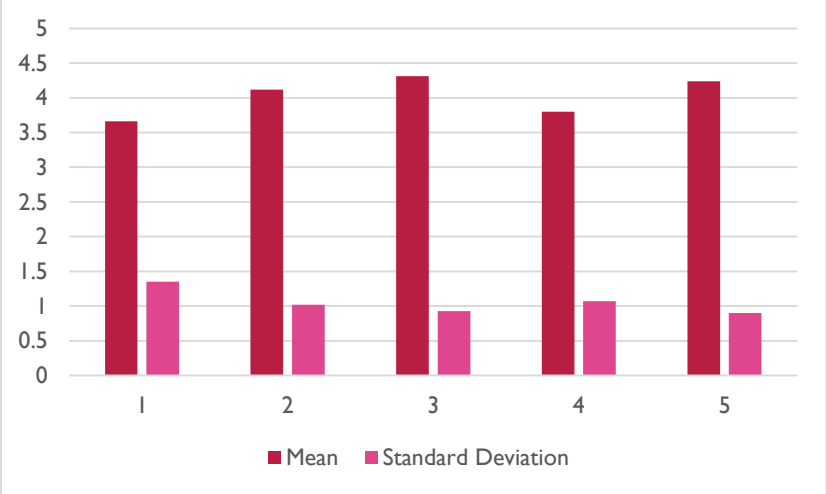

Figure 1 Role of Telemedicine in Physiotherapy Delivery

4.2 Challenges in Implementing Telemedicine in Physiotherapy

Table 2 Challenges in Implementing Telemedicine in Physiotherapy

Item	Mean	Standard Deviation
Limited access to high-quality internet connectivity may hinder the effectiveness of remote physiotherapy.	4.68	0.60
Technological barriers, such as insufficient software or hardware, may affect the smooth delivery of telemedicine services.	4.48	0.83
Resistance from healthcare professionals due to a lack of training or unfamiliarity with telemedicine platforms.	4.10	1.02
Concerns about data privacy and security in storing and transmitting patient information during remote consultations.	4.01	0.83
Inability to provide hands-on therapy or perform physical assessments, which are essential for some physiotherapy treatments.	4.04	1.00

The characteristics of major concerns in applying telemedicine as enhancer for physiotherapy have been summarised in table 2 below with mean scores above average, showing increased concerns. The highest mean score of 4.68 is assigned to the option “Limited access to high-quality internet connectivity” showing that poor connection is considered as a significant barrier to remote physiotherapy delivery. This is followed by the technological barriers where the respondents have an average of 4.48 concerning some of the technological aspects of software or hardware being inadequate to support the delivery of telemedicine services effectively. The two subcategories known as, ‘lack of training’ (mean = 4.10) and ‘data privacy and security’ (mean = 4.01), has highlighted more to do with readiness of the healthcare providers and protection of the patient’s information. Lastly, the challenge “Inability to provide hands-on therapy or perform physical assessments” had a mean of 4.04 therefore reflecting low ability of the physiotherapy exercise regimen for dealing with some of the important therapeutic requirements. The coefficients of variability, being between 0.60 to 1.02, seem to indicate relatively low variability but this variability is increased especially towards the technological barriers and professional resistance. Therefore, these results remark that technical and professional challenges greatly affect the viable use of telemedicine in physiotherapy.

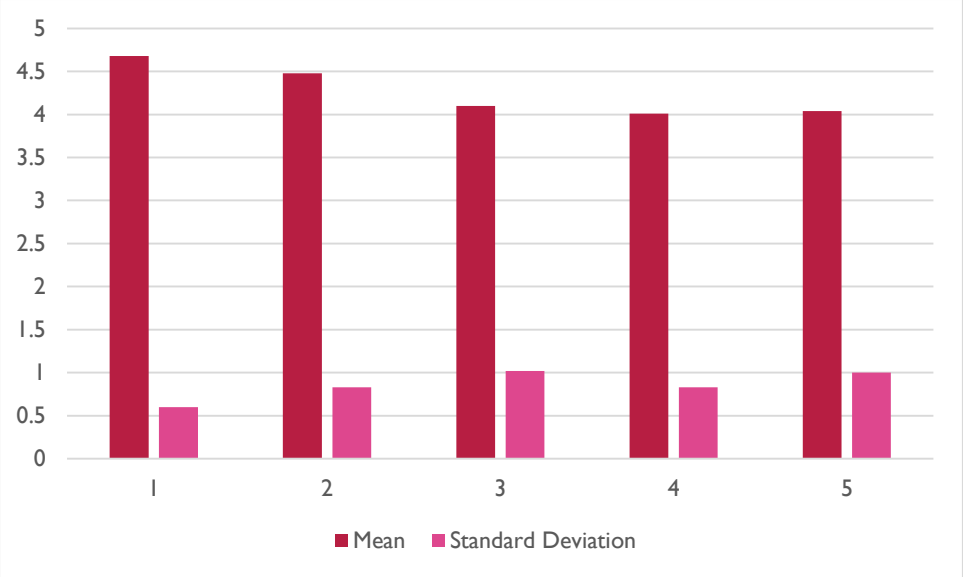

Figure 2 Challenges in Implementing Telemedicine in Physiotherapy

4.3 Impact of Technology and Training on Physiotherapy Delivery

Table 3 Impact of Technology and Training on Physiotherapy Delivery

Item	Mean	Standard Deviation
Access to modern technology ensures that telemedicine platforms function effectively, supporting high-quality consultations.	3.88	1.06
Adequate training for physiotherapists in using telemedicine tools enhances their ability to deliver effective remote care.	3.68	1.21
The availability of user-friendly technology for patients improves their experience and adherence to physiotherapy plans.	3.34	1.31
Insufficient access to technology can lead to delays or interruptions in physiotherapy services, negatively impacting treatment outcomes.	3.62	1.19
Lack of proper training for both patients and healthcare providers may hinder the effectiveness of remote physiotherapy sessions.	3.69	1.10

Table 3 displays cross-tab findings for the effect of technology and training with respect to telemedicine and the delivery of physiotherapy, in which mean scores indicate a range in the significance attached to these factors. The highest mean (3.88) is given to statement “With modern technology telemedicine platforms ensure effectiveness” show that the respondents fully endorse the fact that technology plays a vital role for telemedicine based physiotherapy. Another input which was rated at a mean score of 3.68 the need to adequately train physiotherapists is also viewed as a critical combination to achieving effective remote care delivery. But the mean for “The availability of user-friendly technology for Patients’ (3.34) is comparatively low and it indicate that effectiveness of technology available for patients may cause problem for a patient in terms of usability and thus patients’ engagement and commitment to the treatment plans may also be affected.

Concerning the proposed statement “Insufficient access to technology can lead to delays or interruptions” the coefficient is 3.62/4 = 0.91, indicating respondents’ acknowledgement of the fact that lack of efficient technologies can have negative impact on treatment results. Lastly, the perception that there is inadequate training of patients and healthcare providers seize to makes their remote sessions for the overall success.

The standard deviations of the identified variables vary from 1.06 to 1.31 meaning that there is a significant variation across the responses in relation to the user's impact, preferences and experience and the perceived significance of training more so, in light of the distribution of resources. In sum, the provided results suggest that the development of telemedicine tools and training of professional are decisive factors for the successful implementation of telemedicine physiotherapy services.

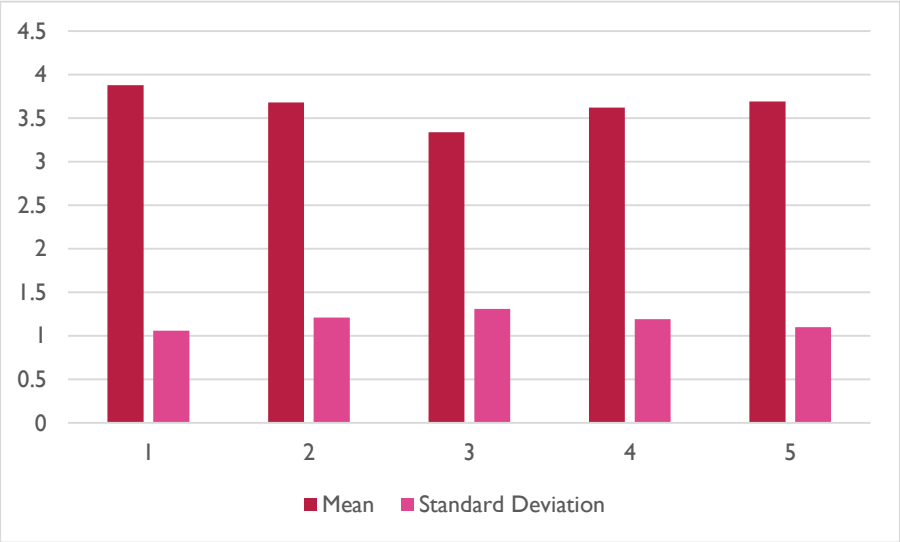

Figure 3 Impact of Technology and Training on Physiotherapy Delivery

4.4 Future Opportunities for Improving Patient Care in Physiotherapy

Table 4 Future Opportunities for Improving Patient Care in Physiotherapy

Item	Mean	Standard Deviation
Advancements in telemedicine technology can lead to more interactive and personalized physiotherapy treatments.	3.66	1.35
Future developments may include the integration of artificial intelligence to enhance patient monitoring and assessment remotely.	4.12	1.02
Telemedicine could help establish a more seamless collaboration between physiotherapists and other healthcare providers for holistic care.	4.31	0.93
The expansion of telemedicine may allow for real-time data analysis, improving the precision and customization of physiotherapy plans.	3.80	1.07
Increased patient education through telemedicine platforms could empower individuals to take an active role in their rehabilitation process.	4.24	0.90

As to the potential for development in the field of telemedicine and application in physiotherapy, respondents flagged several main directions indicated in Table 4. The overall mean for the telemedicine option is 4.31 meaning the telemedicine could help establish a more seamless collaboration between physiotherapist and other healthcare providers for holistic care . Likewise, the authors' assertion that "Improved patient education via telemedicine applications may enable people to become more engaged in their recovery process" (mean = 4.24) was also supported strongly.

The addition of artificial intelligence (mean = 4.12) is seen as positive as a future advancement that might enhance the distant review and evaluation of patients. However, the percep-tion of the opportunities, such as increased technol-ogy usage in telemedicine (mean=3,66) and expanded usage of telemedicine for real-time data analysis (mean=3,80), can be characterized as less perspec-tive-oriented, so they are also considered, but it seems that these opportunities are expected to occur farther in the future as compared to benefits from collaborative telemedicine and patient education.

The coefficients of variation oscillate between 0.90 and 1.35 implying that the variation in response is moderate and increase as the opportunities are more technological. In sum, the work presented here provides evidence that increases hope in telemedicine as an effective approach to optimizing physiotherapy delivery with the use of collaboration technology, patient engagement, and technology-based developments.

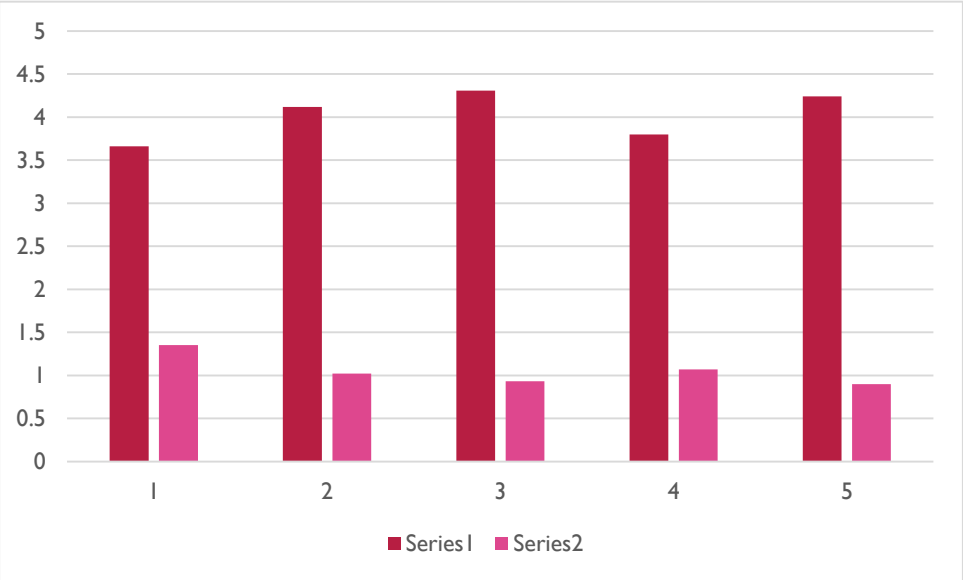

Figure 4 Future Opportunities for Improving Patient Care in Physiotherapy

5. DISCUSSION

Telemedicine has rapidly entered the healthcare industry especially in physiotherapy due to the COVID 19 pandemic. From the observation made in the study, it is evident that the involvement of telemedicine in rendering physiotherapy service has been embraced as a noble task due to the acknowledgment of the profession through the improvement of patient care by the practitioners as presented below.

In the light of the above works, this discussion relates to key findings which were aimed at evaluating the possibility of using telemedicine in physiotherapy, challenges likely to be faced, the effects of technology and training, as well as possible developments in the future.

Based on the following findings, telemedicine was identified as a unique factor that helps increase the availability of physiotherapy for patients in remote regions. These concerns fit well with those raised by [2], who noted that telerehabilitation technologies enable therapists to provide therapy using technology; in this vein, geographical barriers are conquered, and healthcare system strain is relieved.

Thirdly, [1] recognised telemedicine's convenience in allowing constant patient follow-up, which the physiotherapy process requires to be complemented by physical visits. Telemedicine is also considered to increase patient attendance and adherence to rehabilitation plans, which is also coherent with the increased patient compliance observed where patients have an opportunity to attend a therapy session remotely [3].

However, as this study showed, telemedicine is not equivalent to traditional physiotherapy for several reasons related to the numerous barriers or difficulties to its effectiveness, namely, variability of technology, character of physiotherapy as making touch. In their study, [7] noted that the biggest drawback of the modality is the inability to conduct direct physical assessments during remote sessions.

That is why consultations as well as guidance concerning exercise often use technology, but some of the physiotherapy techniques need touch, which one cannot get through a telemedicine approach.

The research unveiled multiple barriers with regards to telemedicine in physiotherapy practice; with restricted access to good internet being the biggest difficulty as stated by the study. This is in line with the study conducted by [6] who pointed out that there are several challenges to the implementation of telemedicine, including weak internet connection and or inadequate hardware.

Moreover, concerns from the healthcare side concerning limited approaches to suitable telemedicine platforms and inadequate knowledge from overall professionals of the technology also underpins the [4] assertion that absence of training

implies a significant barrier to a successful integration of telemedicine into practices of health care.

Furthermore, there were concerns on data privacy and security that was flagged as challenges as reaffirmed by [9]. I showed that they noted that storing and transmitting the patient's highly confidential data through telemedicine poses a severe privacy concern, which must be dealt with to make the patient and healthcare professions have trust in the technology. Such issues point to the need to address Technological Infrastructure and other Regulatory issues required in order to enhance efficient implementation of Telemedicine services.

The study findings reveal that only if physiotherapist is ready with modern technology and has sufficient training he/she can practice effective telemedicine-based physiotherapy.

The results indicate a clear agreement with the statement about modern technology's ability to guarantee the efficient operation of telemedicine platforms, as stated in the work of [5] concerning the ability of technology to support telemedicine services. Furthermore, the results of this study imply that treatments employing telemedicine should be delivered by physiotherapists who have received adequate training; otherwise, there will be a poor quality of care.

But nevertheless, even based on these considerations, the authors of the study found variability of the telemedicine evaluations in terms of the patients' compliance. [12] concur with this by examining if patient engagement is promoted by using tele-Part medication via technology regardless of patient types they find that the usability of the tele-Part medication platforms are critical in influencing patient engagement and treatment outcomes.

This concurs with the relatively low mean score for 'The availability of user friendly technology for patients' meaning that while technology can help with remote physiotherapy it has to be easily achievable technology whereby patients can own and manage depending on their specific conditions.

Possible Future Developments in Physiotherapy with Regard to Enhancing Patient Outcomes

The study also aim towards future possibilities of improving the care for patients with telemedicine application in physiotherapy. This prediction specifically involved telemedicine as respondents' main hope for the future of collaboration among the providers of care and more patient-tailored care. This view accords with [13], who noted that telerehabilitation ensures that physiotherapists consult with other caregivers involved in a patient's treatment plan.

Further, opportunities in artificial intelligence (AI) and real-time information processing of patients and individualization of their treatment plans were also seen to be potential ways to enhance the evaluation of the patients. Telemedicine, according to [7], will allow for the determination of AI-assisted patient progress and various physiotherapy programs. Furthermore, Telemedicine is shown to enhance the patient education of increased patient involvement in their rehabilitation process was also termed, as in [8] that educations of patients through digital platforms ought to translate to superior health.

6. CONCLUSION

The implications for physiotherapy from this research are the increasing significance of telemedicine in physiotherapy practice including the importance of telemedicine in matters of access, engagement, and professional cooperation. However, the effective use of telemedicine is not without some challenges such as technological issues, a lack of support from healthcare practitioners, and issues to do with the protection of data. To sum, these issues should be tackled complemented by proper training of workers and demanded and understandable technology to achieve the potential for telemedicine in physiotherapy. Furthermore there is still a potential in the near future to improve the accuracy of tailored physiotherapy interventions due to the integration of Artificial Intelligence and real-time data analysis. In conclusion, there is great opportunity to extend and popularize telemedicine to improve physiotherapy's quality for patients, but the actualization of this chance calls for the surmounting of the obstacles discussed within the study, as well as the exploitation of certain technological tendencies.

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