Application of Ai Tools for Better Rehabilitation Purposes

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Abstract

Artificial Intelligence is taking over all walks of human life and this can be considered to be a major area that can have massive implications on the lives of people. The study here has focused on understanding the overall use of AI and AI tools in the domain of rehabilitation. With the use of secondary data that is qualitative only, the study has aimed at understanding the basic usage of AI tools in rehabilitation. Further, an understanding of the factors that might play an essential role in the proper implementation of AI tools for rehabilitation purposes has also been presented here. All the factors that ensure and negate the use of AI tools for rehabilitation purposes have been presented in this study using a secondary qualitative data collection method. The data has been analysed using an appropriate systematic review to generate the desired themes, which have been further analysed using critical analysis techniques. This has allowed betterment in terms of the generation of the most appropriate results that are in line with the needs of the study. The study has effectively revealed that AI tools have found growing importance in the domain of rehabilitation. AI and the tools associated with the same are extremely beneficial in engendering betterment associated with the generation of a decentralized model of care. It can help in providing appropriate care interventions and therapeutic interventions from a distance or remotely and this can be a major help.

Keywords: Artificial Intelligence, Therapeutic Intervention, Remote Care

1. Introduction

Artificial Intelligence is gaining a major place in the healthcare sector and especially, in the case of enhancing patient care and experiences. It has been observed that the role that AI plays in this domain is essentially helpful in generating better care and enhances the levels of automation associated with the treatment process. Effective rehabilitation in the case of any patient is essential given the fact that it allows any patient to regain normalcy after a tenure of illness (Amirthalingam *et al.* 2021). Therefore, effective rehabilitation strategies can be extremely beneficial in fostering betterment and can help in promoting the desired outcomes. The use of AI and tools associated with AI is gaining a major impetus in the aspect of rehabilitation. From the perspective of physical therapy, AI tools are gaining massive popularity, which can be seen as a beneficial aspect altogether and can help in essentially improving the impacts associated with the same.

The use of Artificial Intelligence in an appropriate manner can help in ensuring betterment in the domain of physical therapy and therefore, understanding the various applications of the same is essential. AI comes with a unique ability to adapt to changing environmental requirements. Besides, these technologies are driven by effective algorithms that can allow them to react to these changes and come up with appropriate results (Lindsell *et al.* 2020). These tools learn from their own experiences like human beings and therefore, they are essentially being used in the healthcare domain. The margin of error is also minimised and the overall resource requirements are also curtailed using the same. Therefore, the use of AI and AI-generated tools can be a beneficial aspect that can help in fostering betterment in the domain of physical therapy and can ensure a smooth process of rehabilitation.

Effective rehabilitation in the case of any individual is largely dependent on certain critical areas of requirements, which can benefit the overall process. One such requirement is the ability to come up with appropriate learning in the process of rehabilitation and adjust to changes as well. Therefore, the use of AI in the overall rehabilitation process is a critical requirement, which can help in promoting better adjustments towards environmental changes and can also learn from their own experiences (Schiza *et al.* 2019). This can be an extremely helpful area, which can allow better results and adjustments and can ensure a smooth rehabilitation process. Therefore, research in this domain is beneficial and can help in engendering better results overall. It can also help in finding out the various use cases associated with the use of AI and AI tools in the overall process of rehabilitation.

The skills of the individuals or care experts who ensure the rehabilitation of any individual are one area that can impact the process. These skills can be infused using AI-based algorithms, which can benefit the firm and can ensure betterment overall. Therefore, in this regard, as Zeleňák et al.(2021) suggest, the use of AI and Machine Learning (ML) and associated technological tools can be beneficial. It can also help in promoting better rehabilitation processes and can help in engendering betterment. The main area that any rehabilitation must take care of is effective therapies and monitoring of progress. This can allow better tracking of any kind of development associated with any individual or patient. However, monitoring of activities by human beings has a high chance of flaws and this can be a problematic area altogether. The use of AI and ML in this regard, can allow better tracking and monitoring purposes and minimise chances of any errors. Better tracking of patient activities can also be facilitated by the same, which is yet another major area here.

Therefore, the study here has aimed at generating a better understanding of the use of AI and its associated tools for rehabilitation purposes. This involves an understanding of the various usages that can be associated with AI and the impacts this can have on enhancements of rehabilitation. Its overall simplification of rehabilitation processes has been stressed and this can allow betterment in terms of understanding of the most critical aspects that can help in generating better future strategies about the same here. A comprehensive study has been framed, which has been done in alignment with the needs of the topic.

Aim

The main aim that is being considered here is to understand the use of AI tools in the rehabilitation process

Research question

What are the main uses of AI tools in the area of rehabilitation of patients?

2. Methods and procedures

An understanding of the use of AI tools in the domain of rehabilitation has been done here using appropriate secondary data sources. The utilisation of primary sources of data and primary methods of data has not been considered in this case, as the scope of the study is being met using secondary data only. Further, the study has considered the use of only qualitative data and no quantitative data has been used in this case. Therefore, the application of the secondary qualitative data collection method has been undertaken here to reach the best results. The use of existing databases like Google Scholar, PubMed and Google Search work using the most

appropriate keywords have been considered in the case of these studies. A list of keywords that have been employed here has been highlighted below:

1. Artificial Intelligence

2. Rehabilitation processes

3. Use of AI Tools in Rehabilitation

4. Impacts of AI Tools on Rehabilitation

These keywords have been used to shortlist a set of 20 articles that most suited the cause of this study. After selecting these 20 articles the abstracts of these articles were further read and then a list of 10 articles that are most suitable to conduct this study were selected. The sampling technique that has been employed in this case is the purposive sampling technique. The use of this technique has allowed the selection of these 7 articles based on the needs of the researcher and the demand of the topic of the study as well. Further, the sample size is 7 here, as only that number of articles have been utilised in the conduction of the analysis of the study. Therefore, the study has been able to generate better insights by ensuring that the most relevant and appropriate data sources have been utilised.
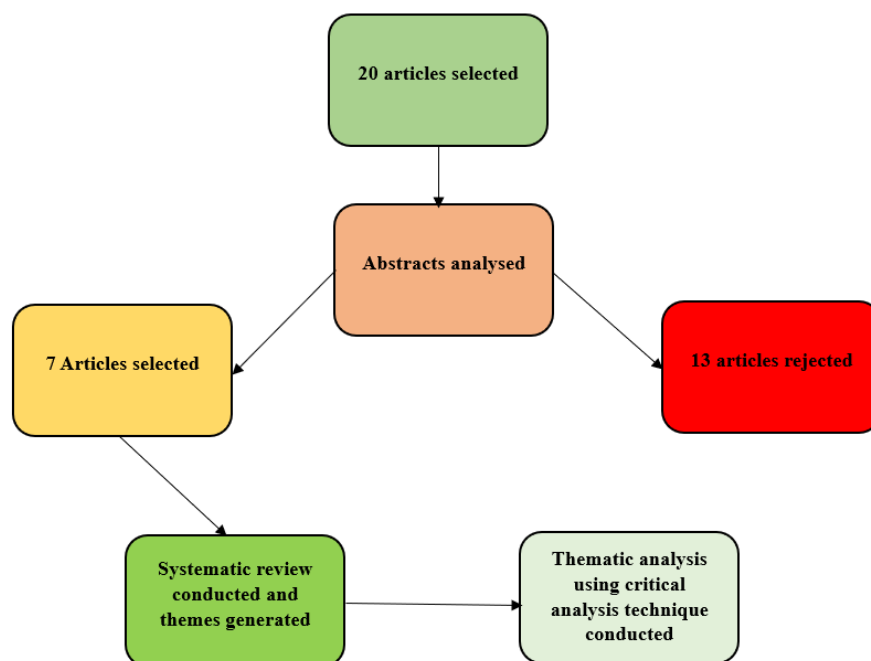

Figure 1: Research process (Source: Researcher)

The collected data has been further analysed using a systematic review approach, wherein, appropriate themes were generated, which were further used for the analysis of the study. These themes were used to compare the views of multiple authors, which allowed a critical analysis and ensured that the most appropriate techniques are used in this regard. The use of the critical analysis technique, which is based on the proper identification of the necessary themes can be seen as a critical aspect that can help in generating the outcomes that are desired in this regard. Further, it has helped in maintaining the authenticity of the data, as only peer-reviewed and authentic and reliable sources have been employed to ensure better authenticity of the study. The inclusion and exclusion criteria included:

Table 1: Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
Recent articles published on or after 2019	Older articles published before 2019
Articles published in the English language	Any other languages have not been used
Peer-reviewed and authentic sources	Random sources have been excluded

Further, it has been ensured that all ethical standards have been maintained and no unethical means have been employed in conducting the study.

3. Findings and results

Table 2: Systematic review table

Author	Title	Type	Findings	Theme
Falter *et al.* 2020	"Digital health in cardiac rehabilitation and secondary prevention: a search for the ideal tool."	Journal	The study has effectively highlighted the fact that a future ideal digital tool using AI and an integrated healthcare system can be generated, which can allow better results in this direction of rehabilitation.	*Theme 1: Artificial Intelligence in Healthcare and Rehabilitation* *Theme 2: Various uses of AI and associated tools in rehabilitation* *Theme 3: Future advancements that can be beneficial* *Theme 4: Best recommendations for appropriate usage*
Carriere *et al.* 2021	"Case report: Utilizing AI and NLP to assist with healthcare and rehabilitation during the COVID-19 pandemic."	Journal	The article has effectively presented the fact that the use of AI and ML and its subsets like Natural Language Processing (NLP) technologies can be employed to assist in the assessment and rehabilitation of acute and chronic diseases.	
Khodatars *et al.* 2021	"Deep learning for neuroimaging-based diagnosis and rehabilitation of autism spectrum disorder: a review."	Journal	The study has highlighted the use of smart glasses, which will employ appropriate Deep Learning to take images of various directions and then process these images for the patients with ASD to ensure better understanding. Such a tool can be facilitated for better rehabilitation.	
Vélez-Guerrero *et al.* 2021	"Artificial intelligence-based wearable robotic exoskeletons for upper limb rehabilitation: A review."	Journal	Multiple gaps can be associated with the use of AI-based wearable robotic exoskeletons for upper limb rehabilitation, which must be filled in. Further research in this direction can play an extremely important role in generating betterment.	
Esmaeilzadeh, 2020	"Use of AI-based tools for healthcare purposes: a survey study from	Journal	AI-based tools have been found to enhance the aspects of prognosis, diagnostics, and care planning. However, there are certain areas of risks of	

	consumers' perspectives."		integration, which must be adequately addressed to generate the best results and integrate AI in the healthcare domain.	

Choo and Chang, 2022	"Use of Machine Learning in Stroke Rehabilitation: Narrative Review."	Journal	The study has predicted greater use of ML in the domain of stroke treatment and rehabilitation. It has indicated the fact that the use of ML in predicting the occurrence of depression and the recovery of language, cognitive, and sensory functions can be generated in the future. Besides, better rehabilitation can also be facilitated using the same.	
Amorim *et al.* 2021	"Machine learning applied to low back pain rehabilitation–a systematic review."	Journal	ML can be employed to engender a remote care process by ensuring that it generates better guidance for patients with lower back pain in ensuring a self-management process. Besides, it can support the clinical decisions associated with the same, which can help in generating better results for patients with LBP.	

Theme 1: Artificial Intelligence in Healthcare and Rehabilitation

Artificial Intelligence and Machine Learning are increasingly being used in the healthcare segment. In the healthcare segment, the use of AI and ML and other sub-tools associated with the same is finding an increasing place (Rojek *et al.* 2020). The rapid advancements that are being made in these domains have been extremely beneficial in pointing out the most impactful usages of AI and associated tools in the sector. It can allow better prognosis, diagnostics, and care planning in the case of any patient and this can be beneficial in engendering higher levels of efficiency associated with the same (Falter *et al.* 2020). It has helped in generating betterment about the efficiency levels associated with any treatment process and has also found its usage in the post-treatment rehabilitation process.

However, the studies that have been conducted here have effectively pointed out the fact that there major risks associated with the use of AI tools that must be considered (Carriere *et al.* 2021). Among these, one issue that can be faced is the lack of appropriate understanding of the usage of these tools. This can have a major impact on the performance of the AI tools and can lead to certain risks as well. Another major area is the issue of acceptance of such digital tools and techniques. There might be fear among patients and this can negate the overall usage of these tools (Ruotsalainen *et al.* 2022). Finally, there is a need to understand that considerable cyber security concerns can also be associated with this area, as a large amount of data is involved and this can compromise patient safety as well.

Theme 2: Various uses of AI and associated tools in rehabilitation

AI tools are being considerably used for rehabilitation purposes and this is evident from the research that has been conducted here. The review above has pointed out that patients suffering from lower back pain, cardiac arrest, stroke, upper limb issues, and autism spectrum disorder can all be rehabilitated by making appropriate

use of AI and associated tools. One of the most significant usages of AI is in the domain of rehabilitation of patients in a remote manner, which can be beneficial in the long run (Khodatars *et al.* 2021). It can help in attaining better results and requires minimal involvement of health professionals. This can be beneficial as the individual patients can also learn self-management and rehabilitation. Therefore, the use of AI is being considered across the plethora of these illnesses and can allow better rehabilitation results associated with the same.

The use of tools of AI like ML, Deep learning, Natural Language Processing, and others can be beneficial as per the studies that have been analysed here. The use of robotics and automation in the case of upper limb rehabilitation can also be seen as an extremely effective area and can have major positive impacts on the overall process of rehabilitation as well (Vélez-Guerrero *et al.* 2021). Further, the appropriate use of NLP and Deep learning can allow a better understanding of patient conditions and issues, which can altogether ensure betterment in the generation of better rehabilitation strategies. Further, the use of AI-powered wearable technologies is also being stressed in current times. Like the robotic exoskeleton, which has been designed for upper limb rehabilitation and is powered by AI. This is one of the most effective tools, which can allow better movement and ensure a smooth rehabilitation process (Adler-Milstein *et al.* 2021). Therefore, all these crucial areas and tools can be beneficial and can help in fostering a better rehabilitation experience.

Theme 3: Future advancements that can be beneficial

Further developments in the domain of AI and its appropriate usage for rehabilitation purposes can be beneficial. Employing the correct strategies and techniques, which are impactful and can benefit enormously is an essential need overall (Esmaeilzadeh, 2020). Besides, the existing usage of these tools of AI is possessing certain critical gaps, which must be filled at all costs. The filling of these gaps requires the appropriate conducting of more advanced research work in this domain. It can also further inform the overall decisions that are to be made in the case of the use of these AI-powered tools and this can help in facilitating betterment overall (Adedinsewo *et al.* 2022). In the long run, it can also help in generating greater ease of handling and can promote betterment in terms of facilitation of the most appropriate techniques of treatment, care and rehabilitation.

Appropriate use of research and development here can be beneficial in engendering better results overall. Besides, a continuous research process can also be beneficial in projecting betterment and can help in enhancing the quality of care associated with the same (Choo & Chang, 2022). Therefore, these areas must be appropriately facilitated and this can help in fostering the desired results associated with the use of these advancements in an appropriate manner for the betterment of the overall domain of rehabilitation using AI tools.

Theme 4: Best recommendations for appropriate usage

The use of AI tools is subject to one massive issue and that is concerning the overall usage of these tools. Patients often find it extremely difficult to use such sophisticated tools and therefore, there is a need to generate a user-friendly interface, which can be easily and remotely used and self-managed by the patients themselves (Amorim *et al.* 2021). Besides, this can also help in ensuring better self-management of the overall rehabilitation process, which can cut down costs significantly and can ensure that appropriate results in this direction are generated. This is a beneficial area that can help foster desired outcomes about the overall area of increase in acceptance associated with these AI tools and can benefit the overall cause (Bernauer *et al.* 2021). Further, it can also help in generating a decentralised and remote rehabilitation process, which can be beneficial.

Another major area of recommendation is to ensure a constant gap analysis of these techniques that are being employed. This can be a beneficial area that can help in engendering betterment and this can also foster better outcomes associated with the same (Ianculescu *et al.* 2019). This is a crucial need as a better gap analysis can help in highlighting the prevailing gaps, which can be worked upon to improve. Further, continuous research work in these directions can be beneficial in coming up with effective solutions to such gaps and can help in fostering an altogether better care and rehabilitation process.

4. Discussion

Artificial Intelligence has become one of the most important areas that can be associated with the healthcare sector. As the integration of various technological advancements is being noted, there is rising use of AI and AI tools in the domain of healthcare (Lee *et al.* 2021). Among these, the rehabilitation aspect is also being largely benefited by the same. The study conducted here has highlighted that the use of AI and associated tools like ML, DL and NLP can be beneficial in generating a better rehabilitation process. It can also allow the preparation of a better care plan and can be used by patients in a remote manner. This suggests the fact that with the use of these tools, better self-management of rehabilitation processes among those who are capable can be generated (Esmaeilzadeh, 2020). Besides, the study has also pointed out the fact that with the use of these tools and techniques, a decentralised model can be facilitated, which can be remotely accessed. This can aid in the betterment of the overall rehabilitation process and can allow betterment in terms of the facilitation of the best results of care.

The use of DL in ensuring better neuroimaging for the treatment of individuals suffering from ASD or autism is one of the common uses of AI tools in complex illnesses. Besides, the use of NLP can be beneficial in the case of diseases like stroke and cardiac arrest. A better insight into the conditioning process can be generated using AI (Carriere *et al.* 2021). Besides, the use of ML can be ensured in generating appropriate robotic interventions in the case of the upper limbs rehabilitation process. However, multiple gaps can be associated with this process, it works and can be beneficial in ensuring smooth movements and exact ones as well (Vélez-Guerrero *et al.* 2021). This can therefore be extremely beneficial in engendering betterment and can promote better outcomes associated with the rehabilitation of the upper limb and similar areas. Besides, AI tools that can constantly monitor body movements and especially, AI-powered wearable technologies are the most common areas that have benefited by ensuring better rehabilitation process generation.
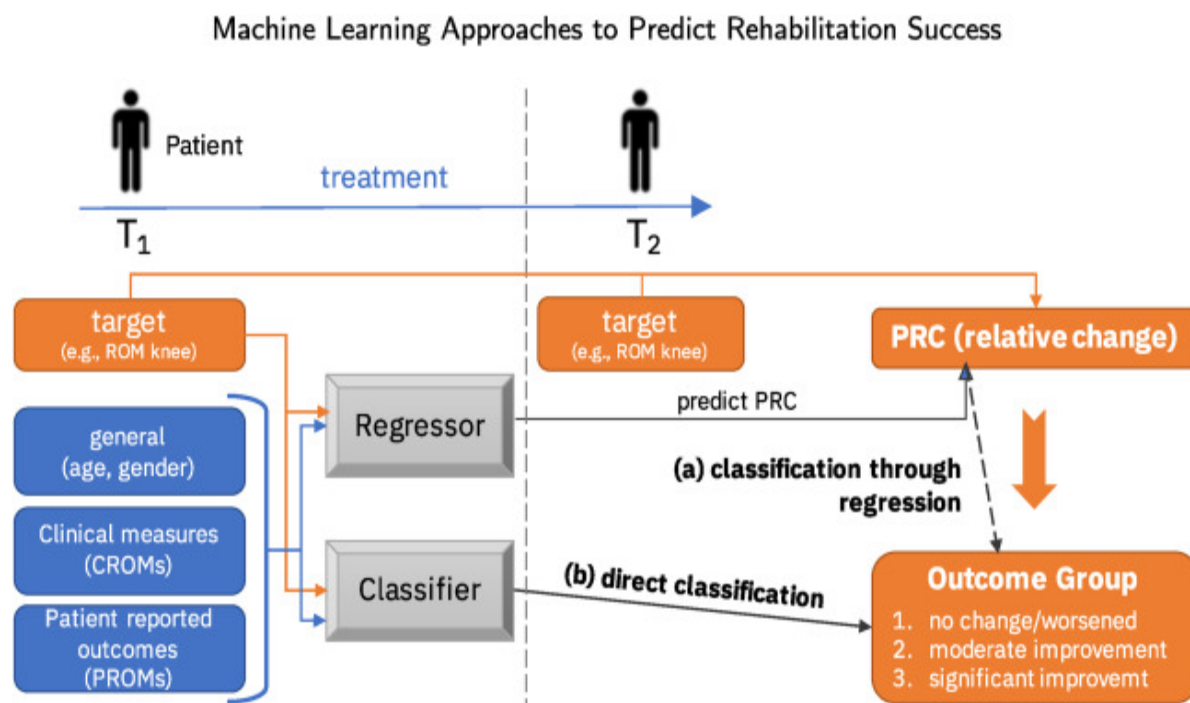

Figure 2: ML in predicting rehabilitation success(Source: Vélez-Guerrero *et al.* 2021)

Therefore, the use of AI and associated tools in the rehabilitation process of patients and individuals can be beneficial. It is an area that can consist of high initial costs but can help in saving multiple costs as well. However, the major concern that is generally associated with such interventions is the acceptance of such interventions among patients (Amorim *et al.* 2021). Besides, without any quantifiable measure of the overall success rate and cost savings, it becomes difficult to generate a wider acceptance of the tool among patients and

individuals. This is a critical area of need that must be considered, along with certain technical areas as well. As AI is an algorithm, the proper design of the same and appropriate changes in the same is essential. Further, in the case of robotic exoskeletons, the use of better materials is also strongly recommended. This calls for continuous research in this direction, which can ensure betterment by facilitating better results in the area of gap mitigation.

5. Conclusion

AI and ML are finding their way in all domains of life and healthcare is no exception to such a phenomenon. The increased use of AI and ML in the healthcare domain and especially in the rehabilitation processes has been noted. Apart from ML, other major areas of AI like DL and NLP have been used in the generation of appropriate rehabilitation strategies among individuals suffering from a wide range of diseases. This means that an individual can make use of AI-powered tools like wearables and robotic exoskeletons, which can facilitate a better process of rehabilitation. Further, deep learning can be employed for better neuroimaging and understanding of the same, which can be another critical area that can be considered here as well.

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