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# How Does the Integration of Wearable Sensor Technology into Upper Extremity Rehabilitation Impact Functional Outcomes in Stroke Patients?

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## Intro OR Objectives

- Stroke, defined by the World Health Organization (WHO), is marked by the sudden onset of clinical signs indicating disruptions in cerebral function, persisting over 24 hours or leading to death, with no evident cause except of vascular origin.[3, 8]
- Strokes are a major cause of disability worldwide, with data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). About 70% of stroke survivors face motor impairments, and 80% deal with mobility issues, resulting in lasting disabilities.
- This has led to an increased emphasis on rehabilitating stroke patients, with ongoing efforts to integrate technology into clinical practices, especially in the realm of stroke rehabilitation. [3,8, 10]

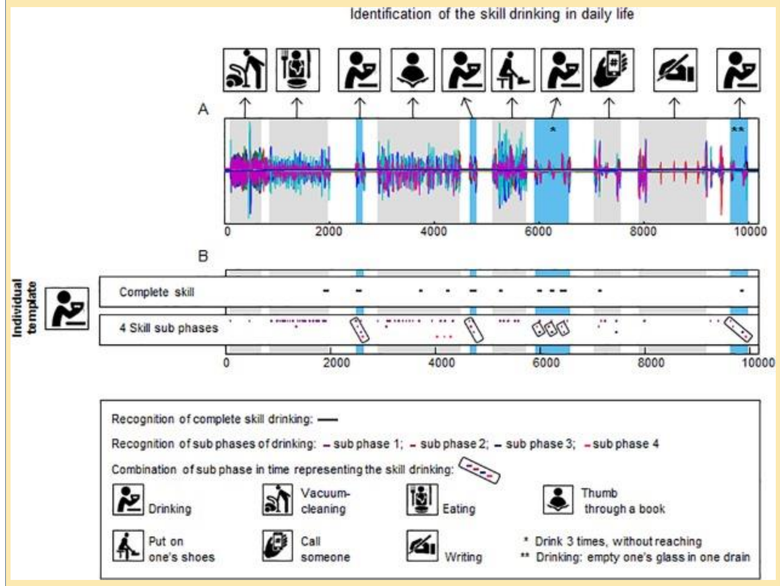
- While notable strides have been taken in wearable sensor technology, there's a scarcity of clinical trials evaluating their effectiveness, especially from a clinical standpoint. Wearable sensors present an opportunity to collect patient data outside clinical settings, which is particularly crucial for assessing their motor function. [1, 6, 7]

## Methods

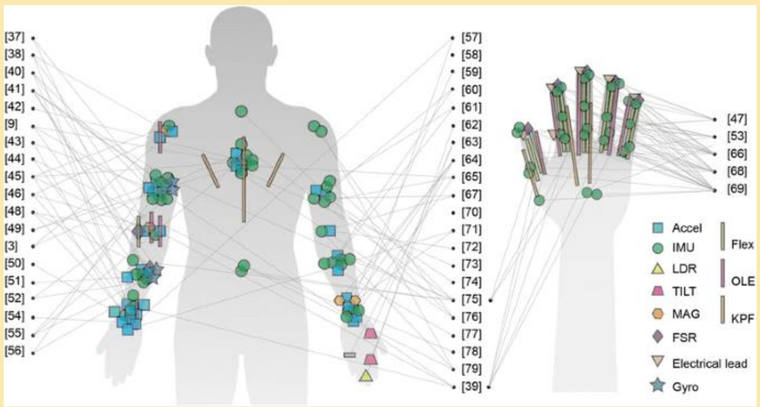
- Peer-reviewed articles related to wearable sensor technology written in English
- Research outside of the U.S was not excluded

| Database Searched | Date of Search | Keyword String | Number of Results |
|---|---|---|---|
| Pubmed | 11/28/23 | “stroke rehabilitation” + “wearable sensor” + “upper limb” | 127 |
| Scopus | 11/28/23 | stroke rehabilitation” + “wearable sensor” + “upper limb” | 148 |

## Results/Outcomes




Adapted from : Lemmens et al.




Adapted from : Kwakkel et al.

- The results obtained from measurements conducted in a controlled setting demonstrate the sensors' capability to distinguish specific activities from a range of activities. One clinical trial revealed successful identification of both unimanual and bimanual activities by utilizing data from sensors attached to the trunk, as well as the arms and hands.[6]

- However, transitioning from laboratory measurements to real-world situations poses challenges. The trials highlighted accelerometers and inertial measurement units (IMUs) as the commonly used sensors, with increasing interest in incorporating multiple sensor types, such as gyroscopes. [10, 12] More research is needed consisting of clinical trials with larger sample sizes and outside laboratory settings.[7, 9]

## Discussion / Conclusion

- Most literature attributes insignificant findings in clinical trials to factors like low sample sizes, inadequate outcome data analysis, and varying stroke severity among participants.[7] Stein et al. highlighted the underutilization of accelerometer sensors in assessing functional activities beyond labs, emphasizing the need to observe their efficiency in real-world situations, which applies to other types of sensors as well.
- The understanding of how diverse rehabilitation approaches contribute to central nervous system restoration after a stroke remains incomplete.[9] There is a need for further research on the use of wearable sensors in stroke rehabilitation, highlighting an area for further clinical research and assessment of long-term outcomes in this population.

## Limitations

- As seen in the figure’s, sensors' efficiency and the ability to quantify motor functions are poised to revolutionize rehabilitation. Exploring wearable sensor capabilities could offer clinicians a more comprehensive analysis of patient rehabilitation in the future. [6, 9]

## References