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Clinician's Commentary on Patterson et al.

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Since the 1990s, research examining functional motor recovery after stroke has shown the contributions of both true physiological recovery and compensation.[2] Questions concerning the nature of true physiological recovery remain, however, and the work by Patterson and colleagues[1] adds to this discussion by examining the recovery of functional balance after stroke. The authors examined whether scores on the Berg Balance Scale (BBS) related to force-plate measures of standing balance in individuals after stroke, which they deemed to be a physiological measure of recovery. They found that individuals who showed recovery of balance with BBS scores within normal limits did not necessarily demonstrate force-plate measures consistent with physiological balance recovery. The authors concluded that higher BBS scores might be the result of compensatory strategies without concomitant recovery of physiological balance. This is an important point because it demonstrates that individuals who may be classified as having normal clinical balance using the BBS may still demonstrate physiological balance impairments that influence safe community mobility.

The goal of physiotherapy is patient-centred functional recovery after stroke. One may think that it does not matter whether functional balance is achieved through true physiological recovery or through compensation—what matters is achieving the patient-centred goal safely. However, if physiotherapists can understand physiological recovery and the factors that inhibit or facilitate recovery, they can tailor treatment on the basis of this knowledge. Indeed, Patterson and colleagues[1] state, "The ability to identify and distinguish primary impairments from compensatory strategies is essential when a physiotherapist is tailoring post-stroke balance interventions to individuals' needs."(p.2) Executing functional movements using compensation is known to have long-term side effects, such as contractures and pain; thus, reducing compensation has implications for patients' long-term quality of life. How, though, do physiotherapists accurately disentangle true physiological recovery from compensation, considering the great variability among patients and in treatments? Put another way, which treatments maximize true physiological recovery? The way research is currently being conducted, the answer to this question will be very difficult to determine.

The article by Patterson and colleagues[1] is an example of how research can occur as part of routine, in-hospital clinical care. Considering the pathophysiology of stroke, full physiological recovery is not achievable for some individuals. Answering research questions that involve untangling the contribution of compensation versus true physiological change is needed and will likely be facilitated with research that is part of routine, in-hospital clinical care at acute and rehabilitation hospital sites through private-practice clinics. An active connection between research and clinical care is required to allow for more seamless and timely longitudinal data collection in a patient population that may otherwise be difficult for researchers to access.

A potential result of these collaborations among researchers, clinicians, and multiple hospital sites is the ability to undertake analysis of "big data"—an approach in which large quantities of data are examined to identify otherwise unrecognizable patterns and associations and thereby explain human behaviour. Such analyses have the potential to explain the day-to-day variability that physiotherapists see in patients and their journey toward functional recovery of balance.

A recent review of stroke endovascular treatment by Liebeskind[3] outlined big data's role in establishing the safety and efficacy of thrombectomy. The author suggested that large data sets helped elucidate the "constellation of variables"(p.335) that enable endovascular treatment to be successful. The challenge of understanding the myriad of variables that influence an individual's recovery is shared by physiotherapists who treat individuals after a stroke. The challenge to date has included translating stroke rehabilitation research results to the individual patient. Altman and Ashley (2015)[4] have advocated the use of "big data to dissect clinical heterogeneity."(p.232) Failure to recognize and account for heterogeneity can confound treatment results and research outcomes. Using big data may be a way to unpack the inherent variability in stroke patients and truly establish which treatment best promotes physiological recovery, compensation, or both and, more important, which patient benefits the most from a particular treatment.

Physiotherapists and researchers interested in maximizing the recovery of motor function need to take advantage of the large number of research and clinical sites that measure balance longitudinally to more fully determine which factors amplify physiological recovery. If rehabilitation-based therapy is to advance together with medicine, physiotherapists and researchers must collect several standardized measurements, such as the BBS and force-plate measures, and scale up the volume of measures taken on larger numbers of patients over time. These measures could include clinical outcome measures; physiological measurements such as electromyography, kinematics, and kinetics (including force plate, Wii Fit, etc.); neuroimaging (electroencephalography, magnetic resonance imaging, etc.); and genetic testing, as well as monitoring activity using wearable technology. By conducting similar tests across multiple sites, we can harness big data to help form predictive models that capture the inherent variability in patients and guide treatments.

Big data is a concept that is gaining traction in the medical world.[2,3] The next challenge is managing these data in a way that protects a patient's privacy while giving clinicians and researchers access for analysis. The gradual acceptance and transition to electronic hospital and clinical records will put rehabilitation specialists in a position to store and pool large amounts of data to enable big data analysis. The possibility of this type of analysis is exciting and may be a way forward toward personalized rehabilitation informed by predictive models of physiological recovery. If physiotherapists can reliably provide each patient with individualized rehabilitation based on his or her clinical balance and physiological predictors of recovery, they stand to significantly advance the field and target the therapy to the patient. In addition, they could predict with a higher level of certainty the amount of physiological recovery and compensatory strategies a patient needs to safely ambulate in the community. Furthermore, they may find that certain combinations of therapies may induce physiological change for a certain patient profile, whereas another combination may bias toward compensatory changes.

This treatment model will work only if physiotherapists come together across Canada in and among their various clinical and research settings and emphasize data sharing and collaboration. Ultimately, collaboration using a big data approach may be a way to answer the ultimate questions in neurorehabilitation, including what induces true physiological recovery.

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