**////Title: Developing Effective Chronic Care Systems for Traumatic Brain Injury**

**////Stand-first**:

An estimated 69 million people worldwide are currently living with traumatic brain injury (TBI). TBI can lead to short- and long-term conditions including sleep disorders, depression, headaches and an increased risk of suicide. TBI has recently been recognised as a chronic condition, although the human factors involved in recovery remain understudied. Working to address this is Professor Barrett S. Caldwell who leads the GROUPER Laboratory at Purdue University, USA.

**////Body text:**

Since 2014, Professor Barrett S. Caldwell and his colleagues have studied the information and technology used to manage traumatic brain injury (TBI) and explored the processes involved in care systems for chronic conditions.

The chronic care model framework describes the key factors involved in the successful management of chronic conditions. These factors include healthcare processes, communication, decision support, clinical information technology systems and self-management support.

To integrate the many different processes and technologies available in the healthcare system, specific procedures have been put in place. These come in the form of written protocols or guidelines and take complex tasks and present them in a way that is understandable and manageable. This allows the standardisation of the quality of care, optimal efficiency and reduction of human error.

The successful management of chronic conditions depends on the correct following of procedures across the healthcare sector. Several factors have been identified that influence how closely a given procedure is followed. These include characteristics of the work environment, characteristics of the operator (or the individual carrying out the procedure) and characteristics of the procedure itself. Professor Caldwell’s team explored the complex processes involved in recovery from TBI to inform the development of a chronic care system for TBI patients.

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In a 2017 study, Professor Caldwell and colleagues explored the suitability of using the existing chronic care models currently used for managing chronic illness in cancer and diabetes patients, in TBI care.

Through making a systematic comparison of chronic care model elements of decision and information support they identified that this approach would be well suited to TBI patients. In particular, they found that existing diabetes care systems can provide substantial insight regarding the application of a chronic care model to TBI management. Additionally, studying cancer survivorship models also provided insight into the long-term psychosocial requirements of TBI patients.

In safety critical environments such as healthcare, human errors that occur whilst following procedures can be detrimental to patient health. Therefore, minimising the chances of human error is extremely important in complex healthcare systems.

Based on earlier GROUPER healthcare human factors research, Professor Caldwell’s group conducted interviews to better understand the roles of care providers, the processes involved in the rehabilitation of patients with TBI and the possible sources of human error. They defined different handoff processes, as handoff from one health system to another, facility handoff; handoff between facilities in the same health system, department handoff; or handoff between departments in the same facility, session-to-session handoff; handoffs between patient’s different appointments and finally, handoffs between work shifts.

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The researchers discovered that many of these handoff events required considerable coordination and effective communication between operators with diverse skill sets and backgrounds. They identified that the communication media used at handoff points had variable rates of success and would often result in the transfer of incomplete information. Loss of information occurred via processes such as scanning and printing records and was hindered by the inability to search for scanned records later on.

The design of procedures requires an understanding of both human nature and the context in which the procedure will be performed. Historically, research into procedure following focused on factors affecting an operator’s compliance, or the act of obeying a given procedural guideline.

In a subsequent study in 2019, Professor Caldwell and his team further explored the development of an effective chronic care system for TBI by studying not only operator compliance but also looking at the quality, accuracy and overall outcome of the procedure following.

They found that in complex systems it was better to determine if an operator’s decision to comply or not comply with a procedure is ‘proper’ or ‘improper’ rather than focusing on the act of compliance or non-compliance alone. They reason that this is because both compliance and non-compliance can lead to positive outcomes when considering the overall system performance goals of a system model.

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When considering the development of a chronic care system, the researchers suggest that the outcomes of the procedure following are the most important factors to consider. For example, in some cases, it may be less important for a procedural goal to be accomplished than for a system performance goal. It is also possible that appropriate non-compliance can lead to a positive outcome and this should be taken into account when designing a systems framework. Similarly, improper compliance can lead to negative outcomes.

In the case of a complex system with multiple goals such as TBI rehabilitation, the many different possible outcomes of procedure following should be considered, including more neutral outcomes where procedural goals are not accomplished but the critical system performance goals are successfully achieved.

In a study published in 2019, Professor Caldwell and colleagues provide a framework and taxonomy that focuses on performance instead of compliance with procedures. Such a framework can be applied to work environments where there are multiple goals such as healthcare systems. For TBI, this framework could be applied to help reduce the effects of human error and design a chronic care system that allows each patient to have a unique and successful rehabilitation process.

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Professor Caldwell and colleagues suggest that particular types of information are more likely to be lost at certain handoff points, and that facility handoffs even within the same health systems can result in the loss of important patient data. As such, they suggest a redesign is needed for the underlying information systems, social network analysis and modelling, and that there should be a further exploration of the handoff processes to design a system that is capable of minimising human error.

As the rehabilitation process is unique for each TBI patient, healthcare workers need to provide evidence-based care that is tailored for the individual. This cannot be achieved without accurate and complete information from all team members and any previous providers who cared for the patient.

By treating TBI as a chronic health condition and moving forward to use a chronic care model framework that takes human error at handoff points into account, it is clear that the successful management of TBI both in the short- and longer-term can be greatly improved.

This SciPod is a summary of the following papers:

‘Considerations for developing chronic care system for traumatic brain injury based on comparisons of cancer survivorship and diabetes management care’, published in Ergonomics, DOI: <https://doi.org/10.1080/00140139.2017.1349932>

‘Evaluating and designing procedures in safety critical environments: a framework and taxonomy based on a critical review and synthesis’, published in Theoretical Issues in Ergonomics Science, DOI: <https://doi.org/10.1080/1463922X.2018.1529205>

and

‘Multi-level, multi-discipline, and temporally-diverse handoffs in traumatic brain injury rehabilitation’, published in Proceedings of the International Symposium on Human Factors and Ergonomics in Health Care, DOI: [https://doi.org/10.1177%2F2327857918071042](https://doi.org/10.1177/2327857918071042)

For further information, you can connect with Professor Caldwell at bscaldwell@purdue.edu