**RUNNING TITLE:** Implementation: the missing link

**TITLE OF ARTICLE:** Implementation: the missing link in the research translation pipeline – is it any wonder no one ever implements evidence-based practice?

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***Abstract***

Despite the exponential growth in the evidence base for stroke rehabilitation, there is still a paucity of knowledge about how to consistently and sustainably deliver evidence-based stroke rehabilitation therapies in clinical practice. This means that people with stroke will not consistently benefit from research breakthroughs, simply because clinicians do not always have the skills, authority, knowledge or resources to be able to translate the findings from a research trial and apply these in clinical practice. This Point of View by an interdisciplinary, international team illustrates the lack of available evidence to guide the translation of evidence to practice in rehabilitation, by presenting a comprehensive and systematic content analysis of articles that were published in 2016 in leading stroke rehabilitation journals. Our review confirms that only a small fraction (2.5%) of published stroke rehabilitation research actually focuses on the implementation or evaluation of evidence-based interventions into health care practice. We argue that in order for stroke rehabilitation research to contribute to enhanced health and wellbeing of people with stroke, journals, funders, policy-makers, researchers, clinicians and professional associations alike need to actively support and promote (through funding, conducting or disseminating) implementation and evaluation research.

***Key words:***

Stroke

Rehabilitation

Translational Medical Research

***Introduction to the Problem***

The burden of stroke due to illness, disability and early death is set to double worldwide within the next 15 years.[1] There have been major advances in acute stroke management (e.g. the widespread implementation of thrombolysis and endovascular clot retrieval), but despite this, the majority of people who survive a stroke live with some form of ongoing disability.[2,3]

The evidence base for stroke rehabilitation is growing exponentially[4] with numerous interventions clearly of benefit to particular cohorts of stroke survivors (for example repetitive task-oriented training[5], constraint induced movement therapy[6] and circuit class therapy[7]). However, the implementation of rehabilitation research remains elusive[8] with audit data from the United Kingdom (UK), Canada and Australia indicating that many evidence-based stroke rehabilitation interventions are not routinely applied in clinical practice.[9-11] Lack of implementation of evidence-based interventions has recently been highlighted as one cause of global underuse of effective healthcare interventions, which leads to unnecessary suffering and disability.[12]

In 2009, a point of view paper published in *Neurorehabilitation and Neural Repair* [13] considered why the traditional model of a "translational research pipeline" had not resulted in improved rehabilitation practice for stroke survivors. The authors concluded that more interaction was needed between patients, front-line clinicians, and clinical and basic scientists. Eight years later, we argue that there is a missing link in the research translation pipeline, due to the lack of knowledge and skill regarding research-informed implementation of evidence-based practice.

From our experience as implementation researchers in stroke rehabilitation, the missing link in the research translation pipeline is not due to a lack of “pull” from clinicians or patients as suggested by previous authors[13], rather we have found that clinicians and patients actively seek assistance to apply the evidence in clinical practice. However, evidence generated from a clinical trial may not easily transfer to a clinical setting, because rehabilitation services need to provide care for people who may present with more complex needs than the carefully selected participants who consent to take part in clinical trials. Further, clinicians may have competing demands and different skills than those held by research trial staff. Changing clinical practice is notoriously difficult, due to the presence of a myriad of personal, professional and system level barriers. Implementation of new evidence-based interventions in clinical settings relies on clinicians knowing about, understanding and believing the evidence and having the motivation and skills to be able to apply this in practice.[14-16] Further, the local ward or health service must be adequately resourced and have a positive culture towards evidence implementation.[14-16]

Dedicated implementation strategies are usually required for successful implementation - without a specific implementation plan, it takes an average of 17 years for new research evidence to become embedded into usual care[17], which is unacceptably long. The need to know more about how to optimise evidence implementation in clinical practice has prompted the development of implementation science, a research stream defined as, “the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice”.[18]

Just as substantial work needs to be done to keep developing and testing the effectiveness of new clinical interventions, so too is further work required to develop

and test strategies to enhance the uptake of evidence in practice. Research is required to build a stronger knowledge base regarding how to implement evidence, accounting for the complex inter-relationships between the nature of the proposed change (including factors such as how different it is from usual practice, how complex it is), the context (including factors such as time and resources, competing priorities) and the people doing the implementation (including factors such as skills, motivation, readiness for change).

This paper highlights the paucity of new evidence available to clinicians and researchers striving to translate stroke rehabilitation research findings into practice or to improve health service delivery, and we offer our points of view on why this is a problem and how it should be addressed.

***Exploring the Problem:***

Clinicians tend to scan a discrete selection of journals to keep abreast with the latest research.[19] To review the literature likely to be read by rehabilitation clinicians, a selection of leading journals in the field of stroke rehabilitation was pragmatically identified by reviewing the 15 highest impact journals listed in the Thomson Reuters 2015 Journal Citation Reports in the Rehabilitation category. The specialty journals *Stroke* and *Lancet Neurology* (highest impact factor specialty stroke journal and clinical neurology journal respectively) were also included for review. The title and scope of each journal as presented on the journal website was examined by 2 reviewers (EL and LC), and journals were excluded if the scope did

not include publishing research relating to clinical care or rehabilitation for people with stroke.

Of the journals that passed the first screen, a second selection process was performed by reviewing the articles published in 2016. Journals were excluded if no publications in 2016 included stroke survivor participants.

Eight journals were included in our final review. The title and scope of each of the eight journals is shown in Table 1 and the process of journal and article selection is presented in Figure 1. Appendix 1 contains details of the 17 screened journals.

All research articles published in the eight included journals were independently reviewed by 2 reviewers (shared between EL, LC and BC) to determine what sort of clinical stroke research was published in 2016.

Articles were excluded if the participants were not humans with stroke, if the studies were undertaken post-mortem, if the focus of study was not on outcomes of people with stroke or health service for people with stroke, or if the research was investigating solely pharmacological or surgical interventions. We excluded reports on pharmacological and surgical interventions because the majority of these studies were conducted in the hyperacute stage. Further, we wanted to focus on rehabilitation interventions that are underpinned by the principles of rehabilitation that have been defined as coordinated multidisciplinary team care, individualised goal setting, high intensity practice and task specific training.[2]

We categorised the included articles according to where in the research-to-practice trajectory they were conducted, guided by the Knowledge to Action framework[20]. Categories comprised:

- **Knowledge inquiry:** First generation knowledge regarding efficacy of interventions to manage stroke e.g. randomised controlled trials or before/after studies of non-pharmacological or non-surgical interventions
- **Knowledge synthesis:** Systematic reviews, meta-syntheses, scoping reviews or realist reviews of non-pharmacological or non-surgical interventions for people with stroke
- **Implementation and evaluation:** Application of findings from knowledge syntheses to clinical practice or population health

In addition, we created a category for:

- **Non-intervention studies:** which we defined as studies examining clinical features of stroke, including prognostic indicators, risk factors, associated conditions, biomarkers of stroke and observations of stroke recovery trajectory.

These categories and their course in the research translation pipeline are shown in Figure 2. Decisions made by the 2 reviewers in relation to categorisation of articles were checked for accuracy and any discrepancies were resolved through discussion with all 3 authors.

*Results*

Between January and December 2016, a total of 1047 research articles were published in the 8 included journals. 763 of these articles were excluded, because participants had not had a stroke (n=625), the research was investigating

pharmacological or surgical interventions (n=86), the article described another research focus such as outcome tool development or validation (n=40), studies were not conducted with human participants (n=11), or research was conducted post-mortem (n=1).

The included 284 articles were categorised as follows: 185 non-intervention studies (65.1% of included studies), 70 knowledge inquiry studies (24.6%), 22 knowledge syntheses (7.7%) and 7 implementation or evaluation studies (2.5%). The comparison of the percentage of articles published from the different categories is presented in Figure 3. The breakdown of the different categories of research published in the included journals is presented in Table 2.

Of the seven articles which presented implementation or evaluation of non-pharmacological, non-surgical management after stroke, three presented findings regarding delivery of rehabilitation services,[21-23] whereas the remaining four articles presented findings regarding quality of care in the acute post-stroke period.[24-27] One rehabilitation study evaluated the real world implementation of early supported discharge,[21] and the other two rehabilitation studies examined physical therapists' self-reported adherence with recommendations from clinical guidelines (electrical stimulation and provision of education about community-based exercise).[22,23] Details of the seven implementation and evaluation studies are presented in Table 3.

To give some indication whether implementation and evaluation research is actually being conducted and not being published, or whether this essential aspect of stroke care is not being researched at all, we scanned a selection of international trial registers (https://www.clinicaltrials.gov, http://www.anzctr.org.au/ and

https://www.isrctn.com/). We identified 5 ongoing and 4 completed stroke rehabilitation studies that could be considered implementation or evaluation studies. Using the trial identifications, we determined that all four of the completed studies had published results in *Implementation Science* journal.[28-31] This led us to explore whether rehabilitation implementation/evaluation publications tend to be clustered in general health services journals, rather than journals designed for clinicians in a particular field. We scanned the titles of publications in 2016 from *Implementation Science, Health Affairs, BMJ Quality & Safety* and *BMC Health Services Research* and identified five articles reporting on implementation or evaluation research in stroke rehabilitation[29,32-35] (one was already identified through trial registration search described above).

Our results indicate that literature published in the leading stroke rehabilitation journals is heavily weighted to exploration and clinical investigation of stroke via the conduct and publication of non-intervention studies, followed by studies reporting on the efficacy of interventions. The evidence base regarding how to apply new or pre-existing research knowledge is barely changing, because only a handful of articles were published in 2016 with a focus on the implementation or evaluation of the use of evidence-based rehabilitation interventions in clinical practice. Seven implementation or evaluation studies were published in leading stroke and rehabilitation journals in 2016 and five publications were identified in health services journals. Of note, only the publications in the health services journals reported on strategies to implement evidence-based interventions, with these studies respectively comparing education with a multifaceted intervention to improve the assessment of rehabilitation needs after stroke[29], using a multifaceted intervention to increase the amount of arm therapy after stroke,[32] a multifaceted intervention to

improve therapists' proficiency in using virtual reality systems,[33] a train-the trainer intervention to improve dysphagia management[34] and a comparison of quality improvement training plus feedback to feedback alone to improve deep vein thrombosis prophylaxis and dysphagia screening after stroke[35]. In contrast, the implementation and evaluation studies in the rehabilitation and stroke journals reported on an evaluation of current provision of early supported discharge[21] and barriers to delivering evidence-based practices.[22,23] It is a concern that information regarding how to overcome barriers and change clinical practice was only published in non-stroke or rehabilitation journals, because when research is published in non-specialty journals, this "scatter" can reduce the likelihood of clinicians being aware of, and making use of this research[19].

***Solution & Recommendation for strategies***

Suboptimal uptake of evidence-based therapies by clinicians has been highlighted as a key causes of underuse of effective healthcare interventions globally[12] and therefore should be a focus of ongoing research. More work is required to determine exactly how to ensure evidence-based rehabilitation interventions are provided to people with stroke, but at present, there are few clear incentives for researchers to conduct implementation research. Historically, implementation research has tended to be observational in nature, which may have deterred potential researchers because observational studies can be difficult to publish in mainstream journals. However, the advent of effectiveness-implementation hybrid trials wherein clinical effectiveness and implementation can be investigated concurrently may be one way

to overcome this barrier.[36] Further, the growing emphasis on demonstrating impact beyond simply publishing results may encourage more researchers to conduct implementation research. Impact relies on successful translation of knowledge from research to enable improvements in human health, quality of life, and broader scale benefits to the community or environment health[37], so investing in research to determine how best to translate research findings into clinical practice to generate a positive impact should be seen as a priority to the research and clinical community. There are promising signs that the research landscape might be changing to support this type of work, with governments providing funding to support collaboratives to conduct research translation, implementation and evaluation (for example Advanced Health Research and Translation Centres commenced in Australia in 2015[38], Collaborations for Leadership in Applied Health Research and Care commenced in the UK in 2008[39]) with a view that producers and users of research work together throughout the research process so that the research answers clinically important questions and any strategies used are more likely to be suitable to implement in the clinical setting. Governments are also providing research funding dedicated for translation, implementation and evaluation projects (for example ongoing work by Canadian Institutes of Health Research which have funded knowledge translation work since 2000[40] and the National Institute of Health in USA which has allocated funding for dissemination and implementation research projects since 2007[41]).

The increased funding for implementation has not as yet translated into increased implementation research publications in stroke rehabilitation journals. This may be due to a time lag, or it may highlight a need for a change in focus from stroke rehabilitation journals. Publications in clinical journals need to be relevant to real-world clinicians, so it would be of value to publish not only clinical research findings,

but also papers which can be used to guide how to apply the new evidence or implement clinical guidelines in clinical settings. Some journals have specific article categories such as systematic reviews; one option to promote research translation would be to introduce a category pertaining to research implementation or health service evaluation. The academic community could support research translation by recognising the importance of research regarding implementation of evidence-based practice and health service evaluation research, by conducting more hybrid efficacy-implementation studies and collaborative implementation research with clinical partners. Finally for researchers conducting implementation research and journal editors selecting which manuscripts to publish, publication of implementation and evaluation research in clinical journals in preference to health services journals would increase the likelihood that the research will come to the attention of clinicians, who are one of the main target audiences for this information.

## Limitations

It is important to acknowledge that this is a perspective paper, not a systematic review. We have used robust methods and a narrow scope, because we wanted to focus on publications that stroke rehabilitation clinicians would be most likely to access and read. In doing this, we have selected leading rehabilitation journals along with *Stroke* and *Lancet Neurology*, and it is acknowledged that some clinicians might well subscribe to journals not included in our review.

Semantic factors affecting the decisions of reviewers when categorising articles could be viewed as a potential limitation of our methods. However, the three

authors work in different countries and come from different professional backgrounds and this diversity has enabled a broad perspective to be taken for the review. Additionally, a decision was taken to err on the side of being over-inclusive in terms of deciding whether an article could be categorised as implementation or evaluation, meaning that the proportion of articles categorised as implementation or evaluation, if anything, is likely to be an overestimate.

This review highlights in a striking fashion the lack of focus within the academic community on the implementation of evidence-based interventions within stroke rehabilitation practice, with less than 3% of stroke rehabilitation research published in the leading stroke rehabilitation journals addressing implementation or evaluation. Given the ongoing need for rehabilitation after stroke, it is imperative that a greater focus on implementation is shown by researchers, publishers, funders and professional bodies in order for people with stroke to benefit from the best possible evidence-based care.

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***Conflict of Interest Statement***

The Authors declare that there are no conflicts of interest.

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