Institution: University of Dundee		
Unit of Assessment: UoA 3 Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: Improving physiotherapy practice and service delivery in stroke rehabilitation		
Period when the underpinning research was undertaken: 2008 to 2014		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Jacqui Morris	**Role(s) (e.g. job title):** Reader in Rehabilitation Research	**Period(s) employed by submitting HEI:** 2006-2020
Period when the claimed impact occurred: 2014 to 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Physiotherapy targets physical recovery after stroke, but practice remains under-researched. Research at the University of Dundee generated new clinical trial and systematic review evidence, making major contributions to physiotherapy knowledge for stroke recovery. The research demonstrated no benefits of bilateral over unilateral arm training; provided definitive evidence of effectiveness of physiotherapy for improving mobility and function, and provided evidence supporting behavioural interventions for post-stroke physical activity promotion. This research has changed physiotherapy practice, service provision and policy change in the UK, Europe, Australia, America and Canada by its inclusion in practice recommendations, clinical guidelines and policy, thereby changing care received by thousands of stroke survivors.

2. Underpinning research

Annually in the UK, over 113,000 people experience physical, cognitive, and communication impairments after stroke, resulting in diminished independence and quality of life. Stroke Association evidence shows annual UK health and social care costs of stroke are £26 billion. Physiotherapy aims to improve and sustain post-stroke physical function and mobility however much practice remains under-researched. Morris's work used diverse methodological approaches to focus on three under-researched practice areas: 1) Bilateral arm training, which had been adopted routinely into physiotherapy practice despite limited evidence of effectiveness compared to traditional unilateral training; 2) Mobility and function training, cornerstones of physiotherapy practice for which effectiveness was not definitively demonstrated; and 3) influences on and effective interventions for physical activity promotion after stroke rehabilitation, an under-researched topic despite strong evidence of physical benefits of physical activity.

International evidence indicates 80% of stroke survivors experience arm impairment affecting performance in daily living tasks that for 50% of patients, persists at four years. Intensive repetitive task training improves arm recovery and function. However, uncertainty existed about the effectiveness of training the affected arm only (unilateral) compared to training both arms simultaneously (bilateral). A randomised controlled trial (RCT) led by Morris **[R1]** funded by the Scottish Government Chief Scientist Office (CSO) and completed in 2006 (£150,000) compared bilateral to unilateral task training. Involving 106 participants, at the time this was the largest trial globally to examine bilateral training. Bilateral training was found to be no more effective for arm impairment, although fine finger dexterity improved more with unilateral training. Morris next co-authored a 2014 Cochrane Review of bilateral task training led by Coupar **[R2]**, which included the original trial. The review confirmed no superiority of bilateral over unilateral training for arm recovery.

Examining effectiveness of physiotherapy for mobility (walking) and function after stroke, Morris was one of three co-applicants on a CSO-funded study (£49,951, completed 2012) led by Pollock (Glasgow Caledonian University). This Cochrane Review **[R3]** included data from 10,401 stroke survivors, uniquely including studies from China and Taiwan. The review showed unequivocally that physiotherapy was effective compared to usual care, or no care, for mobility and function after stroke. Additionally, for the first time the review demonstrated that 30 to 60 minutes per day of physiotherapy, five to seven days a week, is required for significant benefits for independence in activities of daily living, motor function, balance, and gait velocity.

Numerous clinical trials demonstrate that participation in physical activity after stroke maintains physical function, balance, mobility, and cardiovascular health. However, after rehabilitation, most stroke survivors fail to participate in regular physical activity for reasons that were poorly understood. A qualitative study funded by CSO (£128,429, completed 2012), and an associated systematic review led by Morris **[R4,R5]**, identified psychosocial influences on physical activity after stroke, showing how survivors, carers, and physiotherapists' beliefs about physical activity, social context, and environment act as barriers and facilitators to active lifestyles. Another systematic review funded by Chest Heart and Stroke Scotland (£5,000, completed 2012) **[R6]** showed tailored behavioural interventions that account for psychological, environmental, and social factors are more effective for maintaining physical activity participation than supervised exercise alone.

3. References to the research

[R1] Morris, JH, van Wijck, F, Joice, S, Ogston, SA, Cole, I & MacWalter, RS (2008), A comparison of bilateral and unilateral upper-limb task training in early poststroke rehabilitation: a randomized controlled trial, *Archives of Physical Medicine and Rehabilitation*, vol. 89, no. 7, pp. 1237-1245. DOI: 10.1016/j.apmr.2007.11.039

[R2] Coupar, F, Pollock, A, Van Wijck, F, **Morris**, J & Langhorne, P (2010), Simultaneous bilaternal training for improving arm function after stroke, *Cochrane Database of Systematic Reviews*, vol. 2010, no. 4, CD006432, pp. 1-62. DOI: 10.1002/14651858.CD006432.pub2

[R3] Pollock, A, Baer, G, Campbell, P, Choo, PL, Forster, A, **Morris**, J, Pomeroy, VM & Langhorne, P (2014), Physical rehabilitation approaches for the recovery of function and mobility following stroke, *Cochrane Database of Systematic Reviews*, vol. 4, CD001920, pp. 1-443. DOI: 10.1002/14651858.CD001920.pub3 [Peer reviewed and in the top 3 most accessed Cochrane Stroke reviews, 2014-2017]

[R4] Morris, JH, Oliver, T, Kroll, T, Joice, S & Williams, B (2014), From physical and functional to continuity with pre-stroke self and participation in valued activities: a qualitative exploration of stroke survivors', carers' and physiotherapists' perceptions of physical activity after stroke, *Disability and Rehabilitation*, vol. 37, no. 1, pp. 64-77. DOI: 10.3109/09638288.2014.907828 [Peer reviewed]

[R5] Morris, J, Oliver, T, Kroll, T & MacGillivray, S (2012), The importance of psychological and social factors in influencing the uptake and maintenance of physical activity after stroke: a structured review of the empirical literature, *Stroke Research and Treatment*, vol. 2012, 195249. DOI: 10.1155/2012/195249 [Peer reviewed]

[R6] Morris, JH, MacGillivray, S & MacFarlane, S (2014), Interventions to promote long-term participation in physical activity after stroke: a systematic review of the literature, *Archives of Physical Medicine and Rehabilitation*, vol. 95, no. 5, pp. 956-967. DOI: 10.1016/j.apmr.2013.12.016 [Peer reviewed]

Funding for this research: This research was supported by funding from the Chief Scientist Office of the Scottish Government **[R1,R3,R4,R5]**, and Chest Heart and Stroke Scotland **[R6]**. A

total of £333,380 was awarded over a period of 12 years through four competitively awarded funds. Morris was PI or Co-I on all of these projects.

4. Details of the impact

By informing UK, European, Australian, American and Canadian clinical guidelines and policies, and through impact on local physiotherapy practice, Morris's research has changed practice and service delivery for thousands of stroke survivors:

International Impact: Morris's research examining comparative effectiveness of bilateral versus unilateral task training for arm recovery **[R1, R2]** informed Canadian best practice guidelines recommending that bilateral training is not superior to unilateral training for arm function and dexterity **[E1]**. **R1** was a highlighted study within the Canadian 2020 Stroke Rehabilitation Clinician Handbook **[E2]** that guides physiotherapy practice in stroke rehabilitation for around 50,000 Canadian stroke survivors annually. Similarly, the research was included in the evidence review **[E3]** influencing 2014 Dutch Physiotherapy guidelines on bilateral training in stroke **[E4]**. Guideline recommendations are the benchmark against which physiotherapy practice audit is performed in those countries and as world leaders in stroke rehabilitation guideline development, guidelines from these countries are used globally to inform practice.

Review findings that assessment from a physiotherapist improves mobility and function informed the Australian Government 2015 quality indicator for acute stroke care **[E5]** that "*physiotherapy assessment within 48 hours of hospital admission is a good indicator of rehabilitation activity*". The quality and safety of 120 Australian rehabilitation services serving 56,000 stroke survivors annually is measured against this indicator in the National Stroke Audit **[E6]**. Reports show an increase from 67% in 2017 to 72% in 2019 of rehabilitation units meeting the indicator, demonstrating that review findings influenced policy that led to change in rehabilitation service delivery.

International recommendations for strategies to change behaviour and improve uptake and maintenance of post-stroke physical activity have been informed by Morris's research. The review examining effectiveness of post-stroke physical activity promotion **[R6]** was included as evidence supporting the American Heart Association's strategic policy statement **[E7]**, specifically the recommendation for use of tailored counselling to enhance self-management and adherence to physical activity. These policies determine targeted interventions and surveillance of cardiovascular health at national, state and local levels across the USA. The recommendation for use of tailored approaches to physical activity promotion within the German National Recommendations for Physical Activity and Physical Activity Promotion in Adults with Pre-Existing Diseases **[E8]** was directly informed by this research **[R6]**. The recommendations are used to guide the work of the national working group on physical activity at the German Federal Ministry of Health and national implementation of physical activity strategies.

National and Local Impact: The Cochrane Review finding that dose intensity of 30-60 minutes physiotherapy on 5-7 days per week is required for mobility and function influenced the 2020 update to the National Stroke Improvement Programme for Scotland **[E9]** as indicated by the National Lead for Rehabilitation, Scottish Stroke Improvement programme who is also Stroke Managed Clinical Network Lead, NHS Grampian **[E10]**: *"I'm responsible for the rehabilitation elements of the National Stroke Improvement Plan. That piece of work has influenced one of the guidelines…we are recommending, nationally, that each Health Board provides rehabilitation to people on a needs-led basis at least five days a week, if they require that level of intervention".* The improvement plan influences service delivery by around 1500 practitioners for 13,000 people who have stroke annually in Scotland.

Morris's research into understanding physical activity after stroke **[R4, R5, R6]** also influenced how post-rehabilitation exercise services are provided for 1500 stroke survivors in NHS Grampian per year **[E10]**: *"We know from work around ten years ago about exercise after stroke. It was heavily pushed, in terms of, we need to provide stroke specific exercise classes*

for people. In practice, that was quite difficult to actually put in place….So, what we've done, is look at what options are there for physical activity available in Grampian. And we've got a list of stroke specific exercise classes – yes, that's the right thing for some people, but we've also got walking groups, swimming clubs that have supervised support… And by using this evidence to say that behavioural interventions help people to engage too in physical activity and exercise, then we have a range of interventions that support people to do that, because everyone is individual, and we can't expect one treatment fits all".

5. Sources to corroborate the impact

[E1] Canadian Stroke Best Practices (2019) *5.1 Management of the Upper Extremity Following Stroke recommendations for stroke*. Available at: https://www.strokebestpractices.ca/recommendations/stroke-rehabilitation/management-of-the-upper-extremity-following-stroke [Accessed 2 March 2021]

[E2] Teasell, R, Hussein, N, Mirkowski, M, Vanderlaan, D, Saikaley, M, Longval, M, Iruthayarajah, J (2020). Hemiplegic Upper Extremity Rehabilitation in Teasell, R, Hussein, N, Iruthayarajah, J, Saikaley, M, Longval, M, Viana, R. *Stroke Rehabilitation Clinician Handbook 2020* p. 24. Available at: http://www.ebrsr.com/sites/default/files/EBRSR%20Handbook%20Chapter%204_Upper%20Extremity%20Post%20Stroke_ML.pdf [Accessed 2 March 2021]

[E3] Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. (2014) What Is the Evidence for Physical Therapy Poststroke? A Systematic Review and Meta-Analysis. *PLoS ONE* 9(2): e87987. DOI: 10.1371/journal.pone.0087987

[E4] Royal Dutch Society for Physical Therapy (2014, revised 2017) *Guideline Stroke*, p. 39. (In Dutch). Available at: https://www.kngf2.nl/binaries/content/documents/kngf-kennisplatform/producten/richtlijnen/beroerte/beroerte/kngfextranet%3Adownload [Accessed 2 March 2021]

[E5] Australian Commission on Safety and Quality in Health Care. (2015) *Indicator Specification: Acute Stroke Clinical Care Standard*. p.22 Available at: https://www.safetyandquality.gov.au/sites/default/files/migrated/Acute-Stroke-IndicatorSpecification.pdf [Accessed 2 March 2021]

[E6] Stroke Foundation Australia (2019) *Acute Services Report 2019*, p.40. Available at: https://informme.org.au/stroke-data/Acute-audits [Accessed 2 March 2021]

[E7] Labarthe, D.R. et al, (2016) Evidence-based policy making: assessment of the American Heart Association's strategic policy portfolio: a policy statement from the American Heart Association. *Circulation*. 133 (18) pp. e615–e653. DOI: 10.1161/CIR.0000000000000410, pages e637 and e641

[E8] Rutten, A, Pfeifer, K (eds). (2016) *National Recommendations for Physical Activity and Physical Activity Promotion*, Erlangen: FAU University Press, p.102. Available at: https://www.sport.fau.de/files/2015/05/National-Recommendations-for-Physical-Activity-and-Physical-Activity-Promotion.pdf [Accessed 2 March 2021]

[E9] Public Health Scotland (2020). *Scottish Stroke Improvement Programme; 2020 National Report*, p. 24. Available at: https://www.strokeaudit.scot.nhs.uk/Publications/docs/2020-09-01-SSIP-Report.pdf [Accessed 2 March 2021]

[E10] Transcription of interview, National Lead for Rehabilitation, Scottish Stroke Improvement programme (Transcript Provided), pages 13, 17