

Inclusion of stroke patients in expanded cardiac rehabilitation services: a cross-national qualitative study with cardiac and stroke rehabilitation professionals

AUTHOR(S)

Isabelle Jeffares, Niamh Merriman, Frank Doyle, Frances Horgan, Anne Hickey

CITATION

Jeffares, Isabelle; Merriman, Niamh; Doyle, Frank; Horgan, Frances; Hickey, Anne (2021): Inclusion of stroke patients in expanded cardiac rehabilitation services: a cross-national qualitative study with cardiac and stroke rehabilitation professionals. Royal College of Surgeons in Ireland. Journal contribution.
<https://hdl.handle.net/10779/rcsi.17031860.v1>

HANDLE

[10779/rcsi.17031860.v1](https://hdl.handle.net/10779/rcsi.17031860.v1)

LICENCE

CC BY-NC 4.0

This work is made available under the above open licence by RCSI and has been printed from <https://repository.rcsi.com>. For more information please contact repository@rcsi.com

URL

https://repository.rcsi.com/articles/journal_contribution/Inclusion_of_stroke_patients_in_expanded_cardiac_rehabilitation_services_a_cross-national_qualitative_study_with_cardiac_and_stroke_rehabilitation_professionals/17031860/1

Inclusion of stroke patients in expanded cardiac rehabilitation services: a cross-national qualitative study with cardiac and stroke rehabilitation professionals

Isabelle Jeffares^{a*}, Niamh A. Merriman^a, Frank Doyle^a, Frances Horgan^b, Anne Hickey^a

^aDepartment of Health Psychology, Division of Population Health Sciences, Royal College of Surgeons in Ireland, Dublin, Ireland.

^bSchool of Physiotherapy, Royal College of Surgeons in Ireland, Dublin, Ireland.

*Corresponding author:

Isabelle Jeffares

Structured Population and Health-services Research Education Programme (SPHeRE)

Division of Population Health Sciences

Royal College of Surgeons in Ireland

Beaux Lane House

Dublin 2, Ireland.

Tel: +353 1 402 2721

Email: IsabelleJeffares@rcsi.ie

This is an Accepted Manuscript of an article published by Taylor & Francis Group in Disability and Rehabilitation on 02/02/2021, available online:
<https://doi.org/10.1080/09638288.2021.1874548>

ABSTRACT

Purpose: This qualitative study explored healthcare professionals' views in relation to the potential expansion of cardiac rehabilitation services to include stroke patients, thereby becoming a cardiovascular rehabilitation model.

Design and methods: 23 semi-structured interviews were completed with hospital and community-based stroke and cardiac rehabilitation professionals in Switzerland (n=7) and Ireland (n=19). The sample comprised physiotherapists, occupational therapists, speech and language therapists, stroke physicians, cardiologists, psychologists, dieticians and nurses. Interviews were audio-recorded and the transcripts were analysed in *NVivo* using inductive Thematic Analysis.

Results: Barriers and facilitators to cardiovascular rehabilitation were captured under four broad themes; (i) Cardiac rehabilitation as 'low-hanging fruit', (ii) Cognitive impairment ('the elephant in the room'), (iii) Adapted cardiac rehabilitation for mild stroke, and (iv) Resistance to change.

Conclusions: Hybrid cardiac rehabilitation programmes could be tailored to deliver stroke-specific education, exercises and multidisciplinary expertise. Post-stroke cognitive impairment was identified as a key barrier to participation in cardiac rehabilitation. A cognitive rehabilitation intervention could potentially be delivered as part of cardiac rehabilitation, to address the cognitive needs of stroke and cardiac patients.

Keywords: cardiac rehabilitation; mild stroke; cognitive impairment; cognitive rehabilitation; qualitative research; thematic analysis

Word count: 7095 words

Introduction

In cases of mild stroke, patients can be discharged from hospital with little or no follow-up, despite ongoing secondary prevention and rehabilitation needs (1-6). Nationally and internationally, there is evidence of inadequate resourcing that constrains the capacity of healthcare teams to deliver comprehensive stroke rehabilitation (6-8). Access to stroke rehabilitation professionals can vary (6, 9, 10), such that stroke services fail to adhere to recommended therapy guidelines (11-14). Resourcing limitations in acute stroke care suggest that these services are not equipped to deliver comprehensive rehabilitation support, where patient discharge takes priority.

Cardiac rehabilitation is a well-established, evidence-based intervention offered to people diagnosed with heart disease as part of international guidelines for cardiac care (15). The programme involves physical activity and patient education, and aims to promote risk factor management, psychological wellbeing and the adoption of a healthy lifestyle (15, 16). Cardiac rehabilitation may be an appropriate model for addressing unmet rehabilitation need in stroke, due to similar cardiovascular aetiologies and secondary prevention needs (17, 18). Indeed, a large proportion of stroke patients have underlying coronary artery disease, a significant predictor of cardiac events in this population (19, 20).

Numerous studies have reported comparable health benefits for stroke patients from cardiac rehabilitation (21-28). The majority of such studies have delivered cardiac rehabilitation-type interventions to mild stroke patients (22, 23, 25, 29-31), and the terms “mild”, “minor” and “non-disabling” stroke are used interchangeably in the literature (2). A quarter of stroke survivors are affected by mild disability (32, 33) and, although cardiac rehabilitation has been recommended for these patients (34, 35), in practice many services

do not accept them (36). One possible reason for this is the lack of stroke-specific expertise on the multidisciplinary team, such that cardiac rehabilitation professionals may be less confident about prescribing exercise for patients with neurological impairments (21, 37). In a survey of cardiac rehabilitation services in Canada, respondents reported that the lack of exercise prescription guidelines for high-risk patients was a major barrier to the inclusion of stroke patients (38).

The suitability of cardiac rehabilitation for stroke patients depends on both the severity of post-stroke deficits and the capacity of the service to address patients' needs. Post-stroke deficits such as post-stroke fatigue, aphasia and physical disability have been identified as significant barriers to engagement of stroke patients in cardiac rehabilitation (3, 39, 40). In addition, approximately 30%-50% of stroke survivors are affected by post-stroke cognitive impairment (PSCI) (41, 42), and the lack of an established cognitive intervention limits treatment options (43, 44).

In Switzerland, cardiovascular rehabilitation is delivered to a wide range of disease groups, including minor stroke patients (45). A second outpatient programme, *Neurorehabilitation*, is based on the cardiac rehabilitation model and is specifically tailored for mild stroke patients (5). Specialist stroke physiotherapists coordinate rehabilitation activities, which include stroke-specific education and exercise. Patients share some of the same modules with the cardiovascular programme, e.g., managing medications, while others are delivered separately. These programmes offer a useful blueprint for both the expansion of existing cardiac rehabilitation services to include stroke patients (cardiovascular rehabilitation), and the potential development of a separate programme dedicated to stroke patients specifically (neurorehabilitation).

The capacity to expand cardiac rehabilitation services will depend on the financing available for healthcare in a given country. In Switzerland, healthcare expenditure is high and a system of Mandatory Health Insurance (MHI) payments incentivises healthcare providers to treat patients comprehensively (46). This system ensures that healthcare practitioners and hospitals are reimbursed for care on a fee-for-service basis, including all costs associated with cardiac rehabilitation. In Ireland, cardiac rehabilitation is delivered in general hospitals and funded entirely through the public health system, where financing has historically been constrained (47-50).

It is unclear whether existing cardiac rehabilitation services in Ireland could be expanded to include stroke patients, and the potential for delivery of cognitive rehabilitation in that context, where needed. To address this question, a cross-national approach was adopted to examine the views of health professionals in Switzerland and Ireland, to identify barriers and facilitators to expansion of cardiac rehabilitation services. Swiss health professionals had experience delivering cardiovascular rehabilitation and neurorehabilitation programmes to stroke patients, hence this feedback would inform the future implementation of a similar programme in Ireland. The perspectives of Irish health professionals delivering cardiac and stroke rehabilitation were explored to identify context-specific barriers and facilitators to implementation, which may operate differently within the Irish healthcare system.

Materials and methods

Semi-structured interviews were carried out by IJ with stroke and cardiac rehabilitation professionals. A qualitative descriptive approach (51) allowed for deeper exploration of the barriers and facilitators to cardiovascular rehabilitation programmes being adapted to include stroke patients. The findings were analysed using inductive thematic analysis (52).

Sampling procedure

This research employed a purposive sampling strategy (53, 54). Participants were selected based on their experience in stroke and cardiac rehabilitation, many of whom were known experts in the field and senior level practitioners. Twenty-six stroke and cardiac rehabilitation professionals were recruited. Seven hospital-based rehabilitation professionals were interviewed in Switzerland. Nineteen hospital and community-based healthcare professionals were interviewed in the Republic of Ireland. Participants were identified through existing contacts and recruited using a snowball sampling approach. Swiss health professionals were interviewed initially, to explore their experiences of delivering cardiovascular rehabilitation to mixed patient groups, and neurorehabilitation to patients with mild stroke. Participants described how these programmes were delivered, identifying barriers and facilitators to implementation, and this feedback informed subsequent interviews with Irish health professionals. The specific aim of this paper was to identify barriers and facilitators to the potential expansion of cardiac rehabilitation services in Ireland, hence a greater number of Irish healthcare professionals were interviewed.

Data collection

A total of 26 stroke (n= 17) and cardiac (n= 9) rehabilitation professionals were interviewed between September 2019 and January 2020. Interviews which generate a large volume of data on the subject matter tend to have more “information power” (55). The richness and depth of the data gathered determines the quantity of interviews required to answer the research questions (56). To ensure that a sufficient amount of rich data was generated in this study, the interview topic guide was structured to promote depth of discussion and was tailored as appropriate to the participant, depending on the participant’s area of expertise.

The interview topic guide was informed by systematic review of the literature performed by the same authors (43, 44), literature reviews evaluating the benefits of exercise interventions for stroke (18, 21, 27, 28), and research studies delivering adapted cardiac rehabilitation interventions in stroke (22, 23, 25, 29, 31, 57). The questions were refined following pilot testing (Supplementary Table S1). The interviews explored healthcare professionals’ experiences of the following aspects of practice: rehabilitation planning and provision; participation in cardiac rehabilitation; addressing post-stroke cognitive impairment through rehabilitation; and the potential implementation of a cardiovascular rehabilitation model that includes stroke patients. Due to the high prevalence of post-stroke cognitive impairment, frequently not addressed in post-stroke rehabilitation, the feasibility of including a cognitive rehabilitation intervention as part of cardiovascular rehabilitation was of particular interest to the authors. Although many cardiac rehabilitation professionals encounter cognitive impairment in practice, these professionals are not experienced in the delivery of cognitive rehabilitation and this imbalance in knowledge may have influenced the findings. Additionally, the interviewer’s prior knowledge of the literature may have affected the interview process, e.g., the fact that cardiac patients also suffer cognitive impairment

strengthened the rationale for including a cognitive rehabilitation intervention as part of cardiac rehabilitation.

A range of professionals were interviewed, including: physiotherapists, occupational therapists, clinical psychologists, consultant stroke physicians, clinical nurse specialists, cardiologists, cardiac rehabilitation nurses, a speech and language therapist, a dietician and a public health nurse (Table 1). Healthcare professionals from different specialities of stroke and cardiac care were included. It was important to interview professionals involved in all aspects of cardiac rehabilitation, to identify which components of the programme would pose challenges for stroke patients, e.g., exercise training versus education. Similarly, post-stroke deficits were discussed with the relevant specialist, to establish how these patients could be accommodated in cardiac rehabilitation. It should be noted that the majority of Swiss health professionals (n=6) had direct experience of delivering cardiovascular rehabilitation or neurorehabilitation to patients with stroke, while only six Irish participants had delivered cardiac rehabilitation-type interventions to stroke patients, either in practice or as part of research.

Interviews were conducted face-to-face in the participant's workplace (n=24), or by phone (n=2). Interviews were audio-recorded and transcribed verbatim. The duration of interviews ranged from 25 minutes to 78 minutes. Interview transcripts were anonymised and imported into NVivo (Version 12) for qualitative analysis.

Table 1. Healthcare professional demographics (n=26)

ID	Country	Cardiac or Stroke	Professional group	Years in role	Setting	Delivered CR to stroke
HCP01	Switzerland	Stroke	Physiotherapist	>20	Rehabilitation	Yes ^a
HCP02	Switzerland	Stroke	Physiotherapist	>20	Rehabilitation	Yes ^a
HCP03	Switzerland	Cardiac	Cardiologist	>12	Rehabilitation	Yes ^b
HCP04	Switzerland	Cardiac	Physiotherapist	9	Rehabilitation	Yes ^b
HCP05	Switzerland	Cardiac	Cardiologist	6	Rehabilitation	Yes ^b
HCP06	Switzerland	Cardiac	Sports therapist	6	Rehabilitation	Yes ^b
HCP07	Switzerland	Stroke	Stroke Physician	2	Acute	No
HCP08	Ireland	Stroke	Physiotherapist	20	Community	Yes ^c
HCP09	Ireland	Stroke	Physiotherapist	14	Acute	Yes ^c
HCP10	Ireland	Stroke	Speech and Language Therapist	11	Community	No
HCP11	Ireland	Stroke	Psychologist	8	Acute	No
HCP12	Ireland	Stroke	Occupational Therapist	16	Rehabilitation	No
HCP13	Ireland	Stroke	Physiotherapist	8	Rehabilitation	No
HCP14	Ireland	Stroke	Occupational Therapist	11	Rehabilitation	No
HCP15	Ireland	Stroke	Clinical Nurse Specialist	8	Acute	No
HCP16	Ireland	Stroke	Stroke Physician	17	Acute	No
HCP17	Ireland	Cardiac	Nurse	17	Rehabilitation	Yes ^b
HCP18	Ireland	Cardiac	Clinical Psychologist	15	Rehabilitation	No
HCP19	Ireland	Cardiac	Clinical Psychologist	<1	Rehabilitation	No
HCP20	Ireland	Stroke	Dietician	11	Acute	No
HCP21	Ireland	Stroke	Clinical Nurse Specialist	15	Acute	No
HCP22	Ireland	Cardiac	Nurse	>2	Community	Yes ^c
HCP23	Ireland	Cardiac	Physiotherapist	4	Community	Yes ^c
HCP24	Ireland	Stroke	Physiotherapist	11	Rehabilitation	Yes ^c
HCP25	Ireland	Stroke	Occupational Therapist	5	Community	No
HCP26	Ireland	Stroke	Liaison Public Health Nurse	16	Community	No

^a Neurorehabilitation to mild non-disabled stroke patients

^b Cardiac/ Cardiovascular rehabilitation delivered to cardiac and stroke patients

^c Pilot Cardiac Rehabilitation interventions to stroke patients as part of research

Ethical considerations

Ethical approval was obtained from the Royal College of Surgeons in Ireland (RCSI) Research Ethics Committee (REC 1712). Data integrity and confidentiality were maintained throughout the study. All participants provided informed consent and were made aware of their right to withdraw their participation at any time. Interviewees were given the opportunity to review their transcript; two participants availed of this option, though no amendments were requested.

Data analysis

Thematic Analysis was employed (58, 59). The initial coding process permits identification of the main themes and patterns arising from the interviews, without the application of a theoretical framework. Braun and Clarke's six phase approach to analysis was followed (52, 58): (i) familiarisation with the data; (ii) generation of an initial set of codes; (iii) review of codes, collation into initial themes and development of a conceptual map; (iv) review of themes in the context of the interview data; (v) refinement and naming of themes in the context of the overall findings; (vi) results write-up and consultation with the research team.

Data were imported into NVivo 12 and the analysis involved an iterative process of conceptual mapping and reflecting on field notes and annotations, recorded throughout the research study. Field notes were taken during interviews where contextual factors (e.g., interruptions) and non-verbal communication were noted. Annotations and memos were created in NVivo to link participant quotes to existing literature, to document similarities and differences in opinion, and to identify patterns across interviews. Along with conceptual mapping, this process made it possible to develop and link themes in the data.

Quality control measures were applied to ensure consensus on the final themes identified. A second author (NAM) reviewed several interview transcripts to ensure comparable interpretation of the data and the final four themes were agreed through consultation with the research team.

Results

Overall, participants from both Switzerland and the Republic of Ireland agreed that cardiac rehabilitation may be a suitable approach for addressing unmet secondary prevention need in mild stroke, although its suitability would depend on the capacity of the programme to accommodate post-stroke deficits. Inadequate resources and over-subscription of patients to services were identified as major barriers to the expansion of cardiac rehabilitation in Ireland. Resource limitations appeared to be less of a problem in Switzerland. Figure 1 presents the four key themes and subthemes developed during the analysis.

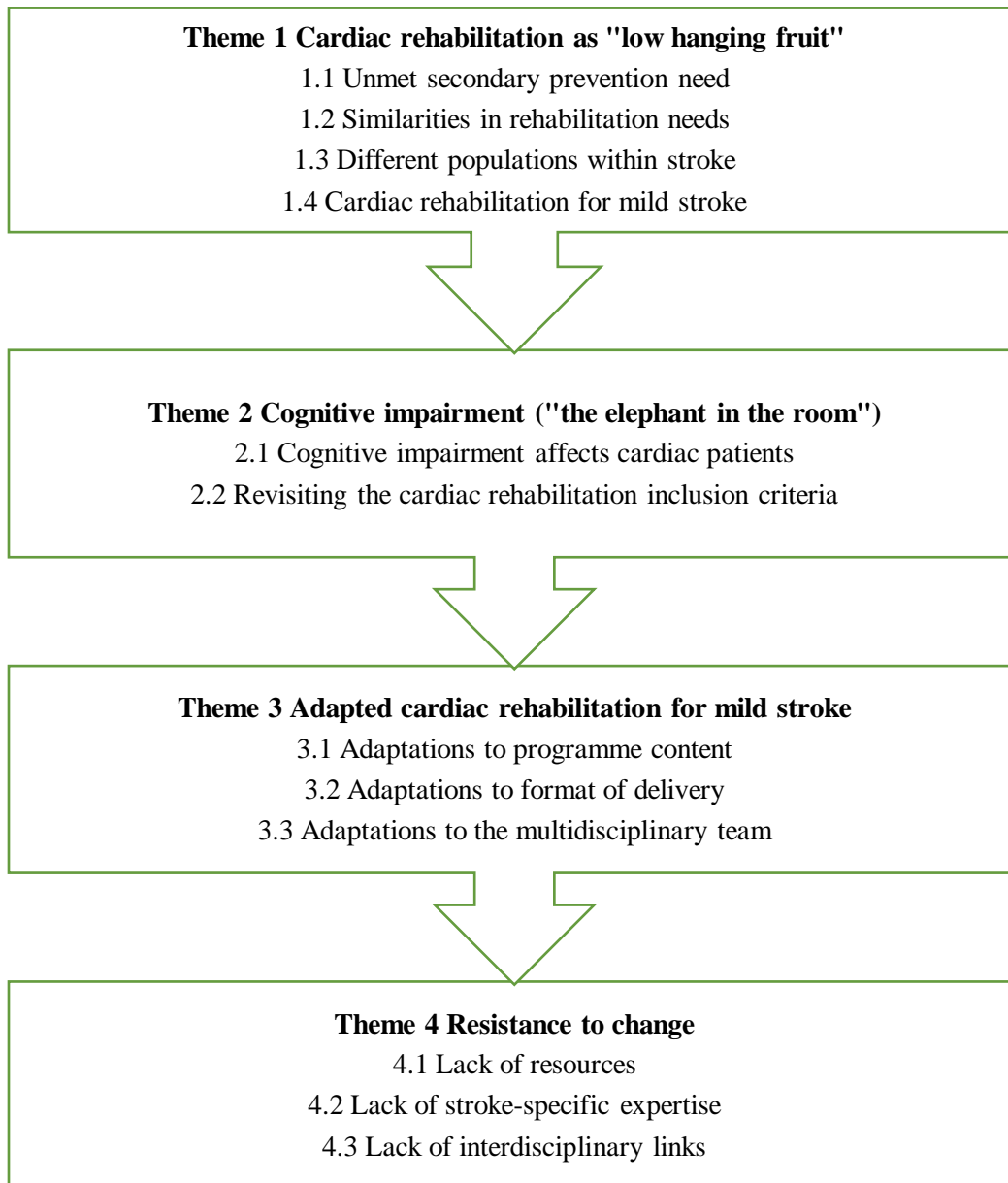


Figure 1. Concept map of themes

Theme 1 Cardiac rehabilitation as “low hanging fruit”

Participants in Ireland described how acute stroke services are currently poorly equipped to provide secondary prevention support, the priority is to promote functional levels to facilitate hospital discharge. Several participants reported on their own personal experiences of delivering adapted cardiac rehabilitation interventions to stroke patients post hospital discharge. While

participants acknowledged that stroke and cardiac patients could experience comparable health benefits from a cardiac rehabilitation approach, post-stroke impairments were identified as restricting rehabilitation options. Four main subthemes emerged, namely unmet secondary prevention need, similarities in rehabilitation needs, different populations within stroke, and cardiac rehabilitation for mild stroke.

Subtheme 1.1 Unmet secondary prevention need

Secondary prevention in stroke focuses primarily on pharmacological therapies. Although psychosocial support and lifestyle change relating to diet and exercise are recommended as part of rehabilitation, these aspects were reported to be largely neglected. Participants highlighted several barriers to the effective delivery of information on secondary prevention. Firstly, patient discharge is a priority due to pressure on inpatient stroke services. Therefore, acute services may not be best placed to deliver comprehensive rehabilitation support. A second barrier is timing; stroke services usually provide patients with secondary prevention information prior to hospital discharge. Participants highlighted that, ideally, secondary prevention support should be accessible at the appropriate point in a stroke survivor's recovery:

...they're completely overwhelmed...they don't take any of it on board...I think timing of information and education is really key, because I think it's given too soon in hospitals.
(HCP13)

Health professionals identified a third barrier in relation to poor communication. Many patients leave hospital with no clear appreciation of the need for lifestyle change after stroke:

...the dog on the street knows that somebody with a heart problem has to reduce their salt,

reduce their saturated fat, walk regularly...and manage their stress...yet nobody seems to be implementing this in any way at all in the stroke population. (HCP08)

A fourth barrier to accessing secondary prevention support was described as a lack of patient follow-up after hospital discharge:

...they go home and this common thing that keeps getting brought up by stroke survivors is that they fall off a cliff, just there's nothing after they go home. (HCP09)

Poor continuity of care in the community was described by participants, where the lack of a formal rehabilitation model was identified as a major barrier to delivery of stroke services in Ireland:

...we don't have a stroke coordinator, we don't have that network of follow-up in the community...people are going out into different services...all being delivered at different times, depending on the different waiting lists... (HCP11)

Subtheme 1.2 Similarities in rehabilitation needs

Participants described cardiac rehabilitation programmes as traditionally involving physical activity and patient education centred on risk factor management, psychosocial health, and long-term health behaviour change. As cardiac and stroke patients have similar secondary prevention needs, many of the components of traditional cardiac rehabilitation were identified as appropriate for stroke patients:

...often stroke patients are cardiac patients. Sometimes a stroke is just a manifestation of a cardiac disease so they should also be treated by cardiologists and neurologists together. (HCP05)

Cardiac professionals regularly emphasised the benefits of supervised exercise for cardiac patients, which allows patients to regain their confidence. This view was also expressed by stroke rehabilitation professionals, highlighting fear of exercise as a major barrier to stroke survivors' recovery:

...people with stroke were afraid to exercise. And there was a lot of misinterpretation of physical symptoms. (HCP11)

Almost half of the professionals interviewed had experience of delivering cardiac rehabilitation interventions to stroke patients, through existing programmes or as part of research. In Switzerland, cardiovascular rehabilitation (an extension of cardiac rehabilitation) is delivered to wide range of disease groups. Patients with mild stroke share some components of the cardiovascular rehabilitation programme, while stroke-specific exercise and education is also delivered through a separate programme of Neurorehabilitation:

...we offer programmes for minor stroke patients...a lot of the concepts concerning risk factors and lifestyle management, adherence to medication, is also true for stroke patients...I think there is a large opportunity to integrate stroke patients in cardiac programmes. (HCP05)

Subtheme 1.3 Different populations within stroke

The heterogeneity of stroke and varying degrees of post-stroke deficits suggests that no single rehabilitation model will suit all stroke patients. While both stroke and cardiac disease have similar

cardiovascular risk factors, stroke severity was highlighted by participants as a crucial barrier to accessing services:

...the neurological consequences are the biggest barriers to accessing secondary prevention. A stroke patient...could have such a myriad of deficits...obviously physical, speech and language, cognitive...perceptual...higher psychological distress because they have acquired disability. (HCP08)

The stroke-specific deficits most commonly identified by participants as significant barriers to participation in cardiac rehabilitation were cognitive impairment, aphasia, post-stroke fatigue, and physical disability. Participants described how cognitive impairment can affect various functions including information processing, attention, concentration, execution, planning, and memory:

At the minute I have two patients, very similar left frontal lesion locations...one has huge information processing difficulties that are then having an impact on memory...the other individual...it's a lot more, almost disinhibited...no two strokes are the same. (HCP12)

Where cognitive impairment affects an individual's awareness, participants highlighted that rehabilitation engagement may be very difficult. Participants agreed that the occupational therapist is best placed to identify cognitive deficits, which are often "hidden" and easily missed by other healthcare professionals:

...the OT is saying 'their cognition is really below par, they're really unsafe'...everyone is looking at them [the patient] going 'there's nothing wrong with them!'...I think that is the problem with cognitive issues...they're not easily identifiable. (HCP13)

Participants emphasised how different post-stroke communication deficits pose a significant barrier to rehabilitation:

...some people with aphasia have good auditory comprehension and very poor reading comprehension...the expression side of things can be a real challenge as well...in terms of the dynamic and the interaction in a therapy session. (HCP10)

Participants highlighted the impact of post-stroke fatigue on rehabilitation. Enduring physical impairments were also perceived as challenging and patients were described as being often embarrassed about their acquired stroke disabilities, making it more difficult to participate in exercise outside the rehabilitation setting:

...the female people...found gyms really off-putting, particularly when they had a disability...they thought people would be looking at them...or that they wouldn't understand if they were slow... (HCP08)

Subtheme 1.4 Cardiac rehabilitation for mild stroke

According to participants, more severe post-stroke deficits restrict rehabilitation options. The general consensus was that patients with higher levels of impairment have additional rehabilitation needs which are not addressed by the cardiac rehabilitation model:

...physiotherapy...may not be available in cardiac rehab. Similarly, if they have ongoing cognition issues...that needs a more focused cognitive rehabilitation programme. So depending on the consequence of the stroke...patients may need a specific rehabilitative plan that would not necessarily be delivered by cardiac rehab. (HCP16)

Both stroke and cardiac rehabilitation professionals agreed that stroke patients with milder impairments could participate in cardiac rehabilitation, or an adapted version of the programme:

I think it is fantastic if it can work...obviously if it is a TIA or minor stroke, yes, they'd probably be very suitable for cardiac rehab. I think people have always excluded probably strokes in the past because of their disability, rather than ability. (HCP21)

Theme 2 Cognitive impairment (“the elephant in the room”)

Participants frequently encountered post-stroke cognitive impairment in patients with mild stroke and described this as a hidden deficit. However, cognitive impairment was identified as also affecting patients with certain cardiac diseases. The findings suggest that the educational component of cardiac rehabilitation would need to be adapted to accommodate patients' cognitive needs.

Subtheme 2.1 Cognitive impairment affects cardiac patients

Participants described how cognitive impairment is not routinely screened for in cardiac patients, nor is it considered part of the remit of cardiac rehabilitation services. Nevertheless, one participant described how contact with more diverse cardiac patients has increased their awareness of cognitive impairment:

...for the classical cardiac patient, the mean age is 59 to 60 years, it's not so clinically relevant at that stage...but now seeing more chronic heart failure patients, seeing also more stroke patients, I think it will be an important issue in the future. (HCP05)

According to participants who were cardiac professionals, cognitive impairment more commonly affects patients with cardiac arrest or heart failure:

...more than half...there's some kind of cognitive issue going on...memory, retrieval issues, some kind of frontal stuff...I've had to kinda do a MoCA [Montreal Cognitive Assessment] on a couple of patients and they've been quite stark. (HCP19)

Subtheme 2.2 Revisiting the cardiac rehabilitation inclusion criteria

Participants described cardiac rehabilitation as traditionally being associated with cardiac patients, for whom there is a clear conceptual link between the disease and the need for rehabilitation. Although Irish healthcare professionals acknowledged stroke as a cardiovascular disease, they described it as not being perceived in the same way as cardiac disease. In practice, participants reported that very few cardiac rehabilitation services actually accept stroke patients:

...the Irish Guidelines do specifically say cerebrovascular disease... 'Participation in cardiac rehab programmes should be available to all patients who require it, including post-cerebrovascular disease.' So, you know, why is it there and yet not happening? (HCP09)

Stroke and cardiac professionals based in Ireland and Switzerland identified post-stroke cognitive impairment as the most significant barrier to participation in cardiac rehabilitation. They described a reluctance of service providers to take on stroke patients in the absence of specific neurological training and expertise. While there are no explicit guidelines specifying the appropriate management of patients with cognitive impairment, there appears to be an unspoken rule regarding the exclusion of these individuals:

I referred a number of people who I would have thought were very high-functioning stroke patients to cardiac rehab classes, and the feedback that I received...was that they didn't have enough personnel to supervise these particular patients...didn't have the expertise to deal with neurological deficits. (HCP08)

Access to cardiac rehabilitation was described by participants as not merely a problem for stroke survivors; the system also disadvantages patients with cardiac arrest and heart failure. Many of these patients suffer cognitive deficits and are exempt from cardiac rehabilitation for this reason, indicating additional unmet need in this service:

...post-cardiac arrest...their short-term memory would be very, very poor...if they're...able to participate in the exercise, we don't want to deny them access to a big piece of cardiac rehabilitation. In terms of the educational piece...typically they will defer to their spouse or partner in terms of any educational impairments they want to address...but typically, they will just do the exercise. (HCP18)

Theme 3 Adapted cardiac rehabilitation for mild stroke

Healthcare professionals' views in relation to the adaptation of cardiac rehabilitation to accommodate mild stroke patients included recommendations for changes to programme content, format of delivery and staffing (presented in Table 2).

Table 2. Programme adaptations to include stroke patients in cardiac rehabilitation

	Cardiac rehabilitation	Adapted programme	Cardiac rehabilitation	Adapted programme
	Education		Exercise	
Content	<p>Six core components of Cardiovascular Disease Prevention and Rehabilitation^a</p> <ul style="list-style-type: none"> • Health behaviour change and education • Risk factor management (physical activity, diet, smoking cessation) • Psychosocial wellbeing • Medications management • Long-term behaviour change • Audit and appraisal 	<p>Delivery of similar secondary prevention education, in addition to:</p> <ul style="list-style-type: none"> • Stroke-specific education materials • Education about stroke diagnosis, post-stroke fatigue, cognitive impairment, promoting awareness of cognitive deficits • Skills building activities, e.g., cookery 	<ul style="list-style-type: none"> • Stress tests, questionnaires, prescription of individualised exercise plan • Aerobic exercise, resistance and weights • Not well equipped for people with physical disabilities 	<ul style="list-style-type: none"> • Additional stroke-specific exercises for balance, coordination, agility and fine motor skills • Adapted exercise machines, e.g., adapted cycle ergometers instead of treadmills
Integrating cardiac and stroke patients in the same programme^b	<ul style="list-style-type: none"> • In programmes which accept stroke referrals, patients are usually integrated 	<ul style="list-style-type: none"> • Some of the education modules could be shared, i.e. risk factor management, medications, diet and lifestyle, behavioural change, psychosocial support; additional stroke-specific education required • Education materials may need to be adapted and delivered in smaller groups for those with cognitive impairment or communication problems 	<ul style="list-style-type: none"> • In programmes which accept stroke referrals, patients are usually integrated 	<ul style="list-style-type: none"> • Aerobic exercise sessions could be shared • Additional stroke-specific exercises (balance, coordination) could be delivered in the same class

Format of delivery	<ul style="list-style-type: none"> • Group-based • Smaller groups for specific patients, e.g., stress management groups, chronic heart failure groups • Secondary prevention education deferred to carer where patient unable to participate (e.g., patients with cardiac arrest) 	<ul style="list-style-type: none"> • Smaller education groups to accommodate post-stroke fatigue • No more than 5 people in a group where communication is an issue • Shorter interactive education sessions rather than lecture style • Include a family member if necessary for those with cognitive or communication deficits 	<ul style="list-style-type: none"> • Group-based 	<ul style="list-style-type: none"> • Group-based; may require additional staff supervision
Multidisciplinary team (MDT)	<ul style="list-style-type: none"> • Physician • Nurse specialist • Physiotherapist or exercise professional • Psychologist • Pharmacist • Dietician • Occupational therapist • Social worker • Administrative personnel 	<p>Stroke-specific expertise from:</p> <ul style="list-style-type: none"> • Stroke nurse • Occupational therapist • Speech and language therapist • Neuropsychologist/ psychologist <p>• Stroke education could potentially be delivered by the wider MDT</p>	<ul style="list-style-type: none"> • Cardiac rehabilitation nurse/ physiotherapist 	<ul style="list-style-type: none"> • Physiotherapist with stroke expertise • Sports Scientist (optional) • Higher staff to patient ratio where patients with physical disabilities are included

^a Adapted from BACPR Standard 2

^b In Ireland, very few cardiac rehabilitation programmes accept stroke patients. In Switzerland, different disease groups (cardiac, stroke, pulmonary, oncology) are integrated in cardiovascular rehabilitation programmes for primary or secondary prevention, due to similar cardiovascular risk factors and rehabilitation need.

Subtheme 3.1 Adaptations to programme content

Cardiac rehabilitation is a programme of physical activity and health education centred on risk factor management, medications, diet and psychosocial support. Much of this secondary prevention education is also applicable to stroke due to similar rehabilitation needs, and these modules could potentially be shared. Nevertheless, participants recommended including additional information about diagnosis, post-stroke fatigue and cognitive impairment. Others highlighted the importance of skills-building activities, such as cookery and exercising safely. The main consensus was that stroke-specific education materials would be preferable.

...stroke-specific would be better because...even within stroke the impairments are so broad and diverse and complex. (HCP09)

In cardiac rehabilitation, psychological support is delivered as a group-based intervention, where patients learn skills in relation to stress management and relaxation. Access to psychological support was noted as a major gap in stroke service provision:

The [psychological] needs are not really being met, nor are they being identified properly because we don't have the time...and there's a fear of identifying a need and then not being able to meet it...it's not resourced appropriately. (HCP11)

Ideally, stroke-specific education would be delivered by a health professional specialised in stroke. Several participants cited the stroke nurse as an appropriate person to deliver this education:

...it would be really useful if maybe one of the stroke nurses could answer some of those questions...I would like a couple of things more finely tuned for the stroke population. (HCP17)

Others suggested that the education sessions could be delivered by the wider team. Several participants suggested training team members to deliver education sessions outside their field of expertise, to reduce pressure on services and provide an opportunity for training.

Post-stroke cognitive impairment can affect an individual's capacity to assimilate new information, indicating that education materials will need to be adapted to accommodate stroke patients' cognitive needs:

...they [stroke patients] couldn't engage as well with the teaching materials...[the psychologists] would see...real difficulty in...assimilating knowledge, in planning, in following through...they would have put it all down to cognitive problems and perhaps...some kind of withdrawal or depression. (HCP08)

Adaptations recommended by participants to accommodate stroke patients with cognitive impairment and aphasia are summarised in Table 3. Aphasia-friendly materials and oral presentations which include images and pictures rather than text, were identified as more suitable for those with communication difficulties. Participants stressed the importance of cognitive screening and the need for additional expertise from occupational therapy or psychology. Cognitive strategies to improve planning and organisational skills were identified, that could be built into the rehabilitation programme and become part of routine practice. Participants suggested a number of approaches to support patients with cognitive impairment, such as keeping a diary, providing written materials to reinforce learning, offering reminder phone calls or texts and involving family members in rehabilitation:

...have written material available...encourage them to get a diary...I've been doing quite a lot of that with my individual patients but it's, certainly not at the moment, a standard part of the care plan. (HCP19)

Participants agreed that cardiac rehabilitation programmes could be tailored to enable patients with mild cognitive deficits to participate. However in practice, the lack of an established cognitive rehabilitation intervention was highlighted as a major barrier to integration of stroke patients in cardiac rehabilitation. The majority of participants agreed that a cognitive rehabilitation module could be added as part of the cardiac rehabilitation programme. Such an intervention would address the cognitive needs of stroke and cardiac patients simultaneously:

...they [cardiac arrest patients] would be facing some similar challenges for the mainstream cardiac rehabilitation programme...there would be some degree of tailoring required for them anyway. If there was an add-on service that accommodated stroke patients...that would actually bridge both needs...in fact, it would make it a more comprehensive service. (HCP18)

In cardiac rehabilitation, exercise is delivered as a group intervention, where each patient follows an individualised exercise plan that is tailored to their own needs and comorbidities. The cardiovascular programme delivered in Switzerland integrates numerous different disease groups (cardiac, stroke, cancer, pulmonary patients) in the aerobic exercise classes, grouping patients in terms of cardiovascular fitness, rather than by disease. Other participants also recognised the value of integrating patients with cardiovascular diseases in rehabilitation:

...we are living in a society that is now comorbid...they all have diabetes, or they all have

hypertension. I think we need to start managing them as chronic disease management.
(HCP23)

Participants suggested that stroke patients might also benefit from additional exercises targeting coordination, strength, balance, agility and fine motor skills. In Switzerland, stroke-specific exercises are delivered as part of the Neurorehabilitation programme:

There are lessons for coordination, balance, force...dexterity...and agility. (HCP02)

Subtheme 3.2 Adaptations to format of delivery

Participants reported that short interactive education sessions are preferred by patients over lecture style format. For those with communication deficits, a maximum of five people per group was recommended by the speech and language therapist. Several participants advocated for the involvement of family in rehabilitation. If a patient has difficulties assimilating information, secondary prevention education may also be provided to the primary caregiver, without necessarily making substantial adaptations to education materials. Programmes delivered in the evenings, lunchtime or weekends would accommodate patients who return to work. A number of participants suggested that community-based cardiac rehabilitation would improve accessibility:

As community facilities become more developed...that's a natural place for it...younger people who are having MI's [Myocardial Infarction] and strokes are hoping to go back to work, you need to be able to offer something more in their community... (HCP22)

Online home rehabilitation programmes make it possible for patients who cannot attend the hospital to engage in rehabilitation. While there is increasing interest in the use of health

technology and monitoring, some participants felt that face-to-face programmes may be preferable in some instances:

Particularly I guess people with cognitive problems...where is the motivation to engage with the programme? ...is this a population that can manage that type of self-direction of exercise? (HCP08)

Healthcare professionals spoke of higher non-attendance and drop-out rates among stroke patients recruited to cardiac rehabilitation programmes. Hence, measures to promote adherence may be particularly important in an integrated programme:

...there was a much poorer attendance rate for stroke patients referred to cardiac rehab.....also, of the stroke patients who did come, their adherence to the programme was a lot poorer. (HCP08)

Additional recommendations to improve programme access and adherence were also provided (Supplementary Table S2).

Table 3. Programme adaptations to accommodate patients with cognitive impairment and aphasia

	Identification	Content	Format of delivery	Multidisciplinary Team
Cognitive impairment	<ul style="list-style-type: none"> • Cognitive assessment by an occupational therapist/ neuropsychological assessment by psychologist • Clear guidelines regarding eligibility and inclusion of patients with cognitive impairment 	<ul style="list-style-type: none"> • Education about cognitive impairment • Cognitive strategies built into programme; planning, organising, memory skills • Reminders, written information, use of a diary • Cognitive rehabilitation intervention – potentially deliver as a module through integrated cardiovascular rehabilitation programme 	<ul style="list-style-type: none"> • Smaller groups • Education to promote insight and awareness • More supportive environment, clear signposting • Family member could also attend rehabilitation 	<ul style="list-style-type: none"> • Occupational therapist • Psychologist
Aphasia	<ul style="list-style-type: none"> • Assessment by a speech and language therapist 	<ul style="list-style-type: none"> • Aphasia-friendly materials, oral presentations to include more images rather than text 	<ul style="list-style-type: none"> • Individual assistance • Smaller groups, aphasia groups 	<ul style="list-style-type: none"> • Speech and language therapist

Subtheme 3.3 Adaptations to the multidisciplinary team

In addition to the more traditional members of the multidisciplinary team including the cardiac nurse, psychologist, dietician, and pharmacist, a range of stroke healthcare professionals were also recommended, including physiotherapists, occupational therapists, and stroke nurses. Participants proposed that the psychologist or the occupational therapist might deliver information about managing fatigue and cognitive impairment, while the speech and language therapist could tailor materials for patients with communication problems. According to several participants, the exercise programme component of cardiovascular rehabilitation should be led by physiotherapists with stroke expertise, who would be in the best position to tailor exercises to accommodate people with disabilities. Access to a social worker and direct links to services such as stress management and smoking cessation were also deemed important.

Theme 4 Resistance to change

Participants identified organisational barriers to expanding cardiac rehabilitation services to include stroke patients. Cardiac professionals in Ireland commonly spoke about pressure on resources, while stroke practitioners highlighted lack of stroke-specific expertise and issues around the management of people with disabilities as major barriers.

Subtheme 4.1 Lack of resources

While cardiac rehabilitation professionals in Switzerland also experienced resource limitations, participants in Ireland more regularly described how cardiac rehabilitation services are under-resourced and over-subscribed. Poor access to psychology and dietetics was frequently highlighted

in the interviews. The lack of greater investment in cardiac rehabilitation services was cited as a key barrier to expansion of existing services:

...unless there was dedicated funding...I think that's going to be met with very tepid enthusiasm...there's also the perception that the services are being allowed to wither on the vine....there is quite a bit of funding for this patient population [stroke], that has not been provided to cardiac rehabilitation for 10 years... (HCP18)

Cardiac rehabilitation is typically nurse-led or delivered by physiotherapists in the UK and Ireland and the mix of expertise on the rehabilitation team differs depending on available resources. Irish participants highlighted substantial variation in staffing, programme duration and the number of sessions delivered in cardiac rehabilitation programmes nationally:

...there's no standardisation. So around the country currently you have programmes from four to twelve weeks... (HCP23)

The expansion of cardiac rehabilitation to include stroke patients would place additional pressure on services. Some participants suggested that resourcing issues in hospitals could be alleviated by moving cardiac rehabilitation into the community, where staff would have a permanent role:

...when acute services are under pressure, they pull staff from all areas...whereas if you are in the community, you won't be pulled to work in another department when it gets busy. (HCP23)

Subtheme 4.2 Lack of stroke-specific expertise

Cardiac rehabilitation participants identified a lack of neurological expertise as a major barrier to integrating patients in cardiac rehabilitation and agreed that experienced senior level stroke staff are needed on the multidisciplinary team. Stroke rehabilitation professionals also perceived cardiac rehabilitation services as less accepting of people with post-stroke disabilities. While existing services might not be well equipped, participants pointed out that adapted exercise machines and increased staff supervision could facilitate the inclusion of less mobile cardiac and stroke patients:

...the adaptive pieces of equipment sat alongside all the other pieces of equipment...I was able to work a [staff] ratio of 1:2 or 1:4...you had some higher-level people...exercising alongside people with more disability. That allowed better staff ratio mixing. (HCP08)

Subtheme 4.3 Lack of interdisciplinary links

Challenges relating to the referral of stroke patients to cardiac rehabilitation were also cited. The Swiss healthcare professionals described the importance of building an effective referral pathway. Interdisciplinary links would make it easier for cardiac services to identify eligible stroke patients for these programmes, as described in Supplementary Table S2. However, participants described how the fragmentation of the Irish health service creates a barrier to communication between disciplines:

...we all have our little silos...our cardiac rehab nurses are in the same building as us [stroke physiotherapy] ...so there was that potential there...it could have happened, but it didn't (HCP09)

Discussion

This study examined healthcare professionals' views in relation to the potential expansion of cardiac rehabilitation services to include stroke patients, thereby becoming a cardiovascular rehabilitation model. The potential delivery of cognitive rehabilitation through such a model was also considered. There was consensus among the study participants that cardiac rehabilitation would be suitable for mild stroke patients, many of whom are discharged from hospital with no follow-up or secondary prevention support after stroke. Transient Ischaemic Attack (TIA) and minor stroke account for up to 82% of all cerebrovascular events (60), indicating a sizeable population of stroke patients who could potentially benefit from cardiac rehabilitation. Nevertheless, participants identified that even the mild stroke population may not be an "easy fit" for cardiac rehabilitation, with one study reporting that 38% of stroke survivors experience enduring cognitive problems up to one year post-stroke (42).

Cognitive rehabilitation is defined as "a systematic, functionally oriented service of therapeutic activities that is based on assessment and understanding of the patient's brain-behavioral deficits" (61). The intervention is most commonly delivered by occupational therapists (62) and therapy involves a combination of restorative and compensatory approaches, which are individualised to a patient's specific rehabilitation needs (62). Cardiac professionals were enthusiastic about the potential addition of a cognitive intervention to cardiac rehabilitation, which could address the needs of cognitively impaired cardiac patients. Although the evidence for the effectiveness of cognitive rehabilitation is limited, research is progressing in this area (43, 44, 63). A systematic review and meta-analysis by Rogers et al. reported small significant effects in general post-stroke cognitive function, in addition to domain-specific improvements, following cognitive rehabilitation (64). Moreover, previous studies have highlighted the potential benefits of group-

based cognitive interventions for stroke patients, where peer support promotes programme satisfaction and enhances adherence (65, 66). Group cognitive interventions appear to be most effective when the patients involved have similar cognitive capacities (67). This suggests a strong need for accurate cognitive assessment to ensure that patients are appropriately matched in terms of cognitive function.

A psychologist or occupational therapist was identified as best placed to deliver cognitive rehabilitation, a finding consistent with other studies (63). Furthermore, the advantages of a collaborative relationship between these professionals in the delivery of cognitive rehabilitation is supported by literature (68-70). If such an intervention were delivered as part of cardiac rehabilitation, the occupational therapist could match patients with similar cognitive abilities for rehabilitation and contribute to the cognitive assessment process. While the delivery of individualised cognitive rehabilitation may not be feasible in this setting, it may be possible to tailor group-based activities to target specific areas of concern.

Although patients with cerebrovascular disease are identified as eligible for cardiac rehabilitation in many guideline documents (34, 35), in practice they are largely excluded (36). Similarly, stroke patients with cognitive deficits are commonly excluded from research studies (25, 30, 57, 71). Furthermore, patients with cardiac arrest and heart failure also experience cognitive deficits which preclude them from participating in cardiac rehabilitation (72), despite evidence of the benefits of cardiac rehabilitation for these patients (72-77). Post-stroke physical disability is an additional barrier to cardiac rehabilitation. Marzolini et al. reported that up to two thirds of eligible stroke patients are excluded from traditional cardiac rehabilitation programmes because they do not meet the criteria for mild non-disabling stroke (78). According to cardiac rehabilitation professionals, neurological expertise is required for the appropriate management of

patients with post-stroke physical deficits. In addition, exercise machines and training programmes can be adjusted for stroke patients with higher levels of physical disability to enable them to exercise safely (27, 37, 57). While stroke and cardiac patients share similar cardiovascular risk factors, stroke is perceived as a more complex condition. These findings suggest that the physical and cognitive capacities required for participation in rehabilitation need to be clearly documented for all patient groups, to ensure that eligible stroke and cardiac patients are referred to the programme.

Typically, cardiac rehabilitation services report very few referrals from stroke services and this may be due in part to the lack of a referral pathway (38). Participants described working in silos within the Irish healthcare system, with little or no cross-disciplinary communication. The fragmentation of the Irish health service has also been highlighted in other studies (79). By linking stroke and cardiac rehabilitation services, a similar system of automatic referral could be developed for the recruitment of stroke patients (38, 78, 80). Patients with mild to moderate stroke are eligible for Early Supported Discharge (ESD), a home rehabilitation programme for up to eight weeks. Once rehabilitation has been completed, it may be possible to link eligible patients back in with the cardiac rehabilitation service for secondary prevention education alongside cognitive rehabilitation.

In this study, the main organisational barriers to expansion of existing cardiac rehabilitation services included inadequate resources and financial support, over-subscription of services, and lack of stroke-specific expertise. The under-resourcing of services appears to contribute to the diversity of cardiac rehabilitation programmes globally (81). Resource limitations appeared to be less of a problem in Switzerland, where healthcare providers are incentivised by fee-for-service contracts and reimbursed for each patient attending cardiac rehabilitation (46). In Ireland, cardiac

rehabilitation is delivered through a more conservative public healthcare system, where a single budget is allocated to cover all care delivered to cardiac patients (47-49). Hence, the expansion of Irish cardiac rehabilitation services to include stroke patients would require substantial financial investment, workforce planning and the development of an effective referral system to facilitate the implementation of cardiovascular rehabilitation.

Stroke patients often need both rehabilitation services and secondary prevention. The educational aspect of secondary prevention is included in current cardiac rehabilitation programmes and could be modified to be relevant and specific to stroke for stroke patient participants. Trying to accommodate additional aspects of secondary prevention within one generalised service is likely to be problematic. The findings from this study suggest that a hybrid model may be preferable, where rehabilitation modules common to both diseases are shared, and stroke-specific content is delivered separately. The inclusion of a cognitive rehabilitation intervention to address the cognitive needs of stroke and cardiac patients might result in a more comprehensive cardiac rehabilitation service. Instead of including a full team of stroke specialists, healthcare professionals could be trained to deliver stroke education and cognitive rehabilitation. This approach would help ensure efficient use of resources and pave the way for an integrated model of cardiovascular care.

Strengths and limitations

This study involved cardiac and stroke professionals from Ireland and Switzerland. Almost half of interviewees had delivered cardiac rehabilitation-type interventions to stroke patients, indicating that these participants were in a good position to comment on the suitability of the cardiac rehabilitation model for stroke. The interviews with the Swiss health professionals permitted

deeper understanding of the challenges related to the delivery of cardiovascular rehabilitation and Neurorehabilitation to stroke patients. These programmes provide a useful framework which can be used to inform implementation of a similar programme of integrated cardiovascular care in Ireland.

There were some limitations to this study. Healthcare professionals from academic hospitals were overrepresented; therefore the results may not be generalizable to other settings. This research did not include any neuropsychologists. In future studies, it would be important to explore the views of these healthcare professionals, particularly in relation to the appropriate delivery of a cognitive rehabilitation intervention. Only twelve participants had delivered cardiac rehabilitation-type interventions to stroke patients, therefore some participants may have been less familiar with programme content or the rationale for including stroke patients. However, stroke-specific barriers to participation in cardiac rehabilitation were consistently identified across interviews, regardless of practical experience. Although cardiac rehabilitation-type programmes may be considered feasible from the perspective of healthcare professionals, it is not clear if stroke survivors would welcome such a programme. Future studies could explore the experiences of stroke survivors involved in cardiovascular rehabilitation programmes, to establish the suitability of an integrated model of rehabilitation compared with a separate model of stroke-specific rehabilitation.

Conclusion

Cardiac rehabilitation could be considered a suitable programme for mild stroke patients. The findings suggest that a hybrid approach might be most appropriate, integrating stroke and cardiac patients in the aerobic exercise classes and education sessions, with additional stroke-specific and cardiac-specific modules delivered separately. In order to accommodate patients with cognitive impairment, strategies around planning and memory can be incorporated as part of rehabilitation. It is important that all patients who could potentially benefit from cardiac rehabilitation and from cognitive rehabilitation can access these programmes. An integrated model of cardiovascular care would support the provision of rehabilitation based on cardiovascular risk and need, as opposed to disease type.

Acknowledgements

The authors would like to acknowledge all participants for their contribution to this study.

Declaration of interest

This research is funded by the Health Research Board SPHeRE/2013/1. The authors report no other declarations of interest.

References

1. Parappilly BP, Mortenson WB, Field TS, et al. Exploring perceptions of stroke survivors and caregivers about secondary prevention: a longitudinal qualitative study. *Disabil Rehabil.* 2019;1-7. doi: 10.1080/09638288.2018.1544296.
2. Finch E, Foster M, Fleming J. Disrupted biographies: making sense of minor stroke after hospital discharge. *Disabil Rehabil.* 2020;1-8. doi: 10.1080/09638288.2019.1708980.
3. Shipley J, Luker J, Thijs V, et al. How can stroke care be improved for younger service users? A qualitative study on the unmet needs of younger adults in inpatient and outpatient stroke care in Australia. *Disabil Rehabil.* 2019;1-8. doi: 10.1080/09638288.2018.1534278.
4. White CL, Cantu A, Motz D, et al. Opportunities and challenges in secondary stroke prevention: a mixed methods study. *Disabil Rehabil.* 2019;41(26):3192-7. doi: 10.1080/09638288.2018.1492029.
5. Kamm CP, Schmid J-P, Müri RM, et al. Interdisciplinary cardiovascular and neurologic outpatient rehabilitation in patients surviving transient ischemic attack or stroke with minor or no residual deficits. *Arch Phys Med Rehabil.* 2014;95(4):656-62. doi: 10.1016/j.apmr.2013.10.013.
6. Stevens E, Emmett E, Wang Y, et al. The burden of stroke in Europe report. London: King's College London for the Stroke Alliance for Europe (SAFE), 2018.
7. Wren M-A, Gillespie P, Smith S, et al. Towards earlier discharge, better outcomes, lower cost: stroke rehabilitation in Ireland. Dublin: The Economic and Social Research Institute, 2014.
8. Norrving B, Barrick J, Davalos A, et al. Action plan for stroke in Europe 2018-2030. *European stroke journal.* 2018;3(4):309-36. doi: 10.1177/2396987318808719.
9. McElwaine P, McCormack J, Harbison J. Irish Heart Foundation/ HSE national stroke audit 2015. Dublin: Irish Heart Foundation, 2015.
10. McElwaine P, McCormack J, Harbison J. Irish Heart Foundation/ HSE national stroke audit rehabilitation units 2016. Dublin Irish Heart Foundation, 2016.
11. European Stroke Organisation (ESO) Executive Committee, ESO Writing Committee. Guidelines for management of ischaemic stroke and transient ischaemic attack 2008. *Cerebrovasc Dis.* 2008;25(5):457-507. doi: 10.1159/000131083.
12. Irish Heart Foundation: Council for stroke. National clinical guidelines and recommendations for the care of people with stroke and transient ischaemic attack. Dublin: Irish Heart Foundation, 2010.
13. Stroke rehabilitation in adults. Clinical guideline. Manchester: National Institute for Health Care and Excellence (NICE); 2013. Available from: <https://www.nice.org.uk/guidance/cg162>.
14. Intercollegiate Stroke Working Party. National clinical guideline for stroke. London: Royal College of Physicians, 2016.
15. Dalal HM, Doherty P, Taylor RS. Cardiac rehabilitation. *BMJ.* 2015;351:h5000. doi: 10.1136/bmj.h5000.
16. Scottish Intercollegiate Guidelines Network (SIGN). Cardiac rehabilitation: a national clinical guideline. Edinburgh: 2017.
17. Pearson TA, Blair SN, Daniels SR, et al. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update. Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. American Heart Association Science Advisory and Coordinating Committee. *Circulation.* 2002;106(3):388-91. doi: 10.1161/01.cir.0000020190.45892.75.
18. Stewart J, Manmathan G, Wilkinson P. Primary prevention of cardiovascular disease: a review of contemporary guidance and literature. *JRSM Cardiovasc Dis.* 2017;6. doi: 10.1177/2048004016687211.
19. Di Pasquale G, Urbinati S, Perugini E, et al. Interactions between cardiovascular and cerebrovascular disease. *Curr Treat Options Neurol.* 2012;14(6):557-93. doi: 10.1007/s11940-012-0204-7.

20. Touzé E, Varenne O, Chatellier G, et al. Risk of myocardial infarction and vascular death after transient ischemic attack and ischemic stroke. *Stroke*. 2005;36(12):2748-55. doi: doi:10.1161/01.STR.0000190118.02275.33.
21. Billinger SA, Arena R, Bernhardt J, et al. Physical activity and exercise recommendations for stroke survivors. *Stroke*. 2014;45(8):2532-53. doi: 10.1161/STR.0000000000000022.
22. Tang A, Closson V, Marzolini S, et al. Cardiac rehabilitation after stroke - need and opportunity. *J Cardiopulm Rehabil Prev*. 2009;29(2):97-104. doi: 10.1097/HCR.0b013e31819a00d4.
23. Tang A, Marzolini S, Oh P, et al. Feasibility and effects of adapted cardiac rehabilitation after stroke: a prospective trial. *BMC Neurol*. 2010;10(40):1-10. doi: 10.1186/1471-2377-10-40.
24. Sachdev PS, Chen X, Brodaty H, et al. The determinants and longitudinal course of post-stroke mild cognitive impairment. *J Int Neuropsychol Soc*. 2009;15(6):915-23. doi: 10.1017/s1355617709990579.
25. Prior PL, Hachinski V, Unsworth K, et al. Comprehensive cardiac rehabilitation for secondary prevention after transient ischemic attack or mild stroke: I: feasibility and risk factors. *Stroke*. 2011;42(11):3207-13. doi: 10.1161/strokeaha.111.620187.
26. Prior PL, Suskin N. Exercise for stroke prevention. *Stroke and Vascular Neurology*. 2018;3(2):59-68. doi: 10.1136/svn-2018-000155.
27. Regan EW, Handlery R, Beets MW, et al. Are aerobic programs similar in design to cardiac rehabilitation beneficial for survivors of stroke? A systematic review and meta-analysis. *Journal of the American Heart Association*. 2019;8(16):e012761-e. doi: 10.1161/JAHA.119.012761.
28. Saunders DH, Sanderson M, Hayes S, et al. Physical fitness training for stroke patients. *Cochrane Database Syst Rev*. 2020(3). doi: 10.1002/14651858.CD003316.pub7.
29. Kirk H, Kersten P, Crawford P, et al. The cardiac model of rehabilitation for reducing cardiovascular risk factors post transient ischaemic attack and stroke: a randomized controlled trial. *Clin Rehabil*. 2014;28(4):339-49. doi: 10.1177/0269215513502211.
30. Brainin M, Matz K, Nemec M, et al. Prevention of poststroke cognitive decline: ASPIS-a multicenter, randomized, observer-blind, parallel group clinical trial to evaluate multiple lifestyle interventions-study design and baseline characteristics. *Int J Stroke*. 2015;10(4):627-35. doi: 10.1111/ij.s.12188.
31. Moore SA, Hallsworth K, Jakovljevic DG, et al. Effects of community exercise therapy on metabolic, brain, physical, and cognitive function following stroke: a randomized controlled pilot trial. *Neurorehabil Neural Repair*. 2015;29(7):623-35. doi: 10.1177/1545968314562116.
32. Rehab therapy after a stroke. Dallas, Texas: American Stroke Association 2019 [cited 2020 07/07/20]. Available from: <https://www.stroke.org/en/life-after-stroke/stroke-rehab/rehab-therapy-after-a-stroke>.
33. Galligan K, Surgeons R, Dublin R. Irish Heart Foundation national audit of stroke care. Dublin: Irish Heart Foundation, 2008.
34. McCreery C, Cradock K, Fallon N, et al. Cardiac rehabilitation guidelines 2013. Dublin: Irish Association of Cardiac Rehabilitation, 2013.
35. Buckley J, Doherty P, Furze G, et al. The BACPR standards and core components for cardiovascular disease prevention and rehabilitation 2017. London: British Association for Cardiovascular Prevention and Rehabilitation, 2017.
36. Fallon N, Dunne D, Gallagher A, et al. Irish Association of Cardiac Rehabilitation Directory 2019. Report. Dublin: Irish Association of Cardiac Rehabilitation, 2019.
37. Hansen D, Dendale P, Coninx K, et al. Exercise prescription in patients with different combinations of cardiovascular disease risk factors: a consensus statement from the EXPERT Working Group. *Eur J Prev Cardiol*. 2017;24(10):1017-31. doi: 10.1177/2047487317702042.
38. Toma J, Hammond B, Chan V, et al. Inclusion of people poststroke in cardiac rehabilitation programs in Canada: a missed opportunity for referral. *CJC Open*. 2020. doi: 10.1016/j.cjco.2020.01.007.
39. Turner GM, McMullan C, Atkins L, et al. TIA and minor stroke: a qualitative study of long-term impact and experiences of follow-up care. *BMC Fam Pract*. 2019;20(1):176. doi: 10.1186/s12875-019-1057-x.

40. Carlsson GE, Möller A, Blomstrand C. Managing an everyday life of uncertainty – a qualitative study of coping in persons with mild stroke. *Disabil Rehabil.* 2009;31(10):773-82. doi: 10.1080/09638280802638857.
41. Mellon L, Brewer L, Hall P, et al. Cognitive impairment six months after ischaemic stroke: a profile from the ASPIRE-S study. *BMC Neurol.* 2015;15:31. doi: 10.1186/s12883-015-0288-2.
42. Sexton E, McLoughlin A, Williams DJ, et al. Systematic review and meta-analysis of the prevalence of cognitive impairment no dementia in the first year post-stroke. *European stroke journal.* 2019;4(2):160-71. doi: 10.1177/2396987318825484.
43. Jeffares I, Merriman NA, Rohde D, et al. A systematic review and meta-analysis of the effects of cardiac rehabilitation interventions on cognitive impairment following stroke. *Disabil Rehabil.* 2019;1-16. doi: 10.1080/09638288.2019.1641850.
44. Merriman NA, Sexton E, McCabe G, et al. Addressing cognitive impairment following stroke: systematic review and meta-analysis of non-randomised controlled studies of psychological interventions. *BMJ open.* 2019;9(2):e024429-e. doi: 10.1136/bmjopen-2018-024429.
45. Saner H. From cardiac rehabilitation to ambulatory preventive care: the Swiss way. *Swiss Sports and Exercise Medicine.* 2016;64(2):26-30.
46. De Pietro C, Camenzind P, Sturny I, et al. Switzerland: health system review. *Health Syst Transit.* 2015;17(4):1-288, xix.
47. Brown A, Jennings S. Country report Ireland – February 2014. France: European Association for Cardiovascular Prevention and Rehabilitation (EACPR), 2014.
48. Geary LM, Lynch B, Turner B. The Irish healthcare system: an historical and comparative review. Dublin: The Health Insurance Authority, 2018.
49. McDaid D, Wiley M, Maresso A, et al. Ireland: health system review. Copenhagen: World Health Organization. Regional Office for Europe; 2009 2009.
50. Connolly S, Wren MA. Unmet healthcare needs in Ireland: Analysis using the EU-SILC survey. *Health Policy.* 2017;121(4):434-41. doi: 10.1016/j.healthpol.2017.02.009.
51. Neergaard MA, Olesen F, Andersen RS, et al. Qualitative description - the poor cousin of health research? *BMC Med Res Methodol.* 2009;9:52. doi: 10.1186/1471-2288-9-52.
52. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology.* 2006;3(2):77-101. doi: 10.1191/1478088706qp063oa.
53. Ritchie J, Lewis J. Qualitative research practice: a guide for social science students and researchers. California: Sage; 2003.
54. Creswell J. Qualitative inquiry and research design: choosing among five approaches. 3rd ed. California: Sage; 2013.
55. Malterud K, Siersma VD, Guassora AD. Sample size in qualitative interview studies: guided by information power. *Qual Health Res.* 2016;26(13):1753-60. doi: 10.1177/1049732315617444.
56. Morse JM. Determining sample size. *Qual Health Res.* 2000;10(1):3-5. doi: 10.1177/104973200129118183.
57. Lennon O, Blake C. Cardiac rehabilitation adapted to transient ischaemic attack and stroke (CRAFTS): a randomised controlled trial. *BMC Neurol.* 2009;9:9. doi: 10.1186/1471-2377-9-9.
58. Braun V, Clark V. Successful qualitative research: a practical guide for beginners. London: SAGE Publications; 2013. 327 p.
59. Green J, Thorogood N. Qualitative methods for health research. 3rd ed. London: Sage; 2014.
60. Rothwell PM, Coull AJ, Giles MF, et al. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). *Lancet.* 2004;363(9425):1925-33. doi: 10.1016/s0140-6736(04)16405-2.
61. Cicerone KD, Dahlberg C, Kalmar K, et al. Evidence-based cognitive rehabilitation: recommendations for clinical practice. *Arch Phys Med Rehabil.* 2000;81(12):1596-615. doi: 10.1053/apmr.2000.19240.

62. Hoffmann T, Bennett S, Koh CL, et al. Occupational therapy for cognitive impairment in stroke patients. *Cochrane Database Syst Rev*. 2010(9). doi: 10.1002/14651858.CD006430.pub2.
63. Merriman NA, Bruen C, Gorman A, et al. "I'm just not a Sudoku person": analysis of stroke survivor, carer, and healthcare professional perspectives for the design of a cognitive rehabilitation intervention. *Disabil Rehabil*. 2019;1-11. doi: 10.1080/09638288.2019.1594400.
64. Rogers JM, Foord R, Stolwyk RJ, et al. General and domain-specific effectiveness of cognitive remediation after stroke: systematic literature review and meta-analysis. *Neuropsychol Rev*. 2018;28(3):285-309. doi: 10.1007/s11065-018-9378-4.
65. Withiel TD, Sharp VL, Wong D, et al. Understanding the experience of compensatory and restorative memory rehabilitation: a qualitative study of stroke survivors. *Neuropsychol Rehabil*. 2020;30(3):503-22. doi: 10.1080/09602011.2018.1479275.
66. Clark E, Bennett K, Ward N, et al. One size does not fit all - stroke survivor's views on group self-management interventions. *Disabil Rehabil*. 2018;40(5):569-76. doi: 10.1080/09638288.2016.1268653.
67. Cicerone KD, Dahlberg C, Malec JF, et al. Evidence-based cognitive rehabilitation: updated review of the literature from 1998 through 2002. *Arch Phys Med Rehabil*. 2005;86(8):1681-92. doi: 10.1016/j.apmr.2005.03.024.
68. Stephens JA, Williamson KN, Berryhill ME. Cognitive rehabilitation after traumatic brain injury: a reference for occupational therapists. *OTJR : occupation, participation and health*. 2015;35(1):5-22. doi: 10.1177/1539449214561765.
69. Johnson-Greene D. Clinical neuropsychology in integrated rehabilitation care teams. *Arch Clin Neuropsychol*. 2018;33(3):310-8. doi: 10.1093/arclin/acx126.
70. Bennett TL. Neuropsychological evaluation in rehabilitation planning and evaluation of functional skills. *Arch Clin Neuropsychol*. 2001;16(3):237-53. doi: 10.1016/S0887-6177(00)00082-2.
71. Ihle-Hansen H, Thommessen B, Fagerland MW, et al. Multifactorial vascular risk factor intervention to prevent cognitive impairment after stroke and TIA: a 12-month randomized controlled trial. *Int J Stroke*. 2014;9(7):932-8. doi: 10.1111/j.1747-4949.2012.00928.x.
72. Green CR, Botha JA, Tiruvoipati R. Cognitive function, quality of life and mental health in survivors of out-of-hospital cardiac arrest: a review. *Anaesth Intensive Care*. 2015;43(5):568-76. doi: 10.1177/0310057x1504300504.
73. Long L, Mordi IR, Bridges C, et al. Exercise-based cardiac rehabilitation for adults with heart failure. *Cochrane Database Syst Rev*. 2019(1). doi: 10.1002/14651858.CD003331.pub5.
74. Morris JH, Chen L. Exercise training and heart failure: a review of the literature. *Cardiac failure review*. 2019;5(1):57-61. doi: 10.15420/cfr.2018.31.1.
75. Vogels RL, Scheltens P, Schroeder-Tanka JM, et al. Cognitive impairment in heart failure: a systematic review of the literature. *Eur J Heart Fail*. 2007;9(5):440-9. doi: 10.1016/j.ejheart.2006.11.001.
76. Hajduk AM, Kiefe CI, Person SD, et al. Cognitive change in heart failure: a systematic review. *Circulation Cardiovascular quality and outcomes*. 2013;6(4):451-60. doi: 10.1161/CIRCOUTCOMES.113.000121.
77. Mędrzycka-Dąbrowska WA, Czyż-Szybenbejl K, Kwiecień-Jaguś K, et al. Prediction of cognitive dysfunction after resuscitation - a systematic review. *Postepy Kardiol Interwencyjnej*. 2018;14(3):225-32. doi: 10.5114/aic.2018.78324.
78. Marzolini S, Fong K, Jagroop D, et al. Eligibility, enrollment, and completion of exercise-based cardiac rehabilitation following stroke rehabilitation: what are the barriers? *Phys Ther*. 2019;100(1):44-56. doi: 10.1093/ptj/pzz149.
79. Donnelly N-A, Humphries N, Hickey A, et al. "We don't have the infrastructure to support them at home": How health system inadequacies impact on long-term care admissions of people with dementia. *Health Policy*. 2017;121(12):1280-7. doi: 10.1016/j.healthpol.2017.09.020.

80. Marzolini S. Integrating individuals with stroke into cardiac rehabilitation following traditional stroke rehabilitation: promoting a continuum of care. *Can J Cardiol*. 2018;34(10 Suppl 2):S240-s6. doi: 10.1016/j.cjca.2018.06.017.
81. Pesah E, Supervia M, Turk-Adawi K, et al. A review of cardiac rehabilitation delivery around the world. *Prog Cardiovasc Dis*. 2017;60(2):267-80. doi: 10.1016/j.pcad.2017.08.007.

Supplementary material

Supplementary Table S1. Interview Topic Guide

Topic area	Questions
Background information	<ul style="list-style-type: none"> • How long have you been involved in this role? • Do you work as part of a multidisciplinary team?
Rehabilitation planning and provision	<ul style="list-style-type: none"> • Can you describe a typical rehabilitation plan you would develop for someone who has had a heart attack/ stroke? • Do current rehabilitation services meet the needs of patients? • What are the main barriers you have encountered in trying to meet the rehabilitation needs of patients? • What are the consequences of unmet rehabilitation need over the long-term?
Addressing post-stroke cognitive impairment through rehabilitation	<ul style="list-style-type: none"> • Have you come across cognitive issues with your patients? • Do you focus on cognition as part of your plan? • Does cognitive impairment affect engagement with rehabilitation? • In your view why is cognitive impairment not addressed through formal rehabilitation? • Are you aware of any services delivering cognitive rehabilitation in stroke?
Participation in Cardiac Rehabilitation	<ul style="list-style-type: none"> • Do you think Cardiac Rehabilitation is an appropriate model for stroke patients? • How could these barriers be overcome so that stroke patients could participate?
Rehabilitation through a new model of cardiovascular care	<ul style="list-style-type: none"> • Tell me about the current resourcing you have for rehabilitation programmes? • Can you describe the ideal model of stroke rehabilitation? • If an effective cognitive rehabilitation intervention were identified, what would be the best way to introduce and deliver it?

Supplementary Table S2. Recommended changes to existing cardiac rehabilitation in preparation for the expansion of services

	Existing cardiac rehabilitation	Suggestions for improvement
Accessibility	<ul style="list-style-type: none"> • Weekdays during working hours • Delivered in the hospital setting primarily 	<ul style="list-style-type: none"> • Lunchtime or evening programmes to accommodate those employed • Rehabilitation to commence at appropriate time in patient's recovery • Deliver programmes in the community • Good public transport links • Online rehabilitation (Cardiac rehabilitation & Neurorehabilitation apps) (1) • Telerehabilitation
Recruitment/ interdisciplinary communication	<ul style="list-style-type: none"> • No formal links between neurology and cardiac rehabilitation services • Existing system of automatic referral works well 	<ul style="list-style-type: none"> • Create interdisciplinary links for better communication and recruitment of stroke patients • Establish a similar system of automatic referral for stroke patients • Define eligibility criteria and assessment tools • Stroke nurse/ other stroke healthcare professionals could recruit eligible patients and refer to programme in similar way to cardiac nurses • Follow-up and enrolment of patients by stroke healthcare professionals • Refer stroke patients to existing cardiac rehabilitation programmes to ensure a sufficient number of patients; permits testing of referral pathways and procedures
Measures to improve adherence	<ul style="list-style-type: none"> • Continuity of care through automatic referral system • Individualised exercise prescription and ongoing contact with the cardiac rehabilitation nurse during <i>Phase II</i>, before formal programme commencement in <i>Phase III</i> 	<ul style="list-style-type: none"> • Identification of stroke related barriers to rehabilitation • Screening for cognitive impairment, communication difficulties, physical disabilities • Individualised programme with specific support for those with cognitive impairment or aphasia • Possibility of continuing exercise in the community

	<ul style="list-style-type: none"> • Physical, psychological and behavioural assessments conducted to develop an individualised programme, tailored to a patient's needs and comorbidities • Identification of barriers to rehabilitation and efforts made to overcome these • Reduce delays to cardiac rehabilitation as far as possible to promote attendance • Continue exercise in the community (<i>Phase IV</i>) 	<ul style="list-style-type: none"> • More administrative support to provide patient reminders
Measurement of outcomes	<ul style="list-style-type: none"> • Measurement of attendance/ adherence to programme and barriers to same • Measurement of patient outcomes before and after the programme 	<ul style="list-style-type: none"> • Ensure that outcomes are measured in a standardised manner to permit comparison across time or between hospitals • Confirm that healthcare professionals delivering the programme understand what constitutes improvement in a given health outcome, e.g., an increase of one metabolic equivalent task (MET) may not indicate adequate improvement in cardiovascular fitness. • Link programme outcomes to best practice • Create a register of cardiovascular research, where HCPs can consult with other trial coordinators and learn from good practice • Improve transparency around ongoing research in this field and encourage information-sharing and learning from the experiences of others who have delivered similar cardiac rehabilitation programmes to stroke patients
1. INSELhealth – Cardio Fit. Bern, Switzerland: Inselspital Bern University Hospital; 2020. Available from: https://www.insel.ch/de/patienten-und-besucher/beratungen-und-dienstleistungen/online-dienstleistungen-und-apps/physiotherapie/		