

# 1 **Implementing constraint induced movement therapy (CIMT) into** 2 **practice in sub-acute stroke: experiences and perceptions of stroke** 3 **survivors and therapists**

## 4 5 **Introduction**

6 Constraint induced movement therapy (CIMT) has been shown to be effective in  
7 a sub-group of sub-acute stroke survivors but has not been widely implemented  
8 in the United Kingdom. This study explored therapist and stroke survivor  
9 perceptions and experiences of CIMT and explored non-agreement  
10 (incongruence) and agreement (congruence) of these perspectives.

## 11 **Method**

12 Consenting occupational therapist (n=3) and physiotherapist (n=5) participated in  
13 a focus group discussion. Four stroke survivors undertook pre- and post-CIMT  
14 interviews. Stroke survivor participants selected and undertook an evidence-  
15 based CIMT protocol. Focus group, and interview audio-recordings were  
16 independently analysed thematically. Therapist and stroke survivor views were  
17 subsequently synthesised using meta-ethnographic principles.

## 18 **Findings**

19 Four over-arching themes were identified: motivation and determination to  
20 participate in CIMT; who benefits; which protocol; making CIMT feasible. The  
21 final over-arching theme comprised five sub-themes: fatigue and sleep; pain;  
22 transport; need for support; training, support and mentorship for therapists.  
23 Stroke survivors and therapists held contrasting views in three themes.

## 24 **Conclusion**

25 Participating stroke survivors successfully undertook a self-selected, evidence-  
26 based CIMT protocol. The identified enablers and barriers should inform future  
27 CIMT protocol development. The contrasting views held by therapists and stroke  
28 survivors reinforces the need for collaborative communication and opportunity  
29 for choice during CIMT.

1           **Key words:** constraint-induced movement therapy, stroke rehabilitation, upper  
2           limb, implementation, therapy, qualitative

### 4   **Introduction**

5   Approximately 70% of stroke survivors experience arm weakness with an estimated  
6   40% continuing to have a long-term reduction in arm function (Intercollegiate Stroke  
7   Working Party, 2023). Constraint induced movement therapy (CIMT) is a therapeutic  
8   intervention to address arm impairment, comprising three components: 1) constraint of  
9   the ipsilesional arm; 2) intensive practice of tasks with the contralesional arm; and 3) a  
10  behavioural transfer package component (Kwakkel et al., 2015). CIMT literature also  
11  describes ‘shaping’ in the practice component to gradually move the person towards  
12  achieving new motor goals through meaningful challenge and feedback (Taub et al.,  
13  1994). Despite evidence indicating a beneficial effect of CIMT for stroke survivors with  
14  some recovery in the arm and hand post-stroke (Kwakkel et al., 2015) and it’s potential  
15  to provide the intensity recommended by clinical guidelines (Intercollegiate Stroke  
16  Working Party, 2023; Stroke Foundation, 2023), previous studies (Christie et al., 2019;  
17  Stockley et al., 2019; Sweeney et al., 2020) have found that the use of CIMT remains at  
18  a low level in practice. A recent national stroke conference identified that evidence-  
19  based CIMT protocols have still not been implemented into routine practice by  
20  therapists working in stroke services in the UK (Jarvis et al., 2022).

### 21  **Literature review**

22  Previous systematic reviews indicate that CIMT improves arm motor function and  
23  activity outcomes in a sub-group of stroke survivors who have a minimum of 10°  
24  extension of at least two metacarpophalangeal and interphalangeal joints and of the  
25  wrist (Corbetta et al., 2015; Pollock et al., 2014; Sirtori et al., 2009). Whilst there is

1 evidence from those reviews to support CIMT, a range of different CIMT protocols are  
2 described, representing modification of the original, intense CIMT protocol of six hours  
3 daily practice for two weeks with constraint of the ipsilesional arm for 90% of waking  
4 hours. These modified CIMT protocols differ from the original protocol and from each  
5 other in terms of the number of training and constraint wearing hours (intensity), the  
6 frequency of the CIMT sessions, and overall length of the protocol (duration). A  
7 systematic review of CIMT protocols for the sub-acute phase of stroke (Jarvis, 2015)  
8 identified 11 different CIMT protocols, all demonstrating evidence of effectiveness in a  
9 sub-group of a sub-acute stroke population with some active movement in the  
10 contralesional wrist and metacarpophalangeal joints. It remains unclear which protocols  
11 should be selected by therapists, and on what basis different protocols might be  
12 preferred by therapists and stroke survivors.

13         There has been limited exploration of therapist perceptions about when, where,  
14 or with whom a CIMT protocol might be used. Stockley et al. (2019) found only 17% of  
15 UK therapist respondents would use CIMT to address mild arm impairment (National  
16 Institutes of Health [NIH] Stroke Scale - able to lift and hold arm up against gravity for  
17 10 seconds) (National Institute of Neurological Disorders and Stroke, 2003), and 15%  
18 to address moderate impairment (NIH Stroke Scale - some ability to move against  
19 gravity). Christie et al. (2019) explored implementation and sustainability of CIMT  
20 programmes through interviews with 11 therapists from six countries who had used  
21 CIMT programmes in their practice. Findings indicated the importance of therapist  
22 knowledge and confidence to implement CIMT, support of organisational leaders and  
23 the need to be able to tailor programmes to promote feasibility and sustainability.  
24 Further studies have identified insufficient staffing (Sweeney et al., 2020), and beliefs

1 about what stroke survivors are able to tolerate (Fleet et al., 2014; Sweeney et al., 2020)  
2 also limit therapist use of CIMT in practice.

3           Stroke survivors' experiences of participating in a protocolised CIMT  
4 programme have also been reported. Three studies (Christie et al., 2022b; Stark et al.,  
5 2019; Walker and Moore, 2016) interviewed 45 stroke (n=41) and brain injury (n=4)  
6 survivors who had completed protocols of between two and four weeks in duration with  
7 a minimum of two hours of active training at least three times a week, with daily  
8 additional constraint of two hours (Stark et al., 2019), four hours (Walker and Moore,  
9 2016) and six hours (Christie et al., 2022b). The enablers included seeing functional  
10 improvements (Christie et al., 2022b), a commitment to the programme (Christie et al.,  
11 2022a; Christie et al., 2022b), social support (Christie et al., 2022b; Stark et al., 2019)  
12 and the structure of the programme, with participants noting that this structure helped  
13 them fill their time (Christie et al., 2022b). Therapist support (Walker and Moore,  
14 2016), and the inclusion of meaningful activities in the training (Walker and Moore,  
15 2016) was important in promoting adherence to the protocol. Barriers included physical  
16 and mental fatigue (Christie et al., 2022b; Stark et al., 2019), frustration (Christie et al.,  
17 2022b; Walker and Moore, 2016) and the repetitive nature of the activities (Christie et  
18 al., 2022b).

19           There is a growing body of evidence to support the use of CIMT following  
20 stroke, and a range of potential enablers and barriers are evident as indicated above.  
21 Whilst CIMT protocol selection may reduce barriers, protocol preference has not been  
22 studied and CIMT remains under-utilised in practice. If CIMT is to be effectively  
23 implemented we need to better understand therapist and stroke survivor perspectives of  
24 a range of protocols and explore the impact of the interplay of these views, on  
25 acceptability and feasibility. The overall aim of this study was to gain an understanding

1 of stroke survivor and therapist perceptions and experiences of evidence-based CIMT  
2 protocols, and to explore the incongruence (non-agreement) and congruence  
3 (agreement) of these perspectives.

#### 4 **Method**

5 Using an exploratory approach, the study was designed in two phases: 1) a focus group  
6 with physiotherapists (PTs) and occupational therapists (OTs); and 2) individual semi-  
7 structured interviews with stroke survivors before and after engaging in a CIMT  
8 protocol.

#### 9 ***Research perspectives***

10 This inductive, qualitative study was underpinned by a social constructionist theoretical  
11 paradigm which accepts that beliefs and views are made (constructed) in the context of  
12 external influence and are shaped by interactions with others (Andrews, 2012) and the  
13 context in which it was developed (Creswell, 2009: p. 8). It was assumed that stroke  
14 survivor perceptions of CIMT were shaped by interactions with therapists, family and  
15 friends, and therapist perceptions were shaped through contact with other therapists  
16 prior to and during the focus group. The lived experiences of the stroke survivor  
17 participants after they had experienced CIMT were seen through a phenomenological  
18 lens (Willig, 2001).

#### 19 ***Research ethics***

20 Ethical approval was gained from Keele University Faculty of Humanities and Social  
21 Sciences Ethics Review Panel for the focus group with therapists, and the National  
22 Research Ethics Service, NRES (13/NW/0309) for interviews with stroke survivors. All  
23 participants gave informed consent.

1 ***Setting***

2 This study setting was an extension to a stroke early supported discharge (ESD) service  
3 in the North-West of England. In this service therapists work with stroke survivors in  
4 the sub-acute phase of stroke (two weeks to nine months post-stroke).

5 ***Sampling and Recruitment***

6 *Focus group with therapists*

7 Consenting qualified OTs and PTs from the participating NHS Hospital Trust were  
8 recruited if they were providing interventions to address arm function to stroke  
9 survivors who were two weeks to nine months post-stroke. A purposive sampling  
10 strategy supported inclusion of participants across both professions with a range of  
11 experience.

12 *Interviews with stroke survivors*

13 Potentially eligible stroke survivors discharged from the ESD service were identified by  
14 ESD therapists and invited to volunteer. Stroke survivors were included if they had:  
15 been diagnosed with a single first stroke of more than two weeks and less than nine  
16 months duration on recruitment to study; been discharged from all occupational therapy  
17 and physiotherapy, to ensure that performance was not influenced by co-interventions;  
18 reduced arm function due to paresis as a result of stroke, that discharging therapists  
19 reported to have ‘plateaued’; at least 10° active extension in the contralesional wrist and  
20 metacarpophalangeal joints; ability to balance safely whilst wearing the restraint  
21 (assessed through clinical observation). They were excluded if they had been previously  
22 diagnosed with another neurological condition, were unable to follow one-step  
23 instructions (required to undertake CIMT) due to changes in cognition or

1 communication, or unable to provide valid consent to participate, assessed using four  
2 questions required for assessment of capacity (Department for Constitutional Affairs,  
3 2007).

#### 4 *Procedures*

5 Therapists and stroke survivors meeting the eligibility criteria were provided with  
6 verbal and written information about the study. Each participant provided a written  
7 consent.

#### 8 *Focus group with therapists*

9 Consenting therapists participated in one focus group lasting no more than 90 minutes,  
10 in a Hospital Trust Education Centre. The focus group was facilitated by a researcher  
11 (qualified OT) with previous experience in facilitating groups (KJ) and attended by a  
12 co-facilitator who observed the group processes, took field notes and identified any  
13 additional areas for discussion. The focus group was audio-recorded and subsequently  
14 transcribed verbatim.

15 During the focus group, participants were invited to consider and discuss their  
16 own needs and those of the organisation in implementing CIMT. The facilitator  
17 presented the range of CIMT protocols (Appendix A), which had been identified from a  
18 systematic review (Jarvis, 2015). Participants were invited to consider each protocol and  
19 respond to questions developed from the study objectives (table 1).

20

21 **Table 1 about here**

22

1 *Interviews with stroke survivors*

2 Demographics and stroke history were recorded from the medical notes of consenting  
3 stroke survivor participants. Validated measures of anxiety and depression, the Hospital  
4 Anxiety and Depression Score (Zigmond and Snaith, 1983), and cognition, the Montreal  
5 Cognitive Assessment (Nasreddine et al., 2005) were also completed prior to interview.  
6 This information was used to describe the sample and gain a deeper understanding of  
7 response to CIMT. Participants were interviewed, by a researcher (KJ), twice: a) prior  
8 to and b) following participation in an agreed CIMT protocol. The interview schedules  
9 (table 2) were shaped by patient advisors who were formally consulted twice during the  
10 planning of the study.

11 In the pre-CIMT semi-structured interview (maximum 60 minutes), participants were  
12 asked to consider and discuss their perceptions of and attitudes towards CIMT. The  
13 range of potential CIMT protocols were presented in written format, supported by a  
14 verbal explanation, to enable participants to consider the feasibility and acceptability of  
15 each.

16

17 **Table 2 about here**

18

19 Following participation in an individually selected, pre-agreed CIMT protocol,  
20 participants were interviewed for a second time (maximum duration 60 minutes), and  
21 invited to discuss their experience of CIMT, and to describe any barriers and enablers to  
22 undertaking the CIMT protocol. This interview was undertaken the day after the CIMT  
23 was completed.



1 Both interviews were audio-recorded and transcribed verbatim unless speech  
2 difficulties indicated it more appropriate for the interviewer to document the interview  
3 using written notes.

#### 4 *The CIMT protocol*

5 Following the pre-CIMT interview, members of the research team (therapist, lead  
6 researcher) met with the participant to discuss and select a CIMT protocol, according to  
7 their preference, from a range of protocols published in the literature for which some  
8 evidence of effectiveness had been established (Appendix 1). The most intensive  
9 protocol comprised constraint for 90% of waking hours and practice activities for six  
10 hours per day, for 10 days over two weeks. The least intensive protocol comprised  
11 constraint for five hours each day, and practice activities in therapy for one hour per day  
12 for three days each week for 10 weeks. Each participant selected their preferred  
13 protocol. Training included an approximately equal amount of functional and task-based  
14 activities. Each activity was selected by the treating therapist to provide a meaningful  
15 challenge to each participant. During the training, feedback was provided by the  
16 therapist to ‘shape’ the participant’s response. The activities undertaken were  
17 documented using the Occupational Therapy Stroke Arm and Hand Treatment Record  
18 (OT-STAR) (Jarvis et al., 2014). The ipsilesional arm was constrained with a C-MIT®  
19 (Odstock Medical Limited).

#### 20 *Data Analysis*

21 The focus group and interview transcripts were analysed separately using Thematic  
22 Analysis described by Braun and Clarke (2006). Two members of the research team (KJ  
23 and SH) familiarised themselves with the text, developing a feel for the data and the  
24 broad concepts encompassed within. Next, they worked through the text line by line

1 and, supported by NVivo 10 (QSR International, 2015) (KJ) and a paper-based system  
2 (SH), used open coding to extract data and capture meaning. Strings of text were  
3 allocated an initial label or code, which were then analysed for shared reference points.  
4 Where there was a perceived sharing of meaning, these codes were clustered to develop  
5 themes. The researchers (KJ and SH) worked independently, and met to compare,  
6 discuss and agree the initial codes and, subsequently, themes and final interpretation.  
7 The pre- and post- CIMT interviews, and the focus group were analysed separately.

8         The relationship between the staff focus group and the pre- and post-CIMT  
9 stroke survivor interviews was explored using the principles of meta-ethnography  
10 (Atkins et al., 2008). This approach was selected as there was no expectation that the  
11 data sets would validate each other disincentivising the use of triangulation. Instead, the  
12 aim was to draw together the two data sets to reveal deeper insights. This approach has  
13 previously been used successfully in health care to explore qualitative data collected  
14 using a variety of study designs (Sattar et al., 2021). The meta-ethnographic synthesis  
15 was undertaken by one researcher (KJ) supported by regular discussions with a second  
16 researcher (SH) to ensure a reflexive and rigorous process. The analysis followed an  
17 established guidance (Noblit and Hare, 1988; Sattar et al., 2021) incorporating  
18 ‘translations’ to compare concepts in one data set with the other data set. First a  
19 reciprocal translation was undertaken. Concepts contained within the themes were  
20 compared for aspects that were incorporated in both data sets. This was followed by a  
21 refutational translation which sought to identify dissimilar or contrasting concepts in the  
22 data sets. Finally, a ‘lines of argument’ synthesis was undertaken, bringing together the  
23 reciprocal and refutational translation to provide new insights into therapist and stroke  
24 survivor perceptions and experiences of evidence-based CIMT protocols. These  
25 translations and the lines of argument synthesis resulted in over-arching themes and

1 sub-themes with exemplar quotations. All participants were allocated pseudonyms and  
2 these are used in the reporting of the findings to preserve anonymity.

3

#### 4 ***Reflexivity***

5 The lead researcher (KJ) kept a reflective journal throughout the analysis phase,  
6 supported by field notes taken during data collection. As an OT experienced in stroke  
7 rehabilitation, she recognised that her presence and her role in facilitating the focus  
8 group and interviews potentially influenced the data collected. Therefore, as part of the  
9 reflexive process, decisions made during data analysis were documented clearly,  
10 producing an audit trail. Field notes were made during the focus group discussion by the  
11 co-facilitator, and the facilitator reflected post-interview. The reflections made during  
12 this process were taken into account in data reporting.

13

#### 14 **Results**

##### 15 ***Focus group***

16 Eight therapists (three OTs, five PTs) took part in the focus group. The therapists had a  
17 breadth of experience characterised by their time working in stroke rehabilitation  
18 (ranging from less than three years to 20 years) and level of seniority as indicated by  
19 Agenda for Change bands (table 3) (The NHS Staff Council, 2013). All eight therapists  
20 were aware of CIMT as an intervention post-stroke; four reported encouraging some  
21 stroke survivors to use a constraint such as an oven glove or pocket to prevent use of the  
22 ipsilesional hand whilst undertaking tasks. However, none had followed an evidenced-  
23 based CIMT protocol. The analysis of the focus group led to six themes: The CIMT

1 Intervention; Personal Characteristics; Setting and Support; Ethical considerations;  
2 Education and Training; and Practicalities.

3 **Table 3-about here**

4

5 ***Individual interviews***

6 Four stroke survivors from the Early Supported Discharge (ESD) Service participated in  
7 individual interviews. A summary of these participants is provided in table 4. The data  
8 analysis from the interviews led to four main themes: Undertaking the CIMT; Impact of  
9 CIMT; What was important; and Barriers and Facilitators.

10

11 **Table 4-about here**

12

13 The meta-ethnographic synthesis enabled further analysis of the focus group and  
14 interview data and led to the development of four over-arching themes: Motivation and  
15 Determination to Participate in CIMT; Who Benefits; Which Protocol? and Making  
16 CIMT Feasible. The final over-arching theme contained five subthemes: fatigue and  
17 sleep; pain; transport; need for support; training, support and mentorship for therapists.

18 ***Theme: Motivation and determination to participate in CIMT***

19 There was agreement amongst the therapists that motivation was an essential  
20 characteristic in undertaking a CIMT protocol:

21 [service users are] keen to get on and motivated, but as soon as we go, they don't  
22 pick up their home exercise programme, they do very little in between our sessions  
23 ...to get them to follow one of these protocols for four or five hours every single  
24 day is a big ask to get them motivated and involved with it. (Monica, focus group)

1 This was supported by evidence that motivation and determination were enablers to  
2 undertaking CIMT, for the stroke survivors who participated in this study. Janet,  
3 Margaret and Tony described points during the process where they called upon these  
4 personal attributes:

5 As I say, steam was coming out of my ears a couple of times...But I won't give up.  
6 Somebody once said of me, you're like a tenacious little terrier (Margaret, post-  
7 CIMT).

8 Tina's motivation was less clear, although she too expressed a level of  
9 determination in the post-CIMT interviewer notes:

10 [I] got on with it because it's the correct thing to do - want my arm working but felt  
11 like hard work (Tina, post-CIMT).

12 The motivation and determination that the therapists perceived to be important  
13 was supported by the stroke survivors who further demonstrated their motivation by  
14 completing the protocol and indicating that they would take up the offer of further  
15 CIMT if it was offered.

#### 16 ***Theme: who benefits***

17 The therapists indicated that they would only offer CIMT to stroke survivors with some  
18 activity in their contralesional hand and seemed to agree that CIMT would be  
19 appropriate for only a small proportion of stroke survivors. They indicated that deciding  
20 when to use CIMT intervention would be based on the potential benefit for a given  
21 person, rather than specifically the time post-stroke. However, there were suggestions  
22 that it might be best utilised in the early stages post-stroke:

23 It might be best to start as early as possible in terms of compliance and in terms of  
24 becoming habitual in their daily routine to build it in (Nic, focus group)

1  
2 The walking wounded that we get in... straight from the acute setting to ESD,  
3 they're the type of people who could be using it (Jane, focus group).

4 The therapists questioned whether a stroke survivor with cognitive impairment  
5 or low mood would be able to undertake CIMT.

6 If you are repeating a task and they're not really seeing it as meaningful...they'll  
7 lose concentration very quickly (Nic, focus group)

8  
9 Our patients are often low in mood and motivation, so getting them to do stuff for  
10 that amount of time without a supervising body would be difficult (Ida, focus  
11 group)

12 There appeared to be a mismatch between the therapist views and stroke survivor  
13 experiences. All participants in this study were able to participate in the CIMT and two  
14 participants (Tina and Tony) were assessed as having a potential cognitive impairment  
15 (Montreal Cognitive Assessment-table 4) and three (Janet, Tina and Tony) were  
16 assessed as having a potential depression (Hospital Anxiety and Depression Score-table  
17 4). The participants all reported benefit from the CIMT programme, and recognised  
18 improved use of their arm:

19 I am trying to use it [arm] more than I was before (Margaret, post-CMT)

20  
21 I even put the scones in the oven yesterday, which I hadn't done before because I  
22 didn't have the strength in my wrist to hold the thing. (Janet, post-CIMT)

23  
24 I think when I'm in company..., I'm having conversation, I move my hands a little  
25 bit more (Tony, post-CIMT).

26 The four participants appeared to benefit from the CIMT, regardless of whether the  
27 stroke survivors met with the therapist view of who may benefit.

1 ***Theme: which protocol***

2 All stroke survivor participants selected a protocol that they felt able to undertake, and  
3 all four participants independently chose a two-week protocol “*to get it over with*”  
4 (Margaret). Three participants selected to undertake three hours training per day, and  
5 one participant (Margaret) selected four hours. The protocol selected by Margaret,  
6 included constraint for 90% of waking hours. However, Margaret reported that she did  
7 not adhere to this constraint protocol; instead, she wore the constraint for a similar time  
8 to the other three participants (approximately three to four hours in addition to the  
9 training time).

10 This did not align with the therapist views. The therapists felt that the protocols  
11 with a smaller training time each week were more feasible. Their preference was for  
12 protocols with not more than four hours training each week. The feasibility of the CIMT  
13 protocol appeared to be based on the time the therapists had available to offer to the  
14 training sessions:

15 The six hours [training] would go over a morning and into an afternoon, taking up  
16 most of your day. We're here seven and a half hours, some of us more, but six  
17 hours is a big chunk of your day to sustain over two weeks. (Ida, focus group)

18 A protocol with four hours of arm training per week was discussed at length in the focus  
19 group as it was representative of the amount of therapy currently offered by the stroke  
20 services:

21 Most of our patients will get four hours a week if they need that four hours. So  
22 they're do-able (Ida, focus group)

1 Whilst the therapists could see how they could fit four hours per week training into their  
2 current workload, they also agreed that it might be possible to offer a slightly more  
3 intensive training over a short period:

4 Two hours [daily training] potentially could be [possible] for like a short-ish period  
5 of time, like two weeks, and it might be something that you could have similar  
6 level patients doing activities, two supervised by one assistant, and you can keep an  
7 eye on both at the same time. (Nic, focus group)

8 The amount of constraint, additional to that incorporated within the training  
9 time, was also discussed. Two therapists felt that constraint of the arm for 90% of the  
10 waking hours was not feasible:

11 But then with 90% of their time restrained per day...it just seems a tad unrealistic. (Ida,  
12 focus group)

13

14 That won't happen in any of our areas. (Petra, focus group)

15

16 Stroke survivors reported that they successfully completed between three and four hours  
17 of additional constraint, and this appeared to align with the therapists' perceptions who  
18 felt four hours were feasible if this was planned:

19 The four [hours constraint], you can almost do breakfast, lunch, evening meal,  
20 bedtime... because at least you can say you're restrained this amount, you can be  
21 free in the afternoon. (Ida, focus group)

22 Overall, there was therapist and stroke survivor agreement about the amount of  
23 additional constraint that was acceptable and feasible. However, this was not the case  
24 for the amount of supervised arm training per week.

25 ***Theme: Making CIMT feasible***

26 Stroke survivor participants were given choice about where the training element of the



1 CIMIT should take place. Three of the participants, Janet, Margaret and Tony, indicated  
2 that their homes were not suitable for undertaking therapy and, therefore, attended the  
3 rehabilitation unit for their therapy, whilst Tina undertook some training at the  
4 rehabilitation unit and some at home. In planning for CIMIT, there were indications that  
5 each participant needed to make adjustments to fit the protocol into their lives; this  
6 included changes to their own occupations (Margaret and Tina), medical appointments  
7 (Tony), and to carer routines (Margaret and Tina).

8 *Sub-theme: Fatigue and sleep*

9 During the pre-intervention interviews, both Janet and Tina indicated that they had a  
10 disrupted sleep pattern, often sleeping during the day.

11 I can stay up until three or four o'clock in the morning, I can stay up all night and not go  
12 to bed because I'm awake, but then other times, like, I'll fall asleep on the couch. (Janet,  
13 pre-CIMIT)

14 The protocol did take effort and caused fatigue, but Janet reported positive effects,  
15 resulting in a higher level of activity:

16 I'm sleeping better, I feel livelier, you know, because I'm not just going home, sitting  
17 down and going to sleep, I'm doing things, playing in the garden with the ball with the  
18 dogs" (Janet, post-CIMIT)

19  
20 Tina accommodated the fatigue with extra sleep and Margaret and Tony managed to  
21 continue usual activities on most days, indicating a relatively small impact of fatigue on  
22 their occupations. This implied that CIMIT did lead to fatigue, but that this may have  
23 positive outcomes for some, whilst for others it may require careful management.

1 *Sub-theme: Pain*

2 In the pre-CIMT interviews, Janet and Tina articulated concerns that the CIMT would  
3 cause pain. At post-CIMT interviews, it was reported that CIMT did have the potential  
4 to increase pain due to the increased levels of functional activity such as baking:

5           That was the first day we made scones and I said, 'oh, I can't do it, it's absolutely  
6           killing me!' (Janet, post-CIMT)

7 However, where this had occurred, the pain was assessed as being due to the result of  
8 increased activity of the muscles in the contralesional arm. In each case the pain was  
9 monitored and managed with analgesics and by adapting the activities involved in  
10 training. Pain may be a feature of CIMT, and where it occurs it needs effective review  
11 and action where this is required.

12 *Sub-theme: Transport*

13 All four stroke survivors used the study transport service and indicated that, without it,  
14 getting to the rehabilitation unit would have been difficult or costly and may have been  
15 a barrier to CIMT.

16           By the end of the post-CIMT follow-up, Tony was considering working towards  
17 re-gaining his driving license, and Janet was starting to use public transport, which she  
18 attributed to an increase in confidence:

19           I'm trying more stuff because I feel more confident this week (Janet, post-CIMT)

20           However, transport remained a potential barrier throughout the CIMT protocol  
21 for all four stroke survivors.

1 *Sub-theme: Need for support*

2 Therapist participants agreed that the majority of CIMT would take place once the  
3 stroke survivor was in a community dwelling. There was also agreement that formal  
4 carers working in the community would not be able to support CIMT due to shortage of  
5 time, but that informal carers may also be able to offer support:

6 I think we'd have more chance of getting family carers on board to help their  
7 stroke-affected relative than formal carers. Could it be something we could link in  
8 with [informal] carers, for example, like the OTs with washing and dressing in the  
9 morning, to show how it could still be done in a timeframe, you know. (Nic, focus  
10 group)

11 Therapists indicated this might be particularly important if a stroke survivor had  
12 cognitive impairment:

13 If somebody had...cognitive impairments, then it might be okay if we had someone  
14 there to prompt them, like a carer (Katrina, focus group)

15 Whilst therapists identified the importance of carers in supporting the CIMT protocol,  
16 for each of the four stroke survivor participants, carer support was not required.  
17 Margaret seemed to see therapy as something she did without her spouse and did not  
18 report needing any additional support at home from her husband. Moreover, the stroke  
19 survivors reported the importance of the therapist during the CIMT intervention, with  
20 Janet indicating that it would have been difficult had she not had a good relationship  
21 with the therapist, who provided her with motivation to achieve her goals, whilst Tony  
22 acknowledged that the therapist's support was instrumental in him achieving his goals:

23 She [the therapist] pushed me to where I want to go (Tony, post-CIMT).

24 *Sub-theme: Training, support, and mentorship for therapists*

25 Therapists strongly expressed a need to be confident in the evidence-base and their  
26 knowledge, and discussed the need for training, identifying a variety of training to

1 increase their knowledge and confidence in using CIMT. This included having someone  
2 senior to whom they could go for advice and from whom they could learn:

3           Probably a formal training session and then a double up with a senior therapist  
4           (Orla, focus group)

5  
6           Someone we can take any potential problems to, like a trouble-shooter. (Nic, focus  
7           group)

8 There was also agreement in the focus group that a short-term reduction in a therapist's  
9 caseload might help in implementing CIMT to support therapists' knowledge  
10 acquisition.

11

## 12 **Discussion**

13 This study has explored and provided a comparison of stroke survivor and therapist  
14 perceptions and experiences of CIMT in a UK setting and found both incongruence  
15 (non-agreement) and congruence (agreement) of the therapist and stroke survivor views.  
16 These have implications for the implementation of CIMT into a sub-acute stroke  
17 service.

18           Previous CIMT implementation studies have utilised the Theoretical Domains  
19 Framework and Behaviour Change Wheel to develop a behaviour change intervention  
20 for therapists (Christie et al., 2023) and to understand the experiences of stroke and  
21 brain injury survivors (Christie et al., 2022b). However, in our study, the findings  
22 aligned closely to the five domains (innovation, individual, inner setting, outer setting,  
23 and implementation) of the Consolidated Framework for Implementation Research  
24 (CFIR) (Damschroder et al., 2022).

25           The CFIR 'innovation' domain (Damschroder et al., 2022), was clearly evident  
26 in our findings that addressed the CIMT protocol. Whilst current guidelines recommend

1 a minimum of three hours daily therapy for people with motor recovery goals  
2 (Intercollegiate Stroke Working Party, 2023), the therapists thought that the most  
3 feasible protocols were those that included less intensive training and focussed  
4 predominantly on two protocols: the first involved one hour of training, three days per  
5 week over 10 weeks; and the second comprised four hours of training on one day per  
6 week. Therapists indicated that they felt that the stroke survivors with whom they  
7 worked would not be able to tolerate the protocols that involved a longer duration of  
8 training or mitt wearing. In contrast, the stroke survivors all chose a protocol, more  
9 aligned with current guideline recommendations (Intercollegiate Stroke Working Party,  
10 2023), comprising three or four hours training per day over two weeks with the  
11 constraint being worn for an additional three to four hours daily outside of the therapy  
12 sessions. There were indications that they perceived the short protocol duration (two  
13 weeks) to be easier to accommodate in their lives. The three hours of training could be  
14 planned into a half day, giving time in the other part of the day for other activities or  
15 rest.

16 Although the intensity of the protocol has been regarded as a potential barrier by  
17 the therapists in this study and in the literature (Viana and Teasell, 2012), this did not  
18 appear to be the case for the four participants. Christie et al. (2022b) suggest that a clear  
19 explanation of the required intensity is important to prepare stroke survivor capability to  
20 participate in CIMT. In our study, the process of selecting a protocol necessitated an  
21 exploration of the intensity and is likely to have provided this explanation. Data from  
22 the interviews indicated that stroke survivors enjoyed the intensive CIMT protocol they  
23 selected, although the intensity could be challenging. In this study and others (Christie  
24 et al., 2022b), the short intensive protocol appeared to be well received, with each  
25 participant in this study completing the protocol; all participants indicated that would

1 undertake CIMT again if it were offered. Our study is the first to include stroke survivor  
2 protocol selection from a range of evidence-based options. A key finding was that a  
3 two-week CIMT protocol that comprised three or four hours of daily training and an  
4 additional three to four hours constraint was both feasible and acceptable to the stroke  
5 survivors in our study.

6         The characteristics of the stroke survivors undertaking the CIMT (CFIR  
7 individuals domain (Damschroder et al., 2022)) provided important insights. In our  
8 study, stroke survivor participants did not require support from a carer. It is possible  
9 that the participants reduced the need for additional support by choosing a protocol they  
10 felt able to undertake independently. Offering a range of protocols may enable  
11 participants to choose a feasible protocol and may overcome the challenges identified  
12 by Stark et al. (2019) where some non-professional CIMT coaches were unable to offer  
13 the support required by the stroke survivor.

14         The therapists believed that only a small number of stroke survivors accessing  
15 their services would be appropriate for CIMT. The recruitment rate for this study  
16 supports this, with 302 stroke survivors going through the ESD service during the 11  
17 months of the study, but only four people being identified by the therapists as being  
18 appropriate for CIMT. Therapists were the gatekeepers for recruitment to the study:  
19 they made decisions about whether a stroke survivor would be appropriate for CIMT  
20 based on therapists' assessment of potential participants' cognition or perceived ability  
21 to undertake the intensive protocol. Therapists may have excluded stroke survivors  
22 based on this belief, yet the participants experiencing low mood and/or a potential mild  
23 cognitive impairment in this study pre-CIMT participated readily in CIMT. Steps must  
24 be taken in future studies to reduce gate-keeping to ensure equal access to all people

1 who meet the inclusion criteria; in this way potential participants can reclaim autonomy  
2 in decisions of beneficence (Sharkey et al., 2010).

3 Pain featured in the stroke survivor pre- and post-CIMT interviews, with two  
4 participants expressing concern about pain, or being unable to use the constrained  
5 ipsilesional arm. This perception may be a barrier to CIMT, deterring stroke survivors  
6 from agreeing to undertake the intervention. Fatigue has also been identified in previous  
7 studies as a possible barrier (Jarvis, 2015), yet neither fatigue or pain had prevented the  
8 participants from completing their CIMT protocol, a finding supported by other studies  
9 (Christie et al., 2022b).

10 Whilst therapists thought that the ‘inner setting’ (defined in CFIR as the setting  
11 in which the activity is implemented (Damschroder et al., 2022)) for the CIMT should  
12 be in the community, three of the four participants selected, in contrast, to receive all  
13 their CIMT in the rehabilitation unit. In her reflections, the Research Therapist noted  
14 benefits of undertaking some of the training in the rehabilitation unit as this made  
15 available a wider range of equipment and activities. A collaborative approach should be  
16 adopted when planning the location of the CIMT training to encourage participation and  
17 variety of occupations.

18 In the ‘Outer Setting’ (defined in CFIR as the setting in which the inner setting  
19 exists (Damschroder et al., 2022)) of the CIMT, transport was provided for stroke  
20 survivors who participated in the CIMT programme; however, this would not be the  
21 case if a CIMT intervention was integrated into the current service. Stroke survivors  
22 would have to cover their own travel costs, which may be considerable if the  
23 rehabilitation unit continued to be the favoured option as the treatment location; in line  
24 with findings from previous studies, transport may become a barrier for some (Christie  
25 et al., 2022b; Nicholson et al., 2014). Evidence-based CIMT protocols could not be

1 integrated without changes to the current ESD service. As identified by the focus group  
2 therapists, these environmental issues remained a barrier and would need to be  
3 considered if a CIMT service was to be commissioned. CIMT via telehealth (Christie et  
4 al., 2022a) may provide some solutions to overcome this barrier for some stroke  
5 survivors.

6 Building on previous CIMT studies, the current study provides additional  
7 evidence to address the CFIR ‘Implementation’ domain (Damschroder et al., 2022).  
8 This study indicates that therapist and stroke survivor pre-CIMT perceptions did not  
9 reflect the stroke survivors’ experience of CIMT. CIMT is an evidence-based  
10 intervention that has the capacity to improve arm recovery outcomes for stroke  
11 survivors. If this opportunity is to be realised occupational therapists need to ensure that  
12 their perceived barriers do not erroneously limit access of stroke survivors to evidence-  
13 based interventions.

14 This was the first study to offer stroke survivor protocol selection. With no  
15 evidence that one CIMT protocol is more effective in improving arm outcomes  
16 (Kwakkel et al., 2015), we recommend that, where possible, a choice of evidence-based  
17 protocols is offered to stroke survivors to support acceptability and feasibility of  
18 participating in the protocol. This collaborative approach provides opportunity for  
19 stroke survivors to consider the intensity of the protocol, their personal circumstances  
20 and the ‘Outer Setting’ to establish if the CIMT protocol will be feasible for them.  
21 TeleCIMT, CIMT provided remotely (Christie et al., 2022a), may also provide an  
22 alternative means to also increase accessibility of the CIMT intervention. If the CIMT  
23 protocol must be defined, a protocol involving three hours training and three to four  
24 hours constraint was considered acceptable and found to be feasible for the stroke  
25 survivors in this study. We would therefore recommend a protocol with these features.



1 Therapist perceptions and beliefs about CIMT protocols that do not align with those of  
2 stroke survivors need to be addressed through pre-registration and post-registration  
3 education. This education should include stroke survivors sharing their experience of  
4 undertaking CIMT.

5         Whilst this was a small study, the findings align and supplement previous CIMT  
6 evidence from outside the UK. Further study should aim to develop implementation  
7 strategies to increase adoption of CIMT in the UK. These studies should be larger and  
8 include quantitative measurement of the impact of the CIMT on arm function outcomes.  
9 Reducing gatekeeping in future studies will help establish who benefit from this  
10 potentially beneficial intervention.

### 11 ***Limitations***

12         This study has gained meaningful insights into the experiences of the stroke  
13 survivors and therapists who participated. The experiences of the stroke survivors in this  
14 study are reflected in other studies (Christie et al., 2022b; Sweeney et al., 2020; Walker  
15 and Moore, 2016) increasing confidence in our findings; however, transferability of the  
16 findings from our study may have been enhanced with additional stroke survivor  
17 participants. The findings provide a wealth of information, with probing utilised to  
18 achieve data saturation at the level of each interview (Saunders et al., 2018).

19 Nonetheless, it is possible that further interviews would enrich the themes.

20         This study did not include a specific behavioural transfer package as part of the  
21 CIMT intervention. Whilst this probably reflected current practice (Christie et al.,  
22 2019), and did not seem to detrimentally influence participation in the protocol, future  
23 work should explore the importance of this, and the other components of CIMT.  
24 Understanding the contribution of each component, will support the selection and

1 implementation of CIMT protocols that are effective, and also acceptable and feasible to  
2 therapists and stroke survivors.

### 3 **Conclusion**

4 There is evidence that although CIMT has been shown to be effective in a small sub-  
5 group of stroke survivors, it has not been widely implemented in the UK. This study  
6 explored therapist and stroke survivor perceptions and experiences of CIMT and  
7 identified a wide range of potential barriers and enablers of CIMT. These should be  
8 considered where CIMT is being commissioned or implemented. It is important that  
9 therapists do not make assumptions about stroke survivors' capacity to undertake a  
10 CIMT protocol based on their own perceived barriers to this evidence-based  
11 intervention. In this study, giving stroke survivors an informed choice over the CIMT  
12 protocol they undertake appeared to enable participation. Three to four hours of training  
13 and three to four hours of additional constraint was found to be acceptable and feasible  
14 to all stroke survivor participants in this study. This information may inform the design  
15 and protocol selection in practice and future CIMT studies.

16

### 17 **Key findings**

18 Three to four hours of training and three to four hours of additional constraint over a  
19 two-week duration was found to be acceptable and feasible to stroke survivor  
20 participants in this study.

21 Therapist perceptions and stroke survivor experiences of the implementation of CIMT  
22 were not congruent.

23 Future CIMT protocol development and implementation should incorporate the

1 authentic involvement and engagement of both therapists and stroke survivors.

2

3

4 **What the study has added**

5 Therapist perceptions may prevent the successful implementation of CIMT. This study  
6 indicates the importance of understanding stroke survivors' views of their rehabilitation  
7 interventions to ensure the potential of evidence-based interventions is appropriately  
8 harnessed.

9

10

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## Appendices

### Appendix 1: Summary of protocols for discussion with stroke survivors

Protocol (P)	Length of protocol	No. of training days per week	Training	Restraint	No. of restraint days per week
P1	2 weeks	5	Up to 6hrs per day <i>Average 4.5hrs</i>	90% of waking hours	7
P2	2 weeks	5	4hrs per day	90% of waking hours	5
P3	2 weeks	12 consecutive days	3hrs	90% of waking hours	12 consecutive days
P4	2 weeks	5	1 hr	4hrs per day	7
P5	2 weeks	5	3hr per day	6 hrs per day	5
P6	3 weeks	5	5hrs per day	5hrs per day	'Each day' not stated if this included weekends
P7	4 weeks	Not reported	4hrs per week	4hrs per day	7
P8	4 weeks	5	3hrs	90% of waking hours	5
P9	10 weeks	3	1hr	5hrs per day	5

## Tables

**Table 1: Focus group schedule-key questions (therapists)**

<b>Focus Group Schedule (key questions)</b>
Facilitator presentation of an overview of the evidence-based CIMT protocols
Main questions to be addressed:
1. Do you think any of the protocols could be provided in the stroke service? If so, which ones?
2. When (time-post stroke) should/could a CIMT protocol be provided?
3. Where (in what therapeutic setting, home, hospital, clinic, other) should/could a CIMT protocol be provided?
4. With whom should/could a CIMT protocol be provided?
5. Do you think there are factors that would help the provision of CIMT protocol?
6. Do you think there are factors that would hinder the provision of CIMT protocol?



**Table 2: Interview schedules-key questions (stroke survivor interviews)**

<b>Pre-CIMT Interview Schedule</b>
<ol style="list-style-type: none"><li>1. Do you think you have experienced CIMT as part of the therapy you have received? If so, what did it entail? Can you tell me what you thought about the CIMT intervention?</li><li>2. Do you think you would be able to undertake a full CIMT protocol (as described earlier)? If no, why do you feel you would be unable to undertake a CIMT protocol?</li><li>3. Which protocol/s do you feel you would be able to undertake and why?</li><li>4. Are there factors that would help you to undertake a CIMT protocol?</li><li>5. Are there factors that would make it harder for you to undertake a CIMT protocol?</li><li>6. Is there anything that would make undertaking a CIMT protocol more acceptable?</li></ol>
<b>Post CIMT Interview Questions</b>
<ol style="list-style-type: none"><li>1. Can you tell me about the CIMT you experienced?</li><li>2. How did it feel to have your hand restrained?</li><li>3. How did it feel to undertake the practice of activities?</li><li>4. Were you able to carry out the CIMT as it was planned?</li><li>5. Were there benefits in undertaking CIMT?</li><li>6. Were there disadvantages to undertaking CIMT?</li><li>7. Did you feel your ability to use your arm and hand changed with the CIMT?</li><li>8. How did you feel during the CIMT?</li><li>9. Were there factors that helped you to undertake the CIMT protocol?</li><li>10. Were there factors that made it harder for you to undertake a CIMT protocol?</li><li>11. If you were offered CIMT again, would you take it?</li></ol>

**Table 3: Summary of therapist characteristics**

Pseudonym	Therapy profession (OT or PT)	Agenda for Change Job Band *	Time working with stroke survivors
Ida	OT	7	6-10 yrs
Jane	OT	6	3-5 yrs
Katrina	OT	6	< 3 yrs
Lena	PT	6	< 3 yrs
Monica	PT	7	11-15 yrs
Nic	PT	6	3-5 yrs
Orla	PT	5	< 3 yrs
Petra	PT	8a	16-20 yrs

\*Further details can be found at: <https://www.nhsemployers.org/topics-networks/pay-pensions-and-reward/nhs-terms-and-conditions-service-agenda-change>

**Table 4: Summary of stroke survivor characteristics**

Pseudonym	Age	Lived alone?	Type/location of stroke	Dominant hand	Pre-CIMT Hospital Anxiety and Depression Score # potential anxiety \$ potential depression	Pre-CIMT Montreal Cognitive Assessment * potential cognitive impairment	Time since stroke
Janet	58	no	Ischaemic/right hemisphere	Right	Anxiety: 11 # Depression: 15 \$	27	6 months
Margaret	69	no	Ischaemic/right hemisphere	Right	Anxiety: 1 Depression: 4	28	6 months
Tina	37	yes	Haemorrhagic transformation of an ischaemic stroke/left hemisphere	Right	Anxiety:12 # Depression:15 \$	22 *	7 months
Tony	55	no	Ischaemic/left hemisphere	Right	Anxiety:7 Depression:10 \$	15 *	6 months