BMJ Open

Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-042879
Article Type:	Original research
Date Submitted by the Author:	17-Jul-2020
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Keywords:	Stroke < NEUROLOGY, REHABILITATION MEDICINE, QUALITATIVE RESEARCH

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Title: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

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Abbreviated title: *Implementation of post-stroke sensory rehabilitation: A qualitative study*

Key words: Occupational therapy, physical therapy, somatosensory disorders, implementation science, health services research, neurosciences

Word Count: 261 (Abstract)
4980 (Introduction, Procedures, Findings, Discussion)

References: 46

Tables: 3

Appendices: 4

ABSTRACT

Objectives Somatosensory loss is common after stroke with one-in-two individuals affected. Although clinical practice guidelines recommend providing somatosensory rehabilitation, this impairment often remains unassessed and untreated. To address the gap between guideline recommendations and clinical practice, this study sought to understand the factors influencing delivery of evidence-based upper limb sensory rehabilitation after stroke.

Design Qualitative focus group interviews. Data analysis used an inductive approach (thematic analysis) and deductive analysis using implementation theory (Theoretical Domains Framework and Normalisation Process Theory).

Setting Eight healthcare organisations in metropolitan and regional areas of Victoria and New South Wales, Australia.

Participants: Eighty-seven rehabilitation therapists (79% occupational therapists and 21% physiotherapists) were purposively recruited and participated.

Results: Three types of factors influenced therapists' delivery of upper limb somatosensory rehabilitation: individual ('*The uncertain, unskilled therapist*'), patient ('*Patient understanding and priorities')* and organisational ('*System pressures and resources'*). Deductive analysis using implementation theory identified key determinants of practice change, such as opportunities to consolidate new skills, the anticipated benefits of upskilling as a therapy team and the work anticipated by therapists to incorporate a new somatosensory rehabilitation approach.

Conclusions: Occupational therapists and physiotherapists hold valuable insights towards practice change in somatosensory rehabilitation from the 'frontline'. Therapists experience barriers to change including a lack of knowledge and skills, lack of resources and organisational pressures. Facilitators for change were identified, including social support and therapists' perceived legitimacy in using new somatosensory rehabilitation approaches. Results will inform the design of a tailored implementation strategy to increase the use of evidence-based somatosensory rehabilitation in Australia.

Trial registration: Australian New Zealand Clinical Trials Registry (ACTRN2615000933550)

Strengths and limitations of this study

Strengths:

- This study used a qualitative design with inductive and deductive data analysis using two knowledge translation theories to increase credibility of findings
- Participants (n=87) from eight different health organisations contributed to a representative sample of stroke rehabilitation therapists
- Three independent researchers were involved in data analysis to increase validity

Limitations:

- Focus groups included therapists of different grades and levels, which may have introduced a power differential in groups and potential for response bias
- The perspectives of stroke survivors and health organisation managers were not included in this study

BACKGROUND

Half of all stroke survivors experience somatosensory loss[1-4] yet treatment for this impairment has been historically overlooked.[5,6] Research reveals a persistent evidence-practice gap in the area of somatosensory rehabilitation.[7-9] Occupational therapists and physiotherapists are professionally responsible for the assessment and treatment of somatosensory loss after stroke. Their accurate detection of somatosensory deficits, such as impaired touch, proprioception or haptic object recognition, give stroke survivors an opportunity for treatment. Standardised assessments are underutilised by occupational therapists and physiotherapists and informal measures are much more common.[7] Treatment for somatosensory loss typically focusses on compensation (such as providing education to avoid limb injury) with a lack of evidence-based treatments aimed at regaining somatosensory function.[7] These practices may discount stroke survivors' perceptions of somatosensory loss as 'significant', 'concerning', and having a negative impact on daily life, promoting a perception the impairment cannot be treated.[10-12]

Following the publication of a Cochrane review[13] evidence for somatosensory rehabilitation has increased.[14] A more recent systematic review found that discrimination retraining programmes may improve upper limb somatosensory impairment after stroke.[15] Clinical guidelines provide recommendations about the assessment and treatment of somatosensory loss.[16-18] However, clinical audits suggest that these recommendations are not widely implemented.[8]

Factors contributing to the underuse of somatosensory assessment and rehabilitation were explored in one Australian study.[19] Occupational therapists and physiotherapists in this study based their assessment and treatment choices on prior knowledge and clinical experience rather than research, as well as organisational factors such as time available and patient length

of stay.[19] Patient factors also influenced practice; somatosensory assessments were often not completed if a stroke survivor did not raise loss of sensation as a concern, or therapists believed that a patient could not participate in the assessment. These factors are consistent with other areas of stroke rehabilitation where implementation of evidence-based practice is influenced by health professionals' lack of time, knowledge, staffing issues and patient factors such as prioritisation and safety.[20] Authors have recommended further research into specific factors influencing clinical decision-making and practice for stroke survivors with somatosensory loss.[7,21]

The aim of our study was to understand the barriers and enablers faced by occupational therapists and physiotherapists in the implementation of somatosensory assessments and interventions for stroke survivors, to provide an explanation of underlying mechanisms that enhance or inhibit such implementation. As this study sought to explore barriers, enablers and any other factors influencing implementation of somatosensory guidelines in practice, the use of implementation theories was warranted, and included the Theoretical Domains Framework[22] and Normalisation Process Theory.[23] Implementation science is a field of study dedicated to methods for increasing research use in practice.[24] The use of theory is central to implementation science.[25] Theory helps provide a framework for investigating influences on behaviour, and a process for guiding behaviour change interventions.[26] Theoretical approaches in implementation science are often interdisciplinary, drawing on fields of psychology, sociology and economics.[27] Multiple theories are sometimes used to provide different perspectives and avoid a 'conceptual straight-jacket'.[28]

One study has previously used an implementation theory to investigate clinical behaviour in somatosensory rehabilitation.[29] A group of nineteen occupational therapists completed an

online questionnaire prior to participating in a workshop based on the Theory of Planned Behaviour. Therapists reported lacking the necessary knowledge and skills to deliver somatosensory rehabilitation, lack of resources and time to locate evidence and use new somatosensory assessments and treatments. That study sample was small and was limited to a self-report questionnaire. A more in-depth study is required, involving interviews with both occupational therapists and physiotherapists who provide somatosensory rehabilitation to stroke survivors.

PROCEDURE

This qualitative study presents data from interviews conducted with occupational therapists and physiotherapists, to enable the development of a tailored implementation strategy. A primary goal of the implementation strategy was to improve the routine use of somatosensory assessments and interventions after stroke (Trial Registry ACTRN2615000933550).[30]

Design

We used a descriptive qualitative design to explore determinants of practice[31] and help explain and describe complex processes and behaviours. Data were collected at eight healthcare organisations using pre-implementation questionnaires and focus group interviews of one-hour duration. Two members of the research team (LSC and YMY) attended focus groups, one person moderating the group, the other person taking notes about group interaction and non-verbal communication. If therapists were unable to attend the focus group, separate interviews were held face-to-face or via telephone by LSC. Interview questions (Appendix 1) were open-ended and informed by the Theoretical Domains Framework.[22] Interviews were audio-recorded with participant consent and transcribed verbatim by authors (LSC and YMY). Field notes were taken during and after each interview.

Participants

Participants were graduate occupational therapists and physiotherapists working with stroke survivors in participating healthcare organisations. Organisations were recruited to the study through telephone and email contact, and face-to-face meetings with managers. Purposive recruitment of therapists occurred during an information session held at the eight participating organisations, presented by LSC and YMY. All therapists attending provided written consent to participate in the study (Ethics approval reference: H2013/04956 HREC/13/Austin/8).

Research team and reflexivity

LSC acted as a facilitator-researcher for interviews and primary coding-researcher. YMY was a facilitator-researcher for interviews. NAL and AM were coding-researchers. LSC is a neurological occupational therapist with a Masters of Public Health. She is a lecturer completing a doctorate on knowledge translation in somatosensory rehabilitation. LSC has experience assessing and treating somatosensory loss in stroke survivors, with an interest in somatosensory rehabilitation which may have been known to participants and be a potential source of bias. LSC had previously worked with some participants at four sites but not at the time of the interviews. YMY is a neurological occupational therapist completing her doctorate on standardised assessment in somatosensory rehabilitation. LSC and YMY have published and presented about somatosensation in stroke rehabilitation at conferences.

NAL and AM are experienced neurological occupational therapists with PhDs, who have been involved in the development of stroke clinical guidelines and stroke implementation studies. NAL and AM were not involved in data collection, and did not know the source of quotes they were coding.

Data analysis

All transcripts were given a unique identifier. A two-staged approach to analysis was used to inductively identify key themes (Stage 1), then data were deductively coded against the TDF and NPT (Stage 2) using a theory-informed approach. Two members of the research team conducted the analysis in each phase.

Stage 1: Thematic Analysis

First an inductive approach was applied using thematic analysis to identify and interpret key themes.[32,33] Two researchers (LSC and AM) open coded a sample (20%) of transcripts line-by-line, then met regularly to develop and revise the coding framework. LSC analysed remaining transcripts with ongoing consultation with co-authors. An audit trail of discussions and decisions was kept, leading to resultant codes, categories and ultimate themes. Any discrepancies were resolved through discussion and review of the original transcripts.

Stage 2: Analysis using the Theoretical Domains Framework and Normalisation Process Theory

Theoretical Domains Framework (TDF)

A deductive analysis approach was then taken using the TDF.[22] LSC and NAL separately coded a sample of transcripts (20%) to relevant domains of the TDF and met regularly to compare and discuss coding decisions. LSC analysed the remaining transcripts, which were collated into domain codes, discussed and revised through an iterative process with NAL. See Appendix 2 for the TDF codebook.

Normalisation Process Theory (NPT)

A complementary deductive analysis occurred using NPT (May & Finch, 2009).[23] Coding to NPT provided insights into how teams of therapists conceptualised somatosensory rehabilitation. It is acknowledged NPT constructs need to be given their own working definition for individual settings[34] to make NPT 'at home' in the context of the study (May et al., 2020).[35] This process was completed through iterative discussion between LSC and AM (See Appendix 3 for NPT codebook). LSC and AM separately coded a sample of transcripts (20%) to categories and constructs of the NPT, followed by discussion. LSC analysed the remaining transcripts, resultant category and construct codings were reviewed, discussed and refined in meetings with AM.

The coding frameworks and domains, categories and constructs in the second and third stages of analysis were reviewed for agreement by NAL and AM.

FINDINGS

Eighty-seven occupational therapists and physiotherapists participated in interviews across eight healthcare organisations. Two sites were private healthcare organisations and six were public healthcare organisations. Tables 1 and 2 outline participant and site characteristics.

Table 1. Characteristics of participants

Characteristic	n = 87
Sex, number female (%)	80 (92)
Discipline, number (%)	
Occupational Therapist	69 (79)
Physiotherapist	18 (21)
Highest Education Level, number (%)	
Bachelor Degree	72 (83)
Coursework Masters	8 (9)
Research Masters	6 (7)
Not specified	1 (1)
Years of clinical experience (*yrs*), mean (SD)	10.6 (2.1)
Years of working in stroke (*yrs*)	7.9 (3.5)

Table 2. Number of participants attending interviews at the eight sites (n=87)

Organisation	**Type of health service and location**	**Focus Group Interview**	**Small group / Individual interviews**
		No. of therapists	No. of therapists
1	Tertiary, Metropolitan	10	1
2	Tertiary, Metropolitan	9	0
3	Tertiary, Regional	12	3*
4	Tertiary, Metropolitan	10	3*
5	Tertiary, Metropolitan	6	1
6	Tertiary, Regional	6	1
7	Tertiary, Metropolitan	12	0
8	Tertiary, Metropolitan	6 and 7^	0

** One small group interview with three participants*
^ Two separate focus group interviews held at geographically separate sites within same organisation

Table 3 provides an overview of themes and codes in different analysis stages.

Table 3: *Overview of themes and prominent codes*

	Phase 1: *Thematic coding*	Phase 2: *Theoretical Domains Framework*	*Normalisation Process Theory*
Inductive analysis	Themes: *(1) The uncertain unskilled therapist* Subtheme: *The importance of getting it right* *(2) The patient's understanding and priorities* Subthemes: *Needing to focus on patient goals* *Helping the patient to understand* *(3) System pressures and resources* Subthemes: *Not having the right tools* *Sharing or deferring professional roles*	**Deductive analysis** Key domains: ***Knowledge*** [Whether or not the therapist has knowledge of evidence-based sensory rehabilitation and how to do it] ***Skills*** [Whether or not the therapist has the ability and competence to provide evidence-based sensory rehabilitation] ***Environmental context and resources*** [Whether or not the therapist believes the environmental context – physical or cultural - supports delivery of sensory rehabilitation] ***Social professional role and identity*** [Whether identity as an occupational therapist or physiotherapist influences whether they provide evidence-based sensory rehabilitation] ***Social influences*** [Interpersonal processes causing therapists to change their thoughts, feelings or behaviours towards evidence-based sensory rehabilitation]	Key categories and constructs: ***Individual specification (Coherence)*** [Does the therapist acknowledge their personal role in, and responsibility to use evidence-based sensory rehabilitation?] ***Internalisation (Coherence)*** [Does the therapist identify any benefit from adopting evidence-based sensory rehabilitation? Therapist coming to a conclusion about its worth] ***Legitimation (Cognitive Participation)*** [Does the therapist believe it is appropriate for them to deliver evidence-based sensory rehabilitation?]

Phase 1: Thematic analysis

Three main themes or factors, and associated sub-themes, were found to influence therapists' delivery of upper limb somatosensory rehabilitation: The uncertain unskilled therapist, patient understanding and priorities, and system pressures and resources.

Theme one: The uncertain unskilled therapist

A key finding was a self-identified lack of knowledge, skill and confidence to deliver somatosensory rehabilitation. Therapists expressed negative emotions related to these experiences and were concerned about using new somatosensory approaches in the 'right' way. Therapists acknowledged they often had little awareness of standardised assessments:

> *"It was realising there's...objective assessments…and not knowing any of them! So that's a bit scary"* (Physiotherapist, Site 1)

Uncertainty about using assessment information to address sensory loss was also acknowledged:

> *"I find that I tend to assess, but then I don't know what to do with that information."* (Occupational therapist, Site 5)

Therapists were aware of their limitations when required to deliver somatosensory rehabilitation. They experienced various emotions including "guilt" and "frustration":

> *"I feel a little bit guilty…about what I have been doing in the past. This…shows me how much more I could have been doing"*(Occupational Therapist, Site 5)

Therapists expressed a lack of confidence related to somatosensory rehabilitation, which led them to deprioritise this area of practice and focus on others:

> *"I find that it isn't a priority for me to assess…as I don't feel confident with it and it kind of gets pushed to the left over time in the session" (Occupational therapist, Site 2)*

Subtheme: The importance of getting it right

Therapists felt a weight of responsibility to change their practice, and use new knowledge and skills appropriately to benefit patients:

> "*I think there's also that little bit of hesitation of something new…. am I going to do it right?" (Occupational therapist, Site 8)*

Lack of skill consolidation after upskilling in evidence-based sensory rehabilitation was a concern to some therapists. Without consistency of practice some therapists worried they might not be ready when the need for their somatosensory skills arose:

> *"I also feel a little bit nervous…with doing this amazing training and there will be no-one to use it on for 6 months… when I finally get to that client, will I be ready?" (Occupational therapist, Site 8)*

Theme two: The patient's understanding and priorities

This theme encompassed therapists' perceptions of patient understanding of sensation, the goals set in rehabilitation and the therapist's role in helping patients understand sensation. Therapists wanted to be guided by patients and set patient-centred goals, but highlighted a

lack of understanding about sensation by some stroke survivors. Sensation was seen as a more abstract concept to patients when contrasted with physical deficits which were more easily described and understood:

> "*There's often a confusion between motor and sensation, like sometimes they'll say 'My muscles need to be stronger' but when you test it's very obvious that it's not actually a motor issue, it's…more of a sensory impairment" (Occupational therapist, Site 6)*

Patient priorities were often perceived to be in areas other than somatosensory rehabilitation, particularly for inpatients:

> *"From an inpatient perspective it's* [sensation] *quite often… not the client's priority" (Occupational therapist, Site 2)*

Subtheme: Needing to focus on patient goals

Goal setting, as a tenet of stroke rehabilitation, was proposed to guide therapists in practice. However, not all patients wanted to set 'sensory-goals' and this perception impacted on therapists' clinical decision-making to conduct somatosensory assessments and provide subsequent treatment:

> *"You can't assess it* (sensation) *and treat it if it's not their goal. It has to be goal driven" (Occupational therapist, Site 6)*

Subtheme: Helping patients to understand

When patients lacked an understanding of sensation, many therapists believed it was part of their professional role to increase patients' knowledge about the impact of somatosensory

loss on upper limb function. Therapists at separate sites independently described the importance of this role for giving patients a 'lightbulb' moment:

> *"It's not until you take time and assess and explain how that* [sensation] *would be affecting the motor problems, and it's almost like a light bulb for people…they haven't had the words to articulate it"(Occupational therapist, Site 7)*

Others mentioned that it suited therapists that patients often didn't understand sensation and prioritise this because they did not know how to deliver somatosensory rehabilitation anyway:

> *"I do find myself wondering whether it's a bit of a chicken and the egg situation…it kind of suits us that sensory stuff is down the bottom but I'm not sure how that goes. Have we articulated that to the patients, to try to help them to understand, or is that an accurate reflection of the patient's experience?" (Occupational therapist, Site 8)*

Theme three: System pressures and resources

This theme includes pressures experienced by therapists in their organisations, the lack of resources to deliver somatosensory rehabilitation and sharing work responsibilities within a rehabilitation team. Therapists described organisational factors that created competing demands and reduced opportunities to provide somatosensory rehabilitation. There was pressure, particularly on inpatient therapists, to facilitate discharge for patients and this was perceived as highly valued by their organisation. This expectation often came at the expense of providing upper limb somatosensory rehabilitation:

"*To facilitate someone to go home, or leaving the hospital is more highly valued* [than somatosensory rehabilitation]*"(Occupational therapist, Site 7)*

Community-based therapists were less affected by hospital discharge pressures but still experienced competing demands related to their own, rather than organisational expectations:

"I find I can't really spend an hour just doing sensation…maybe half an hour doing sensation and then all the return to work and everything else that's going on, so…being able to dedicate pure session for upper limb retraining is hard" (Occupational therapist, Site 1)

Subtheme: Not having the right tools

Lack of appropriate equipment to assess and treat somatosensory deficits was a common barrier for therapists. Disorganised equipment and tools were observed by some as a representation of time and effort placed on somatosensory rehabilitation to date:

"We have bits and pieces, scraps of stuff that we kind of throw together and we haven't got any formal, really good quality assessments or treatments, you know just hobbled together stuff…so it kind of reflects the importance or…how much time we put into it"(Occupational therapist, Site 8)

Therapists, however, anticipated that having the right equipment would improve their practice and skill development, and improve their confidence in delivering somatosensory rehabilitation:

"If you have the proper equipment, we will be more confident to use it and we'll look more professional too" (Occupational therapist, Site 7)

Subtheme: Sharing or deferring professional roles

Occupational therapists and physiotherapists spoke of overlapping professional responsibility in the delivery of somatosensory rehabilitation, and in some situations, sharing the workload. More often, responsibility for upper limb somatosensory rehabilitation was assumed by the occupational therapist. This role expectation was often related to physiotherapists' workload and the need to delegate to focus on other rehabilitation areas:

> *"I'll be the first to admit if I've got an OT working with my client at the same time, then I won't prioritise upper limb sensory" (Physiotherapist, Site 6)*

Phase 2: Analysis using implementation theory

An overview of coding to domains and categories of the TDF[22] and NPT[23] is provided in Appendix 4.

Analysis using The Theoretical Domains Framework

The domains coded most frequently were Knowledge, Skills, Environmental context and resources, Social professional role and identity, and Social influences.

Knowledge

In alignment with thematic coding, lack of knowledge about somatosensory rehabilitation was frequently coded as a barrier to evidence-based practice. Procedural knowledge, a construct of the Knowledge domain, prompted coding of sources of knowledge. Therapists felt that their university education had often left them unprepared to provide somatosensory rehabilitation:

> *"When I went through university as well…I don't think it was an area that I believe was well*

taught at that time…I didn't feel like I had a good grounding to even run with" (Occupational therapist, Site 6)

Opportunities for development of somatosensory knowledge in the workplace were also scarce for some therapists, as were opportunities to acquire skills by observing or asking colleagues:

"*… it's* (sensory rehabilitation) *not something that you can learn off a colleague ….This is not an area where I can ask one of my more experienced colleagues about, it's not something that they would necessarily know" (Occupational therapist, Site 8)*

The TDF Knowledge domain also highlighted what therapists knew about the impact of somatosensory loss on patients, and gaps in therapist knowledge:

"… sometimes it's hard for us to understand the impact of sensory loss. Motor loss you can see the impact…but if they have functional upper limb but sensation is the main issue, I don't think we are as good at realising how much of an impact that could have" (Occupational therapist, Site 5)

Skills

Coding to the Skills domain of the TDF highlighted a perceived skill gap and barrier to evidence-based practice. The ability to develop and consolidate skills through exposure to appropriate patients was seen as an enabler for sustaining skill levels:

"…and to consolidate early so then it becomes second nature rather than lose all the knowledge that we've learnt" (Occupational therapist, Site 1)

Coding to this domain also highlighted the need for specialised skills when working with stroke survivors with common post-stroke deficits such as aphasia or cognitive impairment who needed somatosensory rehabilitation:

> *"Clients that do have communication impairments is the other one…how do I get them to talk this out?...in the past we've done some comparisons with things but if they don't have the language, I really don't know what to do" (Occupational therapists, Site 8)*

Environmental context and resources

Within this TDF domain, the constructs of environmental stressors, resources and person versus environment interactions were most relevant. Environmental stressors were recognised most by inpatient therapists and corresponded with findings in thematic coding (see '*System pressures and resources*'). Resources referred to equipment and physical spaces that were needed to deliver somatosensory rehabilitation, including quiet rooms to facilitate sustained attention on assessments and therapy:

> *"To get to a private space or a quiet space to do the assessment or to have the equipment somewhere easy in a quiet space, that might be a physical barrier" (Physiotherapist, Site 3)*

Theoretically, the workplace provided a supportive culture for evidence-based practice, but practically, implementation was often left up to individual therapists:

> *"Quite often it feels like it's up to individual therapists to – which make sense – to bring on change…but in order to do that ….requires a lot of …energy and effort. And so the organisation embraces it but not necessarily enables it to happen easily"(Occupational*

therapist, Site 6).

Social professional role and identity

Therapists commented on two predominant areas within this TDF domain: their own professional role and identity, and their organisation's identity or 'brand' and how these factors influenced their perspective and practice. Physiotherapists mentioned that they would often defer upper limb sensory rehabilitation to occupational therapists (as per thematic coding, '*System pressures and resources'*, subtheme '*Sharing and deferring professional roles'*). Occupational therapists communicated that although upper limb sensory rehabilitation was a part of their job and assumed expertise, it was not a role they were always comfortable with:

"In terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (Occupational therapist, Site 8)

Organisational identity was also mentioned as an enabler by therapists at sites which aspired to high-quality healthcare, for example, through involvement in research and delivery of evidence-based practice. Therapists felt that this quality 'brand' aligned with their own desire to provide evidence-based stroke rehabilitation and justified their efforts to implement somatosensory rehabilitation:

"We've got a very strong commitment to…using evidence-based practice, and keeping abreast of new research and new techniques that are coming out"(Physiotherapist, Site 1)

Social influences

Interpersonal processes had an impact on therapists' delivery of somatosensory rehabilitation.

This influence was exerted by work colleagues, either peers or managers, or patients. Colleagues supported practice change. The intended team training was anticipated to be beneficial, in contrast to individuals attending a professional development training session and trying to effect change:

> *"It will be really helpful having so many therapists who actually know how to do it* [sensory rehabilitation]*...we can spur each other on and to get each other to do it" (Occupational therapist, Site 7)*

Patients also influenced whether somatosensory rehabilitation was provided or not. Community-based therapists expressed that a precedent could be set when therapy was provided during inpatient rehabilitation. However, if somatosensory impairments were not identified and/or treated there, patients may not want to focus on sensory rehabilitation:

> *"What they've* [patient] *been focused on as an inpatient often comes with them… 'I worked on this while I was in hospital, I want to keep working on it'…so introducing those new things* [sensory rehabilitation] *can also be a challenge"(Occupational therapist, Site 1)*

Therapists found some patients were well-informed about treatment options and wanted to pursue evidence-based rehabilitation:

> *"I'm finding that some patients are very savvy and have read up a lot about things and they will actually say 'Are you doing this treatment technique?'...I've had a couple of people who…have asked for some of the sensory things" (Occupational therapist, Site 2)*

Analysis using Normalisation Process Theory

Constructs most frequently used were Coherence, including Individual specification and Internalisation, and Cognitive Participation, specifically the construct of Legitimation. Coherence refers to work done to make sense of using a new practice, whereas Cognitive participation refers to relational work done to build enrolment and engagement in a new practice.[23]

Coherence: Individual Specification

Individual specification in this study related to therapists' understanding of their personal roles and responsibilities related to evidence-based somatosensory rehabilitation. Therapists were aware that they needed to move forward from previous practice patterns to incorporate something new:

> *"Just breaking what's old habits and changing practice and not defaulting to what's easy when we are feeling pressured and busy and tired…." (Occupational therapist, Site 1)*

Therapists also recognised their role in learning new skills related to equipment use and also providing therapy that required a high level of mastery of therapy techniques:

> *"More just that translating that training* [in sensory rehabilitation] *to then mastering that skill and remembering it" (Occupational therapist, Site 6)*

Coherence: Internalisation

Internalisation in this study referred to therapists' understanding of the value and benefit of using new evidence-based somatosensory rehabilitation approaches, and coming to a conclusion about the practice.[36] Most therapists held positive views about the effectiveness of the new approach and how it would add to their repertoire of skills:

> *"The impression that the treatment approach works so that is what I'm basing my enthusiasm on, that it is actually going to improve people's sensation and translate into their function." (Occupational therapist, Site 2)*

Therapists at some sites observed colleagues using new somatosensory rehabilitation approaches, which contributed to conclusions drawn about the approach:

> *"I can see the difference in the results as well that people who get SENSe training get" (Occupational therapist, Site 7)*

Cognitive Participation: Legitimation

Legitimation in this study referred to therapists' beliefs about whether or not it was appropriate for them to be involved with the new evidence-based sensory rehabilitation approach, in their particular context. Some therapists believed that the evidence base for somatosensory rehabilitation legitimised their future use of it, and helped support the anticipated time required to change practice:

> *"Because there's evidence behind this program already…there's a bit more weight to it in terms of when you are selling it to other health professionals or to our clients and their families in terms of how much time is needed" (Occupational therapist, Site 5)*

Therapists from an inpatient setting wondered how their patients would participate in the therapy. Some believed this area of practice was more suitable for use by their community-based colleagues:

"I'm not sure how well received the treatment would be with all of our patients" (Occupational therapist, Site 5)

Some therapists felt that somatosensory rehabilitation was considered to be an assumed skill by managers, which justified their involvement in, and use of the new rehabilitation approach:

"I don't necessarily think we would have…barriers put up by our direct managers….I think to a degree they'd already expect us to be doing this as part of our jobs" (Occupational therapist, Site 1)

The need for extensive one-to-one therapy as part of this new approach, which required 'hands-on' intervention, was felt to be at odds with current practice at one site, and a potential barrier to practice change, with therapists stating that:

"There is a move for…more self-directed [therapy]*…the patient taking ownership of their problem and working on that themselves, rather than you sitting down one-on-one" (Physiotherapist, Site 3)*

Finally, therapists talked about the importance of goal-directed rehabilitation and felt that SENSe therapy was aligned with this principal:

"It's a goal-based service…the client has a lot of input into their…rehabilitation…by having really specific goals. So it's helpful that SENSe is very goal orientated as well." (Occupational therapist, Site 7)

DISCUSSION

Findings suggest three main themes or factors influencing delivery of upper limb somatosensory rehabilitation by occupational therapists' and physiotherapists': individual therapist factors ('*The uncertain unskilled therapist*'), patient factors ('*The patient's understanding and priorities)* and organisational factors ('*System pressures and resources'*). This study used a multi-phased approach for analysis, including both psychological and sociological implementation theories. Initial inductive analysis allowed a data-driven exploratory approach, before use of a deductive analysis, mapping data to pre-determined theoretical constructs. Implementation theory highlighted key determinants of practice, such as opportunities for practice to consolidate new skills (TDF domain 'Skills'), the anticipated benefits of upskilling as a therapy team (TDF domain 'Social influence'), and the tendency of physiotherapists to defer to occupational therapists for upper limb somatosensory rehabilitation (TDF domain 'Social Professional role and identity'). NPT highlighted the work anticipated and required by therapists, including the time and effort, to incorporate a new approach into practice and learn practical aspects of equipment use. This phased approach to analysis has previously been used in implementation research[37] and avoids theoretical 'blinders' resulting from a single method.[25]

Given the known evidence-practice gaps in somatosensory rehabilitation, [7,38] it is unsurprising that knowledge and skill barriers were prominent, consistent with previous studies.[19,39] Patient factors were rightfully important to therapists. Therapists wanted to be directed by patients about their stroke rehabilitation goals, but acknowledged that sensation was a poorly understood, abstract concept for many patients. For that reason, patients often did not raise sensation as an issue nor set 'sensory goals'. A cycle of patient non-inquiry and therapist non-delivery of somatosensory rehabilitation was suggested, which may be

important to address during implementation. Interestingly, therapists sometimes delineated between 'sensory goals' that were impairment based and 'functional goals' which were not, without noting the association between somatosensory capacities and occupational performance.[40,41]

The role of physiotherapists in somatosensory rehabilitation was also explored through this research. Although the proportion of physiotherapists in the sample was relatively small (21%), one theme that was evident across several sites was that occupational therapists assumed the primary role for upper limb somatosensory rehabilitation. This finding has potential implications for involving physiotherapists in somatosensory rehabilitation.

Organisational pressures were felt strongly by therapists. Inpatient occupational therapists were particularly influenced by pressures to facilitate discharge and clear rehabilitation beds. This pressure often compromised their ability to provide upper limb rehabilitation. Some therapists suggested that it might not be feasible for them to deliver somatosensory rehabilitation in their inpatient setting. This finding is similar to other studies regarding discharge pressures influencing provision of stroke rehabilitation therapies.[42,43] Social influences from colleagues and patients were identified as both enabling and hindering factors for change. Therapists held positive views about anticipated implementation efforts that would be directed towards them as a group rather than individuals. They perceived benefits of upskilling the whole therapy team and working together to use a new therapy approach.

Implementation theory helped to further elucidate perceptions towards changing practice and factors influencing translation. Mapping to domains of the TDF and NPT revealed common data points for triangulation, a layered understanding of themes, and new factors influencing

the implementation of evidence-based somatosensory rehabilitation not apparent during initial coding. An example of intersection between theoretical approaches used in this study was between the NPT category of '*Coherence: Internalisation*' and the TDF domain of '*Beliefs about consequences'*. Therapists' positive views towards the new somatosensory intervention and its effectiveness were mapped to both these components. Similarly, the TDF domain of '*Social Professional Role and Identity'* was found to align with the NPT category of '*Cognitive Participation: Legitimation'* in therapists' belief the intervention may be more suitable for community-based therapists.

Two other studies have used both the TDF and NPT to explore implementation issues [44,45] and multiple studies have applied more than one implementation theory.[46] This study mapped data to implementation theory, improving our understanding of factors which influence practice change, such as professional identity and work anticipated by therapists to embed a new therapy.

Strengths and limitations

There were several strengths of the study design and methods. First, the use of multi-phased analysis and implementation theory can heighten the sensitivity of researchers to interpretations that may not occur using inductive analysis alone[34]. Second, the number of health professionals (n=87) across eight different health organisations provided a representative sample of stroke rehabilitation therapists. Therapists unable to attend initial focus groups were followed up in small group interviews, allowing part-time therapists, and those in senior roles with family/carer responsibilities to participate. Their perspectives were valued. Limitations of this study include the fact that participating health organisations were largely selected by the research team. Furthermore, management personnel within these organisations may have influenced which therapists participated in the study. These factors

may have introduced sampling bias and influenced findings. In addition, therapists with different levels of experience and professional grades participated in the interviews, introducing a possible power differential within the group, and potential response bias.

Conclusions

This study used focus groups to explore the perspectives of occupational therapists and physiotherapists and found individual, patient and organisational factors influence the delivery of evidence-based somatosensory rehabilitation with stroke survivors. Therapists experience barriers to change including a lack of knowledge and skills, lack of resources and organisational pressures. Facilitators for change were identified, including social support and therapists' perceived legitimacy in using new somatosensory rehabilitation approaches. The theoretical lens used in this study will guide implementation during the SENSe Implement study, a project aimed at implementing an evidence-based sensory discrimination program.[14]

Ethics Committees approval:

Ethical approval for this study was granted by the Austin Health Human Research Ethics Committee (Reference: H2013/04956 HREC/13/Austin/8) and La Trobe University (Reference FHEC 14/243). Site specific ethics approval was obtained for all participating sites.

Acknowledgements:

We acknowledge and thank the busy occupational therapists and physiotherapists who participated in this study.

Funding:

We acknowledge support for conduct of the research from the National Health and Medical Research Council (NHMRC) of Australia partnership grant: A network of sites and 'up-skilled' therapists to deliver best practice stroke rehabilitation of the upper limb (GNT 1134495). LSC was supported by an Australian Government Research Training Program Scholarship. NAL was supported by a Future Leader Fellowship (102055) from the National Heart Foundation of Australia. DAO is supported by a NHMRC Translating Research into Practice Fellowship (GNT 1168749).

Competing interests:

LMC is the lead originator of the SENSe approach to sensory rehabilitation, the focus of knowledge translation in The SENSe Implement project. A SENSe training package (manual and DVD) has been developed and is available for purchase. SENSe assessment and training equipment are also available for purchase. LMC has no personal financial interest in the sale

of these resources. There is no patent, or intended application for a patent, associated with these resources. LMC has conducted workshops on the SENSe approach and been invited to give lectures and conference presentations on the approach. All other authors declare that they have no competing interests.

Author statement:

LSC, LC and NAL conceptualised the study. LSC and YMY conducted focus group, small group and individual interviews. LSC, LC, NAL, DAO and AM discussed and determined the approach to deductive analysis using implementation theory. LSC and AM were involved in thematic analysis. LSC, NAL and AM were involved in deductive analysis. LSC and NAL drafted the manuscript; all authors critically reviewed the manuscript and provided feedback.

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Appendix 1.

Focus group questions

Questions used in focus groups and small group interviews
1. *How able do you feel currently to change your practice regarding sensory assessment and treatment?*
2. *What do you think some of the challenges will be in using new assessment and treatment approaches?*
3. *What do you see as some of the strengths of this organisation in supporting your use of new sensory assessments and treatments?*
4. *How do you feel about the prospect of changing the way you assess and treat sensory loss?*
5. *Do you think the working environment (i.e. either cultural / physical) will impact on your ability to use new assessment and treatment approaches?*
6. What are the incentives for you currently, if any, to change your practice in the areas of sensory rehabilitation?
7. *Do you think a change in practice in the area of sensory assessment and treatment will have a positive effect on patient outcomes?*

Appendix 2.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Theoretical Domains Framework (TDF) Codebook

Note:
Sensory rehabilitation refers to both assessment and treatment of sensation, in this case using SENSe Assess and SENSe therapy

TDF Domain	Construct	Guidance/rule	Sample quotes
1. Knowledge An awareness of the existence of something *What do they know and how does that influence what they do?** *Whether the therapist has knowledge of sensory rehabilitation#*	Knowledge (including knowledge of condition/scientific rationale): *An awareness of the existence of something* Procedural knowledge: *Knowing how to do something* Knowledge of task environment: *Knowledge of the social and material context in which a task is undertaken*	Appropriate coding to this domain: Knowledge/Lack of knowledge of: ▪ Nature of post-stroke sensory loss ▪ Scientific rationale for sensory rehabilitation ▪ Clinical practice guidelines ▪ Sensory assessment and treatment approaches ▪ Procedure of sensory rehabilitation ▪ Equipment and materials needed ▪ Anecdotal evidence related to sensory rehabilitation Inappropriate coding to this domain: ▪ The active 'doing' of rehabilitation (code to Skills) ▪ Discussion of who provides sensory rehabilitation (code to Social	*"you educate the patients on you know, safety awareness between hot cold and sharp objects and what not, but in terms of rehabilitation…I'm just not aware of what to do" (Z1_P6)* *"I barely remember even covering sensation at uni" (O5_P3)* *"…they* [sensory assessments] *were all listed and I'm thinking I don't know them…from years of experience, I didn't know any of them……that was disconcerting" (C2_P10)* [Construct: Knowledge] *"I just do things but I don't know what principles they fall under and things like that, so… I was a bit overwhelmed'*

		Professional Role and Identity) ▪ Therapist report of patient knowledge regarding sensation	*(H4_P5)* [Construct: Procedural Knowledge]
2. Skills An ability or proficiency acquired through practice	Skills development: *The gradual acquisition or advancement through progressive stages of an ability or proficiency acquired through training and practice* Competence: *One's repertoire of skills, and ability especially as it is applied to a task or set of tasks* Ability: *Competence or capacity to perform a physical or mental act. Ability may be either unlearned or acquired by education and practice* Interpersonal skills: *An aptitude enabling a person to carry on effective relationships with others, such as an ability to cooperate, to assume appropriate social responsibilities or to exhibit adequate flexibility* Practice: *Repetition of an act, behaviour, or series of activities, often to improve performance or acquire a skill* Skills assessment: *A judgment of the quality, worth, importance. Level or value of an ability or proficiency acquired through training and practice*	Appropriate coding to this domain: ▪ Development of sensory rehabilitation skills ▪ Competence and ability in sensory rehabilitation ▪ Practice of sensory rehabilitation skills ▪ Evaluation of quality of sensory rehabilitation practices ▪ Discussion of how relationship/rapport between therapist and patient may promote use of sensory rehabilitation Inappropriate coding to this domain: ▪ How therapists feel about current skill level (Code to Emotion)	*"So it's not just necessarily about the knowing it's I think sometimes more about the doing….that's sometimes the hard part." (Y8_P1)* *"I also had a young patient recently who…his only issue was sensation, decreased sensation in his hand and I really didn't feel like I had the skills to know where to go in my specific intervention" (Y8_P3)* *"I'm not very skilled in that area* [sensory rehabilitation] *either. So I probably avoid it." (Z11_P1)* *"I think it's that carry over, you kind of get that feeling that you need to be doing it really regularly to be able to keep those skills up-to-date" (W13_P4)* [Construct: Practice] *"I'm probably a bit slap-dash in my approach to sensory assessments (L9_P6)* [Construct: Competence]

3. **Social/professional role and identity** A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting *How does who they are as an occupational therapist or physiotherapist influence whether they do something or not?**	Professional identity: *The characteristics by which an individual is recognised relating to, connected with or befitting a particular profession* Professional role: *The behaviour considered appropriate for a particular kind of work or social position* Social identity: *The set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a social group* Identity: *An individual's sense of self defined by a) a set of physical and psychological characteristics that is not wholly shared with any other person and b) a range of social and interpersonal affiliations (e.g., ethnicity) and social roles.* Professional boundaries: *The bounds or limits relating to, or connected with a particular profession or calling* Professional confidence: *an individual's belief in his or her repertoire of skills and ability especially as it is applied to a task or set of tasks.* Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group*	Appropriate coding to this domain: ▪ Who provides sensory rehabilitation ▪ Link between profession and tasks of sensory rehabilitation ▪ Boundaries between therapists in providing sensory rehabilitation ▪ Organisational commitment Identity could also relate to the identity of the organisation (i.e. a health service having a reputation of 'world-class healthcare')	*"if there's an OT involved we would deflect that as an OT thing as opposed to what we would do"* (C2_P4) [Construct: Professional boundaries] *"And I'll be the first to admit if I've got an OT working with my client at the same time then I won't prioritise upper limb sensory"* (L9_P6) *"in terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (Y3_P6)* [Construct: Social Identity]

	Leadership: *The processes involved in leading others, including organising, directing, coordinating and motivating their efforts toward achievement of certain group or organization goals* Organizational commitment: *An employee's dedication to an organisation and wish to remain part of it.*		
4. Beliefs about capabilities Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use *Do they think they can do what they should do and how does that influence whether they do it or not?** *The extent to which the therapist feels confident/in*	Self-confidence: *Self-assurance or trust in one's own abilities, capabilities and judgement* Perceived competence: *An individual's belief in their ability to learn and execute skills* Self-efficacy: *An individual's capacity to act effectively to bring about desired results, as perceived by the individual* Perceived behavioural control*: an individual's perception of the ease or difficulty of performing the behaviour of interest* Beliefs: *The thing believed; the proposition/set of propositions held true* Self-esteem: *The degree to which the qualities and characteristics contained in one's self-concept are perceived to be positive* Empowerment: *The promotion of the skills, knowledge and confidence*	Appropriate coding to this domain: ▪ Perceived behavioural control in delivery of sensory rehabilitation ▪ Therapist confidence in delivering sensory rehabilitation ▪ How easy or difficult therapists view delivery of sensory rehabilitation ▪ Self-efficacy and beliefs regarding sensory rehabilitation Inappropriate coding to this domain: ▪ Active delivery of sensory rehabilitation (code to Skills) ▪ Expectations of outcomes of using sensory rehabilitation (code to Beliefs about consequences)	*"there's a bit of trepidation around…needing to achieve a certain standard and being able to use a new tool and being able to… do it correctly" (Z1_P3)* *"And just your general confidence in yourself and…you're in the middle of a session and you're thinking I feel confident and competent in this skill…it's less stressful to approach that client with that issue" (W7_P4)* *"I'm coming into this thinking, you know this is really good, and it's obviously evidence based practice but can I provide this? Like there's this guilt that, you know, this is best care, this is what I should be doing with my patients but I don't have capacity for that" (O5_P4) [Construct: perceived behavioural control]*

control over performing the behavior#	*necessary to take great control of one's life as in certain educational or social schemes; the delegation of increase decision-making powers to individuals or groups in a society or organization* Professional confidence*: An individual's beliefs in his or her repertoire of skills, and ability, especially as it is applied to a task or set of tasks.*		
5. Optimism The confidence that things will happen for the best or that desired goals will be attained	Optimism: *The attitude that outcomes will be positive and that people's wishes or aims will be ultimately fulfilled* Pessimism: *The attitude that things will go wrong and that people's wishes or aims are unlikely to be fulfilled* Unrealistic optimism: *the inert tendency for humans to over-rate their own abilities and chances of positive outcomes compared to those of other people*	Appropriate coding to this domain: ▪ Therapist discussion of optimism or pessimism related to use of sensory rehabilitation ▪ Positive or negative view towards process of change in study Inappropriate coding to this domain: ▪ Feeling of anxiety, stress or burnout (code to Emotion) ▪ Thoughts towards outcomes of sensory rehabilitation (code to Beliefs about consequences)	*"I feel a mix of excitement and scepticism, to be honest" (W7_P1)* *"think it's helpful having that structure as well of the study…like there's some ownership you have to take, the responsibility you have to take to actually use the assessments to use the treatment to guide us to how to feedback about that, so, I think that is really good too." (O5_P10)* *"the tests we're using to do the initial assessments aren't great, so to re-test …I can't re-test again, I can't show you were 4 and now you're 5. So I can't prove it to them that what they're doing is working" (Y3_P3)*
		Appropriate coding to this domain:	

6. Beliefs about consequences Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation *The extent to which the therapist is in favour of performing sensory rehabilitation and has positive behavioural beliefs about sensory rehabilitation #*	Beliefs: *The thing believed; the proposition or set of propositions held true* Outcome expectancies: *Cognitive, emotional, behavioural, and affective outcomes that are assumed to be associated with future or intended behaviour. These assumed outcomes can either promote or inhibit future behaviours.* Characteristics of outcome expectancies: *Characteristics of the cognitive, emotional and behavioural outcomes that individuals believe are associated with future or intended behaviours and that are believed to either promote or inhibit these behaviours. These include whether they are sanctions/rewards, proximal/distal, valued/not valued, probable/improbable. Salient/not salient, perceived risks or threats.* Anticipated regret: *A sense of the potential negative consequences of a decision that influences the choice made: for example an individual may decide not to make an investment because of the feelings associated with an imagined loss* Consequents: *An outcome behaviour in a given situation*	▪ Positive or negative expectancies of use of sensory rehabilitation ▪ Beliefs regarding treatment outcomes ▪ Potential long-term outcomes for patients ▪ Anticipated regret in not using sensory rehabilitation Inappropriate coding to this domain: ▪ Beliefs about whether therapists can provide sensory rehabilitation (code to Beliefs about Capabilities) ▪ The confidence goals will be achieved (Code to Optimism)	*"I don't necessarily think the patient outcomes will improve" (C2_P7)* *"… so if there was research that showed direct improvements then I would be adopting things." (H4_P1)* *"you don't actually know yeah, if it's actually making a difference or not, is it your input or is it something else?" (Y3_P6)* *"it's great when you get a change for a client, I love that, so that's the motivator for this, if something's saying that change is possible that's what motivates me" (L9_P4)* [Characteristics of outcome expectancies]

7. Reinforcement Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Rewards (proximal/distal, valued/ not valued, probable/improbable): *Return or recompense made to, or received by a person contingent on some performance.* Incentives: *An external stimulus, such as condition or object, that enhances or serves as a motive for behaviour* Punishment: *The process in which the relationship between as response and some stimulus or circumstance results in the response becoming less probable; a painful, unwanted or undesired event or circumstance imposed as a penalty on a wrongdoer* Consequents: *An outcome of behaviour in a given situation* Reinforcement: *A process in which the frequency of a response is increased by a dependent relationship or contingency with a stimulus* Contingencies: *A conditional probabilistic relation between two events. Contingencies may be arranged via dependencies or they may emerge by accident* Sanctions: *A punishment or other coercive measure, usually administered by a recognized authority, that is used to penalise and deter inappropriate or*	Appropriate coding to this domain: ▪ Rewards or incentives for using sensory rehabilitation ▪ Perceived punishments, consequents, reinforcements, contingencies, sanctions related to sensory rehabilitation Inappropriate coding to this domain: ▪ Opportunities to reinforce or consolidate skills in sensory rehabilitation, code to Skills instead (Construct: Practice/Skill development)	*And also often a patient is really focused on their mobility so if a physio started working on their upper limb they'd be saying - 'but come on!' (L9_P6)* [Construct: Punishment] *"the clinical guidelines are audited and we get feedback and we have to meet the standards" (W7_P8)* *"For me it's definitely about best practice and knowing that this type of technique is best practice, it's backed up by evidence research and that I'm currently probably not doing it correctly or as much as I should be doing it so yeah,* ***I think that's definitely my motivation****" (Y8_P1)* *"I think everyone's very happy to do things if they feel the patient is going to get a better outcome from it, and I think that's one of the biggest drivers for our inpatient team is that outcome" (W7_I_P3)*

	unauthorized actions.		
8. Intentions A conscious decision to perform a behaviour or a resolve to act in a certain way *Have they made a decision to provide SENSe? #*	Stability of intentions: *ability of one's resolve to remain in spite of disturbing influences* Stages of Change model*: A model that proposes that behaviour change is accomplished through five specific stages* Transtheoretical model and stages of change: *a five-stage theory to explain changes in people's health behaviour. It suggests that change takes time, that different interventions are effective at different stages, and that there are multiple outcomes occurring across the stages*	Appropriate coding to this domain: ▪ Discussion of how motivated/unmotivated therapists are to provide sensory rehabilitation ▪ Description of inclination to use sensory rehabilitation and in what situation ▪ Stability of intentions regarding sensory rehabilitation, stages of change model, transtheoretical model and stages of change Inappropriate coding to this domain: ▪ Practical plans to use sensory rehabilitation (code to Goals instead)	*"That's right, if you don't look, you don't know, and you don't have to do anything about it (laughter)!" (Y3_P1)* *"in my limited experience and treatment that I've used some of the SENSe practices with, I've had really significant outcomes so I'm keen to apply it more broadly I guess across the board rather than just the ones that are really severe…sensory issues and see what sort of outcomes we might have." (W13_P2)*
9. Goals Mental representations of outcomes or end states that an individual wants to achieve *How much do they want to do SENSe?#*	Goals (distal/proximal): *Desired state of affairs of a person or system, these may be closer (proximal) or further away (distal)* Goal priority*: Order of importance or urgency of end state toward which one is striving* Goal/target setting: *A process that establishes specific time based behavioural targets that are measureable, achievable and realistic* Goals (autonomous/controlled): *The end*	Appropriate coding to this domain: ▪ Goal priority, action planning and implementation intention related to sensory rehabilitation ▪ Description of whether or not providing sensory rehabilitation is a priority ▪ Practical plans to apply sensory rehabilitation or not Inappropriate coding to this domain: ▪ Discussion of readiness to change	*"there's so many other things we need to look at like home assess and other functions and mobility, so yeah, it's a bit low on the priority list" (Y3_P6)* *"if you have the proper equipment, we will be more confident to use it and we'll look more professional too" (Y3_P6)*

	state toward which one is striving: the purpose of an activity or endeavour. It can be identified by observing that a person ceases or changes their behaviour upon attaining this state; proficiency in a task to be achieved within a set period of time. Action planning: *The action or process of forming a plan regarding a thing to be done or a deed* Implementation intention: *The plan that one creates in advance of when, where and how one will enact a behaviour*	behaviour in sensory rehabilitation (Code to Intentions instead)	
10. Memory, attention and decision processes The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory: *The ability to retain information or a representation of a past experience, based on the mental processes of learning or encoding retention across some interval of time, and retrieval or reactivation of the memory; specific information of a specific task* Attention: *A state of awareness in which the senses are focused selectively on aspects of the environment and the central nervous system is in a state of readiness to respond to stimuli* Attention control: *The extent to which a person can concentrate on relevant cues and ignore all irrelevant cues in a given situation*	Appropriate coding to this domain: ▪ Retaining information on how to deliver sensory rehabilitation ▪ Deciding between the use of different sensory assessments ▪ Cognitive overload/fatigue related to delivering sensory rehabilitation Inappropriate coding to this domain: ▪ Discussion of system pressures that impact on decisions to use sensory rehabilitation (Code to Environmental Context and Resources: e.g. Environmental Stressors)	*"For me it's more about the scale of prioritisation…. is it what they should be doing out amongst all of all their other priorities?" (O5_P2)* *"and that affects your confidence and your quality of treatment because you might…upskill for a patient and you don't have another patient with sensory loss for ages and you're kind of like going back to* ***'oh, what did I do last time?"*** *(Y3_P5)*

	Decision making: *The cognitive process of choosing between two or more alternatives, ranging from the relatively clear-cut to the complex* Cognitive overload/tiredness: *The situation in which the demands placed on a person by mental work are greater than a person's mental abilities*		
11. Environmental context and resources Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour *The extent to which the therapist feels the environmental context supports*	Environmental stressors: *External factors in the environment that cause stress* *Resources/material resources: Commodities and human resources used in enacting a behaviour* Organizational culture/climate: *A distinctive pattern of thought and behaviour shared by members of the same organization and reflected in their language, values, attitudes, beliefs and customs* Salient events/critical incidents: *Occurrences that one judges to be distinctive, prominent or otherwise significant* Person x environment interaction: *Interplay between the individual and their surroundings* Barriers and facilitators: *In psychological contexts, barriers/facilitators are mental, emotional or behavioural*	Appropriate coding to this domain: ▪ Availability of equipment to deliver sensory rehabilitation ▪ Setting in which sensory rehabilitation will be delivered ▪ Organisational culture/climate, impacting on delivery of sensory rehabilitation ▪ Description of how more time will be required to deliver sensory rehabilitation ▪ Patient factors that would influence whether sensory rehabilitation was offered or provided ▪ Salient events related to sensory rehabilitation Inappropriate coding to this domain: ▪ Patient factors based on interpersonal processes and	*"I'm really pleased we're getting the equipment provided because I think that would have been the largest barrier" (Y8_P1)* [Construct: Resources/material resources] *"I feel it's a supportive culture that wants to look at what evidence based information is out there and how do we further our clinicians' knowledge, so I feel… it's a good environment to make change." (L18_P1)* *"I think bed pressures could always be something that could come up, if there's a pressure to discharge a patient and we haven't been able to follow through with all the sensory interventions" (Y8_P6)* *"I think it's just the health care system, of processes have to happen, we have to*

performance of sensory rehabilitation#	*limitations/strengths in individuals or groups*	views/opinions of patients – this should be coded to social influence	*deliver a service and we have to meet targets…improving our practices is only part of what we need to deliver…so….it's all a balance" (L9_P3) [Environmental stressors]* *"the other thing is in my limited experience and treatment that I've used some of the SENSe practices with, I've had really significant outcomes so I'm keen to apply it more broadly" [Salient event]* *"I think it's pretty rare too… that patients come through sort of the inpatient rehab part of the continuum, when sensation is their biggest issue" (W7_P12)*
12. **Social influences** Those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours *What do others think of what they do? Who are they*	Social pressure: *the exertion of influence on a person or group by another person or group* Social norms: *Socially determined consensual standards that indicate a) what behaviours are considered typical in a given context and b) what behaviours are considered proper in the context* Group conformity: *The act of consciously maintaining a certain degree of similarity to those in your general social circles* *Social comparisons: The process by which*	Appropriate coding to this domain: ▪ Views and opinions of others (colleagues, patients, professional groups) influencing decision to provide sensory rehabilitation# ▪ Impact of others on whether or not sensory rehabilitation is provided ▪ Discussing importance of patient engagement/buy-in ▪ Social pressure to deliver or not deliver sensory rehabilitation ▪ Social support to provide sensory	*"I'm finding that some patients are very savvy and have read up a lot about things and they will actually say 'are you doing this treatment technique?'"(R6_P4)* *"our consultant might start asking us questions in terms of why are we spending so much time on sensation when we should be doing A, B and C in terms of discharge planning"* (C2_P5) *"Our stroke consultant's really into research and new things so she'd be very,*

*and how does that influence what they do?** *The extent to which therapists feel social pressure to engage in sensory rehabilitation#* *Interpersonal processes indicate an interaction that is verbal or non-verbal ***	*people evaluate their attitudes, abilities or performance relative to others* Group norms: *Any behaviour, belief, attitude or emotional reaction held to be correct or acceptable by a given group in society* Social support: *The apperception or provision of assistance or comfort to others, typically in order to help them cope with a variety of biological, psychological and social stressors. Support may arise from any interpersonal relationship in an individual's social network, involving friends, neighbours, religious institutions, colleagues, caregivers of support groups* Power: *The capacity to influence others, even when they try to resist this influence* *Intergroup conflict: Disagreement or confrontation between two or more groups and their members. This may involve physical violence, interpersonal discord, or psychological tension.* Alienation: *Estrangement from one's social group; a deep seated sense of dissatisfaction with one's personal experiences that can be a source of lack of trust in one's social or physical environment or in oneself; the experience of separation between thoughts and*	rehabilitation ▪ Modelling of delivery, dose and method of sensory rehabilitation ▪ Patient views regarding sensory rehabilitation *To code patient-related factors to this domain there should be an underlying interpersonal process involved*	*very keen to have this happen" (Y8_P5)* *"quite often it feels like it's up to individual therapists to …to bring on change umm, but in order to do that, that requires a lot of energy….and effort" (L9_P3)* [Construct: alienation] *"There's often a confusion between motor and sensation, like sometimes they'll say [patient]'my muscles need to be stronger' but when you test it's very obvious that it's not actually a motor issue, it's well, it's more of a sensory impairment" (L9_P3)*

	feelings Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group* Modeling: *In developmental psychology the process in which one or more individuals or other entities serve as examples (models) that a child will copy*		
13. Emotion A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear: *An intense emotion aroused by the detection of imminent threat, involving an immediate alarm reaction that mobilizes the organism by triggering a set of physiological changes* Anxiety: *A mood state characterized by apprehension and somatic symptoms of tension in which an individual anticipates impending danger, catastrophe or misfortune.* Affect: *An experience or feeling of emotion, ranging from suffering to elation, from the simplest to the most complex sensations of feelings, and from the most normal to the most pathological emotional reactions.* Stress: *A state of physiological or psychological response to internal or external stressors* Depression: *A mental state that presents*	Appropriate coding to this domain: ▪ Discussion of emotions experienced by therapists towards providing sensory rehabilitation ▪ Description of when therapists would be worried/concerned about providing sensory rehabilitation Inappropriate coding to this domain: ▪ Description of patients' emotions regarding sensory rehabilitation (code to Social Influences instead)	*"I feel a mix of excitement and scepticism, to be honest"* (W7_P1) *"I also feel a little bit nervous…with doing this amazing training and they'll be no one to use it on for 6 months and that makes me feel a bit nervous… when I finally get to that client, will I be ready?" (Y3_P4)* *"there's a bit of trepidation around…needing to achieve a certain standard and being able to use a new tool and being able to… do it correctly" (Z1_P3)*

	with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration Positive/negative affect: *the internal feeling/state that occurs when a goal has/has not been attained. A source of threat has/has not been avoided, or the individual is/is not satisfied with the present state of affairs* Burn-out: *Physical, emotional or mental exhaustion, especially in one's job or career, accompanied by decreased motivation, lowered performance and negative attitudes towards oneself and others*		
14. Behavioural regulation Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring: *A method used in behavioural management in which individuals keep a record of their behaviour, especially in connection with efforts to changes or regulate the self; a personality trait reflecting an ability to modify one's behaviour in response to a situation* Breaking habit: *to discontinue a behaviour or sequence of behaviours that is automatically activated by relevant situational cues* Action planning: *The action or process of*	Appropriate coding to this domain: ▪ Discussion regarding habits and breaking old habits to allow for sensory rehabilitation ▪ Self-regulatory strategies that would influence provision of sensory rehabilitation ▪ Descriptions of auditing recommended for implementation	*"am I going to mess it up and fall back to my old ways?" (Y3_P7)* *"it's a big organisation, but here locally, it's quite small so changes will happen quite quickly." (H4_P10)* *"I think it's* [change] *something that's always possible but not necessarily always easy. I think sometimes it's really hard to change your practice and that might be for multiple reasons, maybe you've practised in that way for a long time or that's what you were taught in a particular course or*

	forming a plan regarding a thing to be done or a deed.		*at university and so with the new literature and research that's coming out and evidence-base, sometimes it's more difficult to take that on board" (Y8_P1)* *I find on inpatient rehab where we've got more access to time I can introduce that and then we can go with, ok for 3 days a week for lower limbs and 2 days a week we work on lower limbs but we have access to seeing them everyday.* ***We can accommodate sometimes that way*** *(L9_P1)* [Construct: Action planning]

Structure and definitions in codebook guided by:

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Appendix 3.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Normalisation Process Theory (NPT) Codebook

Construct 1: COHERENCE *"Making sense of it"*			
Coherence is the sense-making work that people do individually & collectively when faced with the problem of operationalizing some set of practices. *What knowledge, skills, behaviours, actors and actions are required to implement SENSe?*			
Component	Definition	Guidance	*Sample quotes*
Differentiation *Understanding the uniqueness of it* *Does the therapist recognize the SENSe approach as different from their existing ways of working?*	How a set of practices and their objects are different from each other	Appropriate coding to this construct component: ▪ Understanding the differences between informal and standardised sensory Axs ▪ Understanding the differences between other and past sensory rehabilitation approaches and SENSe therapy Inappropriate coding: views on effectiveness of SENSe (code to communal specification)	*"I do assess sensation and I do treat sensation but I don't actually use any of those **formalised things**" (W7_P5)* *"it's all about **compensating** for something and educating a patient or their family rather than actually taking the time to retrain" (C2_P7)*
Individual specification *Individually interpreting it:* *Does the therapist identify their personal role and responsibilities with using SENSe?*	Understanding specific tasks and responsibilities around a set of practices	Appropriate coding to this construct component: ▪ Individual tasks a therapist needs to do to understand and start using SENSe Assess and SENSe therapy	*"it's helpful having that structure as well of the study…there's some ownership you have to take, the responsibility you have to take to **actually use the assessments**" (O5_P10)* *"I think the hard thing for me is because I did go to a SENSe workshop, I know that there is so much more that could be done and with us not having the equipment, **it's a matter perhaps making do with the principles** but you…but like just knowing that's there's so much more that could be done" (H4_P2)*
Communal specification *Collectively interpreting it:*	Building a shared understanding of aims, objectives,	Appropriate coding to this construct component: ▪ The development of a group or department understanding of SENSe Assess and SENSe therapy	*"I suppose, you know, if it (SENSe therapy) **needs a lot of kind of one-on-one focus**, that might be a problem." (H17_P1)* *"It feels more old-fashioned not to empower them to go away and train the carer to do the program with a client, we don't do a*

Does the therapist recognise the steps needed to assist in the integration of SENSe?	and expected benefits of a set of practices.	▪ A group trying to identify and anticipate how SENSe Assess and SENSe therapy will fit with current practice	*lot of stuff to people…" (W7_P1)* *"also with the intensity with which we provide therapy, I feel like we, it's so much less than what is in the SENSe study and even though I am aware of it, and I just can't imagine how I can give that intensity to a client" (O5_P8)*
Internalization *Coming to a conclusion:* *Does the therapist identify any benefit in adopting the SENSe approach?*	Understanding the value, benefits and importance of a set of practices	Appropriate coding to this construct component: ▪ Understanding the value, benefits and importance of SENSe Assess and SENSe therapy	*"I guess the impression is that the **treatment approach works** so that is what I'm basing my enthusiasm on that it is actually going to improve people's sensation and translate into their function" (R6_P3)* *"well we also have a lot of people here…there's a sense that (laughs) well, there's a sense the SENSe is valuable" (O5_P8)* *"because the loss of sensation does have such huge impact on people's function and I think to be able to implement something that is going to make a huge difference for patients is really exciting, regardless of how that is actually put in place" (H4_P2)* *"but also at the back of my mind going, how long do all of these assessments take and ….**would they actually assess everything that I need to know for my patients**." (O5_01_P7)*

Construct 2: COGNITIVE PARTICIPATION *'Enrolment and **engagement** of individuals and groups' "Working out participation"*

***Cognitive Participation** is the **relational work** that people do to build and sustain a community of practice around a new technology or complex intervention. Do participants view the intervention as something worthwhile and appropriate to commit their individual time and effort [signing up] to bring about the intended outcome?*

Component	Definition	Guidance	*Sample quotes*
Initiation Having the skills to engage *To what extent does the therapist appear to be a supporter of the process to integrate SENSe?*	Whether or not users are working to drive an intervention forward	Appropriate coding to this construct component: ▪ The work done to setup systems and procedures to allow the use of SENSe Assess and SENSe therapy ▪ The engagement with others to introduce SENSe	*"we're getting training…we're getting kits.. we're getting the assessment tools and..we all would know about it I think helps me to feel more able to do something a lot more formally and a lot more structured way" (O5_01_P7)* *"And…if we did need to see our client more than what our usual is, which is once a week, then that would be agreed, if we could justify it" (W7_P3)*

Enrolment Organising people *Has the therapist made any adaptations or assisted in the reorganisation process leading to implementation?*	The work users do to organise themselves and their co-workers to participate in the new practice.	Appropriate coding to this construct component: ▪ Therapists 'buy-in' towards SENSe ▪ The building of communal engagement towards SENSe	*"I would like us to be known as a centre of excellence and to be able to provide it (SENSe)" (Z1_P1)* *"Maybe we can co-treat together" (O5_P8)*
Legitimation *Believing practice is valid* *Does the therapist believe that it is appropriate for them to be involved in integrating SENSe?*	Users' belief that the practice is right for them in their context, and that they can make a valid contribution to it.	Appropriate coding to this construct component: ▪ The role of OT/PT in sensory rehabilitation ▪ The contribution therapists feel they can make Inappropriate coding to this domain: ▪ Who does the work (code to Skill set workability)	*"For me it's more about the scale of prioritisation… is it [SENSe] what they should be doing out amongst all of all their other priorities?" (O5_P2)* *"in terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (Y3_P6)*
Activation *Defining actions* *Has the therapist taken steps to sustain the use of SENSe?*	Collectively defining the actions and procedures needed to sustain a practice and to stay involved.	Appropriate coding to this construct component: ▪ The sustainability of SENSe ▪ The visibility of SENSe in the organisation ▪ The ongoing connection between SENSe and those who should use it	*"I just feel a bit unsure how it's going to be carried out, and if it's… sustainable across the service." (O5_P3)* *"Handing that over to the AHA might not meet the criteria of the study, so I think…. once we have done the study, we might be able to think about using our AHAs a bit more effectively for that" (O5_P8)*
Construct 3: COLLECTIVE ACTION *'Work done to enable the intervention to happen'*			
Collective Action is the **operational work** that people do to enact a set of practices, whether these represent a new technology or complex healthcare intervention. *How far will existing work practices and the division of labour have to be changed or adapted to implement SENSe? Is SENSe consistent with the existing norms and goals of the groups, the workplace and overall organization?* **** Coding to this construct needs to involve a therapist talking about 'doing' or intended 'doing' related to using SENSE**			
Component	Definition	Guidance	Sample quotes

Interactional workability *Performing the actions* *What work does the therapist do with others to operationalise the use of the SENSe approach?*	Interactional work people do to operationalize the practice in everyday settings	Appropriate coding to this construct component: ▪ Interaction between therapists in the use of SENSe and SENSe equipment to put them into use Inappropriate coding to this domain: • Division of labour related to use of SENSe (code to Skill set Workability)	*"that might be the benefit of this study that it…encourages co-assessments and co-treatments so that we're both (OT & PT) learning together really, which I think gives us benefit." (L18_P3)* *"so I guess looking at across OT and physio how you can work together to try and implement the amount that you would need to, to change" (W7_P3)*
Relational integration *Working with and trusting the work of others (and SENSe as an intervention)* *To what extent does the integration of SENSe help or impede people's work?*	Knowledge work people do to build accountability and maintain confidence in a set of practices and in each other as they use them.	Appropriate coding to this construct component: ▪ The confidence therapists have in SENSe and its ability to detect and treat sensory loss in stroke survivors	*"we would actually articulate and educate your patients well to try and do the [SENSe] principles, I hope then then yes, and the outcomes will be better" (O5_P9)*
Contextual integration *Allocating resources* *Does the integration of SENSe fit with the objectives of the organisation/ individual?*	Managing a set of practices through allocation of resources, execution of protocols, policies and procedures.	Appropriate coding to this construct component: ▪ The management of the health service (staff, resources) to allow for delivery of SENSe	*"you're not going to spend a lot of time assessing someone if you can't actually treat them…that would probably lead to someone thinking I'll let that go for home-based therapy or outpatient therapy" (W7_P2)* *"we have grade one rotations and OTs who rotate every 6 months…obviously someone else who is going on maternity leave…if we have new people coming in that means we have to train them as well so that they can use the equipment so I guess can be a bit difficult" (Y3_P6)*
Skill set workability *Appropriate division of tasks*	The allocation work that underpins the division of labour that is built up around a set of practices	Appropriate coding to this construct component: ▪ Who does the work related to the	*"if it's an assessment [SENSe] that both can do…if the physio is too busy the OT can help out or vice versa. We can all help with the time management side of things" [H17_P1]*

Who does the therapist view as being best placed to make use of the SENSe approach? *How compatible is the SENSe approach with their current tasks?*		use of SENSe? *Related to Legitimation – see point on difference above	*"I'll communicate with the OT and I would probably have a list of other priorities this big and I'll go "Great! The OT can do this, one less thing for me to worry about!" (H4_P1)*
REFLEXIVE MONITORING *'formal and informal appraisal of benefits and costs of the intervention'*			
Reflexive Monitoring is the **appraisal work** that people do to assess and understand the ways that a new set of practices affect them and others around them. *What is the informal and formal appraisal of SENSe and its benefits for participants?* ***** Coding to this construct needs to involve a therapist reflecting on the 'doing'/ use of SENSE***			
Component	Definition	Guidance	Sample quotes
Systematization *Collecting feedback information* *Has the therapist taken practical steps to measure the influence of adopting the new techniques?*	Collecting information to determine the effectiveness and utility of an intervention	Appropriate coding to this construct component: ▪ Formal (e.g. RCT) or informal (anecdotal) sources of information on how effective & useful SENSe is From discussion with AM: e.g. audit	*"in my limited experience and treatment that I've used some of the SENSe practices with, **I've had really significant outcomes** so I'm keen to apply it more broadly I guess across the board rather than just the ones that are really severe…sensory issues and see what sort of outcomes we might have." (W13 _P2)*
Communal appraisal *Collectively evaluating it* *Are there any joint efforts to appraise the impact of implementation?*	Participants working together to evaluate the worth of a set of practices.	Appropriate coding to this construct component: ▪ Therapists asking each other 'Is SENSe working?' ▪ Communal appraisal of SENSe	* Likely to be more relevant at end of implementation
Individual appraisal Individually evaluating it *Does the therapist reflect personally on the*	Participants working experientially as individuals to appraise the practice's effects on them and the contexts in which they are set.	Appropriate coding to this construct component: ▪ Therapists individual appraisal of the worth of SENSe and the impact on other work tasks	** Likely to be more relevant at end of implementation*

impact of the SENSe approach on his/her routine?			
Reconfiguration Changing the way things are done *Has the therapist made attempts to modify the way the SENSe approach is used as a result of experience?*	Appraisal work done by users to redefine procedures or modify practices	Appropriate coding to this construct component: ▪ Changes to the delivery of SENSe therapists make to allow it to fit with practice	* Likely to be more relevant at end of implementation

Structure and definitions in codebook guided by:

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Appendix 4.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Number of quotes coded to Theoretical Domains Framework and Normalisation Process Theory domains and categories

Theoretical Domains Framework (TDF):

	SITE							
TDF Domain	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Knowledge	5	3	7	7	13	6	15	13
Skills	5	6	10	9	7	9	6	18
Social/Prof Role and Identity	9	16	15	22	19	23	7	20
Beliefs about capabilities	4	3	4	1	8	12	4	12
Optimism	3	8	7	3	8	1	14	11
Beliefs about consequences	7	7	4	12	3	6	15	17
Reinforcement	3	1	1	5	4	5	1	6
Intentions	2	6	4	13	4	9	5	15
Goals	5	6	4	4	7	5	0	10
Memory, attention & decision processes	3	3	4	3	6	7	4	3
Environmental context and resources	41	38	52	45	36	40	56	77
Social influences	9	6	8	4	10	24	13	11
Emotion	8	1	8	7	5	9	4	14
Behavioural regulation	3	1	1	4	0	3	1	3

* Green/shaded numbers indicate three domains coded to most frequently at each site

Normalisation Process Theory (NPT):

	SITE							
NPT Category and Construct	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
COHERENCE								
Differentiation	6	3	10	7	7	4	17	10
Individual specification	14	3	14	3	11	5	10	14
Communal specification	5	3	7	8	6	4	7	10
Internalisation	7	9	15	15	11	6	8	15
COGNITIVE PARTICIPATION								
Initiation	4	8	6	8	5	4	10	5
Enrolment	4	4	5	3	6	11	6	9
Legitimation	15	10	14	11	12	11	14	16
Activation	2	0	4	8	6	2	2	5
COLLECTIVE ACTION								
Interactional workability	4	1	3	1	4	0	3	7
Relational integration	3	0	3	2	0	1	2	2
Contextual integration	7	0	5	2	1	2	3	8

Skill set workability	5	0	1	2	0	3	1	0
REFLEXIVE MONITORING								
Systematization	0	0	0	0	1	0	0	0
Communal appraisal	0	0	0	0	0	0	0	0
Individual appraisal	0	0	3	1	1	0	1	1
Reconfiguration	0	0	0	0	0	0	0	0

* Green/shaded numbers indicate three domains coded to most frequently at each site

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide Questions/Description	Reported on Page No. / Comment
Domain 1: Research team and reflexivity			
Personal Characteristics			
1	Interviewer/facilitator	Which author/s conducted the interview or focus group?	Page 7. Liana S Cahill (LSC) and Yvonne Mak-Yuen (YMY) conducted focus groups and interviews.
2	Credentials	What were the researcher's credentials?	Page 8. Credentials of LSC and YMY detailed under 'Research Team and Reflexivity'
3	Occupation	What was their occupation at the time of the study?	Page 8. LSC and YMY noted to be research occupational therapists under 'Research Team and Reflexivity'
4	Gender	Was the researcher male or female?	Page 8. Researchers female as noted by female pronouns.
5	Experience and training	What experience or training did the researcher have?	Page 8. Professional training and background of researchers noted under 'Research Team and Reflexivity'
Relationship with participants			
6	Relationship established	Was a relationship established prior to study commencement?	Not for the purposes of the study. It is noted LSC previously worked with some participants, but not at the time of the study – see Page 8, 'Research Team and Reflexivity'
7	Participant knowledge of the interviewer	What did the participants know about the researcher? *e.g. personal goals, reasons for doing the research*	Participants were aware LSC and YMY were completing their doctorates in somatosensory rehabilitation. See Page 8, 'Research Team and Reflexivity'.
8	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants were likely aware of the interviewers' special interest in somatosensory rehabilitation stemming from

			clinical practice. See Page 8, 'Research Team and Reflexivity'.
Domain 2: study design			
Theoretical framework			
9	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 9-10. Thematic analysis and use of two theoretical frameworks (Theoretical Domains Theory and Normalisation Process Theory) is described.
Participant selection			
10	Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 8. Purposive recruitment of therapists to the study is described, see 'Participants'
11	Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Page 8. Approach to health organisations via telephone and email and approach to therapists via face-to-face presentations described, see 'Participants'
12	Sample size	How many participants were in the study?	Page 10. Eighty seven occupational therapists and physiotherapists participated. See 'Findings'
13	Non-participation	How many people refused to participate or dropped out? Reasons?	Page 8. All therapists attending recruitment presentations agreed to participate. No refusals or drop-outs occurred. See 'Participants'
Setting			
14	Setting of data collection	Where was the data collected? *e.g. home, clinic, workplace*	Page 7. Focus groups were held at therapists' health organisations. Separate interviews were held over the phone for those unable to attend. See 'Design'.
15	Presence of non-participants	Was anyone else present besides the participants and researchers?	Page 7. No. Two members of the research team (LSC and YMY) attended focus groups,

			no one else was present besides participants. See 'Design'.
16	Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Page 8. Participants were graduate occupational therapists and physiotherapists who worked with stroke survivors at participating health organisations. See 'Participants'. A demographics table describing characteristics of participants is provided , see Table 1.
Data collection			
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 7. Interview questions are provided in Appendix 1 and were guided by the Theoretical Domains Framework. Questions were not formally pilot tested but were discussed with the research group. See 'Design'.
18	Repeat interviews	Were repeat interviews carried out? If yes, how many?	Repeat interviews were not conducted, though individuals who missed original focus groups were followed up in individual or small group interviews.
19	Audio/visual recording	Did the research use audio or visual recording to collect the data?	Page 7. Interviews were audio-recorded. See 'Design'
20	Field notes	Were field notes made during and/or after the interview or focus group?	Page 7. Field notes were taken during and after each interview. See 'Design'
21	Duration	What was the duration of the interviews or focus group?	Page 7. Focus groups were of 1-hour duration. See 'Design'.
22	Data saturation	Was data saturation discussed?	Data saturation considered, n=87 therapists across 8 different health organisation was aimed to provide a representative sample

23	Transcripts returned	Were transcripts returned to participants for comments and/or correction?	No. Given the workloads of therapists involved, participants were not expected to review transcripts. The interviewer and co-moderator (LSC & YMY) discussed transcripts and made comments and corrections.
Domain 3: analysis and findings			
Data analysis			
24	Number of data coders	How many data coders coded the data?	Pages 9-10. Three researchers were involved in data analysis (LSC, NAL and AM). See 'Data Analysis'
25	Description of the coding tree	Did authors provide a description of the coding tree?	Codebooks used are provided in Appendices 2 and 3.
26	Derivation of the themes	Were themes identified in advance or derived from the data?	Pages 9-10. In Phase one, themes were derived from the data in an inductive approach, in Phase two, themes were deductively derived from pre-determined theories with specified domains and categories. See 'Data analysis'.
27	Software	What software, if applicable, was used to manage the data?	N/a
28	Participant checking	Did participants provide feedback on the findings?	Given the workloads of therapists involved, participants were not expected to provide feedback on findings.
Reporting			
29	Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? *e.g. participant number*	Page 13-25. Participant quotes used to illustrate findings. Participants identified by discipline (e.g. Occupational therapist or physiotherapist) and site number. See 'Findings'

30	Data and findings consistent	Was there consistency between the data presented and findings?	Page 25. Consistency in triangulation between data analysis approaches and findings provided and examples given. See 'Discussion'.
31	Clarity of major themes	Were major themes clearly presented in the findings?	Page 12. An overview of major themes, along with prominent domains and categories from implementation theory, provided. See Table 3. (Detail also provided in 'Findings').
32	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Page 12. A description of sub-themes is provided. See Table 3 and additional detail in 'Findings' > subthemes.

BMJ Open

Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-042879.R1
Article Type:	Original research
Date Submitted by the Author:	05-Jan-2021
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Primary Subject Heading:	Health services research
Secondary Subject Heading:	Qualitative research
Keywords:	Stroke < NEUROLOGY, REHABILITATION MEDICINE, Neurological injury < NEUROLOGY

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Abbreviated title: *Implementation of post-stroke sensory rehabilitation: A qualitative study*

Key words: Occupational therapy, physical therapy, somatosensory disorders, implementation science, health services research, neurosciences

Word Count: 267 (Abstract)
5345 (Introduction, Procedures, Findings, Discussion)

References: 49

Tables: 3

Appendices: 4

ABSTRACT

Objectives Somatosensory loss is common after stroke with one-in-two individuals affected. Although clinical practice guidelines recommend providing somatosensory rehabilitation, this impairment often remains unassessed and untreated. To address the gap between guideline recommendations and clinical practice, this study sought to understand the factors influencing delivery of evidence-based upper limb sensory rehabilitation after stroke.

Design Qualitative study involving focus groups and interviews. Data analysis used an inductive approach (thematic analysis) and deductive analysis using implementation theory (the Theoretical Domains Framework and Normalisation Process Theory).

Setting Eight healthcare organisations in metropolitan and regional areas of Victoria and New South Wales, Australia.

Participants: Eighty-seven rehabilitation therapists (79% occupational therapists and 21% physiotherapists) were purposively sampled and participated in a knowledge translation study with staggered recruitment from 2014 - 2018.

Results: Three types of factors influenced therapists' delivery of upper limb somatosensory rehabilitation: individual ('*The uncertain, unskilled therapist*'), patient ('*Patient understanding and priorities')* and organisational ('*System pressures and resources'*). Deductive analysis using implementation theory identified key determinants of practice change, such as opportunities to consolidate new skills, the anticipated benefits of upskilling as a therapy team and the work anticipated by therapists to incorporate a new somatosensory

rehabilitation approach.

Conclusions: Occupational therapists and physiotherapists hold valuable insights towards practice change in somatosensory rehabilitation from the 'frontline'. Therapists experience barriers to change including a lack of knowledge and skills, lack of resources and organisational pressures. Facilitators for change were identified, including social support and therapists' perceived legitimacy in using new somatosensory rehabilitation approaches. Results will inform the design of a tailored implementation strategy to increase the use of evidence-based somatosensory rehabilitation in Australia.

Trial registration: Australian New Zealand Clinical Trials Registry (ACTRN12615000933550)

Strengths and limitations of this study

Strengths:

- This study used a qualitative design with inductive and deductive data analysis guided by the Theoretical Domains Framework and Normalisation Process Theory to increase credibility of findings
- Participants (n=87) from eight different health organisations contributed to a representative sample of stroke rehabilitation therapists
- Three independent researchers were involved in data analysis to increase validity

Limitations:

- Focus groups included therapists with different levels of experience and seniority, which may have introduced a power differential during discussion and potential for response bias
- The perspectives of stroke survivors and health organisation managers were not included in this study

BACKGROUND

Somatosensation has been considered the most complex of the human senses[1] and includes pain, tactile discrimination, joint position sense and haptic object recognition. Half of all stroke survivors experience somatosensory loss[2-5] yet treatment for this impairment has been historically overlooked.[6,7] Research reveals a persistent evidence-practice gap in the area of somatosensory rehabilitation.[8-10] Somatosensory rehabilitation includes assessment of somatosensory loss and treatment of somatosensory modalities[11] by occupational therapists and physiotherapists. Their accurate detection of somatosensory deficits, such as impaired touch, proprioception or haptic object recognition, give stroke survivors an opportunity for treatment.

Standardised assessments are underutilised by occupational therapists and physiotherapists, with informal measures being more common.[8] Typical treatment for somatosensory loss focusses on compensation (such as providing education to avoid limb injury) with a lack of use of evidence-based treatments aimed at regaining somatosensory function.[8] These practices may discount stroke survivors' perceptions of somatosensory loss as being 'significant', 'concerning', and having a negative impact on daily life: and promote a perception that the impairment cannot be treated.[12-14]

Following the publication of a Cochrane review[15] evidence for somatosensory rehabilitation has increased.[16] A more recent systematic review found that discrimination retraining programmes may improve upper limb somatosensory impairment after stroke.[11] SENSe therapy is a discrimination retraining program for upper limb somatosensory loss and uses principles such as attentive exploration and calibration to remediate somatosensory function.[16] Stroke clinical guidelines recommend standardised assessment and sensory-specific treatment for somatosensory loss.[17,18] [19] However, clinical audits suggest that these recommendations

are not widely implemented.[9]

Factors contributing to the underuse of somatosensory assessment and treatment were explored in one Australian study.[20] Occupational therapists and physiotherapists in this study (n=172) based their assessment and treatment choices on prior knowledge and clinical experience rather than research, as well as organisational factors such as time available and patient length of stay.[20] Patient factors also influenced practice; somatosensory assessments were often not completed if a stroke survivor did not raise loss of sensation as a concern, or therapists believed that a patient could not participate in the assessment. These findings are consistent with stroke rehabilitation more broadly where use of evidence in practice is influenced by a lack of time, knowledge and staffing issues, and patient factors such as prioritisation and safety.[21] There is a need for further research into factors that influence clinical decision-making for stroke survivors with somatosensory loss.[8,22]

Doyle and Bennett[23] investigated clinical behaviour in somatosensory rehabilitation in a survey of occupational therapists prior to delivering a workshop based on the Theory of Planned Behaviour. Therapists reported a lack of knowledge and skills to deliver somatosensory rehabilitation, and a lack of resources and time to locate evidence and use unfamiliar assessments and treatments. The sample for this study was small (n=19), and responses were limited to a self-report questionnaire. A more in-depth study is required, involving perspectives from both occupational therapists and physiotherapists who provide somatosensory rehabilitation to stroke survivors.

The aim of our study was to understand the barriers and enablers faced by occupational therapists and physiotherapists in the implementation of somatosensory assessments and

interventions for stroke survivors, to provide an explanation of underlying mechanisms that enhance or inhibit such implementation. As this study sought to explore barriers, enablers and any other factors influencing implementation of somatosensory guidelines in practice, the use of implementation theory was warranted.

Implementation science is a field of study dedicated to methods for increasing use of research in practice[24] and the use of theory is central to the field.[25] Theory helps provide a framework for investigating influences on behaviour, and a process for guiding behaviour change interventions.[26] Theoretical approaches in implementation science are often interdisciplinary, drawing on fields of psychology, sociology and economics.[27] The theories applied in this study were the Theoretical Domains Framework[28] and Normalisation Process Theory.[29] Use of multiple theories, common in implementation research, provided an opportunity to view barriers and enablers from different perspectives and avoid a 'conceptual straight-jacket'.[30] The Theoretical Domains Framework, based on psychological theory, offers a comprehensive, synthesised lens to explore individual motivators and capabilities for change, and social and environmental influences on behaviour[31]. Normalisation Process Theory provides an alternative theoretical lens and is a sociological theory that considers work required by individuals and groups to embed, or normalise, a new practice.

PROCEDURE

This qualitative study presents data from focus groups and interviews conducted with occupational therapists and physiotherapists, to enable the development of a tailored implementation strategy. A primary goal of the implementation strategy was to improve the routine use of somatosensory assessments and interventions after stroke (Trial Registry ACTRN12615000933550).[32]

Design

We used a descriptive qualitative design to explore determinants of practice[33] and help explain and describe complex processes and behaviours. Data were collected at eight healthcare organisations using pre-implementation questionnaires and focus groups of one-hour duration. Two members of the research team (LSC and YMY) attended focus groups; LSC facilitated focus groups and YMY took notes about group interaction and non-verbal communication. If therapists were unable to attend the focus group, separate interviews (20-30 minutes duration) were held face-to-face or via telephone by LSC. Content of focus groups were not discussed in individual interviews. Focus group and interview questions were the same (Appendix 1), were open-ended and were informed by the Theoretical Domains Framework.[28]

Participants

Participating health organisations were recruited to the study through telephone and email contact, and face-to-face meetings with managers. All organisations were in Australia; seven in Victoria and one in New South Wales. Participants were graduate occupational therapists and physiotherapists working with stroke survivors in participating healthcare organisations. There was no minimum clinical experience level required for eligibility to participate. Participant recruitment occurred via an information session presented by LSC and YMY held at participating organisations where purposive sampling was used. All participants provided written informed consent to participate in the study (Ethics approval reference: H2013/04956 HREC/13/Austin/8).

Research team and reflexivity

LSC acted as the facilitator for focus groups and interviews and was the primary coding-researcher. YMY was the notetaker for focus groups. LSC is a neurological occupational therapist with a Masters of Public Health and a university lecturer completing a doctorate on knowledge translation in somatosensory rehabilitation. LSC completed workshop training on focus group facilitation prior to leading the focus groups. YMY is an experienced neurological occupational therapist, completing her doctorate on standardised assessment in somatosensory rehabilitation. LSC had previously worked with some participants at four sites but not at the time of the focus groups and interviews; YMY had not worked with any participants previously. Both LSC and YMY have experience assessing and treating somatosensory loss in stroke survivors, and have published and presented on somatosensation in stroke at conferences. This interest in somatosensory rehabilitation may have been known to participants and be a potential source of bias.

NAL and AM were coding-researchers in this study. Both are experienced neurological occupational therapists and senior researchers, who have been involved in the development of stroke clinical guidelines and stroke implementation studies. NAL and AM were not involved in data collection, and remained blind to the source of quotes they were coding.

Patient and Public Involvement

Patients and/or the public were not directly involved in the design, recruitment or implementation of this study. Consumer representatives are members of the broader SENSe Implement Steering Committee, and regular reviews by consumers of the SENSe study documents (policies and reports) are undertaken.

Data analysis

Focus groups and interviews were audio-recorded with participant consent and transcribed verbatim by authors (LSC and YMY). Field notes were taken during and after each focus group and interview. All organisations and participants were given a unique identifier. A two-staged approach to analysis was used to inductively identify key themes (Stage 1), then data were deductively coded against the Theoretical Domains Framework (TDF) and Normalisation Process Theory (NPT) (Stage 2) using a theory-informed approach. Two members of the research team conducted the analysis in each phase. Any discrepancies were resolved through discussion and review of the original transcripts.

Stage 1: Thematic Analysis

First an inductive approach was applied using thematic analysis to identify and interpret key themes.[34,35] Two researchers (LSC and AM) open coded a sample of transcripts (20%, three transcripts) line-by-line, then met regularly to develop and revise the coding framework. LSC analysed remaining transcripts with ongoing consultation with co-authors. An audit trail of discussions and decisions was kept, leading to resultant codes, categories and ultimate themes.

Stage 2: Analysis using the Theoretical Domains Framework and Normalisation Process Theory

Theoretical Domains Framework (TDF)

A deductive analysis approach was then taken using the TDF.[28] LSC and NAL separately coded a sample of transcripts (20%, three transcripts) to relevant domains of the TDF and met

regularly to compare and discuss coding decisions. LSC analysed the remaining transcripts, which were collated into domain codes, discussed and revised through an iterative process with NAL. See Appendix 2 for the TDF codebook.

Normalisation Process Theory (NPT)

A complementary deductive analysis occurred using NPT (May & Finch, 2009).[29] Coding to NPT provided insights into how teams of therapists conceptualised somatosensory rehabilitation. It is acknowledged NPT constructs need to be given their own working definition for individual settings[36] to make NPT 'at home' in the context of the study (May et al., 2020).[37] This process was completed through iterative discussion between LSC and AM (See Appendix 3 for NPT codebook). LSC and AM separately coded a sample of transcripts (20%, three transcripts) to categories and constructs of the NPT, followed by discussion. LSC analysed the remaining transcripts, resultant category and construct codings were reviewed, discussed and refined in meetings with AM.

The coding frameworks and domains, categories and constructs in the second and third stages of analysis were reviewed for agreement by LSC, NAL and AM.

FINDINGS

Eighty-seven occupational therapists and physiotherapists participated in focus groups and interviews across eight healthcare organisations. Six organisations were public healthcare organisations (government funded) and two sites were private (privately funded). Tables 1 and 2 outline participant and site characteristics.

Table 1. Characteristics of participants

Characteristic	n = 87
Sex, number female (%)	80 (92)
Discipline, number (%)	
Occupational Therapist	69 (79)
Physiotherapist	18 (21)
Highest Education Level, number (%)	
Bachelor Degree	72 (83)
Coursework Masters	8 (9)
Research Masters	6 (7)
Not specified	1 (1)
Years of clinical experience (*yrs*), mean (SD)	10.6 (2.1)
Years of experience working with stroke survivors (*yrs*), mean (SD)	7.9 (3.5)

Table 2. Overview of organisations and participants in focus groups and interviews (Total participants n=87)

Organisation	**Type of health service and location^**	**Focus Groups** Number of participants (No. of focus groups)	**Interviews** Number of participants (No. of interviews)
1	Tertiary, Metropolitan	10 (1)	1 (1)
2	Tertiary, Metropolitan	9 (1)	0 (0)
3	Tertiary, Regional	15 (2*)	0 (0)
4	Tertiary, Metropolitan	13 (2†)	0 (0)
5	Tertiary, Metropolitan	6 (1)	1 (1)
6	Tertiary, Regional	6 (1)	1 (1)
7	Tertiary, Metropolitan	12 (1)	0 (0)
8	Tertiary, Metropolitan	13 (2#)	0 (0)

^ All organisations have dedicated rehabilitation services, engage in research and teaching and have affiliations with a university
* First focus group = 12, second focus group = 3
† First focus group = 10, second focus group = 3
# First focus group = 6, second focus group = 7

Table 3 provides an overview of themes and codes in different analysis stages.

Table 3: *Overview of themes and prominent codes*

	Phase 1: *Thematic coding*	Phase 2: *Theoretical Domains Framework*	*Normalisation Process Theory*
Inductive analysis	Themes: *(1) The uncertain unskilled therapist* Subtheme: *The importance of getting it right* *(2) The patient's understanding and priorities* Subthemes: *Needing to focus on patient goals* *Helping the patient to understand somatosensation* *(3) System pressures and resources* Subthemes: *Not having the right tools* *Sharing or deferring professional roles*	**Deductive analysis** Key domains: ***Knowledge*** [Whether or not the therapist has knowledge of evidence-based sensory rehabilitation and how to do it] ***Skills*** [Whether or not the therapist has the ability and competence to provide evidence-based sensory rehabilitation] ***Environmental context and resources*** [Whether or not the therapist believes the environmental context – physical or cultural - supports delivery of sensory rehabilitation] ***Social professional role and identity*** [Whether identity as an occupational therapist or physiotherapist influences whether they provide evidence-based sensory rehabilitation] ***Social influences*** [Interpersonal processes causing therapists to change their thoughts, feelings or behaviours towards evidence-based sensory rehabilitation]	Key categories and constructs: ***Individual specification (Coherence)*** [Does the therapist acknowledge their personal role in, and responsibility to use evidence-based sensory rehabilitation?] ***Internalisation (Coherence)*** [Does the therapist identify any benefit from adopting evidence-based sensory rehabilitation? Therapist coming to a conclusion about its worth] ***Legitimation (Cognitive Participation)*** [Does the therapist believe it is appropriate for them to deliver evidence-based sensory rehabilitation?]

Phase 1: Thematic analysis

Three main themes or factors, and associated sub-themes, were found to influence therapists' delivery of upper limb somatosensory rehabilitation: The uncertain unskilled therapist, patient understanding and priorities, and system pressures and resources.

Theme one: The uncertain unskilled therapist

A key finding was a self-identified lack of knowledge, skill and confidence to deliver somatosensory rehabilitation. Therapists expressed negative emotions related to these experiences and were concerned about using new somatosensory approaches in the 'right' way. Therapists acknowledged they often had little awareness of standardised assessments:

> *"It was realising there's...objective assessments…and not knowing any of them! So that's a bit scary"* (P4, Physiotherapist, Site 1, focus group)

Uncertainty about using assessment information to address sensory loss was also acknowledged:

> *"I find that I tend to assess, but then I don't know what to do with that information."* (P1, Occupational therapist, Site 5, focus group)

Therapists were aware of their limitations when required to deliver somatosensory rehabilitation. They experienced various emotions including "guilt" and "frustration":

> *"I feel a little bit guilty…about what I have been doing in the past. This…shows me how much more I could have been doing"*(P3, Occupational Therapist, Site 5, focus group)

Therapists expressed a lack of confidence related to somatosensory rehabilitation, which led them to deprioritise this area of practice and focus on others:

> *"I find that it isn't a priority for me to assess…as I don't feel confident with it and it kind of gets pushed to the left over time in the session" (P1, Occupational therapist, Site 2, focus group)*

Subtheme: The importance of getting it right

Therapists felt a weight of responsibility to change their practice, and use new knowledge and skills appropriately to benefit patients:

> "*I think there's also that little bit of hesitation of something new…. am I going to do it right?" (P5, Occupational therapist, Site 8, focus group 1)*

Lack of skill consolidation after upskilling in evidence-based sensory rehabilitation was a concern to some therapists. Without consistency of practice some therapists worried they might not be ready when the need for their somatosensory skills arose:

> *"I also feel a little bit nervous…with doing this amazing training and there will be no-one to use it on for 6 months… when I finally get to that client, will I be ready?" (P4, Occupational therapist, Site 8, focus group 2)*

Theme two: The patient's understanding and priorities

This theme encompassed therapists' perceptions of patient understanding of sensation, the goals set in rehabilitation and the therapist's role in helping patients understand sensation. Therapists wanted to be guided by patients and set patient-centred goals, but highlighted a

lack of understanding about sensation by some stroke survivors. Sensation was seen as a more abstract concept to patients when contrasted with physical deficits which were more easily described and understood:

> "*There's often a confusion between motor and sensation.. sometimes they'll say 'My muscles need to be stronger' but when you test it's very obvious that it's not actually a motor issue, it's…more of a sensory impairment" (P3, Occupational therapist, Site 6, focus group)*

Patient priorities were often perceived to be in areas other than somatosensory rehabilitation, particularly for inpatients:

> *"From an inpatient perspective it's* [sensation] *quite often… not the client's priority" (P3, Occupational therapist, Site 2, focus group)*

Subtheme: Needing to focus on patient goals

Goal setting, as a tenet of stroke rehabilitation, was proposed to guide therapists in practice. However, not all patients wanted to set 'sensory-goals' and this perception impacted on therapists' clinical decision-making to conduct somatosensory assessments and provide subsequent treatment:

> *"You can't assess it* (sensation) *and treat it if it's not their goal. It has to be goal driven" (P1,Occupational therapist, Site 6, focus group)*

Subtheme: Helping patients to understand somatosensation

When patients lacked an understanding of sensation, many therapists believed it was part of their professional role to increase patients' knowledge about the impact of somatosensory

loss on upper limb function. Therapists at separate sites independently described the importance of this role for giving patients a 'lightbulb' moment:

> *"It's not until you take time and assess and explain how that* [sensation] *would be affecting the motor problems, and it's almost like a light bulb for people…they haven't had the words to articulate it"(P12, Occupational therapist, Site 7, focus group)*

Others mentioned that it suited therapists that patients often didn't understand sensation and prioritise this because they did not know how to deliver somatosensory rehabilitation anyway:

> *"I do find myself wondering whether it's a bit of a chicken and the egg situation…it kind of suits us that sensory stuff is down the bottom but I'm not sure how that goes. Have we articulated that to the patients, to try to help them to understand, or is that an accurate reflection of the patient's experience?" (P7, Occupational therapist, Site 8, focus group)*

Theme three: System pressures and resources

This theme includes pressures experienced by therapists in their organisations, the lack of resources to deliver somatosensory rehabilitation and sharing work responsibilities within a rehabilitation team. Therapists across all sites described organisational factors that created competing demands and reduced opportunities to provide somatosensory rehabilitation. There was pressure, particularly on inpatient therapists, to facilitate discharge for patients and this was perceived as highly valued by their organisation. This expectation often came at the expense of providing upper limb somatosensory rehabilitation:

> "*To facilitate someone to go home, or leaving the hospital is more highly valued* [than somatosensory rehabilitation]*"(P2, Occupational therapist, Site 7, focus group)*

Therapists working in the community, rather than inpatient settings, were less affected by hospital discharge pressures but still experienced competing demands related to their own, rather than organisational expectations:

> *"I find I can't really spend an hour just doing sensation…maybe half an hour doing sensation and then all the return to work and everything else that's going on, so…being able to dedicate pure session for upper limb retraining is hard" (P8, Occupational therapist, Site 1, focus group)*

Subtheme: Not having the right tools

Lack of appropriate equipment to assess and treat somatosensory deficits was a common barrier for therapists. Disorganised equipment and tools were observed by some as a representation of time and effort placed on somatosensory rehabilitation to date:

> *"We have bits and pieces, scraps of stuff that we kind of throw together and we haven't got any formal, really good quality assessments or treatments, you know just hobbled together stuff…so it kind of reflects the importance or…how much time we put into it"(P7, Occupational therapist, Site 8 focus group 2)*

Therapists, however, anticipated that having the right equipment would improve their practice and skill development, and improve their confidence in delivering somatosensory rehabilitation:

> *"If you have the proper equipment, we will be more confident to use it and we'll look more*

professional too" (P6, Occupational therapist, Site 7, focus group)

Subtheme: Sharing or deferring professional roles

Occupational therapists and physiotherapists spoke of overlapping professional responsibility in the delivery of somatosensory rehabilitation, and in some situations, sharing the workload. More often, responsibility for upper limb somatosensory rehabilitation was assumed by the occupational therapist. This role expectation was often related to physiotherapists' workload and the need to delegate to focus on other rehabilitation areas:

"I'll be the first to admit if I've got an OT working with my client at the same time, then I won't prioritise upper limb sensory" (P6, Physiotherapist, Site 6, focus group)

Phase 2: Analysis using implementation theory

An overview of coding to domains and categories of the TDF[28] and NPT[29] is provided in Appendix 4.

Analysis using The Theoretical Domains Framework

The domains coded most frequently were Knowledge, Skills, Environmental context and resources, Social professional role and identity, and Social influences.

Knowledge

In alignment with thematic coding, lack of knowledge about somatosensory rehabilitation was frequently coded as a barrier to evidence-based practice. Procedural knowledge, a construct of the Knowledge domain, prompted coding of sources of knowledge. Therapists felt that their university education had often left them unprepared to provide somatosensory rehabilitation:

"When I went through university as well…I don't think it was an area that I believe was well taught at that time…I didn't feel like I had a good grounding to even run with" (P4, Occupational therapist, Site 6, focus group)

Opportunities for development of somatosensory knowledge in the workplace were also scarce for some therapists, as were opportunities to acquire skills by observing or asking colleagues:

"*… it's* (sensory rehabilitation) *not something that you can learn off a colleague ….This is not an area where I can ask one of my more experienced colleagues about, it's not something that they would necessarily know" (P3, Occupational therapist, Site 8, focus group 2)*

The TDF Knowledge domain also highlighted what therapists knew about the impact of somatosensory loss on patients, and gaps in therapist knowledge:

"… sometimes it's hard for us to understand the impact of sensory loss. Motor loss you can see the impact…but if they have functional upper limb but sensation is the main issue, I don't think we are as good at realising how much of an impact that could have" (P1, Occupational therapist, Site 5, focus group)

Skills

Coding to the Skills domain of the TDF highlighted a perceived skill gap and barrier to evidence-based practice. The ability to develop and consolidate skills through exposure to appropriate patients was seen as an enabler for sustaining skill levels:

"…and to consolidate early so then it becomes second nature rather than lose all the

knowledge that we've learnt" (P3, Occupational therapist, Site 1, focus group)

Coding to this domain also highlighted the need for specialised skills when working with stroke survivors with common post-stroke deficits such as aphasia or cognitive impairment who needed somatosensory rehabilitation:

"Clients that do have communication impairments is the other one…how do I get them to talk this out?...in the past we've done some comparisons with things but if they don't have the language, I really don't know what to do" (P6, Occupational therapist, Site 8, focus group 2)

Environmental context and resources

Within this TDF domain, the constructs of environmental stressors, resources and person versus environment interactions were most relevant. Environmental stressors were recognised most by inpatient therapists and corresponded with findings in thematic coding (see '*System pressures and resources*'). Resources referred to equipment and physical spaces that were needed to deliver somatosensory rehabilitation, including quiet rooms to facilitate sustained attention on assessments and therapy:

"To get to a private space or a quiet space to do the assessment or to have the equipment somewhere easy in a quiet space, that might be a physical barrier" (P3, Physiotherapist, Site 3, focus group 2)

Theoretically, the workplace provided a supportive culture for evidence-based practice, but practically, implementation was often left up to individual therapists:

"Quite often it feels like it's up to individual therapists to – which make sense – to bring on

change…but in order to do that ….requires a lot of …energy and effort. And so the organisation embraces it but not necessarily enables it to happen easily"(P3, Occupational therapist, Site 6, focus group).

Social professional role and identity

Therapists commented on two predominant areas within this TDF domain: their own professional role and identity, and their organisation's identity or 'brand' and how these factors influenced their perspective and practice. Physiotherapists mentioned that they would often defer upper limb sensory rehabilitation to occupational therapists (as per thematic coding, '*System pressures and resources'*, subtheme '*Sharing and deferring professional roles'*). Occupational therapists communicated that although upper limb sensory rehabilitation was a part of their job and assumed expertise, it was not a role they were always comfortable with:

"In terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (P7, Occupational therapist, Site 8, focus group 2)

Organisational identity was also mentioned as an enabler by therapists at organisations which aspired to high-quality healthcare, for example, through involvement in research and delivery of evidence-based practice. Therapists felt that this quality 'brand' aligned with their own desire to provide evidence-based stroke rehabilitation and justified their efforts to implement somatosensory rehabilitation:

"We've got a very strong commitment to…using evidence-based practice, and keeping abreast of new research and new techniques that are coming out"(P1, Physiotherapist, Site 1, interview)

Social influences

Interpersonal processes had an impact on therapists' delivery of somatosensory rehabilitation. This influence was exerted by work colleagues, either peers or managers, or patients. Colleagues supported practice change. The intended team training was anticipated to be beneficial, in contrast to individuals attending a professional development training session and trying to effect change:

> *"It will be really helpful having so many therapists who actually know how to do it* [sensory rehabilitation]*...we can spur each other on and to get each other to do it" (P9, Occupational therapist, Site 7, focus group)*

Patients also influenced whether somatosensory rehabilitation was provided or not. Community-based therapists expressed that a precedent could be set when therapy was provided during inpatient rehabilitation. However, if somatosensory impairments were not identified and/or treated there, patients may not want to focus on sensory rehabilitation:

> *"What they've* [patient] *been focused on as an inpatient often comes with them… 'I worked on this while I was in hospital, I want to keep working on it'...so introducing those new things* [sensory rehabilitation] *can also be a challenge"(P10, Occupational therapist, Site 1, focus group)*

Therapists found some patients were well-informed about treatment options and wanted to pursue evidence-based rehabilitation:

> *"I'm finding that some patients are very savvy and have read up a lot about things and they*

will actually say 'Are you doing this treatment technique?'…I've had a couple of people who…have asked for some of the sensory things" (P8, Occupational therapist, Site 2, focus group)

Analysis using Normalisation Process Theory

Constructs most frequently used were Coherence, including Individual specification and Internalisation, and Cognitive Participation, specifically the construct of Legitimation. Coherence refers to work done to make sense of using a new practice, whereas Cognitive participation refers to relational work done to build enrolment and engagement in a new practice.[29]

Coherence: Individual Specification

Individual specification in this study related to therapists' understanding of their personal roles and responsibilities related to evidence-based somatosensory rehabilitation. Therapists were aware that they needed to move forward from previous practice patterns to incorporate something new:

"Just breaking what's old habits and changing practice and not defaulting to what's easy when we are feeling pressured and busy and tired…." (P10, Occupational therapist, Site 1, focus group)

Therapists also recognised their role in learning new skills related to equipment use and also providing therapy that required a high level of mastery of therapy techniques:

"More just that translating that training [in sensory rehabilitation] *to then mastering that skill and remembering it" (P1, Occupational therapist, Site 6, interview)*

Coherence: Internalisation

Internalisation in this study referred to therapists' understanding of the value and benefit of using new evidence-based somatosensory rehabilitation approaches, and coming to a conclusion about the practice.[38] Most therapists held positive views about the effectiveness of the new approach and how it would add to their repertoire of skills:

> *"The impression that the treatment approach works so that is what I'm basing my enthusiasm on, that it is actually going to improve people's sensation and translate into their function." (P5, Occupational therapist, Site 2, focus group)*

Therapists at some sites observed colleagues using new somatosensory rehabilitation approaches, which contributed to conclusions drawn about the approach:

> *"I can see the difference in the results as well that people who get SENSe training get" (P8, Occupational therapist, Site 7, focus group)*

Cognitive Participation: Legitimation

Legitimation in this study referred to therapists' beliefs about whether or not it was appropriate for them to be involved with the new evidence-based sensory rehabilitation approach, in their particular context. Some therapists believed that the evidence base for somatosensory rehabilitation legitimised their future use of it, and helped support the anticipated time required to change practice:

> *"Because there's evidence behind this program already…there's a bit more weight to it in terms of when you are selling it to other health professionals or to our clients and their*

families in terms of how much time is needed" (P2, Occupational therapist, Site 5, focus group)

Therapists from an inpatient setting wondered how their patients would participate in the therapy. Some believed this area of practice was more suitable for use by their community-based colleagues:

"I'm not sure how well received the treatment would be with all of our patients" (P1, Occupational therapist, Site 5, focus group)

Some therapists felt that somatosensory rehabilitation was considered to be an assumed skill by managers, which justified their involvement in, and use of the new rehabilitation approach:

"I don't necessarily think we would have…barriers put up by our direct managers….I think to a degree they'd already expect us to be doing this as part of our jobs" (P7, Occupational therapist, Site 1, focus group)

The need for extensive one-to-one therapy as part of this new approach, which required 'hands-on' intervention, was felt to be at odds with current practice at one site, and a potential barrier to practice change, with therapists stating that:

"There is a move for…more self-directed [therapy]*…the patient taking ownership of their problem and working on that themselves, rather than you sitting down one-on-one" (P10, Physiotherapist, Site 3, focus group 1)*

Finally, therapists talked about the importance of goal-directed rehabilitation and felt that SENSe therapy was aligned with this principle:

> *"It's a goal-based service…the client has a lot of input into their…rehabilitation…by having really specific goals. So it's helpful that SENSe is very goal orientated as well." (P9, Occupational therapist, Site 7, focus group)*

DISCUSSION

Findings suggest three main factors influencing delivery of upper limb somatosensory rehabilitation by therapists: individual therapist factors ('*The uncertain unskilled therapist*'), patient factors ('*The patient's understanding and priorities)* and organisational factors ('*System pressures and resources'*). This study used a multi-phased approach for analysis, including both psychological and sociological implementation theories. Initial inductive analysis allowed a data-driven exploratory approach before use of a deductive analysis mapped data to pre-determined theoretical constructs. Implementation theory highlighted key determinants of practice, such as opportunities for practice to consolidate new skills (TDF domain 'Skills'), the anticipated benefits of upskilling as a therapy team (TDF domain 'Social influence'), and the tendency of physiotherapists to defer to occupational therapists for upper limb somatosensory rehabilitation (TDF domain 'Social Professional role and identity'). NPT highlighted the work anticipated and required by therapists, including the time and effort, to incorporate a new approach into practice and learn practical aspects of equipment use. This phased approach to analysis has previously been used in implementation research[39] and avoids theoretical 'blinders' resulting from a single method.[25]

Given the known evidence-practice gaps in somatosensory rehabilitation, [8,40] it is

unsurprising that knowledge and skill barriers were prominent, consistent with previous studies.[20,41] Patient factors were rightfully important to therapists. Therapists wanted to be directed by patients about their stroke rehabilitation goals, but acknowledged that sensation was a poorly understood, abstract concept for many patients. For that reason, patients often did not raise sensation as an issue nor set 'sensory goals'. A cycle of patient non-inquiry and therapist non-delivery of somatosensory rehabilitation was suggested, which may be important to address during implementation. Interestingly, therapists sometimes delineated between 'sensory goals' that were impairment based and 'functional goals' which were not, without noting the association between somatosensory capacities and occupational performance.[42,43]

The role of physiotherapists in somatosensory rehabilitation was also explored through this research. Although the proportion of physiotherapists in the sample was relatively small (21%), one theme that was evident across several sites was that occupational therapists assumed the primary role for upper limb somatosensory rehabilitation, with physiotherapists focused on other areas such as mobility retraining. This finding has potential implications for involving physiotherapists in somatosensory rehabilitation and tailored strategies for behaviour change, such as training, persuasion and modelling, are likely required[44].

Organisational pressures were felt strongly by therapists. Inpatient therapists were particularly influenced by discharge pressures. This pressure often compromised their ability to provide upper limb rehabilitation. Some therapists suggested that it might not be feasible for them to deliver somatosensory rehabilitation in their inpatient setting. This finding is similar to other studies where discharge pressure influenced provision of rehabilitation.[45,46] Social influences from colleagues and patients were identified as both enabling and hindering

factors for change. Therapists held positive views about anticipated implementation efforts that would be directed towards them as a group rather than individuals. They perceived benefits of upskilling the whole therapy team and working together to use a new therapy approach.

Implementation theory helped to further elucidate perceptions towards changing practice and factors influencing translation. Mapping to domains of the TDF and NPT revealed common data points for triangulation, a layered understanding of themes, and new factors influencing the implementation of evidence-based somatosensory rehabilitation not apparent during initial coding. An example of intersection between theoretical approaches used in this study was between the NPT category of '*Coherence: Internalisation*' and the TDF domain of '*Beliefs about consequences'*. Therapists' positive views towards the new somatosensory intervention and its effectiveness were mapped to both of these components. Similarly, the TDF domain of '*Social Professional Role and Identity'* was found to align with the NPT category of '*Cognitive Participation: Legitimation'* in therapists' belief the intervention may be more suitable for community-based therapists.

Two other studies have used both the TDF and NPT to explore implementation issues [47,48] and multiple studies have applied more than one implementation theory.[49] This study mapped data to implementation theory, improving our understanding of factors which influence practice change, such as professional identity and work anticipated by therapists to embed a new therapy. The findings in this study will be used to further tailor implementation strategies in the SENSe Implement knowledge translation study[32]. Improved understanding of key determinants of practice change suggest the value of individual consolidation of skills in somatosensory rehabilitation, upskilling as a therapy team, and organisational support for

resources and change.

Strengths and limitations

There were several strengths of the study design and methods. First, the use of multi-phased analysis and implementation theory can heighten the sensitivity of researchers to interpretations that may not occur using inductive analysis alone[36]. Second, the number of health professionals (n=87) across eight different health organisations provided a representative sample of stroke rehabilitation therapists. Therapists unable to attend initial focus groups were followed up in individual interviews, allowing part-time therapists, and those in senior roles with family/carer responsibilities to participate. Their perspectives were valued. Limitations of this study include the fact that participating health organisations were largely selected by the research team. Furthermore, management personnel within these organisations may have influenced which therapists participated in the study. These factors may have introduced sampling bias and influenced findings. In addition, therapists with different levels of experience and seniority participated in the focus groups, introducing a possible power differential within the group, and potential response bias. Finally, the perspectives of stroke survivors and health organisation managers were not included in this study; these viewpoints may have provided a more comprehensive analysis of the barriers and enablers of somatosensory rehabilitation.

Conclusions

This study used focus groups and interviews to explore the perspectives of occupational therapists and physiotherapists and found individual, patient and organisational factors influence the delivery of evidence-based somatosensory rehabilitation with stroke survivors.

Therapists experience barriers to change including a lack of knowledge and skills, lack of resources and organisational pressures. Facilitators for change were identified, including social support and therapists' perceived legitimacy in using new somatosensory rehabilitation approaches. The theoretical lens used in this study will guide implementation during the SENSe Implement study, a project aimed at increasing the use of an evidence-based sensory discrimination program.[16]

Ethics Committees approval:

Ethical approval for this study was granted by the Austin Health Human Research Ethics Committee (Reference: H2013/04956 HREC/13/Austin/8) and La Trobe University (Reference FHEC 14/243). Site specific ethics approval was obtained for all participating sites.

Acknowledgements:

We acknowledge and thank the occupational therapists and physiotherapists who participated in this study.

Funding:

We acknowledge support for conduct of the research from the National Health and Medical Research Council of Australia partnership grant: A network of sites and 'up-skilled' therapists to deliver best practice stroke rehabilitation of the upper limb (GNT 1134495). LSC was supported by an Australian Government Research Training Program Scholarship. NAL was supported by a Future Leader Fellowship (102055) from the National Heart Foundation of Australia. DAO is supported by a NHMRC Translating Research into Practice Fellowship (GNT 1168749).

Competing interests:

LMC is the lead author of the SENSe approach to sensory rehabilitation, the focus of knowledge translation in the SENSe Implement project. A SENSe training package (manual and DVD) has been developed and is available for purchase from a Not for Profit organisation. SENSe assessment and training equipment are also available for purchase.

LMC has no personal financial interest in the sale of these resources. There is no patent, or intended application for a patent, associated with these resources. LMC has conducted workshops on the SENSe approach and been invited to give lectures and conference presentations on the approach. All other authors declare no competing interests.

Author Contribution:

LSC, LMC and NAL conceptualised the study. LSC and YMY conducted focus groups and individual interviews. LSC, LMC, NAL, DAO, CN and AM discussed and determined the approach to deductive analysis using implementation theory. LSC and AM were involved in thematic analysis. LSC, NAL and AM were involved in deductive analysis. LSC and NAL drafted the manuscript; all authors (LMC, DAO, YMY, CN) critically reviewed the manuscript and provided feedback.

Data availability statement: De-identified therapist data are available from the corresponding author. Additional data (therapists quotes) are included in the supplementary material (Appendix 2 and 3 codebooks).

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Appendix 1.

Focus group and interview questions

Questions used in focus groups and interviews
1. *How able do you feel currently to change your practice regarding sensory assessment and treatment?*
2. *What do you think some of the challenges will be in using new assessment and treatment approaches?*
3. *What do you see as some of the strengths of this organisation in supporting your use of new sensory assessments and treatments?*
4. *How do you feel about the prospect of changing the way you assess and treat sensory loss?*
5. *Do you think the working environment (i.e. either cultural / physical) will impact on your ability to use new assessment and treatment approaches?*
6. *What are the incentives for you currently, if any, to change your practice in the areas of sensory rehabilitation?*
7. *Do you think a change in practice in the area of sensory assessment and treatment will have a positive effect on patient outcomes?*

Appendix 2.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Theoretical Domains Framework (TDF) Codebook

Note:
Sensory rehabilitation refers to both assessment and treatment of sensation, in this case using SENSe Assess and SENSe therapy

TDF Domain	Construct	Guidance/rule	Sample quotes
1. Knowledge An awareness of the existence of something *What do they know and how does that influence what they do?** *Whether the therapist has knowledge of sensory rehabilitation*	Knowledge (including knowledge of condition/scientific rationale): *An awareness of the existence of something* Procedural knowledge: *Knowing how to do something* Knowledge of task environment: *Knowledge of the social and material context in which a task is undertaken*	Appropriate coding to this domain: Knowledge/Lack of knowledge of: ▪ Nature of post-stroke sensory loss ▪ Scientific rationale for sensory rehabilitation ▪ Clinical practice guidelines ▪ Sensory assessment and treatment approaches ▪ Procedure of sensory rehabilitation ▪ Equipment and materials needed ▪ Anecdotal evidence related to sensory rehabilitation Inappropriate coding to this domain: ▪ The active 'doing' of rehabilitation (code to Skills) ▪ Discussion of who provides sensory rehabilitation (code to Social	*"you educate the patients on you know, safety awareness between hot cold and sharp objects and what not, but in terms of rehabilitation…I'm just not aware of what to do" (Site 4_P6)* *"I barely remember even covering sensation at uni" (Site 7_P3)* *" …they* [sensory assessments] *were all listed and I'm thinking I don't know them…from years of experience, I didn't know any of them……that was disconcerting" (Site 1_P10)* [Construct: Knowledge] *"I just do things but I don't know what principles they fall under and things like*

		Professional Role and Identity) ▪ Therapist report of patient knowledge regarding sensation	*that, so… I was a bit overwhelmed' (Site 4_P5)* [Construct: Procedural Knowledge]
2. Skills An ability or proficiency acquired through practice	Skills development: *The gradual acquisition or advancement through progressive stages of an ability or proficiency acquired through training and practice* Competence: *One's repertoire of skills, and ability especially as it is applied to a task or set of tasks* Ability: *Competence or capacity to perform a physical or mental act. Ability may be either unlearned or acquired by education and practice* Interpersonal skills: *An aptitude enabling a person to carry on effective relationships with others, such as an ability to cooperate, to assume appropriate social responsibilities or to exhibit adequate flexibility* Practice: *Repetition of an act, behaviour, or series of activities, often to improve performance or acquire a skill* Skills assessment: *A judgment of the quality, worth, importance. Level or value of an ability or proficiency acquired through training and practice*	Appropriate coding to this domain: ▪ Development of sensory rehabilitation skills ▪ Competence and ability in sensory rehabilitation ▪ Practice of sensory rehabilitation skills ▪ Evaluation of quality of sensory rehabilitation practices ▪ Discussion of how relationship/rapport between therapist and patient may promote use of sensory rehabilitation Inappropriate coding to this domain: ▪ How therapists feel about current skill level (Code to Emotion)	*"So it's not just necessarily about the knowing it's I think sometimes more about the doing….that's sometimes the hard part." (Site 8_P1)* *"I also had a young patient recently who…his only issue was sensation, decreased sensation in his hand and I really didn't feel like I had the skills to know where to go in my specific intervention" (Site 8_P3)* *"I'm not very skilled in that area* [sensory rehabilitation] *either. So I probably avoid it." (Site 4_P1)* *"I think it's that carry over, you kind of get that feeling that you need to be doing it really regularly to be able to keep those skills up-to-date" (Site 3_P4)* [Construct: Practice] *"I'm probably a bit slap-dash in my approach to sensory assessments (Site 6_P6)* [Construct: Competence]

3. **Social/professional role and identity** A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting *How does who they are as an occupational therapist or physiotherapist influence whether they do something or not?**	Professional identity: *The characteristics by which an individual is recognised relating to, connected with or befitting a particular profession* Professional role: *The behaviour considered appropriate for a particular kind of work or social position* Social identity: *The set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a social group* Identity: *An individual's sense of self defined by a) a set of physical and psychological characteristics that is not wholly shared with any other person and b) a range of social and interpersonal affiliations (e.g., ethnicity) and social roles.* Professional boundaries: *The bounds or limits relating to, or connected with a particular profession or calling* Professional confidence: *an individual's belief in his or her repertoire of skills and ability especially as it is applied to a task or set of tasks.* Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group*	Appropriate coding to this domain: ▪ Who provides sensory rehabilitation ▪ Link between profession and tasks of sensory rehabilitation ▪ Boundaries between therapists in providing sensory rehabilitation ▪ Organisational commitment Identity could also relate to the identity of the organisation (i.e. a health service having a reputation of 'world-class healthcare')	*"if there's an OT involved we would deflect that as an OT thing as opposed to what we would do"* (Site 1_P4) [Construct: Professional boundaries] *"And I'll be the first to admit if I've got an OT working with my client at the same time then I won't prioritise upper limb sensory"* (Site 6_P6) *"in terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (Site 8_P7)* [Construct: Social Identity]

	Leadership: *The processes involved in leading others, including organising, directing, coordinating and motivating their efforts toward achievement of certain group or organization goals* Organizational commitment: *An employee's dedication to an organisation and wish to remain part of it.*		
4. Beliefs about capabilities Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use *Do they think they can do what they should do and how does that influence whether they do it or not?** *The extent to which the therapist feels confident/in*	Self-confidence: *Self-assurance or trust in one's own abilities, capabilities and judgement* Perceived competence: *An individual's belief in their ability to learn and execute skills* Self-efficacy: *An individual's capacity to act effectively to bring about desired results, as perceived by the individual* Perceived behavioural control*: an individual's perception of the ease or difficulty of performing the behaviour of interest* Beliefs: *The thing believed; the proposition/set of propositions held true* Self-esteem: *The degree to which the qualities and characteristics contained in one's self-concept are perceived to be positive* Empowerment: *The promotion of the skills, knowledge and confidence*	Appropriate coding to this domain: ▪ Perceived behavioural control in delivery of sensory rehabilitation ▪ Therapist confidence in delivering sensory rehabilitation ▪ How easy or difficult therapists view delivery of sensory rehabilitation ▪ Self-efficacy and beliefs regarding sensory rehabilitation Inappropriate coding to this domain: ▪ Active delivery of sensory rehabilitation (code to Skills) ▪ Expectations of outcomes of using sensory rehabilitation (code to Beliefs about consequences)	*"there's a bit of trepidation around…needing to achieve a certain standard and being able to use a new tool and being able to… do it correctly" (Site 4_P3)* *"And just your general confidence in yourself and…you're in the middle of a session and you're thinking I feel confident and competent in this skill…it's less stressful to approach that client with that issue" (Site 3_P4)* *"I'm coming into this thinking, you know this is really good, and it's obviously evidence based practice but can I provide this? Like there's this guilt that, you know, this is best care, this is what I should be doing with my patients but I don't have capacity for that" (Site 7_P4) [Construct: perceived behavioural control]*

control over performing the behavior	*necessary to take great control of one's life as in certain educational or social schemes; the delegation of increase decision-making powers to individuals or groups in a society or organization* Professional confidence*: An individual's beliefs in his or her repertoire of skills, and ability, especially as it is applied to a task or set of tasks.*		
5. Optimism The confidence that things will happen for the best or that desired goals will be attained	Optimism: *The attitude that outcomes will be positive and that people's wishes or aims will be ultimately fulfilled* Pessimism: *The attitude that things will go wrong and that people's wishes or aims are unlikely to be fulfilled* Unrealistic optimism: *the inert tendency for humans to over-rate their own abilities and chances of positive outcomes compared to those of other people*	Appropriate coding to this domain: ▪ Therapist discussion of optimism or pessimism related to use of sensory rehabilitation ▪ Positive or negative view towards process of change in study Inappropriate coding to this domain: ▪ Feeling of anxiety, stress or burnout (code to Emotion) ▪ Thoughts towards outcomes of sensory rehabilitation (code to Beliefs about consequences)	*"I feel a mix of excitement and scepticism, to be honest" (Site 3_P1)* *"think it's helpful having that structure as well of the study…like there's some ownership you have to take, the responsibility you have to take to actually use the assessments to use the treatment to guide us to how to feedback about that, so, I think that is really good too." (Site 7_P10)* *"the tests we're using to do the initial assessments aren't great, so to re-test …I can't re-test again, I can't show you were 4 and now you're 5. So I can't prove it to them that what they're doing is working" (Site 8_P3)*
		Appropriate coding to this domain:	

6. Beliefs about consequences Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation *The extent to which the therapist is in favour of performing sensory rehabilitation and has positive behavioural beliefs about sensory rehabilitation*	Beliefs: *The thing believed; the proposition or set of propositions held true* Outcome expectancies: *Cognitive, emotional, behavioural, and affective outcomes that are assumed to be associated with future or intended behaviour. These assumed outcomes can either promote or inhibit future behaviours.* Characteristics of outcome expectancies: *Characteristics of the cognitive, emotional and behavioural outcomes that individuals believe are associated with future or intended behaviours and that are believed to either promote or inhibit these behaviours. These include whether they are sanctions/rewards, proximal/distal, valued/not valued, probable/improbable. Salient/not salient, perceived risks or threats.* Anticipated regret: *A sense of the potential negative consequences of a decision that influences the choice made: for example an individual may decide not to make an investment because of the feelings associated with an imagined loss* Consequents: *An outcome behaviour in a given situation*	▪ Positive or negative expectancies of use of sensory rehabilitation ▪ Beliefs regarding treatment outcomes ▪ Potential long-term outcomes for patients ▪ Anticipated regret in not using sensory rehabilitation Inappropriate coding to this domain: ▪ Beliefs about whether therapists can provide sensory rehabilitation (code to Beliefs about Capabilities) ▪ The confidence goals will be achieved (Code to Optimism)	*"I don't necessarily think the patient outcomes will improve" (Site 1_P7)* *"… so if there was research that showed direct improvements then I would be adopting things." (Site 4_P1)* *"you don't actually know yeah, if it's actually making a difference or not, is it your input or is it something else?" (Site 8_P6)* *"it's great when you get a change for a client, I love that, so that's the motivator for this, if something's saying that change is possible that's what motivates me" (Site 6_P4)* [Characteristics of outcome expectancies]

7. Reinforcement Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus	Rewards (proximal/distal, valued/ not valued, probable/improbable): *Return or recompense made to, or received by a person contingent on some performance.* Incentives: *An external stimulus, such as condition or object, that enhances or serves as a motive for behaviour* Punishment: *The process in which the relationship between as response and some stimulus or circumstance results in the response becoming less probable; a painful, unwanted or undesired event or circumstance imposed as a penalty on a wrongdoer* Consequents: *An outcome of behaviour in a given situation* Reinforcement: *A process in which the frequency of a response is increased by a dependent relationship or contingency with a stimulus* Contingencies: *A conditional probabilistic relation between two events. Contingencies may be arranged via dependencies or they may emerge by accident* Sanctions: *A punishment or other coercive measure, usually administered by a recognized authority, that is used to penalise and deter inappropriate or*	Appropriate coding to this domain: ▪ Rewards or incentives for using sensory rehabilitation ▪ Perceived punishments, consequents, reinforcements, contingencies, sanctions related to sensory rehabilitation Inappropriate coding to this domain: ▪ Opportunities to reinforce or consolidate skills in sensory rehabilitation, code to Skills instead (Construct: Practice/Skill development)	*And also often a patient is really focused on their mobility so if a physio started working on their upper limb they'd be saying - 'but come on!' (Site 6_P6)* [Construct: Punishment] *"the clinical guidelines are audited and we get feedback and we have to meet the standards" (Site 3_P8)* *"For me it's definitely about best practice and knowing that this type of technique is best practice, it's backed up by evidence research and that I'm currently probably not doing it correctly or as much as I should be doing it so yeah, **I think that's definitely my motivation**" (Site 8_P1)* *"I think everyone's very happy to do things if they feel the patient is going to get a better outcome from it, and I think that's one of the biggest drivers for our inpatient team is that outcome" (Site 3_P3)*

	unauthorized actions.		
8. Intentions A conscious decision to perform a behaviour or a resolve to act in a certain way *Have they made a decision to provide SENSe?*	Stability of intentions: *ability of one's resolve to remain in spite of disturbing influences* Stages of Change model*: A model that proposes that behaviour change is accomplished through five specific stages* Transtheoretical model and stages of change: *a five-stage theory to explain changes in people's health behaviour. It suggests that change takes time, that different interventions are effective at different stages, and that there are multiple outcomes occurring across the stages*	Appropriate coding to this domain: ▪ Discussion of how motivated/unmotivated therapists are to provide sensory rehabilitation ▪ Description of inclination to use sensory rehabilitation and in what situation ▪ Stability of intentions regarding sensory rehabilitation, stages of change model, transtheoretical model and stages of change Inappropriate coding to this domain: ▪ Practical plans to use sensory rehabilitation (code to Goals instead)	*"That's right, if you don't look, you don't know, and you don't have to do anything about it (laughter)!" (Site 8_P1)* *"in my limited experience and treatment that I've used some of the SENSe practices with, I've had really significant outcomes so I'm keen to apply it more broadly I guess across the board rather than just the ones that are really severe…sensory issues and see what sort of outcomes we might have." (Site 3_P2)*
9. Goals Mental representations of outcomes or end states that an individual wants to achieve *How much do they want to do SENSe?*	Goals (distal/proximal): *Desired state of affairs of a person or system, these may be closer (proximal) or further away (distal)* Goal priority*: Order of importance or urgency of end state toward which one is striving* Goal/target setting: *A process that establishes specific time based behavioural targets that are measureable, achievable and realistic* Goals (autonomous/controlled): *The end*	Appropriate coding to this domain: ▪ Goal priority, action planning and implementation intention related to sensory rehabilitation ▪ Description of whether or not providing sensory rehabilitation is a priority ▪ Practical plans to apply sensory rehabilitation or not Inappropriate coding to this domain: ▪ Discussion of readiness to change	*"there's so many other things we need to look at like home assess and other functions and mobility, so yeah, it's a bit low on the priority list" (Site 8_P6)* *"if you have the proper equipment, we will be more confident to use it and we'll look more professional too" (Site 7_P6)*

	state toward which one is striving: the purpose of an activity or endeavour. It can be identified by observing that a person ceases or changes their behaviour upon attaining this state; proficiency in a task to be achieved within a set period of time. Action planning: *The action or process of forming a plan regarding a thing to be done or a deed* Implementation intention: *The plan that one creates in advance of when, where and how one will enact a behaviour*	behaviour in sensory rehabilitation (Code to Intentions instead)	
10. Memory, attention and decision processes The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives	Memory: *The ability to retain information or a representation of a past experience, based on the mental processes of learning or encoding retention across some interval of time, and retrieval or reactivation of the memory; specific information of a specific task* Attention*: A state of awareness in which the senses are focused selectively on aspects of the environment and the central nervous system is in a state of readiness to respond to stimuli* Attention control: *The extent to which a person can concentrate on relevant cues and ignore all irrelevant cues in a given situation*	Appropriate coding to this domain: ▪ Retaining information on how to deliver sensory rehabilitation ▪ Deciding between the use of different sensory assessments ▪ Cognitive overload/fatigue related to delivering sensory rehabilitation Inappropriate coding to this domain: ▪ Discussion of system pressures that impact on decisions to use sensory rehabilitation (Code to Environmental Context and Resources: e.g. Environmental Stressors)	*"For me it's more about the scale of prioritisation…. is it what they should be doing out amongst all of all their other priorities?" (Site 7_P2)* *"and that affects your confidence and your quality of treatment because you might…upskill for a patient and you don't have another patient with sensory loss for ages and you're kind of like going back to* ***'oh, what did I do last time?"*** *(Site 8_P5)*

	Decision making: *The cognitive process of choosing between two or more alternatives, ranging from the relatively clear-cut to the complex* Cognitive overload/tiredness: *The situation in which the demands placed on a person by mental work are greater than a person's mental abilities*		
11. Environmental context and resources Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour *The extent to which the therapist feels the environmental context supports*	Environmental stressors: *External factors in the environment that cause stress* *Resources/material resources: Commodities and human resources used in enacting a behaviour* Organizational culture/climate: *A distinctive pattern of thought and behaviour shared by members of the same organization and reflected in their language, values, attitudes, beliefs and customs* Salient events/critical incidents: *Occurrences that one judges to be distinctive, prominent or otherwise significant* Person x environment interaction: *Interplay between the individual and their surroundings* Barriers and facilitators: *In psychological contexts, barriers/facilitators are mental, emotional or behavioural*	Appropriate coding to this domain: ▪ Availability of equipment to deliver sensory rehabilitation ▪ Setting in which sensory rehabilitation will be delivered ▪ Organisational culture/climate, impacting on delivery of sensory rehabilitation ▪ Description of how more time will be required to deliver sensory rehabilitation ▪ Patient factors that would influence whether sensory rehabilitation was offered or provided ▪ Salient events related to sensory rehabilitation Inappropriate coding to this domain: ▪ Patient factors based on interpersonal processes and	*"I'm really pleased we're getting the equipment provided because I think that would have been the largest barrier" (Site 8_P1)* [Construct: Resources/material resources] *"I feel it's a supportive culture that wants to look at what evidence based information is out there and how do we further our clinicians' knowledge, so I feel… it's a good environment to make change." (Site 6_P1)* *"I think bed pressures could always be something that could come up, if there's a pressure to discharge a patient and we haven't been able to follow through with all the sensory interventions" (Site 8_P6)* *"I think it's just the health care system, of processes have to happen, we have to*

performance of sensory rehabilitation	*limitations/strengths in individuals or groups*	views/opinions of patients – this should be coded to social influence	*deliver a service and we have to meet targets…improving our practices is only part of what we need to deliver…so….it's all a balance" (Site 6_P3) [Environmental stressors]* *"the other thing is in my limited experience and treatment that I've used some of the SENSe practices with, I've had really significant outcomes so I'm keen to apply it more broadly" [Salient event]* *"I think it's pretty rare too… that patients come through sort of the inpatient rehab part of the continuum, when sensation is their biggest issue" (Site 3_P12)*
12. **Social influences** Those **interpersonal processes** that can cause individuals to change their thoughts, feelings or behaviours *What do others think of what they do? Who are they*	Social pressure: *the exertion of influence on a person or group by another person or group* Social norms: *Socially determined consensual standards that indicate a) what behaviours are considered typical in a given context and b) what behaviours are considered proper in the context* Group conformity: *The act of consciously maintaining a certain degree of similarity to those in your general social circles* *Social comparisons: The process by which*	Appropriate coding to this domain: ▪ Views and opinions of others (colleagues, patients, professional groups) influencing decision to provide sensory rehabilitation ▪ Impact of others on whether or not sensory rehabilitation is provided ▪ Discussing importance of patient engagement/buy-in ▪ Social pressure to deliver or not deliver sensory rehabilitation ▪ Social support to provide sensory	*"I'm finding that some patients are very savvy and have read up a lot about things and they will actually say 'are you doing this treatment technique?'"(Site 2_P8)* *"our consultant might start asking us questions in terms of why are we spending so much time on sensation when we should be doing A, B and C in terms of discharge planning"* (Site 1_P5) *"Our stroke consultant's really into research and new things so she'd be very,*

*and how does that influence what they do?** *The extent to which therapists feel social pressure to engage in sensory rehabilitation* *Interpersonal processes indicate an interaction that is verbal or non-verbal ***	*people evaluate their attitudes, abilities or performance relative to others* Group norms: *Any behaviour, belief, attitude or emotional reaction held to be correct or acceptable by a given group in society* Social support: *The apperception or provision of assistance or comfort to others, typically in order to help them cope with a variety of biological, psychological and social stressors. Support may arise from any interpersonal relationship in an individual's social network, involving friends, neighbours, religious institutions, colleagues, caregivers of support groups* Power: *The capacity to influence others, even when they try to resist this influence* *Intergroup conflict: Disagreement or confrontation between two or more groups and their members. This may involve physical violence, interpersonal discord, or psychological tension.* Alienation: *Estrangement from one's social group; a deep seated sense of dissatisfaction with one's personal experiences that can be a source of lack of trust in one's social or physical environment or in oneself; the experience of separation between thoughts and*	rehabilitation ▪ Modelling of delivery, dose and method of sensory rehabilitation ▪ Patient views regarding sensory rehabilitation *To code patient-related factors to this domain there should be an underlying interpersonal process involved*	*very keen to have this happen" (Site 8_P5)* *"quite often it feels like it's up to individual therapists to …to bring on change umm, but in order to do that, that requires a lot of energy….and effort" (Site 6_P3)* [Construct: alienation] *"There's often a confusion between motor and sensation, like sometimes they'll say [patient]'my muscles need to be stronger' but when you test it's very obvious that it's not actually a motor issue, it's well, it's more of a sensory impairment" (Site 6_P3)*

	feelings Group identity: *the set of behavioural or personal characteristics by which an individual is recognizable [and portrays] as a member of a group* Modeling: *In developmental psychology the process in which one or more individuals or other entities serve as examples (models) that a child will copy*		
13. Emotion A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event	Fear: *An intense emotion aroused by the detection of imminent threat, involving an immediate alarm reaction that mobilizes the organism by triggering a set of physiological changes* Anxiety: *A mood state characterized by apprehension and somatic symptoms of tension in which an individual anticipates impending danger, catastrophe or misfortune.* Affect: *An experience or feeling of emotion, ranging from suffering to elation, from the simplest to the most complex sensations of feelings, and from the most normal to the most pathological emotional reactions.* Stress: *A state of physiological or psychological response to internal or external stressors* Depression: *A mental state that presents*	Appropriate coding to this domain: ▪ Discussion of emotions experienced by therapists towards providing sensory rehabilitation ▪ Description of when therapists would be worried/concerned about providing sensory rehabilitation Inappropriate coding to this domain: ▪ Description of patients' emotions regarding sensory rehabilitation (code to Social Influences instead)	*"I feel a mix of excitement and scepticism, to be honest"* (Site 3_P1) *"I also feel a little bit nervous…with doing this amazing training and they'll be no one to use it on for 6 months and that makes me feel a bit nervous… when I finally get to that client, will I be ready?" (Site 8_P4)* *"there's a bit of trepidation around…needing to achieve a certain standard and being able to use a new tool and being able to… do it correctly" (Site 4_P3)*

	with depressed mood, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration Positive/negative affect: *the internal feeling/state that occurs when a goal has/has not been attained. A source of threat has/has not been avoided, or the individual is/is not satisfied with the present state of affairs* Burn-out: *Physical, emotional or mental exhaustion, especially in one's job or career, accompanied by decreased motivation, lowered performance and negative attitudes towards oneself and others*		
14. Behavioural regulation Anything aimed at managing or changing objectively observed or measured actions	Self-monitoring: *A method used in behavioural management in which individuals keep a record of their behaviour, especially in connection with efforts to changes or regulate the self; a personality trait reflecting an ability to modify one's behaviour in response to a situation* Breaking habit: *to discontinue a behaviour or sequence of behaviours that is automatically activated by relevant situational cues* Action planning: *The action or process of*	Appropriate coding to this domain: ▪ Discussion regarding habits and breaking old habits to allow for sensory rehabilitation ▪ Self-regulatory strategies that would influence provision of sensory rehabilitation ▪ Descriptions of auditing recommended for implementation	*"am I going to mess it up and fall back to my old ways?" (Site 8_P7)* *"it's a big organisation, but here locally, it's quite small so changes will happen quite quickly." (Site 4_P10)* *"I think it's* [change] *something that's always possible but not necessarily always easy. I think sometimes it's really hard to change your practice and that might be for multiple reasons, maybe you've practised in that way for a long time or that's what you were taught in a particular course or*

	forming a plan regarding a thing to be done or a deed.		*at university and so with the new literature and research that's coming out and evidence-base, sometimes it's more difficult to take that on board" (Site 8_P1)* *I find on inpatient rehab where we've got more access to time I can introduce that and then we can go with, ok for 3 days a week for lower limbs and 2 days a week we work on lower limbs but we have access to seeing them everyday.* ***We can accommodate sometimes that way*** *(Site 6_P1)* [Construct: Action planning]

Structure and definitions in codebook guided by:

Presseau J, Mutsaers B, Al-Jaishi AA, Squires, et al. (2017). Barriers and facilitators to healthcare professional behaviour change in clinical trials using the Theoretical Domains Framework: a case study of a trial of individualized temperature-reduced haemodialysis. *Trials*, *18*(1), 227.

Bosch M, McKenzie JE, Ponsford JL, Turner S, et al. (2019). Evaluation of a targeted, theory-informed implementation intervention designed to increase uptake of emergency management recommendations regarding adult patients with mild traumatic brain injury: results of the NET cluster randomised trial. *Imp Sci*, *14*(1), 4.

Michie, S., Atkins, L., & West, R. (2014). The behaviour change wheel. *A guide to designing interventions. 1st ed. Great Britain: Silverback Publishing*, 1003-1010.

Appendix 3.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Normalisation Process Theory (NPT) Codebook

Construct 1: COHERENCE *"Making sense of it"*			
Coherence is the sense-making work that people do individually & collectively when faced with the problem of operationalizing some set of practices. *What knowledge, skills, behaviours, actors and actions are required to implement SENSe?*			
Component	Definition	Guidance	*Sample quotes*
Differentiation *Understanding the uniqueness of it* *Does the therapist recognize the SENSe approach as different from their existing ways of working?*	How a set of practices and their objects are different from each other	Appropriate coding to this construct component: ▪ Understanding the differences between informal and standardised sensory Axs ▪ Understanding the differences between other and past sensory rehabilitation approaches and SENSe therapy Inappropriate coding: views on effectiveness of SENSe (code to communal specification)	*"I do assess sensation and I do treat sensation but I don't actually use any of those **formalised things**" (Site 3_P5)* *"it's all about **compensating** for something and educating a patient or their family rather than actually taking the time to retrain" (Site 1_P7)*
Individual specification *Individually interpreting it:* *Does the therapist identify their personal role and responsibilities with using SENSe?*	Understanding specific tasks and responsibilities around a set of practices	Appropriate coding to this construct component: ▪ Individual tasks a therapist needs to do to understand and start using SENSe Assess and SENSe therapy	*"it's helpful having that structure as well of the study…there's some ownership you have to take, the responsibility you have to take to **actually use the assessments**" (Site 7_P10)* *"I think the hard thing for me is because I did go to a SENSe workshop, I know that there is so much more that could be done and with us not having the equipment, **it's a matter perhaps making do with the principles** but you…but like just knowing that's there's so much more that could be done" (Site 4_P2)*
Communal specification *Collectively interpreting*	Building a shared understanding	Appropriate coding to this construct component: ▪ The development of a group or department	*"I suppose, you know, if it (SENSe therapy) **needs a lot of kind of one-on-one focus**, that might be a problem." (Site 4_P1)* *"It feels more old-fashioned not to empower them to go away*

it: *Does the therapist recognise the steps needed to assist in the integration of SENSe?*	of aims, objectives, and expected benefits of a set of practices.	understanding of SENSe Assess and SENSe therapy ▪ A group trying to identify and anticipate how SENSe Assess and SENSe therapy will fit with current practice	*and train the carer to do the program with a client, we don't do a lot of stuff to people…" (Site 3_P1)* *"also with the intensity with which we provide therapy, I feel like we, it's so much less than what is in the SENSe study and even though I am aware of it, and I just can't imagine how I can give that intensity to a client" (Site 7_P8)*
Internalization *Coming to a conclusion:* *Does the therapist identify any benefit in adopting the SENSe approach?*	Understanding the value, benefits and importance of a set of practices	Appropriate coding to this construct component: ▪ Understanding the value, benefits and importance of SENSe Assess and SENSe therapy	*"I guess the impression is that the **treatment approach works** so that is what I'm basing my enthusiasm on that it is actually going to improve people's sensation and translate into their function" (Site 2_P3)* *"well we also have a lot of people here…there's a sense that (laughs) well, there's a sense the SENSe is valuable" (Site 7_P8)* *"because the loss of sensation does have such huge impact on people's function and I think to be able to implement something that is going to make a huge difference for patients is really exciting, regardless of how that is actually put in place" (Site 4_P2)* *"but also at the back of my mind going, how long do all of these assessments take and ….**would they actually assess everything that I need to know for my patients**." (Site 7_P7)*

Construct 2: COGNITIVE PARTICIPATION *'Enrolment and **engagement** of individuals and groups' "Working out participation"*

***Cognitive Participation** is the **relational work** that people do to build and sustain a community of practice around a new technology or complex intervention. Do participants view the intervention as something worthwhile and appropriate to commit their individual time and effort [signing up] to bring about the intended outcome?*

Component	Definition	Guidance	*Sample quotes*
Initiation Having the skills to engage *To what extent does the therapist appear to be a supporter of the*	Whether or not users are working to drive an intervention forward	Appropriate coding to this construct component: ▪ The work done to setup systems and procedures to allow the use of SENSe Assess and SENSe therapy	*"we're getting training…we're getting kits.. we're getting the assessment tools and..we all would know about it I think helps me to feel more able to do something a lot more formally and a lot more structured way" (Site 7_P7)* *"And…if we did need to see our client more than what our usual*

process to integrate SENSe?		▪ The engagement with others to introduce SENSe	*is, which is once a week, then that would be agreed, if we could justify it" (Site 3_P3)*
Enrolment Organising people *Has the therapist made any adaptations or assisted in the reorganisation process leading to implementation?*	The work users do to organise themselves and their co-workers to participate in the new practice.	Appropriate coding to this construct component: ▪ Therapists 'buy-in' towards SENSe ▪ The building of communal engagement towards SENSe	*"I would like us to be known as a centre of excellence and to be able to provide it (SENSe)" (Site 5_P1)* *"Maybe we can co-treat together" (Site 7_P8)*
Legitimation *Believing practice is valid* *Does the therapist believe that it is appropriate for them to be involved in integrating SENSe?*	Users' belief that the practice is right for them in their context, and that they can make a valid contribution to it.	Appropriate coding to this construct component: ▪ The role of OT/PT in sensory rehabilitation ▪ The contribution therapists feel they can make Inappropriate coding to this domain: ▪ Who does the work (code to Skill set workability)	*"For me it's more about the scale of prioritisation… is it [SENSe] what they should be doing out amongst all of all their other priorities?" (Site 7_P2)* *"in terms of the other disciplines, they look to us (OT) as an expert in this area, and there's a very uncomfortable feeling" (Site 8_P7)*
Activation *Defining actions* *Has the therapist taken steps to sustain the use of SENSe?*	Collectively defining the actions and procedures needed to sustain a practice and to stay involved.	Appropriate coding to this construct component: ▪ The sustainability of SENSe ▪ The visibility of SENSe in the organisation ▪ The ongoing connection between SENSe and those who should use it	*"I just feel a bit unsure how it's going to be carried out, and if it's… sustainable across the service." (Site 7_P3)* *"Handing that over to the AHA might not meet the criteria of the study, so I think…. once we have done the study, we might be able to think about using our AHAs a bit more effectively for that" (Site 7_P8)*
Construct 3: COLLECTIVE ACTION *'Work done to enable the intervention to happen'*			
Collective Action is the **operational work** that people do to enact a set of practices, whether these represent a new technology or complex healthcare intervention. *How far will existing work practices and the division of labour have to be changed or adapted to implement SENSe? Is SENSe consistent with the existing norms and goals of the groups, the workplace and overall organization?* **** Coding to this construct needs to involve a therapist talking about 'doing' or intended 'doing' related to using SENSE**			

Component	Definition	Guidance	Sample quotes
Interactional workability *Performing the actions* *What work does the therapist do with others to operationalise the use of the SENSe approach?*	Interactional work people do to operationalize the practice in everyday settings	Appropriate coding to this construct component: ▪ Interaction between therapists in the use of SENSe and SENSe equipment to put them into use Inappropriate coding to this domain: • Division of labour related to use of SENSe (code to Skill set Workability)	*"that might be the benefit of this study that it…encourages co-assessments and co-treatments so that we're both (OT & PT) learning together really, which I think gives us benefit." (Site 6_P3)* *"so I guess looking at across OT and physio how you can work together to try and implement the amount that you would need to, to change" (Site 3_P3)*
Relational integration *Working with and trusting the work of others (and SENSe as an intervention)* *To what extent does the integration of SENSe help or impede people's work?*	Knowledge work people do to build accountability and maintain confidence in a set of practices and in each other as they use them.	Appropriate coding to this construct component: ▪ The confidence therapists have in SENSe and its ability to detect and treat sensory loss in stroke survivors	*"we would actually articulate and educate your patients well to try and do the [SENSe] principles, I hope then then yes, and the outcomes will be better" (Site 7_P9)*
Contextual integration *Allocating resources* *Does the integration of SENSe fit with the objectives of the organisation/ individual?*	Managing a set of practices through allocation of resources, execution of protocols, policies and procedures.	Appropriate coding to this construct component: ▪ The management of the health service (staff, resources) to allow for delivery of SENSe	*"you're not going to spend a lot of time assessing someone if you can't actually treat them…that would probably lead to someone thinking I'll let that go for home-based therapy or outpatient therapy" (Site 3_P2)* *"we have grade one rotations and OTs who rotate every 6 months…obviously someone else who is going on maternity leave…if we have new people coming in that means we have to train them as well so that they can use the equipment so I guess can be a bit difficult" (Site 8_P6)*
Skill set workability	The allocation work that underpins the	Appropriate coding to this construct	*"if it's an assessment [SENSe] that both can do…if the physio is*

Appropriate division of tasks *Who does the therapist view as being best placed to make use of the SENSe approach?* *How compatible is the SENSe approach with their current tasks?*	division of labour that is built up around a set of practices	component: ▪ Who does the work related to the use of SENSe? *Related to Legitimation – see point on difference above	*too busy the OT can help out or vice versa. We can all help with the time management side of things" (Site 4_P1)* *"I'll communicate with the OT and I would probably have a list of other priorities this big and I'll go "Great! The OT can do this, one less thing for me to worry about!" (Site 4_P1)*
REFLEXIVE MONITORING *'formal and informal appraisal of benefits and costs of the intervention'*			
Reflexive Monitoring is the **appraisal work** that people do to assess and understand the ways that a new set of practices affect them and others around them. *What is the informal and formal appraisal of SENSe and its benefits for participants?* ***** Coding to this construct needs to involve a therapist reflecting on the 'doing'/ use of SENSE***			
Component	Definition	Guidance	Sample quotes
Systematization *Collecting feedback information* *Has the therapist taken practical steps to measure the influence of adopting the new techniques?*	Collecting information to determine the effectiveness and utility of an intervention	Appropriate coding to this construct component: ▪ Formal (e.g. RCT) or informal (anecdotal) sources of information on how effective & useful SENSe is From discussion with AM: e.g. audit	*"in my limited experience and treatment that I've used some of the SENSe practices with, **I've had really significant outcomes** so I'm keen to apply it more broadly I guess across the board rather than just the ones that are really severe…sensory issues and see what sort of outcomes we might have." (Site 3 _P2)*
Communal appraisal *Collectively evaluating it* *Are there any joint efforts to appraise the impact of implementation?*	Participants working together to evaluate the worth of a set of practices.	Appropriate coding to this construct component: ▪ Therapists asking each other 'Is SENSe working?' ▪ Communal appraisal of SENSe	* Likely to be more relevant at end of implementation
Individual appraisal Individually evaluating it	Participants working experientially as individuals to appraise the practice's effects on them and the contexts in	Appropriate coding to this construct component: ▪ Therapists individual appraisal of	** Likely to be more relevant at end of implementation*

Does the therapist reflect personally on the impact of the SENSe approach on his/her routine?	which they are set.	the worth of SENSe and the impact on other work tasks	
Reconfiguration Changing the way things are done *Has the therapist made attempts to modify the way the SENSe approach is used as a result of experience?*	Appraisal work done by users to redefine procedures or modify practices	Appropriate coding to this construct component: ▪ Changes to the delivery of SENSe therapists make to allow it to fit with practice	* Likely to be more relevant at end of implementation

Structure and definitions in codebook guided by:

May C, Finch T. (2009). Implementing, embedding, and integrating practices: an outline of normalization process theory. *Sociology*, *43*(3), 535-554.

Sutton E, Herbert G, Burden S, Lewis S, et al. (2018) Using the Normalization Process Theory to qualitatively explore sense-making in implementation of the Enhanced Recovery After Surgery programme: "It's not rocket science" PLoS ONE 13(4): e0195890.

Murray E, Treweek S, Pope C, MacFarlane A. et al. (2010). Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. *BMC med*, *8*(1), 63.

Alverbratt C, Carlström E, Åström S, Kauffeldt A et al. (2014). The process of implementing a new working method—a project towards change in a Swedish psychiatric clinic. *J Hosp Admin*, *3*(6), 174.

Kennedy A, Rogers A, Chew-Graham C, Blakeman T et al. (2014). Implementation of a self-management support approach (WISE) across a health system: a process evaluation explaining what did and did not work for organisations, clinicians and patients. *Imp Sci*, *9*(1), 129.

Clarke DJ, Hawkins R, Sadler E, Harding G et al. (2014). Introducing structured caregiver training in stroke care: findings from the TRACS process evaluation study. *BMJ Open*, *4*(4), e004473.

McNaughton RJ, Steven A, Shucksmith J. (2019). Using Normalization Process Theory as a practical tool across the life course of a qualitative research project. *Qual health res*, 1049732319863420.

Appendix 4.

Study: Factors influencing allied health professionals' implementation of upper limb sensory rehabilitation for stroke survivors: A qualitative study to inform knowledge translation

Number of quotes coded to Theoretical Domains Framework and Normalisation Process Theory domains and categories

Theoretical Domains Framework (TDF):

	SITE							
TDF Domain	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
Knowledge	5	3	7	7	13	6	15	13
Skills	5	6	10	9	7	9	6	18
Social/Prof Role and Identity	9	16	15	22	19	23	7	20
Beliefs about capabilities	4	3	4	1	8	12	4	12
Optimism	3	8	7	3	8	1	14	11
Beliefs about consequences	7	7	4	12	3	6	15	17
Reinforcement	3	1	1	5	4	5	1	6
Intentions	2	6	4	13	4	9	5	15
Goals	5	6	4	4	7	5	0	10
Memory, attention & decision processes	3	3	4	3	6	7	4	3
Environmental context and resources	41	38	52	45	36	40	56	77
Social influences	9	6	8	4	10	24	13	11
Emotion	8	1	8	7	5	9	4	14
Behavioural regulation	3	1	1	4	0	3	1	3

* Green/shaded numbers indicate three domains coded to most frequently at each site

Normalisation Process Theory (NPT):

	SITE							
NPT Category and Construct	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
COHERENCE								
Differentiation	6	3	10	7	7	4	17	10
Individual specification	14	3	14	3	11	5	10	14
Communal specification	5	3	7	8	6	4	7	10
Internalisation	7	9	15	15	11	6	8	15
COGNITIVE PARTICIPATION								
Initiation	4	8	6	8	5	4	10	5
Enrolment	4	4	5	3	6	11	6	9
Legitimation	15	10	14	11	12	11	14	16
Activation	2	0	4	8	6	2	2	5
COLLECTIVE ACTION								
Interactional workability	4	1	3	1	4	0	3	7
Relational integration	3	0	3	2	0	1	2	2
Contextual integration	7	0	5	2	1	2	3	8
Skill set workability	5	0	1	2	0	3	1	0
REFLEXIVE MONITORING								
Systematization	0	0	0	0	1	0	0	0
Communal appraisal	0	0	0	0	0	0	0	0

Individual appraisal	0	0	3	1	1	0	1	1
Reconfiguration	0	0	0	0	0	0	0	0

* Green/shaded numbers indicate three domains coded to most frequently at each site

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide Questions/Description	Reported on Page No. / Comment
Domain 1: Research team and reflexivity			
Personal Characteristics			
1	Interviewer/facilitator	Which author/s conducted the interview or focus group?	Page 8. Liana S Cahill (LSC) and Yvonne Mak-Yuen (YMY) conducted focus groups and interviews.
2	Credentials	What were the researcher's credentials?	Page 9. Credentials of LSC and YMY detailed under 'Research Team and Reflexivity'
3	Occupation	What was their occupation at the time of the study?	Page 9. LSC and YMY noted to be research occupational therapists under 'Research Team and Reflexivity'
4	Gender	Was the researcher male or female?	Page 9. Researchers female as noted by female pronouns.
5	Experience and training	What experience or training did the researcher have?	Page 9. Professional training and background of researchers noted under 'Research Team and Reflexivity'
Relationship with participants			
6	Relationship established	Was a relationship established prior to study commencement?	Not for the purposes of the study. It is noted LSC previously worked with some participants, but not at the time of the study – see Page 9, 'Research Team and Reflexivity'
7	Participant knowledge of the interviewer	What did the participants know about the researcher? *e.g. personal goals, reasons for doing the research*	Participants were aware LSC and YMY were completing their doctorates in somatosensory rehabilitation. See Page 9, 'Research Team and Reflexivity'.
8	Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants were likely aware of the interviewers' special interest in somatosensory rehabilitation stemming from

			clinical practice. See Page 9, 'Research Team and Reflexivity'.
Domain 2: study design			
Theoretical framework			
9	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 10-11. Thematic analysis and use of two theoretical frameworks (Theoretical Domains Theory and Normalisation Process Theory) is described.
Participant selection			
10	Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Page 8. Purposive recruitment of therapists to the study is described, see 'Participants'
11	Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Page 8. Approach to health organisations via telephone and email and approach to therapists via face-to-face presentations described, see 'Participants'
12	Sample size	How many participants were in the study?	Page 11. Eighty seven occupational therapists and physiotherapists participated. See 'Findings'
13	Non-participation	How many people refused to participate or dropped out? Reasons?	Page 8. All therapists attending recruitment presentations agreed to participate. No refusals or drop-outs occurred. See 'Participants'
Setting			
14	Setting of data collection	Where was the data collected? *e.g. home, clinic, workplace*	Page 8. Focus groups were held at therapists' health organisations. Separate interviews were held over the phone for those unable to attend. See 'Design'.
15	Presence of non-participants	Was anyone else present besides the participants and researchers?	Page 8. No. Two members of the research team (LSC and YMY) attended focus groups,

			no one else was present besides participants. See 'Design'.
16	Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Page 8. Participants were graduate occupational therapists and physiotherapists who worked with stroke survivors at participating health organisations. See 'Participants'. A demographics table describing characteristics of participants is provided , see Table 1.
Data collection			
17	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 8. Interview questions are provided in Appendix 1 and were guided by the Theoretical Domains Framework. Questions were not formally pilot tested but were discussed with the research group. See 'Design'.
18	Repeat interviews	Were repeat interviews carried out? If yes, how many?	Repeat interviews were not conducted, though individuals who missed original focus groups were followed up in individual or small group interviews.
19	Audio/visual recording	Did the research use audio or visual recording to collect the data?	Page 8. Interviews were audio-recorded. See 'Design'
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21	Duration	What was the duration of the interviews or focus group?	Page 8. Focus groups were of 1-hour duration. See 'Design'.
22	Data saturation	Was data saturation discussed?	Data saturation considered, n=87 therapists across 8 different health organisation was aimed to provide a representative sample

23	Transcripts returned	Were transcripts returned to participants for comments and/or correction?	No. Given the workloads of therapists involved, participants were not expected to review transcripts. The interviewer and co-moderator (LSC & YMY) discussed transcripts and made comments and corrections.
Domain 3: analysis and findings			
Data analysis			
24	Number of data coders	How many data coders coded the data?	Pages 10-11. Three researchers were involved in data analysis (LSC, NAL and AM). See 'Data Analysis'
25	Description of the coding tree	Did authors provide a description of the coding tree?	Codebooks used are provided in Appendices 2 and 3.
26	Derivation of the themes	Were themes identified in advance or derived from the data?	Pages 10-11. In Phase one, themes were derived from the data in an inductive approach, in Phase two, themes were deductively derived from pre-determined theories with specified domains and categories. See 'Data analysis'.
27	Software	What software, if applicable, was used to manage the data?	N/a
28	Participant checking	Did participants provide feedback on the findings?	Given the workloads of therapists involved, participants were not expected to provide feedback on findings.
Reporting			
29	Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? *e.g. participant number*	Page 14-26. Participant quotes used to illustrate findings. Participants identified by discipline (e.g. Occupational therapist or physiotherapist) and site number. See 'Findings'

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