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Rehabilitation treatment specification system: identifying barriers, facilitators, and strategies for implementation in research, education, and clinical care

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Title: Rehabilitation Treatment Specification System: Identifying barriers, facilitators, and strategies for implementation in research, education, and clinical care

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Rehabilitation Treatment Specification System: Identifying barriers, facilitators, and strategies for implementation in research, education, and clinical care

Abstract

Objective: To investigate the barriers to, and facilitators for, implementing the Rehabilitation Treatment Specification System (RTSS) in research, education, and clinical care.

Design: One RTSS implementation needs assessment was completed by rehabilitation professionals. Survey data was analyzed with consensus-based qualitative methods and two implementation science frameworks: Consolidated Framework for Implementation Research (CFIR) and the Expert Recommendations for Implementing Change (ERIC).

Setting: Rehabilitation professionals across research, educational, and clinical settings.

Participants: One hundred and eleven rehabilitation professionals—including speech-language pathologists, occupational therapists, physical therapists, physicians, psychologists, researchers, and clinic directors—who explored possible uses or applicaåtions of the RTSS for clinical care, education, or research.

Interventions: Not applicable

Main outcome measures: Frequency of reported CFIR barriers and facilitators, as well as keywords related to CFIR and ERIC constructs.

Results: The barriers and facilitating strategies differed according to the end-users' intended use, i.e., research, education, or clinical. Overall, the four most frequently encountered CFIR barriers were the RTSS's complexity, a lack of available RTSS resources, reduced access to knowledge and information about the RTSS, and limited knowledge and beliefs about the RTSS. The ERIC-CFIR matching tool identified seven ERIC strategies to address these barriers, which include conducting educational meetings, developing and distributing educational materials, accessing new funding, capturing and sharing local knowledge, identifying and preparing champions, and promoting adaptability.

Conclusions: When attempting to use the RTSS, rehabilitation professionals commonly encountered barriers towards understanding and skillfully using the framework. Theory-driven implementation strategies have been identified that have potential for addressing the RTSS's complexity and lack of educational and skill-building resources. Future work can develop the identified implementation strategies and evaluate their beneficial effects on RTSS implementation.

Key words

Rehabilitation, therapeutics, methods, implementation science

Abbreviations

ACRM	American Congress of Rehabilitation Medicine
CFIR	Consolidated Framework for Implementation Research
ERIC	Expert Recommendations for Implementing Change
OT	Occupational therapist
PT	Physical therapist
SLP	Speech language pathologist
RTSS	Rehabilitation Treatment Specification System

INTRODUCTION (Original Research Article)

It is well known that rehabilitation treatments are not described in ways that explicitly identify the hypothesized active ingredients and associated improved outcomes.[1-3] This problem impairs the field's ability to systematically improve, compare, and clinically adopt and adapt treatments. Reporting guidelines have been the most common approach to solve this problem, as hundreds have been developed (see https://www.equator-network.org/) and most journals require that authors use a reporting guideline to be eligible for publication. However, guidelines typically list categories of information that should be described—e.g., components of a

treatment, procedures for tailoring the treatment—without a theory-driven framewååork that outlines how to identify and specify the relevant aspects of treatment thought to bring about observable, functional changes.[4,5]

The Rehabilitation Treatment Specification System (RTSS) addresses this issue, as it is a cross-discipline, theory-driven framework proposing how to identify and describe the critical clinician actions and modified patient functions of rehabilitation treatments.[6] The RTSS's most significant theoretical advancements include guidance to parse [1] the clinician actions ostensibly responsible for modified patient functioning (i.e., ingredients) versus non-critical actions within a treatment activity, [2] ingredients' direct versus indirect effects on various patient functions (targets versus aims, respectively), and [3] ingredients' clinically meaningful changes in patient functioning (i.e., targets) versus modified patient functions that describe why an ingredient affects a target (i.e., mechanisms of action). In-depth description of the RTSS is outside the scope of this manuscript and can be found elsewhere.[5-8]

Multiple disciplines and condition-specific work groups have begun to practically demonstrate the benefits of RTSS application. Researchers have used the RTSS to more clearly identify/describe treatment ingredients and targets as well as their connecting mechanisms of action in voice disorders,[9] social communication impairments,[10] dementia,[11] and aphasia.[12-15] Methodologists have used the RTSS to identify when rehabilitation targets and ingredients are unique or overlapping[16], code and quantify ingredients and targets in standard clinical care with high reliability and validity,[17] increase the interpretability of treatment effect sizes and power analyses across theoretically dissimilar types of treatments[18,19], and revise treatment reporting guidelines.[20] Educators are beginning to show improved clinical decision making when including the RTSS in graduate curriculum.[21] Thought leaders across multiple disciplines have found the RTSS's conceptual advancements valuable enough to write editorials recommending RTSS use in occupational therapy (OT),[22] physical therapy (PT),[23] and speech-language pathology (SLP).[24] Finally, rehabilitation clinicians, educators, and researchers are interested in the RTSS's theoretical advancements, as 752 rehabilitation practitioners from 55 countries have downloaded the RTSS manual over the past three and a half years. This interest appears to be

increasing, as the number of professionals accessing the manual has increased from seven per month in 2018 to 25 per month in 2021.

Despite the RTSS's advancements, it is well known that innovations are often poorly adopted (if adopted at all) when no strategies are designed to explicitly facilitate implementation.[25,26] The field of implementation science provides many theory-driven frameworks[27-29] that can help identify the barriers and facilitators of RTSS adoption/adaptation. For example, the Consolidated Framework for Implementation Research (CFIR)[30] includes barrier/facilitator constructs that have been associated with implementation across multiple disciplines and hundreds of published studies. Once barriers and facilitators are identified, these frameworks can also help identify and tailor strategies to improve implementation. For example, the Expert Recommendations for Implementing Change (ERIC)[31] includes a list of implementation strategy categories, which have been mapped to CFIR barrier categories according to expert opinion.[32]

Traditionally, implementation projects aim to put an evidenced-based treatment, practice guideline, innovation, etc. into clinical practice. In contrast, the RTSS is a framework that should facilitate implementation of various research (identifying active ingredients, performing meta-analyses), clinical (adoption and adaptation of an evidence-based treatment), or educational (teaching clinical decision making) projects. The strategies to facilitate RTSS implementation with high fidelity will undoubtedly differ depending upon the intended application. For example, a researcher would need the skill to create an in-depth specification of their research treatment. A clinician does not need in-depth specification skills, but instead must understand how an evidence-based treatment's specification translates to the activities they perform and document for each individual patient. While researchers and clinicians often require specifications with minimal uncertainty—i.e., they must "know" what they are delivering and the desired changes in patient functioning—educators might be more interested in specification ambiguities to facilitate clinical reasoning skills, e.g., discussing various alternative specifications for a treatment or patient.

A substantial body of literature supports the critical importance of evaluating the needs of end-users[33,34] in the development or refinement of any innovation, such as the RTSS, even in the earliest stages of evidence

building.[35] As a first step towards developing implementation strategies, this study aimed to identify the perceived and/or experienced barriers to RTSS use as well as any perceived or experienced facilitators that addressed these barriers. An online survey acquired information on the needs of rehabilitation stakeholder groups—especially researchers, clinicians, and educators—attempting to use the RTSS. It is expected that this information will directly influence the future creation of RTSS implementation strategies for researchers, educators, and clinicians. This study did not require human subjects review.

METHODS

Survey

The design is a cross-sectional study. As shown in Table 1, an RTSS implementation assessment survey was developed to explore how end-users used (or were unable to use) the RTSS in their rehabilitation endeavors, barriers encountered, and potential or experienced facilitators. The survey was emailed to 489 rehabilitation professionals who downloaded the Manual for Rehabilitation Treatment Specification (via Research Electronic Data Capture) and/or were members of the ACRM's Networking Group for Rehabilitation Treatment Specification (via Survey Monkey). To prevent individuals completing the survey twice, the emails were automatically linked to each survey. The original survey email provided a 3 month time limit for responses. The rehabilitation professionals were provided with three email reminders: one month later, two months later, and 1 week before the deadline. An incentive for answering the survey was also included, which was the chance to win a $100 Amazon gift card in a random drawing.

[INSERT TABLE 1 APPROXIMATELY HERE]

Data analysis

First, comments were classified according to the CFIR barrier and facilitator categories based on consensus agreement amongst three coders. The CFIR was chosen, out of many available frameworks, because of

its application in health services (e.g., rehabilitation services) research, and its barriers have been directly mapped to the standard categories of implementation strategies in ERIC. Open-ended comments were extracted from the survey questions concerning barriers (Questions 1 and 3) and facilitators (Question 4). After being trained by an experienced CFIR coder,[36,37] two coders independently classified each reported barrier and facilitator to a single CFIR construct. To guide coding, the coders used the detailed descriptions and rationales for each construct in the CFIR codebook (https://cfirguide.org/constructs/). To establish consensus, the experienced coder reconciled disagreements between the two other coders. Table 2 provides examples of original responses mapped to CFIR constructs.

[INSERT TABLE 2 APPROXIMATELY HERE]

Second, a key word analysis was used to explore any specific barriers and facilitators underlying the more general CFIR constructs. It was also used to describe obvious differences between user groups (i.e., clinicians, educators, researchers) within each barrier or facilitator. A single rater summarized the topic(s) of each raw survey response.

Third, the CFIR-ERIC matching tool used a subset of CFIR barriers—those frequently reported by the RTSS end-users, specifically $\geq$2 total occurrences per subgroup—to produce expert-recommended implementation strategies. The number of CFIR barriers input into the ERIC matching tool was based on reported frequency for two reasons. First, subgroup differences cannot be explored unless a barrier is reported frequently enough to permit investigation. Thus, at least two occurrences per subgroup was chosen as a lower cutoff. Second, the publicly available CFIR-ERIC matching tool allows users to select any number of CFIR barriers and will match the summation of all, as well as individual, barriers to recommended implementation strategies endorsed by a panel of implementation scientists.[32] As a result, it is pragmatically beneficial to input a parsimonious number of barriers to minimize the quantity of implementation strategies while increasing the strategies' potential applicability. Those who did not use the RTSS were excluded from this analysis because the survey's

branching logic did not explicitly ask them about facilitators, and upon review of the responses, only one of these respondents listed a potential facilitator in their response.

RESULTS

One hundred and eleven rehabilitation professionals completed the survey (~25% response rate). Survey responders and nonresponders were qualitatively similar in occupation: 32 (29%) versus 114 (30%) SLPs, 31 (28%) versus 83 (22%) OTs, 16 (14%) versus 63 (17%) PTs, 14 (13%) versus 58 (15%) Physicians, 10 (9%) versus 40 (11%) Psychologists, 8 (7%) versus 20 (5%) other occupations (respectively). Survey responders and nonresponders were qualitatively similar in two RTSS applications: clinical care projects—33 (30%) versus (128, 34%), respectively—and educational projects; 21 (19%) versus 78 (20%), respectively. Survey responders and nonresponders, were not qualitatively similar in two RTSS applications: research projects—36 (32%) versus 82 (22%), respectively—and exploring various uses of the RTSS; 18 (16%) versus 93 (24%), respectively. Forty-one of the responders (37%) did not ultimately use the RTSS and 5 (5%) did not select a specific use for the RTSS. Those who did not use the RTSS were evenly distributed across professions—7 SLPs, 10 OTs, 7 PTs, 10 Physicians, 6 Psychologists, 6 Other—and mostly attempting to use the RTSS for research (n = 14) or exploring potential uses (n = 18).

[INSERT TABLE 3 APPROXIMATELY HERE]

Table 3 outlines the CFIR barrier categories reported by clinicians, educators, researchers, and those who did not use the RTSS. For clinicians, their institution's lack of resources and access to knowledge and information about the RTSS were the most frequently reported barriers to RTSS application. According to the key word analysis, clinicians primarily felt that they lacked the time and educational resources necessary to learn/use the RTSS. For educators, incomplete knowledge and/or beliefs about the RTSS was the most frequently reported barrier. According to the key word analysis, educators reported not understanding the RTSS

clearly enough to confidently teach others about it. For researchers, the RTSS's complexity was the most frequently reported barrier. The key word analysis provided specific reasons for this complexity: the RTSS contains new terminology with technical definitions, the terms interact with each other, the RTSS requires considerable time to learn, and the RTSS requires a more fine-grained description than current practice. For those who did not eventually use the RTSS, the main barrier was available resources. The keyword analysis showed that many end-users did not have the time to familiarize themselves with the RTSS.

[INSERT TABLE 4 APPROXIMATELY HERE]

Table 4 outlines the CFIR facilitator categories reported by clinicians, educators, and researchers. Only "external change agents" was reported to have been an experienced facilitator and the other facilitators were suggested as potential facilitators. All three groups wanted more materials showing the RTSS's adaptability through concrete, applied examples in discipline- and condition-specific treatments. All three groups also wanted increased access to knowledge and information about the RTSS. However, extracted key words were different among the groups. Clinicians requested that the RTSS be integrated into their electronic medical or health records. Researchers asked for educational materials that simplify the RTSS's concepts and application, e.g., "a cheat sheet" or "RTSS for beginners." Educators wanted materials that could be incorporated into their teaching curriculum.

[INSERT TABLE 5 APPROXIMATELY HERE]

The CFIR-ERIC matching tool evaluated the four most frequently reported barriers, which were 1) complexity, 2) availability of resources, 3) access to knowledge and information, and 4) individual knowledge and beliefs about the RTSS. Table 5 outlines the matching tool's 17 recommended implementation strategies. Three suggested ERIC strategies may directly address the barriers of access to knowledge/information and

knowledge/beliefs about the RTSS: 1) Develop education materials, 2) Distribute educational materials, and 3) Conduct educational meetings. The suggested ERIC strategies of "promote adaptability" and "identifying and preparing champions" aligns with user feedback for more high quality, applied RTSS examples and external change agents, respectively. "Accessing new funding" is a suggested ERIC strategy to directly address the barrier of available resources. The matching tool suggested one broadly applicable strategy—over 20% expert agreement for all four barriers—that was not mentioned by the RTSS end-users: capture and share local knowledge.

DISCUSSION

Rehabilitation professionals attempting to use the RTSS identified four barriers that frequently occurred, regardless of specific RTSS application: the RTSS's complexity, a lack of available RTSS resources, reduced access to knowledge and information about the RTSS, and limited knowledge and beliefs about the RTSS. In response to these four general barriers, the ERIC-CFIR matching tool and/or RTSS users identified seven general implementation strategies: conduct educational meetings, develop educational materials, distribute educational materials, access new funding, capture and share local knowledge, identify and prepare champions, and promote adaptability. The frequency at which these barriers and facilitators were reported—as well as the underlying keywords—qualitatively varied based on whether the RTSS was being used for clinical, educational, or research projects; thus, the specific implementation strategies will likely need to be tailored for the specific RTSS use. For example, educational materials (to improve knowledge) and concrete RTSS examples (to promote adaptability) would need to be tailored to facilitate in-depth specification skills for researchers, correct use of already-specified treatments in an RTSS-based electronic medical records for clinicians, or direct integration of RTSS concepts into course curricula for educators. Since consulting RTSS experts (i.e., "identify and prepare champions or external change agents") helped many respondents to apply the framework, the development of new materials should align with education or training programs designed to increase the number of RTSS experts in various disciplines and specialties, e.g., train the trainer models.

Most RTSS work has focused on creating educational and training materials to improve the knowledge, beliefs, skills, and self-efficacy of the end-users.[9-16,18,19,21-24] However, barriers such as limited available resources, minimal leadership engagement, and lack of outer setting policies would require implementation strategies at the organizational or societal level. Bigger picture strategies could focus on facilitating the development and enacting/monitoring policies and guidelines relevant to research, educational, and clinical institutions as well as professional organizations, e.g., American Speech-Language-Hearing Association, American Physical Therapy Association, American Occupation Therapy Association. Typically, organizations have resource constraints and any policy or guideline that integrates the RTSS will require resources such as time, money, personnel, etc. This might be mitigated in the short-term by acquiring funding to provide these additional resources, as suggested by the CFIR-ERIC matching tool. Also, some implementation strategies, such as electronic medical record menus, would obviously benefit from consistency at a national level, international level, or by professional societies rather than individual implementation efforts across many local institutions. Future work could focus on developing strategies associated with societal and organizational changes such as accreditation or licensure standards, involving executive or advisory boards, engaging with policy makers, and directly working with various educational, medical, and professional institutions.

Implementation science is typically focused on facilitating the adoption of specific clinical best practices supported by emerging evidence.[25] In contrast, RTSS implementation is not the adoption of any specific evidence-based treatment but implementing a way of studying and communicating about treatments in general. As such, more specific skills will need to be measured during implementation, e.g., research reporting, treatment documentation, clinical decision making. Thus, it's probably most useful to consider the barriers and facilitators to adoption of RTSS-informed changes in the critical skills and behaviors specific to research, clinical care, and education. Future work would undoubtedly benefit from iterative stakeholder input to both guide specific implementation strategy development and identify what kinds of "evidence of benefit" would most motivate adoption by researchers, educators, clinicians, i.e., investigating feasibility with an embedded process evaluation. An iterative, stakeholder approach could help ensure that any abstractions of research, clinical care, and education have

maximal potential for realizing the practical benefits of RTSS implementation.

Study limitations:

First, the primary barriers were identified by frequency, which is less preferable than eliciting/extracting information regarding the relative importance or weight among the barriers. Future work could obtain more qualitative data regarding the relative importance of each barrier. Second, the survey design was based on the more general implementation concepts of barriers and facilitators, not the specific frameworks that were used for data analysis, e.g., CFIR or ERIC, such that potentially critical concepts within those frameworks may not have been thoroughly explored. This is an acceptable limitation because the project was designed as a preliminary needs assessment to identify frequently occurring barriers and facilitators and future steps. Moreover, the qualitative data was successfully retrofitted to the more specific constructs of the CFIR and ERIC. Third, since few RTSS implementation efforts were mature, respondents had encountered more barriers whereas most of their facilitators were "wants" rather than experienced facilitators. However, as noted, there was substantial correspondence between these desired facilitators and the CFIR-recommended facilitators for the experienced barriers.

CONCLUSION

A needs assessment was completed with over 100 rehabilitation professionals across multiple disciplines to identify commonly encountered barriers and facilitators for RTSS implementation in research, education, and clinical care. According to the CFIR, the four most frequently faced barriers were the RTSS's complexity, a lack of available resources, reduced access to knowledge and information, and limited knowledge and beliefs. The ERIC-CFIR matching tool identified seven general implementation strategies to address these barriers, which include conducting educational meetings, developing educational materials, distributing educational materials, accessing new funding, capturing and sharing local knowledge, identifying and preparing champions, and promoting adaptability. The specific barriers and facilitating strategies differed according to the end-users'

intended use, i.e., research, education, or clinical. Future work is needed to collaborate with rehabilitation research and practice stakeholders towards developing specific implementation strategies and evaluating the strategies' benefits to RTSS implementation.

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INTRODUCTION (Original Research Article) [3,000 word limit = 2950]

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treatment, procedures for tailoring the treatment—without a theory-driven framewååork that outlines how to identify and specify the relevant aspects of treatment thought to bring about observable, functional changes.[4,5]

The Rehabilitation Treatment Specification System (RTSS) addresses this issue, as it is a cross-discipline, theory-driven framework proposing how to identify and describe the critical clinician actions and modified patient functions of rehabilitation treatments.[6] The RTSS's most significant theoretical advancements include guidance to parse [1] the clinician actions ostensibly responsible for modified patient functioning (i.e., ingredients) versus non-critical actions within a treatment activity, [2] ingredients' direct versus indirect effects on various patient functions (targets versus aims, respectively), and [3] ingredients' clinically meaningful changes in patient functioning (i.e., targets) versus modified patient functions that describe why an ingredient affects a target (i.e., mechanisms of action). In-depth description of the RTSS is outside the scope of this manuscript and can be found elsewhere.[5-8]

Multiple disciplines and condition-specific work groups have begun to practically demonstrate the benefits of RTSS application. Researchers have used the RTSS to more clearly identify/describe treatment ingredients and targets as well as their connecting mechanisms of action in voice disorders,[9] social communication impairments,[10] dementia,[11] and aphasia.[12-15] Methodologists have used the RTSS to identify when rehabilitation targets and ingredients are unique or overlapping[16], code and quantify ingredients and targets in standard clinical care with high reliability and validity,[17] increase the interpretability of treatment effect sizes and power analyses across theoretically dissimilar types of treatments[18,19], and revise treatment reporting guidelines.[20] Educators are beginning to show improved clinical decision making when including the RTSS in graduate curriculum.[21] Thought leaders across multiple disciplines have found the RTSS's conceptual advancements valuable enough to write editorials recommending RTSS use in occupational therapy (OT),[22] physical therapy (PT),[23] and speech-language pathology (SLP).[24] Finally, rehabilitation clinicians, educators, and researchers are interested in the RTSS's theoretical advancements, as 752 rehabilitation practitioners from 55 countries have downloaded the RTSS manual over the past three and a half years. This interest appears to be

increasing, as the number of professionals accessing the manual has increased from seven per month in 2018 to 25 per month in 2021.

Despite the RTSS's advancements, it is well known that innovations are often poorly adopted (if adopted at all) when no strategies are designed to explicitly facilitate implementation.[25,26] The field of implementation science provides many theory-driven frameworks[27-29] that can help identify the barriers and facilitators of RTSS adoption/adaptation. For example, the Consolidated Framework for Implementation Research (CFIR)[30] includes barrier/facilitator constructs that have been associated with implementation across multiple disciplines and hundreds of published studies. Once barriers and facilitators are identified, these frameworks can also help identify and tailor strategies to improve implementation. For example, the Expert Recommendations for Implementing Change (ERIC)[31] includes a list of implementation strategy categories, which have been mapped to CFIR barrier categories according to expert opinion.[32]

Traditionally, implementation projects aim to put an evidenced-based treatment, practice guideline, innovation, etc. into clinical practice. In contrast, the RTSS is a framework that should facilitate implementation of various research (identifying active ingredients, performing meta-analyses), clinical (adoption and adaptation of an evidence-based treatment), or educational (teaching clinical decision making) projects. The strategies to facilitate RTSS implementation with high fidelity will undoubtedly differ depending upon the intended application. For example, a researcher would need the skill to create an in-depth specification of their research treatment. A clinician does not need in-depth specification skills, but instead must understand how an evidence-based treatment's specification translates to the activities they perform and document for each individual patient. While researchers and clinicians often require specifications with minimal uncertainty—i.e., they must "know" what they are delivering and the desired changes in patient functioning—educators might be more interested in specification ambiguities to facilitate clinical reasoning skills, e.g., discussing various alternative specifications for a treatment or patient.

A substantial body of literature supports the critical importance of evaluating the needs of end-users[33,34] in the development or refinement of any innovation, such as the RTSS, even in the earliest stages of evidence

building.[35] As a first step towards developing implementation strategies, this study aimed to identify the perceived and/or experienced barriers to RTSS use as well as any perceived or experienced facilitators that addressed these barriers. An online survey acquired information on the needs of rehabilitation stakeholder groups—especially researchers, clinicians, and educators—attempting to use the RTSS. It is expected that this information will directly influence the future creation of RTSS implementation strategies for researchers, educators, and clinicians. This study did not require human subjects review.

METHODS

Survey

The design is a cross-sectional study. As shown in Table 1, an RTSS implementation assessment survey was developed to explore how end-users used (or were unable to use) the RTSS in their rehabilitation endeavors, barriers encountered, and potential or experienced facilitators. The survey was emailed to 489 rehabilitation professionals who downloaded the Manual for Rehabilitation Treatment Specification (via Research Electronic Data Capture) and/or were members of the ACRM's Networking Group for Rehabilitation Treatment Specification (via Survey Monkey). To prevent individuals completing the survey twice, the emails were automatically linked to each survey. The original survey email provided a 3 month time limit for responses. The rehabilitation professionals were provided with three email reminders: one month later, two months later, and 1 week before the deadline. An incentive for answering the survey was also included, which was the chance to win a $100 Amazon gift card in a random drawing.

[INSERT TABLE 1 APPROXIMATELY HERE]

Data analysis

First, comments were classified according to the CFIR barrier and facilitator categories based on consensus agreement amongst three coders. The CFIR was chosen, out of many available frameworks, because of

its application in health services (e.g., rehabilitation services) research, and its barriers have been directly mapped to the standard categories of implementation strategies in ERIC. Open-ended comments were extracted from the survey questions concerning barriers (Questions 1 and 3) and facilitators (Question 4). After being trained by an experienced CFIR coder,[36,37] two coders independently classified each reported barrier and facilitator to a single CFIR construct. To guide coding, the coders used the detailed descriptions and rationales for each construct in the CFIR codebook (https://cfirguide.org/constructs/). To establish consensus, the experienced coder reconciled disagreements between the two other coders. Table 2 provides examples of original responses mapped to CFIR constructs.

[INSERT TABLE 2 APPROXIMATELY HERE]

Second, a key word analysis was used to explore any specific barriers and facilitators underlying the more general CFIR constructs. It was also used to describe obvious differences between user groups (i.e., clinicians, educators, researchers) within each barrier or facilitator. A single rater summarized the topic(s) of each raw survey response.

Third, the CFIR-ERIC matching tool used a subset of CFIR barriers—those frequently reported by the RTSS end-users, specifically $\geq$2 total occurrences per subgroup—to produce expert-recommended implementation strategies. The number of CFIR barriers input into the ERIC matching tool was based on reported frequency for two reasons. First, subgroup differences cannot be explored unless a barrier is reported frequently enough to permit investigation. Thus, at least two occurrences per subgroup was chosen as a lower cutoff. Second, the publicly available CFIR-ERIC matching tool allows users to select any number of CFIR barriers and will match the summation of all, as well as individual, barriers to recommended implementation strategies endorsed by a panel of implementation scientists.[32] As a result, it is pragmatically beneficial to input a parsimonious number of barriers to minimize the quantity of implementation strategies while increasing the strategies' potential applicability. Those who did not use the RTSS were excluded from this analysis because the survey's

branching logic did not explicitly ask them about facilitators, and upon review of the responses, only one of these respondents listed a potential facilitator in their response.

RESULTS

One hundred and eleven rehabilitation professionals completed the survey (~25% response rate). Survey responders and nonresponders were qualitatively similar in occupation: 32 (29%) versus 114 (30%) SLPs, 31 (28%) versus 83 (22%) OTs, 16 (14%) versus 63 (17%) PTs, 14 (13%) versus 58 (15%) Physicians, 10 (9%) versus 40 (11%) Psychologists, 8 (7%) versus 20 (5%) other occupations (respectively). Survey responders and nonresponders were qualitatively similar in two RTSS applications: clinical care projects—33 (30%) versus (128, 34%), respectively—and educational projects; 21 (19%) versus 78 (20%), respectively. Survey responders and nonresponders, were not qualitatively similar in two RTSS applications: research projects—36 (32%) versus 82 (22%), respectively—and exploring various uses of the RTSS; 18 (16%) versus 93 (24%), respectively. Forty-one of the responders (37%) did not ultimately use the RTSS and 5 (5%) did not select a specific use for the RTSS. Those who did not use the RTSS were evenly distributed across professions—7 SLPs, 10 OTs, 7 PTs, 10 Physicians, 6 Psychologists, 6 Other—and mostly attempting to use the RTSS for research (n = 14) or exploring potential uses (n = 18).

[INSERT TABLE 3 APPROXIMATELY HERE]

Table 3 outlines the CFIR barrier categories reported by clinicians, educators, researchers, and those who did not use the RTSS. For clinicians, their institution's lack of resources and access to knowledge and information about the RTSS were the most frequently reported barriers to RTSS application. According to the key word analysis, clinicians primarily felt that they lacked the time and educational resources necessary to learn/use the RTSS. For educators, incomplete knowledge and/or beliefs about the RTSS was the most frequently reported barrier. According to the key word analysis, educators reported not understanding the RTSS

clearly enough to confidently teach others about it. For researchers, the RTSS's complexity was the most frequently reported barrier. The key word analysis provided specific reasons for this complexity: the RTSS contains new terminology with technical definitions, the terms interact with each other, the RTSS requires considerable time to learn, and the RTSS requires a more fine-grained description than current practice. For those who did not eventually use the RTSS, the main barrier was available resources. The keyword analysis showed that many end-users did not have the time to familiarize themselves with the RTSS.

[INSERT TABLE 4 APPROXIMATELY HERE]

Table 4 outlines the CFIR facilitator categories reported by clinicians, educators, and researchers. Only "external change agents" was reported to have been an experienced facilitator and the other facilitators were suggested as potential facilitators. All three groups wanted more materials showing the RTSS's adaptability through concrete, applied examples in discipline- and condition-specific treatments. All three groups also wanted increased access to knowledge and information about the RTSS. However, extracted key words were different among the groups. Clinicians requested that the RTSS be integrated into their electronic medical or health records. Researchers asked for educational materials that simplify the RTSS's concepts and application, e.g., "a cheat sheet" or "RTSS for beginners." Educators wanted materials that could be incorporated into their teaching curriculum.

[INSERT TABLE 5 APPROXIMATELY HERE]

The CFIR-ERIC matching tool evaluated the four most frequently reported barriers, which were 1) complexity, 2) availability of resources, 3) access to knowledge and information, and 4) individual knowledge and beliefs about the RTSS. Table 5 outlines the matching tool's 17 recommended implementation strategies. Three suggested ERIC strategies may directly address the barriers of access to knowledge/information and

knowledge/beliefs about the RTSS: 1) Develop education materials, 2) Distribute educational materials, and 3) Conduct educational meetings. The suggested ERIC strategies of "promote adaptability" and "identifying and preparing champions" aligns with user feedback for more high quality, applied RTSS examples and external change agents, respectively. "Accessing new funding" is a suggested ERIC strategy to directly address the barrier of available resources. The matching tool suggested one broadly applicable strategy—over 20% expert agreement for all four barriers—that was not mentioned by the RTSS end-users: capture and share local knowledge.

DISCUSSION

Rehabilitation professionals attempting to use the RTSS identified four barriers that frequently occurred, regardless of specific RTSS application: the RTSS's complexity, a lack of available RTSS resources, reduced access to knowledge and information about the RTSS, and limited knowledge and beliefs about the RTSS. In response to these four general barriers, the ERIC-CFIR matching tool and/or RTSS users identified seven general implementation strategies: conduct educational meetings, develop educational materials, distribute educational materials, access new funding, capture and share local knowledge, identify and prepare champions, and promote adaptability. The frequency at which these barriers and facilitators were reported—as well as the underlying keywords—qualitatively varied based on whether the RTSS was being used for clinical, educational, or research projects; thus, the specific implementation strategies will likely need to be tailored for the specific RTSS use. For example, educational materials (to improve knowledge) and concrete RTSS examples (to promote adaptability) would need to be tailored to facilitate in-depth specification skills for researchers, correct use of already-specified treatments in an RTSS-based electronic medical records for clinicians, or direct integration of RTSS concepts into course curricula for educators. Since consulting RTSS experts (i.e., "identify and prepare champions or external change agents") helped many respondents to apply the framework, the development of new materials should align with education or training programs designed to increase the number of RTSS experts in various disciplines and specialties, e.g., train the trainer models.

Most RTSS work has focused on creating educational and training materials to improve the knowledge, beliefs, skills, and self-efficacy of the end-users.[9-16,18,19,21-24] However, barriers such as limited available resources, minimal leadership engagement, and lack of outer setting policies would require implementation strategies at the organizational or societal level. Bigger picture strategies could focus on facilitating the development and enacting/monitoring policies and guidelines relevant to research, educational, and clinical institutions as well as professional organizations, e.g., American Speech-Language-Hearing Association, American Physical Therapy Association, American Occupation Therapy Association. Typically, organizations have resource constraints and any policy or guideline that integrates the RTSS will require resources such as time, money, personnel, etc. This might be mitigated in the short-term by acquiring funding to provide these additional resources, as suggested by the CFIR-ERIC matching tool. Also, some implementation strategies, such as electronic medical record menus, would obviously benefit from consistency at a national level, international level, or by professional societies rather than individual implementation efforts across many local institutions. Future work could focus on developing strategies associated with societal and organizational changes such as accreditation or licensure standards, involving executive or advisory boards, engaging with policy makers, and directly working with various educational, medical, and professional institutions.

Implementation science is typically focused on facilitating the adoption of specific clinical best practices supported by emerging evidence.[25] In contrast, RTSS implementation is not the adoption of any specific evidence-based treatment but implementing a way of studying and communicating about treatments in general. As such, more specific skills will need to be measured during implementation, e.g., research reporting, treatment documentation, clinical decision making. Thus, it's probably most useful to consider the barriers and facilitators to adoption of RTSS-informed changes in the critical skills and behaviors specific to research, clinical care, and education. Future work would undoubtedly benefit from iterative stakeholder input to both guide specific implementation strategy development and identify what kinds of "evidence of benefit" would most motivate adoption by researchers, educators, clinicians, i.e., investigating feasibility with an embedded process evaluation. An iterative, stakeholder approach could help ensure that any abstractions of research, clinical care, and education have

maximal potential for realizing the practical benefits of RTSS implementation.

Study limitations:

First, the primary barriers were identified by frequency, which is less preferable than eliciting/extracting information regarding the relative importance or weight among the barriers. Future work could obtain more qualitative data regarding the relative importance of each barrier. Second, the survey design was based on the more general implementation concepts of barriers and facilitators, not the specific frameworks that were used for data analysis, e.g., CFIR or ERIC, such that potentially critical concepts within those frameworks may not have been thoroughly explored. This is an acceptable limitation because the project was designed as a preliminary needs assessment to identify frequently occurring barriers and facilitators and future steps. Moreover, the qualitative data was successfully retrofitted to the more specific constructs of the CFIR and ERIC. Third, since few RTSS implementation efforts were mature, respondents had encountered more barriers whereas most of their facilitators were "wants" rather than experienced facilitators. However, as noted, there was substantial correspondence between these desired facilitators and the CFIR-recommended facilitators for the experienced barriers.

CONCLUSION

A needs assessment was completed with over 100 rehabilitation professionals across multiple disciplines to identify commonly encountered barriers and facilitators for RTSS implementation in research, education, and clinical care. According to the CFIR, the four most frequently faced barriers were the RTSS's complexity, a lack of available resources, reduced access to knowledge and information, and limited knowledge and beliefs. The ERIC-CFIR matching tool identified seven general implementation strategies to address these barriers, which include conducting educational meetings, developing educational materials, distributing educational materials, accessing new funding, capturing and sharing local knowledge, identifying and preparing champions, and promoting adaptability. The specific barriers and facilitating strategies differed according to the end-users'

intended use, i.e., research, education, or clinical. Future work is needed to collaborate with rehabilitation research and practice stakeholders towards developing specific implementation strategies and evaluating the strategies' benefits to RTSS implementation.

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Table 1. Online survey questions and branching logic.

	Questions	Branching logic	Response
0	Have you attempted to apply (or are planning to apply) the RTSS to your work?	Always ask	yes, no
1	Why have you not applied (or attempted to apply) the RTSS?	If Question 0 = "no"	free text
2	Please describe how you have tried to apply the RTSS, being as specific as you can.	If Question 0 = "yes"	free text
3	What do you think are significant barriers/ obstacles to using the RTSS in the ways you hope to?	If Question 0 = "yes"	free text
4	What, if anything, would be helpful to circumvent these barriers/obstacles?	If Question 0 = "yes"	free text

Table 2. Example CFIR coding of raw barrier and facilitator survey responses

Raw survey response	CFIR code
(Barrier) Lack of understanding RTSS concept, only was exposed to 1 power point presentation about the topic and it seems more complex than that.	Intervention characteristics: Complexity
(Facilitator) More discipline specific applications/examples would be helpful.	Intervention characteristics: Adaptability
(Facilitator) A well-organized campaign to address ASHA, AOTA, and CAPTE.	Outer setting: External policy & incentives
(Barrier) It takes quite a bit of time to understand and then more time to apply it to my own work to see if it will be useful.	Inner setting: Readiness: Available resources
(Facilitator) RTSS built into our EMR-system!	Inner setting: Readiness: Access to knowledge & information
(Barrier) It may be difficult to get consensus to use among the 3 disciplines and to teach in the academic settings.	Inner setting: Implementation climate: Compatibility
(Barrier) Lack of clear understanding when educating others on concepts	Characteristics of individuals: Knowledge & beliefs about the intervention
(Facilitator) Feedback from an experienced [RTSS] user was very helpful!	Process: External change agents

Table 3. Number of occurrences (% of total) the RTSS end-users identified a CFIR barrier construct.

CFIR construct	Total occurrences	Occurrences split according to RTSS application			
		Clinic	Education	Research	Did not use
Intervention characteristics	44 (31)	14 (24)	4 (17)	15 (43)	11 (35)
Complexity	*22 (15)*	*5 (8)*	*3 (13)*	*10 (30)*	*4 (14)*
Adaptability	*8 (6)*	*5 (8)*		*2 (6)*	*1 (3)*
Design quality & packaging	*7 (5)*	*3 (5)*	*1 (4)*	*1 (3)*	*2 (7)*
Evidence strength & quality	*4 (3)*			*2 (6)*	*2 (7)*
Relative advantage	*2 (1)*				*2 (7)*
Trialability	*1 (1)*	*1 (2)*			
Inner setting	69 (48)	35 (59)	10 (43)	11 (31)	13 (42)
Readiness for implementation					
Available resources	*31 (22)*	*12 (20)*	*5 (22)*	*6 (18)*	*8 (28)*
Access to knowledge & information	*18 (13)*	*11 (19)*	*2 (9)*	*2 (6)*	*3 (10)*
Leadership engagement	*5 (3)*	*3 (5)*		*1 (3)*	*1 (3)*
Implementation climate					
Compatibility	*7 (5)*	*3 (5)*	*2 (9)*	*2 (6)*	
Tension for change	*2 (1)*	*1 (2)*	*1 (4)*		
Relative priority	*3 (2)*	*3 (5)*			
Organizational incentives & rewards	*1 (1)*	*1 (2)*			
Learning climate	*1 (1)*				*1 (3)*
Networks & communications	*1 (1)*	*1 (2)*			
Characteristics of Individuals	29 (20)	9 (15)	8 (35)	7 (20)	5 (16)
Knowledge & beliefs about the intervention	*26 (18)*	*8 (14)*	*8 (35)*	*6 (18)*	*4 (14)*
Self-efficacy	*3 (2)*	*1 (2)*		*1 (3)*	*1 (3)*
Process	1(1)	1(2)	0 (0)	0 (0)	0 (0)
External change agents	*1 (1)*	*1 (2)*			
Outer setting	1 (1)	0 (0)	1 (4)	0 (0)	0 (0)
External policy & incentives	*1 (1)*		*1 (4)*		

Table 4. Number of occurrences (%) the RTSS end-users identified a CFIR facilitator construct. Of note, those who reported not using the RTSS were excluded because the survey's branching logic did not explicitly ask them about facilitators.

CFIR construct	Total occurrences	Occurrences split according to RTSS application		
		Clinic	Education	Research
Intervention characteristics	32 (36)	12 (30)	8 (30)	12 (54)
Adaptability	*21 (24)*	*9 (23)*	*4 (15)*	*8 (36)*
Evidence strength & quality	*6 (7)*	*2 (5)*	*2 (7)*	*2 (9)*
Complexity	*2 (2)*		*1 (4)*	*1 (4)*
Design quality & packaging	*2 (2)*	*1 (3)*	*1 (4)*	
Trialability	*1 (1)*			*1 (4)*
Inner setting	43 (49)	21 (54)	16 (59)	6 (27)
Readiness for implementation				
Access to knowledge & information	*37 (42)*	*17 (44)*	*15 (56)*	*5 (23)*
Available resources	*2 (2)*	*2 (5)*		
Leadership engagement	*2 (2)*	*1 (3)*		*1 (4)*
Implementation climate				
Compatibility	*2 (2)*	*1 (3)*	*1 (4)*	
Characteristics of individuals	3 (3)	2 (6)	0 (0)	1 (4)
Knowledge & beliefs about the intervention	*2 (2)*	*1 (3)*		*1 (4)*
Other personal attributes	*1 (1)*	*1 (3)*		
Process	6 (7)	3 (8)	1 (4)	2 (9)
External change agents	*6 (7)*	*3 (8)*	*1 (4)*	*2 (9)*
Outer setting	4 (5)	1 (3)	2 (7)	1 (4)
External policy & incentives	*4 (5)*	*1 (3)*	*2 (7)*	*1 (4)*

Table 5. ERIC strategies and their level of expert consensus (% agreement) in relation to the most frequently identified CIFR barriers. *Top quartile agreement in original CFIR-ERIC matching tool ≥ 20%; **Majority expert agreement.

ERIC strategies	CFIR Barriers			
	Complexity	Available resources	Access to knowledge & information	Knowledge & beliefs about the intervention
Conduct educational meetings	13	0	79**	56**
Develop educational materials	13	4	59**	36*
Distribute educational materials	3	0	55**	16
Access new funding	3	78**	0	8
Capture & share local knowledge	27*	22*	31*	24*
Create a learning collaborative	33*	9	45*	16
Identify & prepare champions	30*	4	24*	40*
Conduct ongoing training	37*	9	38*	12
Assess for readiness, identify barriers/ facilitators	30*	13	7	16
Promote adaptability	40*	4	7	16
Stage implementation scale up	30*	13	3	20*
Develop a formal implementation blueprint	43*	4	14	4
Conduct cyclical small tests of change	37*	13	3	12
Conduct educational outreach visits	7	0	28*	28*
Facilitation	20*	4	10	20*
Change physical structure and equipment	3	48*	0	0
Identify early adopters	20*	0	10	20*

Table #. The Checklist for Reporting of Survey Studies (CROSS)

Section/topic	Item	Item description	Reported on page #
Title and abstract			
Title and abstract	1a	State the word "survey" along with a commonly used term in title or abstract to introduce the study's design.	1
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions.	1-2
Introduction			
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed.	2-4
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study.	4-5
Methods			
Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal).	5
Data collection methods	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used).	Table 1, page 5
	5b	Describe all questionnaire instruments that were used in the survey to measure particular concepts. Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any).	5-7
	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population.	N/A
	5d	Questionnaire if possible, should be fully provided (in the article, or as appendices or as an online supplement).	Table 1
Sample characteristics	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).	6
	6b	Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied.	6
	6c	Provide information on sample size, along with details of sample size calculation.	7
	6d	Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys.	5
Survey administration	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient room or by use of online tools, such as SurveyMonkey).	5
	7b	Provide information of survey's time frame, such as periods of recruitment, exposure, and follow-up days.	5
	7c	Provide information on the entry process: –>For non-web-based surveys, provide approaches to minimize human error in data entry. –>For web-based surveys, provide approaches to prevent "multiple participation" of participants.	5
Study preparation	8	Describe any preparation process before conducting the survey (e.g., interviewers' training process, advertising the survey).	N/A
Ethical considerations	9a	Provide information on ethical approval for the survey if obtained, including informed consent, institutional review board [IRB] approval, Helsinki declaration, and good clinical practice [GCP] declaration (as appropriate).	5

	9b	Provide information about survey anonymity and confidentiality and describe what mechanisms were used to protect unauthorized access.	N/A
Statistical analysis	10a	Describe statistical methods and analytical approach. Report the statistical software that was used for data analysis.	5-7
	10b	Report any modification of variables used in the analysis, along with reference (if available).	N/A
	10c	Report details about how missing data was handled. Include rate of missing items, missing data mechanism (i.e., missing completely at random [MCAR], missing at random [MAR] or missing not at random [MNAR]) and methods used to deal with missing data (e.g., multiple imputation).	5-7
	10d	State how non-response error was addressed.	N/A
	10e	For longitudinal surveys, state how loss to follow-up was addressed.	N/A
	10f	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for non-representativeness of the sample.	N/A
	10g	Describe any sensitivity analysis conducted.	N/A
Results			
Respondent characteristics	11a	Report numbers of individuals at each stage of the study. Consider using a flow diagram, if possible.	7
	11b	Provide reasons for non-participation at each stage, if possible.	N/A
	11c	Report response rate, present the definition of response rate or the formula used to calculate response rate.	7
	11d	Provide information to define how unique visitors are determined. Report number of unique visitors along with relevant proportions (e.g., view proportion, participation proportion, completion proportion).	5
Descriptive results	12	Provide characteristics of study participants, as well as information on potential confounders and assessed outcomes.	7
Main findings	13a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates along with 95% confidence intervals and p-values.	N/A
	13b	For multivariable analysis, provide information on the model building process, model fit statistics, and model assumptions (as appropriate).	N/A
	13c	Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible).	N/A
Discussion			
Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders.	11-12
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research.	9-12
Generalizability	16	Discuss the external validity of the results.	11-12
Other sections			
Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis.	Title page
Conflict of interest	18	Declare any potential conflict of interest.	Title page

Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research.	12