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A Quantitative Test of an Implementation Framework in 38 VA Residential PTSD Programs

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Abstract

This study examines the implementation of two evidence-based psychotherapies, Prolonged Exposure (PE) and Cognitive Processing Therapy (CPT), in the Department of Veterans Affairs residential Posttraumatic Stress Disorder treatment programs. Two hundred and one providers from 38 programs completed an online survey concerning implementation of PE delivered on an individual basis and CPT delivered in individual and group formats. For PE, a supportive organizational context (dedicated time and resources, and incentives and mandates) and overall positive view of the treatment were related to its implementation. For both group and individual CPT, only the supportive organizational context was significantly associated with outcome. Implications for implementation efforts are discussed.

Keywords

Implementation; Evidence-based Practice; Posttraumatic stress disorder

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Implementation of evidence-based treatments (EBTs) is a national priority. Despite extensive data from randomized controlled trials supporting the efficacy of EBTs, there is inconsistent adoption in routine community practice. Indeed, dissemination of new knowledge generated by research into clinical care has historically been markedly slow, taking an average of 17 years (Institute of Medicine Committee on Quality of Health Care in America 2001).

Until recently most research concerning implementation of EBTs for adult mental health problems has typically not been guided by theory (McHugo et al. 2007; Proctor et al. 2009). One comprehensive theoretical framework for understanding implementation of EBTs was initially developed by Rogers (Rogers 1962, 2003) and elaborated by Greenhalgh and colleagues (Greenhalgh et al. 2004). Based a systematic review of evidence from 13 distinct research traditions, this framework is largely consistent with findings from other systematic narrative reviews (e.g., Durlak and DuPre 2008; Stith et al. 2006) regarding factors that predict implementation. The Rogers–Greenhalgh framework construed implementation as a complex process influenced by five broad constructs: (a) perceived characteristics of innovation, (b) potential adopter characteristics, (c) communication and influence, (d) inner organizational context (e.g., system readiness to change), and (e) outer organizational context. In Table 1, the first four of these constructs and their sub-components are listed and briefly defined. Figure 1 depicts these constructs in relation to implementation outcomes tested here. A copy of the full quantitative survey can be accessed here: http://www.implementationscience.com/content/7/1/59.

The association between perceived characteristics of innovations (e.g., relative advantage, compatibility) and implementation is well-established in the general health care arena (for review see Greenhalgh et al. 2004). Indeed, although not sufficient to fully explain implementation, perceived characteristics account for a significant portion of its variance. The other constructs in the framework have received less empirical investigation. Adopter characteristics, such as one's interest in new ideas and motivation, have long been hypothesized as predictive of uptake of new practices (Rogers 1962). Some data support that communication and influence variables (e.g., social networks and access to expert opinion leaders; Cook et al. 2009a, b) are related to adoption of EBTs. Additionally, inner-organizational context, which encompasses both system antecedents and readiness for innovation (e.g., dedicated time and resources), appear to contribute a modest but significant amount of variance in implementation of EBTs (Greenhalgh et al. 2004).

EBTs for Posttraumatic Stress Disorder (PTSD) in the Department of Veterans Affairs (VA)

Posttraumatic stress disorder (PTSD) is a major public health concern. Twenty million Americans develop PTSD at some point in their life (Kessler et al. 2005). If left untreated, PTSD can become a chronic disorder contributing to substantial psychological and physical impairments, as well as social and occupational disabilities (Kessler 2000). The EBTs for PTSD, Prolonged Exposure (PE; Foa et al. 2007) and Cognitive Processing Therapy (CPT; Resick and Schnicke 1993), are infrequently utilized in community practice (e.g., Becker et al. 2004; Gray et al. 2007).

The prevalence of PTSD is particularly high among veterans (Kulka et al. 1990; Tanielian and Jaycox 2008). The Department of Veterans Affairs (VA) instituted national initiatives to provide training and consultation in PE and CPT. In brief, PE is an 8–15-session individually-delivered therapy that involves four main components: education about reactions to trauma and PTSD; breathing training; exposure to trauma-related situations that are objectively safe but avoided due to trauma-related distress (in vivo exposure); and exposure to trauma memories through repeated recounting out loud by the client of the details of their most disturbing event (imaginal exposure). CPT is a 12-session individually or group delivered therapy that focuses on feelings, beliefs, and thoughts which directly emanate from the trauma.

In addition to the multi-day face-to-face trainings, supervision and consultation, the VA provided other top-down endeavors to enhance the implementation of PE and CPT. These included a mandate that all veterans receiving PTSD treatment be offered these EBTs (U.S. Department of Veterans Affairs 2008), the creation of a mentoring program to improve communication between regional and national program leaders (Bernardy et al. 2011), and the appointment of at least one staff member at each medical center assigned to be the evidence-based psychotherapy coordinator.

Despite these extensive efforts, a review of progress notes of veterans receiving PTSD care at six VA outpatient PTSD programs in New England found that only 6.3 % received at least one session of PE or CPT (Shiner et al. 2012). Similarly in one large Midwestern VA PTSD outpatient clinic, although 70 % of the veterans who initiated PE or CPT completed the treatment, only 11 % began this type of treatment (Mott et al. 2014). However to date, there has been limited evaluation of PE and CPT implementation more broadly across VA treatment settings (Eftekhari et al. 2013; Karlin et al. 2010).

The VA is one of the most expansive providers of health care services in the world (Solberg 2009). Although unique in some aspects of management and resources, the VA also serves as an excellent laboratory to understand the implementation of best practices as it is a more organized and controlled environment, free of the barriers faced in other more fragmented segments of the U.S. health care system (Solberg 2009). In a sense, the VA provides a “best case” scenario for other systems and can provide important lessons for the setting of realistic goals in other less controlled and resourced settings.

Residential PTSD programs have been a cornerstone of VA treatment of PTSD for the past 30 years. These typically serve veterans whose need for treatment exceeds what can be provided in an outpatient setting. Residential PTSD programs within VA vary in length of treatment, number of veterans served, staffing and funding resources, and target population (e.g., combat-related PTSD, PTSD with comorbid substance abuse, and/or military sexual trauma).

The aim of this study was to test Rogers–Greenhalgh implementation framework in understanding the self-report use of PE and CPT in a national sample of VA residential PTSD treatment programs (N = 38). We hypothesized that the following four constructs would be associated with the use of PE and CPT: (1) providers’ perceived characteristics of

PE and CPT (e.g., potential for reinvention); (2) provider characteristics (e.g., motivation); (3) communication and influence (e.g., social networks); and (4) inner context: receptive context for change.

Method

Participants

All PTSD treatment providers in 38 VA residential treatment settings in the U.S. that currently reported patient outcomes to the VA's Northeast Program Evaluation Center (NEPEC) were invited to participate. Of the 241 providers identified as working in the programs, 15 (6.2 %) had left their setting by the assessment period. Of the 229 eligible, 216 (94.3 %) responded and completed the survey, and 201 (87.8 %) had adequate data to be included in the analyses. Only information on gender and professional discipline was available for non-participants. There were no significant differences between those who participated and those who did not in terms of the proportion of gender (37.2 vs. 42.3 %), χ^2 (1, N = 229) = 0.09, *ns*, or proportion of doctoral-level psychologists (51.4 vs. 40.7 %), χ^2 (1, N = 229) = 1.94, *ns*.

Measures

Model variables—Thirty-three sub-constructs across four broad constructs (i.e., perceived characteristics of the innovations, adopter characteristics, communication and influence, and receptive context for change) from the framework were included in the survey. The other constructs from Rogers-Greenhalgh's framework (inner context: system readiness for innovation and outer context) were difficult to assess in a quantitative survey format and are thus not included here. The qualitative measurement of these constructs and others are reported elsewhere (Cook et al. 2014).

One difficulty with formally studying the Rogers– Greenhalgh framework was that there were no explicit recommendations for operational definitions or items to measure most of the identified constructs. Thus, in order to advance toward a testable theory and thus benefit implementation science, our research group set out to operationalize the constructs. A complete description of the survey development process can be found elsewhere (Cook et al. 2012). In brief, we conducted a systematic literature search of key words representing the constructs and their sub-constructs. Using an iterative process, existing items from previously published measures were reviewed for potential item inclusion. Where no one measure was deemed appropriate, we developed other items to measure the constructs through consensus. To reduce respondent burden and maximize response rate, each construct was assessed with a small number of items, between one and four (typically two) items. These sub-constructs and their reliability data are summarized below.

Ten sub-constructs of perceived characteristics of the innovations (for PE and CPT) were examined: relative advantage, compatibility, complexity, trialability, observability, potential for reinvention, risk, task issues, nature of knowledge, and augmentation/technical support. Because the perceived characteristics of PE and CPT could differ, mirrored items assessing these characteristics were developed specific to each treatment. For example, an item

measuring compatibility of PE read, “Using PE fits well with the way I like to work,” while the parallel item measuring compatibility of CPT read, “Using CPT fits well with the way I like to work.” From the construct adopter characteristics, 13 sub-constructs were assessed: needs, motivation, values and goals, tenure, skills, tolerance of ambiguity, knowledge-seeking, cosmopolitan-ness, learning style, and locus of control. Three sub-constructs within communication and influence factors were assessed: social networks, peer opinion leadership, and boundary spanner. Seven sub-constructs representing inner organizational context: receptive context for change were assessed: risk-taking climate, managerial relations, goals and priorities, leadership and vision, high quality data capture, enabling knowledge sharing, and dedicated time and resources.

Because the Rogers–Greenhalgh framework has not been comprehensively tested, and because of the very large number of variables included in the model, it was necessary to evaluate our assessment of the sub-constructs. Each of the sub-constructs described in Table 1 were examined for their internal consistency and correlation with other constructs within the domain. Sub-constructs that were inadequate on these were considered for dropping from further analyses. Relatively relaxed criteria for consideration were applied, given the limited number of items used (suggesting a relaxation of criteria for internal consistency) and the possibility of multiple statistical factors in the same domain (suggesting a relaxation of correlation with the other constructs within the domain). Sub-constructs with internal consistency lower than 0.50 were considered for dropping as were sub-constructs with correlations with a domain less than 0.20. This resulted in the exclusion of our measures of learning style, locus of control, and tolerance of ambiguity from subsequent analyses.

Table 2 presents the internal consistency and item-total correlation for each of the retained sub-constructs. Internal reliabilities ranged from 0.56 to 0.95, with most over 0.70, indicating fair to good internal consistency. Thus overall all the sub-constructs had adequate to high internal consistency. In terms of their relationship to the relevant constructs, there were particularly modest scores for adopter characteristics, and for the risk sub-construct in relation to the perceived characteristics construct.

Given the relatively small number of providers interviewed, and the nested nature of the data, it was also necessary to examine the possibility that the variance captured by the 33 sub-constructs might be captured by a smaller number of factors. Exploratory factor analyses (EFA) were conducted on the sub-constructs in each construct, separately, with the goal of determining a smaller number of factors within each construct. Specifically, maximum likelihood estimation EFAs were conducted using direct oblimin rotations to take into account the likely correlation among potential factors within domains. To determine the number of factors to extract for each EFA, both parallel analysis with a 0.95 threshold (O’Connor 2000) and scree plot inspection were used. Because some constructs included parallel sub-constructs assessing PE and CPT separately, separate EFAs were conducted including the PE and CPT sub-constructs.

The results of these EFAs are presented in Table 3. Receptive context appeared to contain two factors in scree plot examination, and in parallel analysis on receptive context for PE. In parallel analysis on receptive context for CPT, the second eigenvalue obtained was slightly

lower than the threshold suggested by parallel analyses. However, given that the results using two factors were very similar to those for receptive context for PE, and that scree plot inspection resulted in two factors, we retained two factors for both. As well, as can be seen in the two factor solution for these constructs, there was very limited overlap in loadings between the two factors. The supportive context included dedicated time and resources, and incentives and mandates, while the structural context included risk-taking climate, managerial relations, goals and priorities, leadership and vision, high quality data capture and enabling of knowledge sharing.

According to both parallel analysis and scree plot examination, the perceived characteristics construct contained a single factor, which was labeled positive view. All sub-constructs loaded highly on this factor, with the exception of risk, which had negative and moderate loadings in the context of PE and negative but non-significant loadings in the context of CPT. It was not included in positive view. However, because of the theoretical importance of the construct of risk, it was retained in the analyses, as a separate factor, labeled risk.

According to both parallel analysis and scree plot examination, the adopter characteristics construct contained two factors, labeled openness and drive. After direct oblimin rotation, there was very limited overlap in loadings between the two factors, although some loadings were relatively modest (skills and knowledge-seeking for PE, and tenure and skills for CPT).

Finally, according to both parallel analysis and scree plot examination, the communication and influence construct contained a single factor, labeled connections. All sub-constructs loaded highly on this single factor. The factors resulting from this process were retained for the multilevel modeling analyses.

Outcome variables—The outcome variables were implementation of PE administered on an individual basis, CPT administered on an individual basis, and CPT administered on a group basis (PE is not routinely delivered as a group intervention). Each of these three outcomes was assessed using a single item. For example, the item assessing PE read, “How often do you conduct PE on an individual basis?” items assessing CPT in individual and group formats were similar. Response options were on a seven-point scale, ranging from “0—not at all” to “6—with over 90 % of clients.” These implementation outcome variables can be viewed as clinician reported reach or penetration (as discussed by Proctor et al. 2011).

Procedure

All PTSD providers in 38 VA residential PTSD treatment programs were invited to complete a web-based survey measuring many of the sub-constructs in the implementation framework. All providers were asked to log on to an encrypted Internet site and give their assent before participation. This study was deemed exempt from formal review by the Yale Human Research Protection Program due to perceived low risk and approved by the VA Connecticut Health Care System Institutional Review Board.

Data Analysis

To account for possible shared variance among providers assessed at the same VA program, the outcomes were modeled using multilevel modeling, with providers nested within sites as a random effect, and the substantive variables of interest as fixed effects. Although this represents a two-level test, the primary purpose in modeling the random effect of site is to account for the covariance structure due to anticipated correlations among participants at the same site (SPSS 2005). In reporting these results, we focus here on the fixed effects as the substantive test of hypotheses, and briefly describe the random effects. Bivariate associations between each of the component sub-constructs and the three outcome variables were examined using multilevel modeling. Then multivariate analyses were conducted, using the following modeling procedure. In the first step, a baseline model was estimated, using the intercept only model. Next, a block of control variables (number of beds, average length of patient stay, and professional discipline of provider) was entered. These three control variables were chosen to account for potentially significant differences between programs' fixed structural and personnel characteristics, which may account for a differential ability to implement the treatments. Other aspects of the provider and/or setting likely influence implementation in addition to the Rogers–Greenhalgh framework. Finally, all of the component sub-constructs were entered, and a final model estimated. To give an estimate of the variance explained by each of the models, a pseudo-R^2 statistic was estimated using the −2 log likelihood method.

Results

The bivariate associations between the sub-constructs and the outcomes are presented in Table 4. Among the potential control variables, only profession was significantly associated with PE implementation and none of the control variables were significantly associated with CPT implementation. The significant bivariate correlates of PE implementation were: support, positive view, and openness. These same variables also were significantly associated with CPT individual implementation. Support and positive view were both significantly associated with CPT group implementation.

The final models of implementation of each of the three EBTs are presented in Table 5. None of the control variables were associated with implementation of any treatment, and the overall variance explained by them was quite modest. However, the model variables (sub-constructs) examined explained a substantial portion of the variance in implementation of all treatments. Higher levels of support were associated with implementation of all treatments. In addition, higher levels of positive view were associated with higher levels of PE implementation. There were no significant unique effects of the structural factor in receptive context for change, risk, adopter characteristics or communication/influence for any outcome. The effects of site were significant for both CPT individual and CPT group, but the amount of variance explained was quite modest.

To briefly explore whether the inclusion of those without training in the interventions was influencing the results, we performed similar analyses to those described above, but including only those who reported having had training in PE (n = 151) for the PE implementation outcome, and training in CPT (n = 173) for the CPT implementation

outcomes. The results for both PE implementation and CPT group implementation were very similar; effects significant in the broader analyses were significant in these analyses, effects not significant in the broader analyses were not significant here, and all effects, significant or not, were in the same direction and of roughly the same magnitude. There was one exception to this general rule for CPT implementation, where a significant relationship emerged between connections and CPT individual implementation in those with training; specifically, those with more connections were significantly less likely to implement CPT individual treatment.

Discussion

This is the first systematic study to investigate the implementation of PE and CPT in 38 VA residential PTSD treatment programs across the United States. Supportive context (dedicated time and resources, and incentives and mandates) was associated with use of individual CPT, group CPT and PE, and overall positive view of the treatment was also associated with PE. Before discussing these findings and noting their potential implications to future implementation efforts, it is important to note that this study is the also the first attempt to formally test the Rogers–Greenhalgh implementation framework as it applies to mental health treatments.

Many components from the conceptual model were not significantly related to implementation in these analyses. This may reflect problems with the model, its application to mental health treatments, our operationalization of it or something unique about the VA context that makes these variables operate differently than they might elsewhere. In regards to operationalization, the model has many areas of conceptual overlap between sub-constructs (e.g., peer opinion leader, champion) and in that the model fails to provide rankings for sub-constructs' influence and importance. In addition, some of the sub-constructs have a limited empirical base and/or some of the evidence for their influence comes from fields other than healthcare. It is also important to note that the Rogers-Greenhalgh's framework was published almost 10 years ago and that there are over 61 other dissemination and implementation models in the literature (for review, see Tabak et al. 2012) as well as other efforts in implementation measure development related to additional frameworks (e.g., Aarons et al. 2014; Jacobs et al. 2014; Shea et al. 2014). The work presented here is also consistent with efforts conducted by the Society for Implementation Research Collaboration to develop measures that map on to implementation frameworks (http://www.seattleimplementation.org/sirc-projects/sirc-instrument-project/) as well as the Grid-Enabled Measures Database (http://cancercontrol.cancer.gov/brp/ gem.html) project.

Our work represents a first step to examine the properties of a survey developed to capture the Roger-Greenhalgh implementation framework in health care settings. Items from existing measures were utilized or adapted and where no one measure was deemed appropriate, other items were developed through iterative consensus. We retained only those subscales whose estimates of internal consistency for survey items obtained met conventional standards and were considered acceptable, particularly given the limited number of items on each sub-construct scale. In a few instances, particularly for motivation, coefficient alpha was somewhat lower than conventional thresholds for adequate reliability,

although all alphas were higher than 0.50. However, within broader constructs, there were high intercorrelations among sub-constructs, which are inconsistent with the model of them each as distinct constructs and suggest that the unwieldy number of sub-constructs could be consolidated. Thus it is possible that there are simply too many variables in the Rogers–Greenhalgh framework. Of course, it is possible that the apparent overlap is due to inadequate measurement of each subconstruct (and indeed, the psychometric properties of three of the sub-constructs were not adequate and thus removed, while two more—motivation and relative advantage—are at best adequate psychometric utility). However we conducted univariate analyses on all the sub-constructs and found a similar lack of effects suggesting that shared variance was not the primary reason for the lack of significant findings in the multivariate analyses.

A focus on internal consistency assumes that the variables measured are reflective (i.e., all items are interchangeable measures of a unitary construct) rather than formative (i.e., items assess different components of a summary construct and may not be interchangeable; Diamantopoulos and Siguaw 2006). This assumption is often not met, and may be especially unlikely to be met in very brief assessments of relatively complex constructs (Borsboom et al. 2003).

One important area that is not covered in the Rogers– Greenhalgh implementation framework is patient characteristics. It is important for future studies to include patient characteristics (e.g., symptom presentations, preferences, etc.) as part of research designs to assess implementation (Glasgow and Emmons 2007). Our lack of measurement of patient level characteristics is a limit to our investigation.

A recent investigation of VA PTSD outpatient programs found directors' perceptions of patient readiness to participate in and benefit from trauma-focused treatments appeared to be influential in the programs adoption of PE and CPT (Hamblen et al., under review). Thus some VA organizational work units that are more supportive of these EBTs may actually be doing a better job of screening patients with adequate PE and CPT readiness.

Supportive organizational context was associated with the implementation of all three interventions: PE on an individual basis, CPT on an individual basis and CPT on a group basis. This domain consisted primarily of programs' dedicated time and resources, and incentives and mandates for implementing these EBTs. In other words, if there was adequate time, adequate numbers of trained providers, and availability of consultation to implement the EBT, it was more likely to be implemented, or if providers were expected to use the EBT as part of their job, then they were more likely to use it. In addition, our multi-level modeling took into account correlations within site and we controlled for other aspects of site, all of which make the significant effects of supportive context more striking.

These results are consistent with findings from others (Tomoaia-Cotisel et al. 2013) and from a formative evaluation of PE and CPT in these settings (Cook et al. 2013). Resource inadequacy, notably time constraints, was perceived by providers to be a determining factor in their use of both PE and CPT. Perceived lack of time needed for learning and carrying out

an intervention has also been identified as a significant barrier to implementation in a large sample of community psychotherapists (Cook et al. 2009a, b).

There were somewhat less robust effects of positive view that, for CPT, were subsumed in the multivariate models. Finally, there were some effects of adopter openness for the individual treatments, but again, these were subsumed in the multivariate models. We found no evidence of any significant effect for structural context, risk, adopter drive, or connections.

Perhaps the reason for this is that support within the organization and setting have a larger influence on implementation than other factors. For example, it may be that providers working for organizations and not in private practice are more restricted in their ability to make autonomous decisions about adopting treatments. These data seem to indicate that contextual support takes precedence over individual provider decision-making. Thus individual provider perceptions and choices may be constrained by how the treatment gets implemented into their context and how resources are made available to accommodate their use. There were some effects of both provider perceptions of interventions and openness to interventions, but these were less robust and were no longer significant after taking into account contextual support. It has been acknowledged that implementation of EBTs is shaped by the internal change capacity of the receiving setting and the context in which it is situated (Dobson and Singer 2005). However, the internal capacity or environmental constraints might override individual provider perception. This is an important line of future investigation.

The dissemination efforts for PE and CPT within the VA involved all qualifying providers working with PTSD populations. However, this study included only residential providers. Residential providers likely work in a context in which they do not have free-ranging control over their use of interventions. Although outpatient providers may have constraints in regards to which treatments they use, the limits may be greater in the context of a residential setting given the schedules of these programs and the many things that providers in the programs need to do.VA PTSD services are vast and varied (e.g., outpatient, tele-health) and while it is likely that a number of the findings here may apply across these settings, further investigations to test for generalizability are needed.

In an examination of influential contextual factors to the successful dissemination of primary care interventions in 14 distinct programs, connectivity to a larger national organization was reported by all sites as positively influencing adoption (Tomoaia-Cotisel et al. 2013). Though unique in a variety of ways (e.g., geographic area served, number of beds, number of licensed providers etc.) all programs in this study are part of the larger VA network and subject to the same governing rules and mandates. This has likely been a strength in expediting the dissemination effort but, also, a limitation to its generalizability and its potential transportability to other settings.

Other limitations to this investigation warrant mention. First, in future work, it will be important to further refine assessment of several key sub-constructs. Our measure development is preliminary and needs further evaluation with confirmatory factor analysis

and validity (e.g., convergent, discriminant, concurrent, predictive) analyses. Furthermore, this study relied on provider self and site assessment of the implementation of PE and CPT and is therefore subject to the biases and limitations of self-report. In an ideal case, many of the constructs, particularly the implementation outcomes, would be rated objectively by independent raters other than the providers themselves. The quality, fidelity, or clinical outcomes of PE and CPT were not assessed at this time or reported in this study. Although the VA has an electronic health record, data regarding services are currently not detailed enough to determine if PE or CPT were provided. The VA is working on nationally instituting PE and CPT progress note templates and future investigations should include this source of data to help eliminate potential self-report bias issues.

Additionally, future investigations should include the effect of this framework on other implementation outcomes (e.g., acceptability, appropriateness, fidelity, implementation cost and sustainability) as identified by Proctor et al. (2011). Another potential threat to the validity of these conclusions is common method bias, in which the amount of variance in implementation outcome could be due to the measurement method rather than the actual constructs the measure represents (Podsakoff et al. 2003). Findings from this study may be unique to VA, a national centralized health care system, that is relatively unconcerned about competition or cost, and that has been actively working to transform its quality of care (Solberg 2009). Other health care systems (e.g., public mental health agencies, private for profit agencies, private not for profit agencies and private practice) are different in size and scope. Investigation of this conceptual framework in those settings is necessary before generalizability can be addressed.

These findings suggest that institutional support is a key correlate of successful implementation. With some exceptions (e.g., Aarons and Sawitzky 2006; Glisson 2002; Jacobs et al. 2014), these aspects have largely been underemphasized in both research and in attempts at implementation where much more attention has been paid to provider characteristics and their decision-making. Context including institutional support is often inadequately captured by routine checklists and instead requires multilayered, mixed-methods assessment to create a comprehensive explanatory narrative (Tomoaia-Cotisel et al. 2013). Our research group is engaging now in such a process by triangulating results reported here with administrative and qualitative data.

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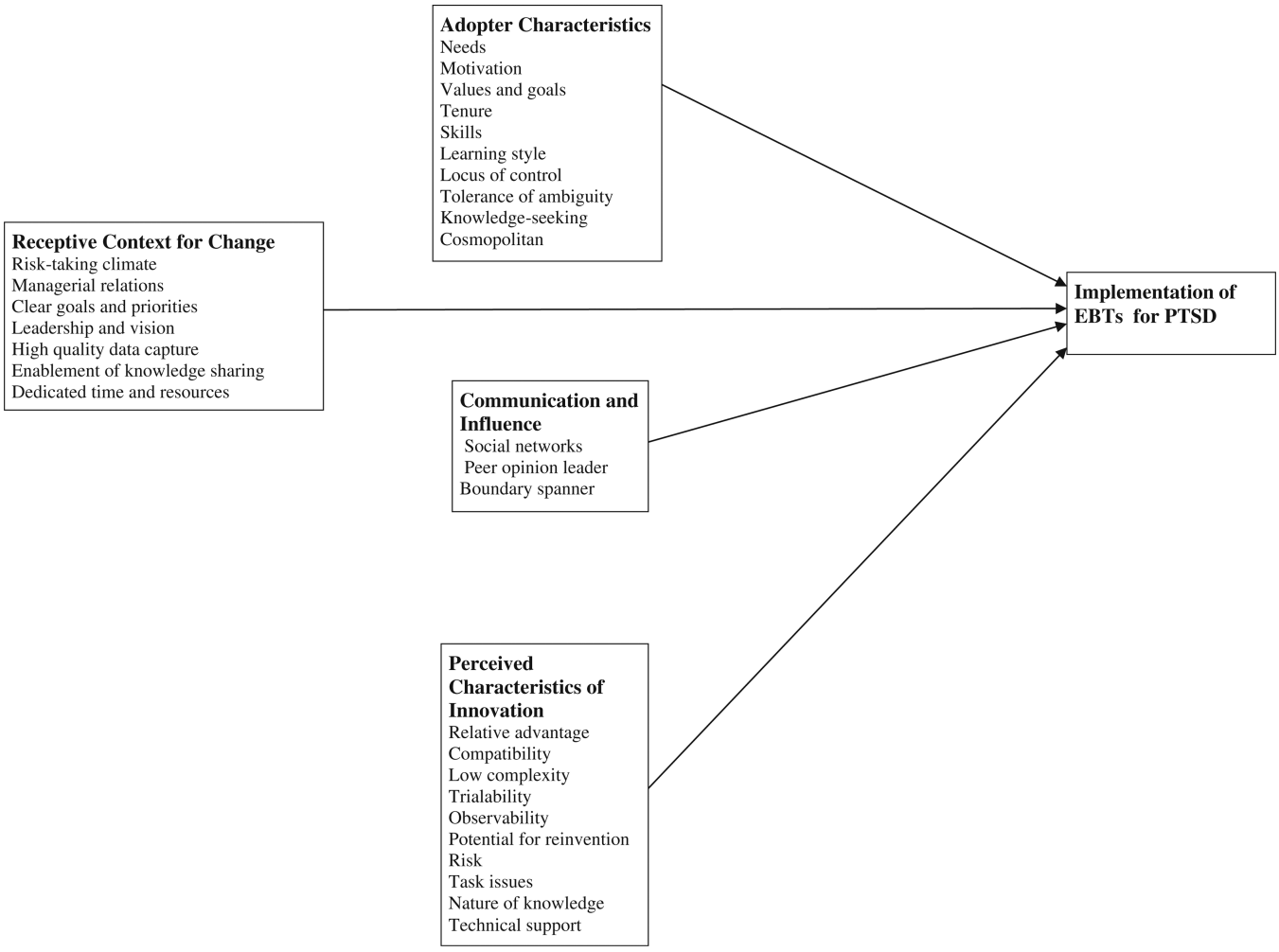

Fig 1.
Rogers–Greenhalgh constructs tested in relationship to implementation outcomes

Table 1

Operational definitions for Rogers–Greenhalgh implementation framework constructs tested here

Construct	Operational definition
Innovation	
Relative advantage	Degree to which the innovation is considered superior to existing practices
Compatibility	Innovations' consistency with existing values, experiences, and needs of adopter and system
Complexity	Level of difficulty to understand and use the innovation
Trialability	Ability to experiment with the innovation on a limited or trial basis
Observability	Innovations' results are observable to others
Potential for reinvention	Ability to refine, elaborate and modify the innovation
Risk	Risk or uncertainty of outcome associated with the innovation
Task issues	Concerns about the innovation that need to be focused on to accomplish implementation
Nature of knowledge	Information about the innovation can be codified and transferred from one context to another
Technical support	Available support components (e.g., training, manuals, consultation help desk)
Adopter characteristics	
Needs	Observed or experienced deficit in an adopter's practice or organizational setting
Motivation	Adopter's interest and willingness to learn new things
Values and goals	What adopters place value in and what are their intended goals for treatment
Tenure	Length of employment in setting and in field
Skills	Adopter's context specific skill set
Learning style	Adopter's consistent patterns in perceiving, remembering, judging and thinking about new information
Locus of control	Adopter's belief that events are under one's personal control (internal) or that events are largely a matter of chance or due to external events (external)
Tolerance of ambiguity	Adopter's ability to accept uncertainty
Knowledge-seeking	Adopter's autonomous efforts to attain knowledge/information
Cosmopolitan	Adopter's strong connections with professional network; Engagement and attendance at professional meetings and other informational venues
Communication and influence	
Social networks	Structure and quality of social network, both formal and informal
Peer opinion leader	Internal member of the social network able to exert influence on providers' beliefs and actions through representativeness and credibility (can be positive or negative)
Boundary spanner	An individual who is part of the work environment and part of the innovation technology (e.g., trainer in the innovation)
Receptive context for change	
Risk-taking climate	A work environment that encourages experimentation with new practices, ideas and technologies
Managerial relations	Relationship between staff and program leadership
Clear goals and priorities	Explicitness of organizational purposes and aims
Leadership and vision	Style of leadership and presence of identified and articulated trajectory with guided direction toward implementation
High quality data capture	Utilization of context specific data in implementation process
Enablement of knowledge sharing	Creation of venues for sharing information
Dedicated time and resources	Available means needed to implement an innovation (e.g., funding, time, access, administrative support, etc.)

Table 2

Reliability of constructs

Construct	α	Item-total correlation
Context		
Risk-taking climate	0.81	0.71
Managerial relations	0.80	0.73
Goals and priorities	0.81	0.78
Leadership and vision	0.83	0.76
High quality data capture	0.90	0.64
Enabling of knowledge sharing	0.88	0.68
Dedicated time and resources: PE	0.66	0.45
Dedicated time and resources: CPT	0.74	0.50
Incentives and mandates: PE	0.78	0.36
Incentives and mandates: CPT	0.82	0.44
Perceived characteristics (PE)		
Relative advantage	0.56	0.53
Compatibility	0.82	0.78
Complexity	0.74	0.73
Trialability	0.70	0.54
Observability	0.63	0.70
Potential for reinvention	0.81	0.57
Risk	0.65	−.39
Task issues	0.66	0.76
Nature of knowledge	0.93	0.63
Augmentation-technical support	0.81	0.59
Perceived characteristics (CPT)		
Relative advantage	0.80	0.75
Compatibility	0.89	0.79
Complexity	0.84	0.73
Trialability	0.73	0.68
Observability	0.68	0.77
Potential for reinvention	0.91	0.68
Risk	0.73	−.14
Task issues	0.82	0.81
Nature of knowledge	0.95	0.71
Augmentation-technical support	0.90	0.72
Adopter characteristics		
Needs	n/a	0.09
Motivation	0.57	0.05
Values and goals	0.73	0.23
Tenure	0.63	−.31
Skills PE	n/a	0.13

Construct	α	Item-total correlation
Skills CPT	n/a	0.02
Knowledge-seeking	0.67	0.14
Cosmopolitan	n/a	0.04
Communication and influence		
Social networks	0.83	0.55
Peer opinion (leader)	n/a	0.57
Boundary spanner	0.75	0.52

Table 3

Exploratory factor analyses

Construct	Obtained factor loadings	
Context (PE)	Structural	Support
Risk-taking climate	**0.79**	−.06
Managerial relations	**0.90**	−.10
Goals and priorities	**0.86**	0.03
Leadership and vision	**0.66**	0.24
High quality data capture	**0.63**	0.10
Enabling of knowledge sharing	**0.82**	−.06
Dedicated time and resources	0.16	**0.54**
Incentives and mandates	−.12	**0.98**
Context (CPT)	Structural	Support
Risk-taking climate	**0.75**	0.03
Managerial relations	**0.94**	−.14
Goals and priorities	**0.88**	−.04
Leadership and vision	**0.60**	0.29
High quality data capture	**0.63**	0.06
Enabling of knowledge sharing	**0.79**	0.03
Dedicated time and resources	0.12	**0.58**
Incentives and mandates	−.06	**0.82**
Perceived characteristics (PE)	Positive view	
Relative advantage	**0.61**	
Compatibility	**0.84**	
Complexity	**0.77**	
Trialability	**0.58**	
Observability	**0.77**	
Potential for reinvention	**0.60**	
Risk	**−.41**	
Task issues	**0.84**	
Nature of knowledge	**0.69**	
Augmentation-technical support	**0.67**	
Perceived characteristics (CPT)	Positive view	
Relative advantage	**0.80**	
Compatibility	**0.83**	
Complexity	**0.75**	
Trialability	**0.72**	
Observability	**0.82**	
Potential for reinvention	**0.74**	
Risk	−.14	
Task Issues	**0.87**	
Nature of knowledge	**0.74**	

Construct	Obtained factor loadings	
Augmentation-technical support	**0.74**	
Adopter characteristics (PE)	Openness	Drive
Needs	−.03	**0.77**
Motivation	0.01	**0.53**
Values and goals	**0.55**	0.14
Tenure	**−.40**	−.18
Skills	**0.39**	−.13
Knowledge-seeking	**0.32**	0.21
Cosmopolitan	**0.49**	−.18
Adopter characteristics (CPT)	Openness	Drive
Needs	−.07	**0.86**
Motivation	0.07	**0.47**
Values and goals	**0.43**	0.14
Tenure	**−.33**	−.16
Skills	**0.34**	−.08
Knowledge-seeking	**0.46**	0.16
Cosmopolitan	**0.52**	−.19
Communication and influence	Connections	
Social networks	**0.77**	
Peer opinion (leader)	**0.71**	
Boundary spanner	**0.63**	

All factor analyses conducted using oblimin rotation, using the variables within each domain. Bold font represents rotated loadings greater than 0.30

Table 4

Mixed models of the three implementation outcomes: bivariate associations

Fixed effects	PE			CPT individual			CPT group		
	B	***SE***	***t***	***B***	***SE***	***t***	***B***	***SE***	***t***
Control									
How many beds	0.01	0.01	0.58	0.02	0.02	1.39	0.04	0.02	1.87
Avg. length of stay	−0.01	0.01	−1.75	−0.01	0.01	−1.19	0.01	0.01	0.96
Type: psychiatrist	−0.26	0.66	−0.39	−1.05	0.64	−1.64	−1.70	0.92	−1.75
Type: psychologist	1.02	0.33	3.11*	0.23	0.33	0.73	−0.04	0.47	−0.09
Type: Social worker	0.79	0.35	2.24*	0.60	0.35	1.75	0.49	0.50	0.58
Context									
Structural	0.02	0.07	0.36	0.07	0.07	0.96	0.03	0.10	0.33
Support	0.43	0.06	6.91*	0.40	0.07	5.42*	0.58	0.10	5.58*
Perceived characteristics									
Positive view	0.83	0.11	7.66*	0.49	0.12	3.94*	0.84	0.17	4.90*
Risk	−0.13	0.07	1.89	−0.04	0.07	0.57	−0.16	0.09	−1.74
Adopter characteristics									
Openness	0.60	0.12	5.16*	0.29	0.12	2.37*	0.51	0.18	2.88
Drive	−0.21	0.12	−1.81	0.06	0.11	0.52	0.26	0.16	1.63
Communication/influence Connections	0.05	0.13	0.37	0.25	0.14	1.82	0.30	0.18	1.70

*$p < 0.05$

Table 5

Mixed models of the three implementation outcomes: multivariate models

Fixed effect	**PE**			**CPT individual**			**CPT group**		
	B	***SE***	***t***	***B***	***SE***	***t***	***B***	***SE***	***t***
Intercept	0.36	1.09	0.34	−0.27	1.13	−0.24	0.17	1.54	0.1
Control									
How many beds	0.00	0.01	0.16	0.00	0.01	0.32	0.01	0.02	0.54
Avg. length of stay	−0.01	0.01	−0.97	−0.01	0.01	−1.00	0.01	0.01	1.05
Type: psychiatrist	−0.29	0.84	−0.35	−1.18	0.73	−1.61	−1.21	1.00	−1.22
Type: psychologist	0.26	0.40	0.66	−0.52	0.38	−1.37	−0.85	0.52	−1.63
Type: Social worker	0.35	0.41	0.87	0.03	0.01	0.40	−0.17	0.55	−0.31
Context									
Structural	−0.09	0.09	−0.97	−0.07	0.09	−0.77	−0.15	0.12	−1.23
Support	0.25	0.09	2.82*	0.40	0.10	3.86*	0.52	0.14	3.67*
Perceived characteristics									
Positive view	0.56	0.17	3.31*	0.24	0.16	1.46	0.38	0.22	1.75
Risk	0.04	0.08	0.59	0.04	0.07	0.53	−0.06	0.09	−0.62
Adopter characteristics									
Openness	0.11	0.18	0.63	0.12	0.15	0.79	0.23	0.21	1.10
Drive	−0.16	0.11	−1.43	0.00	0.11	0.00	0.19	0.15	1.26
Communication/influence									
Connections	−0.18	0.16	−1.10	−0.19	0.16	−1.20	0.02	0.22	0.12
Random effects	*B*	*SE*	*Wald Z*	*B*	*SE*	*Wald Z*	*B*	*SE*	*Wald Z*
Site	0.04	0.12	0.34	0.60	0.26	2.32*	1.18	0.50	2.38*
Pseudo R^2									
Fixed control block	0.025			0.018			0.018		
Fixed substantive	0.227*			0.188*			0.192*		
Random	0.002			0.019*			0.021*		

Pseudo R^2 based on −2 restricted log

* $p < 0.05$