



Challenges in Measuring Healthcare Transition Readiness: Taking Stock and Looking Forward

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ABSTRACT

Theoretical principles: The construct of transition readiness has become commonplace in healthcare transition (HCT) research, yet conceptualization of this construct is rarely considered. Given the centrality of construct conceptualization in measure development and validity theory, analysis of measurement implications of conceptualizations of transition readiness is essential.

Phenomenon addressed: The purpose of this paper is to provide a review and critical analysis of transition readiness measurement through the lens of construct conceptualization and its implications for validation and healthcare transition research.

Research linkages: Drawing on contemporary validity theory, theoretical discussions of construct conceptualization from management studies, and transition readiness measurement research, this paper will explore how transition readiness has been conceptualized and operationalized in HCT research and articulate problems, challenges and gaps relevant to transition readiness. There remains a lack of consensus on what transition readiness is or should be and careful attention to the implications of elements of conceptual definitions are essential to move the field of transition readiness measurement forward. Recommendations for future work in the field in relation to conceptual clarity, the implications of multidimensionality, change over time, and consequences of measurement are suggested.

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Medical advances over the last three decades have resulted in increasing numbers of youth with chronic conditions living into adulthood. As the practice of transferring youth with chronic conditions from pediatric to adult health and social services at 18 to 21 years of age became commonplace, mounting evidence demonstrated poor health and social outcomes for these adults (e.g. Dieluweit et al., 2010; Lorenzi et al., 2011; Newman et al., 2011). Researchers hypothesized that when young adults transferred to adult care, the structure and expectations of the adult health care system were not necessary aligned with young adults' health care needs and competencies related to independence in managing their chronic condition (Rosen, Blum, Britto, Sawyer, & Siegel, 2003). As a result, preparation for transfer to adult-oriented care through the acquisition of knowledge and skills to enhance youths' autonomy, personal responsibility and independence prior to transferring to adult-oriented care has become a priority (Rosen et al., 2003). In North America and some European countries, the term *transition readiness* has come to represent this intermediate outcome of transition preparation.

Measurement of transition readiness dates back to the late 1980s and 1990s (Betz, 2000; Cappelli, MacDonald, & McGrath, 1989); however, it was not until the late 2000s that transition readiness measurement became more common. In 2011, the American Academy of Pediatrics, the American Academy of Family Physicians and the American College of Physicians-American Society of Internal Medicine released a clinical report presenting recommendations and an algorithm to guide the transition process. In this report, planning for transition and promoting transition readiness were central; however, a lack of measures of transition readiness with a certain degree of validity evidence was quickly identified as a major barrier to enacting the recommendations in the report (Sawicki et al., 2011; Zhang, Ho, & Kennedy, 2014). This realization led to an explosion of research focused on the measurement of transition readiness. While most contributions to this field of healthcare transition (HCT) have been made by medicine and rehabilitation disciplines, nursing has taken an increasing interest and role in supporting successful transition (e.g. Betz, 2013; Joly, 2016; Lapp & Chase, 2018; Moons, Hildersen, & Van Deyk, 2008; Rehm, Fuentes-Afflick, Fisher, & Chesla, 2012; Society of Pediatric Nurses, 2016). Furthermore, a review of the previous special issue on healthcare transition in this journal revealed an increasing number of articles focused explicitly on measuring transition readiness. Given pediatric nursing's mandate to support the biopsychosocial needs of children and adolescents,

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concepts such as transition readiness are important for nursing practice with youth living with chronic conditions.

While the focus on transition readiness measurement and research in the field of HCT has increased dramatically over the last decade, few have sought to compare and critically analyze these measures and their use. In 2014, three systematic reviews explored results of psychometric studies of transition readiness measures (Schwartz et al., 2014; Stinson et al., 2014; Zhang et al., 2014). Schwartz et al. (2014) reviewed generic and condition-specific transition readiness measures and the studies evaluating them and concluded that, among other challenges, consistency in the conceptualization and operationalization of the construct of transition readiness was lacking. Most researchers openly acknowledge the importance of construct conceptualization, yet it often does not receive the attention it deserves in health measurement and research (Dahinten, 2017, personal communication). With the increasing number of studies focused on transition readiness in the five years since Schwartz et al.'s (2014) review was published and considering the impact of construct conceptualization on the validation process and validity of inferences in research and practice (MacKenzie, 2003; Polit & Yang, 2015), it seems timely to revisit this often taken-for-granted issue of construct conceptualization in and the implications for transition readiness measurement. The purpose of this paper is therefore to review and critically analyze the issue of construct conceptualization and operationalization in transition readiness measurement. Drawing on contemporary validity theory and theoretical discussions of construct conceptualization from management studies, this paper will explore how transition readiness has been conceptualized and operationalized in HCT research. Problems and challenges in development, validation and use in relation to these conceptualizations and operationalizations will be explored and gaps requiring additional attention will be articulated.

Construct conceptualization and validity

In this paper, validity is viewed as “an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions based on test scores or other modes of assessment” (Messick, 1990, p. 1). In this sense, validity is not a property of the measure; instead, the focus shifts to the meaning of the interpretations one makes and actions one takes based on a particular score (Hubley & Zumbo, 1996, 2011). Validation, therefore, aims to build evidence to support a judgment that interpretations of the scores obtained through a transition readiness measure *with particular populations in particular contexts* are appropriate, meaningful and as proposed by the measure developer. In contemporary validity theory, there are five sources of validity evidence: content evidence, response processes, internal structure evidence, relationships with other variables, and consequences of testing (American Educational Research Association [AERA], American Psychological Association, and National Council on Measurement in Education, 2014). Each of these types of evidence, in some way, relies on a clear understanding of how the construct is conceptualized. In other words, making a judgment about the degree to which evidence supports interpretations of scores that align with the proposed uses of measures requires clarity about the intended conceptualization of the construct of interest. In this way, many challenges in measurement and validation can be fundamentally linked to construct conceptualization (MacKenzie, 2003). Yet, most psychometrics and research methods texts (e.g. Furr, 2018; Polit & Beck, 2017; Polit & Yang, 2015) generally do not spend more than a couple paragraphs discussing construct conceptualization. Conceptualizing and operationalizing transition readiness presents a number of challenges, but without clear conceptualizations, developing clinically-relevant measures and building evidence for validity become challenging. Furthermore, if a conceptualization of transition readiness does not align with the views and goals of some groups of youth or its validity with these groups is limited, errors

in inferences may arise and lead to implementation of interventions that could have negative consequences for those youth with whom the measure is used.

In developing a conceptual definition, the intent is to identify what the measure is intended to capture and how this is distinct from other constructs. Developing a strong conceptual definition should first involve an examination of previous conceptualizations of the construct through literature reviews and consultation with subject matter experts and those who experience the construct of interest (MacKenzie, Podsakoff, & Podsakoff, 2011). Second, the phenomenon of interest, the property of interest and the referent of the construct should be articulated (MacKenzie et al., 2011). By property of interest, MacKenzie et al. (2011) were referring to whether the construct represents a feeling, thought, perception, or action, for example, whereas referent refers to the entity to which the construct applies, such as a person or an organization. The third element involves articulating the set of attributes and characteristics of the construct, the dimensionality of the construct and the expected stability of the construct across time, situations or cases (MacKenzie et al., 2011).

A lack of explicit attention to construct conceptualization can have significant consequences for validity judgments and inferences made from a measure (MacKenzie et al., 2011). In developing a measure, researchers aim to minimize construct underrepresentation and construct-irrelevant variance. Construct underrepresentation refers to the situation in which key domains of the construct are, perhaps inadvertently, excluded from the measure (Hubley & Zumbo, 2011). Construct-irrelevant variance refers to variance due to extraneous variables or methods of measurement that are not directly relevant to the construct (Hubley & Zumbo, 2011). The challenge for researchers developing transition readiness measures is to articulate a conceptual definition that encompasses what it means to be ready without excluding relevant domains or including irrelevant domains for the intended population. In situations of unclear construct conceptualization, a vicious cycle can arise in which a lack of conceptual clarity can lead to challenges in building coherent theory about how the construct relates to other similar constructs and how this, in turn, can lead to poorly developed measures or practices (Hubley & Zumbo, 1996, 2011; MacKenzie, 2003). This lack of clarity can undermine the credibility of inferences about how transition readiness, for example, relates to other constructs or how transition readiness changes as the result of an intervention.

Measuring transition readiness

The analysis of transition readiness conceptualizations and operationalizations in this paper is informed by theoretical discussions from prominent HCT scholars (Betz & Nehring, 2007; Schwartz, Tuchman, Hobbie, & Ginsberg, 2011) and conceptualizations and operationalizations of transition readiness in commonly used transition readiness measures in North America. Some studies of transition readiness clearly articulate explicit conceptual definitions; however, for most studies and measures, conceptualizations of transition readiness and the inherent measurement challenges can be inferred through careful examination of the measures in these studies. Commonly used measures in HCT research and practice are briefly introduced below, with additional details provided in Table 1, to provide some context for the subsequent discussions.

Transition Readiness Assessment Questionnaire (TRAQ)

The Transition Readiness Assessment Questionnaire (TRAQ) was developed in the late 2000s and early 2010s in the United States (Sawicki et al., 2011). In this measure, transition readiness is viewed as the level of preparation to enact behaviors for self-care, decision-making and self-advocacy (Sawicki et al., 2011). The likert-type response scale was informed by the Stages of Change Model, which focuses on the individual's level of readiness to adopt a particular behavior (Linke, Robinson, &

Table 1
Summary of common transition readiness tools.

	TRAQ-29 (Sawicki et al., 2011)	TRAQ (revised) (Wood et al., 2014)	STAR _x (Ferris et al., 2015)	UNC TR _x ANSITION (Ferris et al., 2012)
Conceptualization of transition readiness	Level of readiness to behaviors for self-care, decision-making and self-advocacy; medical self-management skills as well as employment and independent living skills	Level of readiness to behaviors for self-care, decision-making and self-advocacy; medical self-management skills as well as employment and independent living skills	Self-management of health in terms of knowing, doing and difficulty Topics include: knowledge of condition, engagement, independence, self-efficacy to transition, self-management, medication-related issues, concerns and expectations	Knowledge and mastery of skills for successful healthcare transition A broad collection of ten conceptual domains
Conceptual domain	Perception of level of engagement in behaviors (self-report)	Perception of level of engagement in behaviors (self-report)	Perception (self-report)	Provider perception of youths' knowledge/skills through semi-structured interview
Purpose	To identify gaps in transition-relevant skills for the purposes of goal-setting and intervention	To identify gaps in transition-relevant skills for the purposes of goal-setting and intervention; designed to be used regularly with hope of eventual use to develop evidence for interventions and monitor progress	To assess readiness, guide interventions tailored to needs and gaps in knowledge and skills, and measure improvements in readiness	To identify gaps in key areas of healthcare transition, facilitate the process of transition; monitor change
Theoretical underpinnings	Stages of Change model informed responses Developmental theories	Stages of Change Model informed responses Developmental theories	Got Transition model Developmental theories	Learning with understanding framework Self-determination theory Developmental theories
Structure	29 items with 2 factors; organized by factor • Self-management (16 items) • Self-advocacy (13 items)	20 items with 5 factors; organized by factor • Managing Medications (4 items) • Appointment Keeping (7 items) • Tracking Health Issues (4 items) • Talking with Providers (2 items) • Managing Daily Activities (3 items)	18 items in 3 sections • Section 1- "How often have you done the following things?" in the past 3 months (9 items) • Section 2- "How much do you know?" today (3 items) • Section 3- "How easy or hard is it for you to do the following things?" today (6 items) 6 factors; measure is not organized by factor • Medication Management (4 items) • Provider Communication (3 items) • Engagement During Appointments (3 items) • Disease Knowledge (3 items) • Adult Health Responsibilities (2 items) • Resource Utilization (3 items)	32 items on 10 conceptual domains; semi-structured interview tool • Type of chronic condition [knowledge] (3 items) • Medications [knowledge] (4 items) • Adherence [behavior] (3 items) • Nutrition [knowledge and behavior] (3 items) • Self-management skills [behavior] (7 items) • Issues of reproduction [knowledge] (4 items) • Trade/school [knowledge and future plans] (1 item) • Insurance [knowledge] (4 items) • Ongoing support [knowledge] (1 item) • New healthcare providers [knowledge] (2 items)
Item examples	"Do you take medications correctly and on your own?" "Do you tell the doctor or nurse what you are feeling?" "Do you order medical equipment before they run-out?" "Do you call the suppliers when there is a problem with the equipment?"	"Do you take medications correctly and on your own?" "Do you tell the doctor or nurse what you are feeling?" "Do you plan or prepare meals/food?"	Section 1- "How often did you take your medications?" Section 2- "How much do you know about taking care or your illness?" Section 3- "How easy or hard is it to talk to your doctor?"	"What are the names of the medicines, vitamins, and/or supplements your doctor has asked you to take for your health condition?" "Are you supposed to follow ant special diet because you have [name of health condition]?" "What are your future plans in regards to school and/or a job?"
Likert-type response format	1 = No, I do not know how 2 = No, but I want to learn 3 = No, but I am learning to do this 4 = Yes, I have started doing this 5 = Yes, I always do this when I need to (after initial validation, added an additional item: "Not needed for my care")	1 = No, I do not know how 2 = No, but I want to learn 3 = No, but I am learning to do this 4 = Yes, I have started doing this 5 = Yes, I always do this when I need to	Varies by section: 0 = Never/Nothing/Very hard 1 = Almost never/Not much/Somewhat hard 2 = Sometimes/A little/Neither hard nor easy 3 = Almost always/Some/Somewhat easy 4 = Always/A lot/Very easy 5 = I do not take medications right now	Varies based on conceptual domain: 1.0 = Correct/can name all/yes/knows definitely 0.5 = Non-specific/can name some/sometimes/has an idea 0.0 = does not know/cannot name any/no/does not know
Scoring	Mean score for each subscale and overall scale [range = 1–5]	Mean score for each subscale and overall scale [range = 1–5]	Summation of item scores; 2 items in Section 1 reverse coded [range = 0–78]	Mean score for each conceptual domain [range = 0–1]

(continued on next page)

	TRANSITION Q (Klassen et al., 2015)	Am I on TRAC for adult care? Questionnaire (Moynihan et al., 2015)	Readiness to transition questionnaire (Gilleland et al., 2012)
Conceptualization of transition readiness	“Transition readiness” not explicitly the construct of interest. Measures self-management skills as an element of transition preparation: “skills required to manage one’s health and healthcare” (p. 548)	Knowledge, skills and behaviors	Readiness to assume complete responsibility for health care and transfer to adult care; overall readiness, adolescent responsibility and parental involvement (treatment, appointments, insurance)
Conceptual domain	Perceptions of engagement in behaviors (self-report)	Perceptions of their knowledge and ability; perception of the frequency of engagement in behaviors (self-report)	Perception of level of involvement (self-report)
Purpose	To measure and track the development of skills in managing health and healthcare	To evaluate youths’ level of preparedness for transition, measure change over time and identify areas for targeted intervention	To identify potential deficits in responsibility and self-management prior to transfer for adult care and test interventions that aim to improve transition readiness
Theoretical underpinnings	Developmental theories	ON TRAC Framework (Paone et al., 2006)	Developmental transitional model
Structure	14-item unidimensional scale focusing on skills related to areas such as: communication with providers, medication management, managing appointments and knowledge of condition(s)	Two independent measures: (1) knowledge scale and (2) behavior index Knowledge scale (unidimensional): • Level of knowledge and ability to perform tasks related to youths’ condition and general medical self-care (17 items) Behavior index: • Frequency of engagement in behaviors (9 items)	Two sub-scales, the same 10 items make up each: Responsibilities of adolescent and parent related to: • Labs • Daily medications • Scheduling specialty appointments • Scheduling primary care appointments • Ordering refills • Explaining condition Overall readiness to: • Assume complete responsibility • Transfer to adult care Rate responsibility for: • Getting monthly labs • Taking medications daily as prescribed • Attending medical appointments 1 = Not responsible at all 2 = Sometimes responsible 3 = Often responsible 4 = Almost always responsible
Item examples	“I am in charge of taking any medication that I need.” “I ask the doctor of nurse questions.” “I summarize my medical history when I am asked to.”	Knowledge scale: “I can describe my health condition to others.”; “I can get to clinic appointments on my own.” Behavior index: “I meet with healthcare providers on my own.”; “I participate in activities/exercise to stay healthy.”	
Likert-type response format	4-point likert-type scale: 0 = Never 1 = Sometimes or often 2 = Always	Knowledge scale: 1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree Behavior index: 1 = Never 2 = Rarely 3 = Sometimes 4 = Often 5 = Always	
Scoring	Overall score summing the scores on the items	Knowledge scale: 14 of 16 items are included in total score [range = 11–44] Behavior index: • Raw score: Sum of item scores [range = 9–45] • Cutoff score: Each item is assigned a threshold score out of 5. Item recoded as 0 if threshold not met and 1 if threshold met. A score of 7–9 interpreted as being “ready”.	Overall score summing the scores on two overall readiness items [range = 2–8]

Pekmezi, 2014; Sawicki et al., 2011). Each option in the response scale aligns with the stages of the model: precontemplation, contemplation, preparation, action, and maintenance (Sawicki et al., 2011). The original TRAQ contained 29 items in two sub-scales. In 2014, a revised TRAQ was published with 20 items organized in 5 sub-scales (Wood et al., 2014).

UNC TR_xANSITION Index

The UNC TR_xANSITION Index was developed in the early 2010s in response to an identified need for a clinical measure of the components of healthcare transition that extended beyond and addressed some of the limitations of self-report measures of transition readiness (Ferris et al., 2012). This index purports to measure “knowledge and skill mastery and key areas critical for healthcare transition readiness” (Ferris et al., 2012, p. 745). The index consists of ten conceptual domains: type of illness, medications, allergies, nutrition, self-management, informed-reproduction, trade/school, insurance, ongoing support, and new healthcare provider (Ferris et al., 2012). This tool is designed to be administered in a semi-structured interview format by a health care provider and enables verification of the youth’s answers with the medical record (Cantú-Quintanilla et al., 2015; Ferris et al., 2012).

STAR_x questionnaire

While the UNC TR_xANSITION Index provides a provider-administered tool to assess transition readiness, Ferris et al. (2015) recognized that a self-report tool was needed to complement this index in their transition program. Thus, the STAR_x Questionnaire was focused on self-reports of self-management and transitioning to adulthood for those with treatments (Ferris et al., 2015). In this measure, transition readiness was defined in terms of self-management, self-efficacy, independence, and expectations of adulthood (Ferris et al., 2015). The tool consists of three sections focusing on frequency in engagement in particular self-management behaviors, the youth’s perception of level of knowledge about their care, and how easy or hard it is to do certain things in their daily care (Cohen et al., 2015; Ferris et al., 2015).

Am I ON TRAC for adult care? Questionnaire

The ‘Am I ON TRAC for Adult Care?’ Questionnaire, hereafter referred to as the ON TRAC tool, was developed in British Columbia, Canada as part of a program developed to improve the transition to adult care in the province and has been used for over a decade in outpatient pediatric clinics (Moynihan, Saewyc, Whitehouse, Paone, & McPherson, 2015). Transition readiness was viewed as youths’ perceived knowledge and ability in terms of factors related to participation in and independent management of health (Moynihan et al., 2015). The ON TRAC tool consists of a 16-item knowledge scale and a 7-item behavior index and is informed by the ON TRAC framework, which consists of six content domains: (1) self-advocacy and self-esteem, (2) independent healthcare behaviors, (3) sexual health, (4) social supports, (5) education, vocation and financial planning, and (6) health and lifestyle (Moynihan et al., 2015; Paone, Wigle, & Saewyc, 2006). The knowledge scale and behavior index are independent and, therefore, not integrated into a composite score (Moynihan et al., 2015).

Transition Q questionnaire

The Transition Q questionnaire was originally developed for youth with childhood cancer and then expanded to apply to chronic conditions in general due to the absence of a generic measure with relevance to Canadian youth (Klassen et al., 2014). The Transition Q does not purport to measure transition readiness explicitly; however, it is included here due to its uptake in research aiming to measure transition readiness (e.g. Ekim, Kolay, & Ocakci, 2018). This questionnaire was designed to measure youth’s abilities in managing their health and healthcare

(Klassen et al., 2014). This 14-item unidimensional scale includes items focused on general health management behaviors such as appointment keeping, communicating with providers, and managing medications (Klassen et al., 2014).

Readiness for Transition Questionnaire

While the previously discussed measures are classified as generic measures, in which the aim is to capture elements common across disease groups, many researchers and clinicians have also identified the need for measures that focus on elements relevant to particular disease groups. For example, the Readiness for Transition Questionnaire (RTQ) for youth who have undergone kidney transplants was developed with the acknowledgement that medication and treatment adherence are essential factors for success in adult care for this population (Gilleland, Amaral, Mee, & Blount, 2012; Zhang et al., 2014). In this measure, transition readiness was defined as “the adolescent’s readiness to assume complete responsibility for their healthcare (e.g., process) and their readiness to transfer to adult medical care (e.g. event)” (Gilleland et al., 2012, p. 87). The focus of the measure is frequency of the youth’s involvement in their care alongside the family’s involvement in the youth’s care.

Defining and operationalizing transition readiness

Given that many challenges in measurement and validation can be linked back to construct conceptualization (Hubley & Zumbo, 2011; MacKenzie, 2003), MacKenzie et al.’s (2011) elements of a strong conceptual definition and concepts from contemporary validity theory can aid in exploring conceptualizations of transition readiness and associated measurement challenges.

Overarching definitions and guiding theories

Considering the conceptualizations explicitly or implicitly articulated in theoretical discussions and the measures in Table 1, there appears to be agreement that transition readiness refers to youths’ level of preparation for the adult world or adult-oriented care; however, beyond this, there is little consensus as to what that actually means, especially in relation to domains of transition readiness. Several theories have informed conceptualizations and operationalizations of transition readiness. Developmental theories are prominently featured in all transition readiness measures given the focus on preparedness for adult life. In addition, some researchers have employed self-determination theory, the stages of change model, learning with understanding theory and/or social ecological theories to understand, conceptualize and measure transition readiness (Ferris et al., 2012; Ferris et al., 2015; Moynihan et al., 2015; Sawicki et al., 2011; Schwartz et al., 2011). In the subsequent sections, the specific areas of consensus or lack thereof in elements of conceptualizations of transition readiness will be explored further alongside the measurement issues related to these elements.

Property of interest, dimensionality and conceptual domains

In most transition readiness measures, items sample knowledge, behaviors or both. For example, the TRAQ focuses entirely on behaviors whereas the STAR_x Questionnaire and UNC TR_xANSITION Index incorporate a combination of items addressing knowledge and behaviors (Ferris et al., 2012; Ferris et al., 2015; Sawicki et al., 2011). In addition, most transition readiness measures are subjective; that is, the scores on the measure should be interpreted as youth’s perceptions of, for example, their readiness of transition, their knowledge of their condition, or their level of mastery of self-management-related behaviors. Some of these measures, such as the RTQ and revised TRAQ, also have parent-report versions (Gilleland et al., 2012; Lapp & Chase, 2018). The UNC

TR_xANSITION Index, as a provider-administered tool, is an exception. This index can be interpreted as the clinician's interpretation of the youth's level of readiness. It is essential that the distinction between self-report, parent-report and provider-interpreted measures are considered as several studies have established a difference between scores on self-reports compared to parent-reports of readiness or perceptions of transitional care for youth with chronic conditions (e.g. Lapp & Chase, 2018; Sonneveld, Strating, van Staa, & Nieboer, 2013).

HCT researchers almost universally agree that transition readiness should be conceptualized as a multidimensional construct (Ferris et al., 2012; Wood et al., 2014). Yet, comparing the key domains in the measures summarized in Table 1 reveals significant heterogeneity—some focus primarily on domains related to medical self-management (e.g. Gilleland et al., 2012; Sawicki et al., 2011); others take a more holistic approach to also include domains such as beliefs, social relationships, psychosocial conditions, reproductive knowledge, future plans, daily living skills, and level of family support (e.g. Ferris et al., 2012; Moynihan et al., 2015; Schwartz et al., 2011). A significant challenge with this heterogeneity arises in instances in which composite scores are computed and guide inferences in HCT research. Specifically, it is often unclear if two measures used in different studies, both of which purport to be measuring *transition readiness*, are actually measuring the same thing and can be interpreted in a similar manner. To make higher-level theoretical assertions about transition readiness based on composite scores based on findings from measures that include significantly different domains can feed into challenges with theory development as discussed earlier.

Subscales

Another layer of complexity is uncovered in considering the elements of a conceptual definition with subscales, whether conceptualized a priori or resulting from exploratory factor analysis (EFA). Applying a label to a subscale shapes how we think about the subscale and the overall construct (Hubley & Zumbo, 2011); thus, great care must be taken in labelling subscales. For example, one of the subscales of the TRAQ-29 was identified through EFA and labeled *self-advocacy* (Sawicki et al., 2011), but with no clear conceptual definition. While it is acknowledged that the TRAQ-29 had some challenges with interpretability (Wood et al., 2014), the volume of HCT research that has used the TRAQ-29 (e.g. Hart, Pollock, Hill, & Maslow, 2017; Mackie et al., 2016; Stewart et al., 2017) suggests this example is important to consider. A closer examination of this subscale reveals significant heterogeneity in the content of its items, including communicating with providers, tracking appointments, using community and financial supports, and daily living skills such as meal preparation (Sawicki et al., 2011). While these items represent important skills for becoming an adult, it is unclear how or if youths' perceptions of their level of readiness to complete these tasks reflect more conventional definitions of self-advocacy. Thus, conflating this self-advocacy subscale with more conventional definitions of self-advocacy may risk weaker theoretical rationale for hypotheses as well as errors in inferences about the impact of self-advocacy skills in the transition process, which can have significant implications for how clinicians construct their interventions and the resulting outcomes.

The above example further reflects the important, but rarely investigated, issue of subscale specificity. Questions of subscale specificity address the relationship between the subscale and the occurrence of the construct implied by the label (e.g. self-advocacy) (Lehmann et al., 2013). For example, one could examine whether the subscale "self-advocacy" in the TRAQ-29 uniquely predicts one's ability to self-advocate in everyday life. If subscales have unique variance that can predict outcomes in practice, their scores can be more meaningfully used in research and practice. In contrast, a lack of subscale specificity could limit the utility of subscales on their own, particularly in research or prediction of outcomes.

Another often overlooked aspect of measuring with constructs conceptualized as multidimensional concerns measurement invariance (MI). MI is an assumption of classical test theory and concerns "(psychometric) equivalence of a construct across groups or measurement occasions and demonstrates that a construct has the same meaning to those groups or across repeated measurements" (Putnick & Bornstein, 2016, p. 71). In investigating MI between groups, researchers may consider if people interpret a measure in a way that is conceptually similar or if there are any differences (e.g. gender, ethnic, geographic, disease-specific, etc.) that lead individuals to respond in particular ways (Vandenberg & Lance, 2000). For example, studies of other health-related measures have demonstrated varying degrees of non-invariance between different chronic condition groups (Schuler et al., 2014). If a degree of non-invariance is present, challenges may arise in meaningfully comparing scores between groups. In other words, if a study demonstrated a degree of non-invariance between groups on a transition readiness measure, one could not be sure that the between-group differences in scores on the measure are attributable to actual differences in transition readiness between groups. MI should, therefore, be an important area of investigation in transition readiness measurement.

Relationships between domains and "Transition Readiness"

An important but often overlooked aspect of developing a measure that is conceptually defined as multidimensional is specifying the relationship between indicators (items) or sub-dimensions and higher-order constructs or sub-dimensions (MacKenzie et al., 2011; Polit & Beck, 2017). These relationships can be specified as reflective or formative. A reflective conceptualization reflects a realist ontology in which the construct is assumed to exist external to the individual and at a deeper level than its sub-dimensions or indicators (MacKenzie et al., 2011). A reflective relationship implies that the sub-dimensions or indicators are manifestations of the construct (Polit & Beck, 2017). For example, the relationship between the items on the Transition Q questionnaire and the construct of health management abilities is conceptualized as reflective. Specifically, the items in this scale are viewed as manifestations of the latent construct of youths' abilities to manage their health.

A formative conceptualization of these relationships reflects a constructivist or instrumentalist ontology in which sub-dimensions or indicators are viewed as defining characteristics of the higher-order construct (MacKenzie et al., 2011). For example, a formative conceptualization of the relationship between sub-dimensions of a measure and the construct of transition readiness implies that the sub-dimensions taken together would define what it means to be ready to transition. In such formative relationships, a change in the overall construct may be associated with a change in only one of the sub-dimensions or indicators (Bagozzi, 2007; MacKenzie et al., 2011). For example, the relationship between the construct of transition readiness and the sub-dimensions of the UNC TR_xANSITION tool (Ferris et al., 2015) is formative as the sub-dimensions represent components of transition readiness. The behavior index of the ON TRAC tool is also conceptualized as formative (Moynihan et al., 2015); that is, the items are independent abilities required for adult care. In fact, when conceptualizations of transition readiness are considered in a more broad and holistic sense beyond self-management in which domains are articulated as quite different yet important parts of a larger whole, it appears that a formative conceptualization of the relationships between these domains and transition readiness would be more natural.

While transition readiness measures have incorporated both reflective and formative conceptualizations of the relationship between transition readiness as its domains, challenges arise when this distinction is not clear. Specifically, incorrectly distinguishing between formative and reflective relationships can lead to construct underrepresentation as a result of measure refinement techniques. An important difference

between formative and reflective conceptualizations is that formative relationships do not necessarily require that items or sub-dimensions are intercorrelated (MacKenzie et al., 2011). Yet, most commonly used psychometric methods for the development and refinement of measures in nursing and health care are based on classical test theory and assume reflective relationships (MacKenzie et al., 2011; Polit & Yang, 2015). If relationships are incorrectly assumed to be reflective, the application of methods used to explore internal consistency or internal structure may result in the removal of items that are in fact essential to the conceptual domain of the construct. For example, while some authors suggest that subscales with less than three items should not be retained in a measure (Polit & Beck, 2017), when Wood et al.'s (2014) exploratory and confirmatory factor analyses yielded a two-item factor on the revised TRAQ that they labeled "Talking with Providers", they chose to retain this subscale, citing the two items as representing necessary skills for successful transition. If Wood et al. had instead chosen to exclude these items, an element that has been well-acknowledged as necessary for transition readiness would have been excluded from the measure, thereby impacting the validity of inferences based on the measure.

Expected stability over time

Given the developmental nature of HCT, levels of transition readiness are, of course, expected to change over time as a result of developmental changes or intervention. Therefore, most, if not all, conceptualizations implicitly conceptualize transition readiness as a construct that should increase across time. Yet, when and in what domains this increase should occur is rarely specified. While conceptualizing transition readiness in this way is arguably essential, transition readiness measures may be vulnerable to response shift, which could complicate the validation process in pursuit of evidence of responsiveness as recommended by Schwartz et al. (2014).

Response shift has been defined as a shift in understanding of a construct over time even when the construct has not changed (Polit & Yang, 2015). Response shift may occur due to recalibration, in which a person's use of the scale changes, or reconceptualization, in which the person's definition of a construct or interpretation of an item changes (Polit & Yang, 2015). For example, youths' use of the STAR_x Questionnaire may change as a result of a change in perception of what it means for something to be easy or hard. In addition, self-report measures rely, to an extent, on the respondent's insight into the construct or item of interest. For example, youths' insights into their level of knowledge or abilities or interpretations of items may change as a result of an education intervention—perhaps they realize they knew less than they thought they did—or as a result of developmental progression.

Response shift can have important implications for scores and measure structure. First, these changes in perceptions may impact reliability of scores on the measure. Second, MI across time may be more challenging to maintain (Putnick & Bornstein, 2016; Vandenberg & Lance, 2000). In fact, in some cases, a degree of non-invariance across time may be expected; for example, as young people grow and develop, they acquire new knowledge and skills that may reorganize how they think, process information and make judgments (Putnick & Bornstein, 2016). While items should be able to withstand such changes to an extent, non-invariance over time is still a possibility in measures in which the aim is often to use the measure with the same individual starting as young as age 12 or 13 through into their twenties. Thus, MI is also essential to consider in pursuit of evidence of responsiveness in transition readiness measures.

Values, consequences and conceptualizations

While the content of conceptualizations is essential in measurement, it is important to acknowledge that measurement is also shaped by personal and societal values and assumptions and by those engaged in

conceptualization of and research with the construct (Hubley & Zumbo, 2013). As Hubley and Zumbo (2011) astutely observe, even in the mere act of assigning a particular label to a measure or conceptualization, researchers and clinicians actually, themselves, shape the construct and its conceptualization. Furthermore, when the content of and values and assumptions embedded in conceptualizations and measures do not align with the perceptions and lived experiences of particular individuals or groups, inferences based on scores may have limited validity and the use of these measures may have negative impacts on youth and their families (Hubley & Zumbo, 2011).

The challenge in developing transition readiness measures is to capture commonalities in the context of heterogeneity of needs, characteristics and chronic conditions. Inevitably, some particularities of specific chronic conditions may be lost. There are also significant risks in terms of clinical decisions made based on generic measures when there is a mismatch between youths' needs and goals and the content of and the assumptions that underlie the measure. Uncritical uptake of conceptualizations and operationalizations of transition readiness that, for example, emphasize independent self-management skills even has the potential to contribute to conditions of marginalization for youth with complex chronic conditions or severe disabilities by accentuating what may not be possible or achievable (Hamdani, Mistry, & Gibson, 2015). It is, therefore, essential that researchers and clinicians consider the implications of their choices in conceptualizing and measuring transition readiness with different populations.

Taking stock and looking forward

A key to developing measures, building evidence for validity of interpretations of scores on these measures, and generating knowledge to support youth in the HCT process is conceptual clarity to support the credibility of hypotheses and inferences made as a result of hypothesis testing (MacKenzie, 2003; Polit & Yang, 2015). It is clear from this analysis of transition readiness measurement that there is a significant lack of consensus and clarity as to what transition readiness actually is. It should be noted, however, that this discussion is in no way a suggestion that there should be one way of conceptualizing what it means to be ready for the adult world or adult-oriented care or that any one existing conceptualization is inherently better than another. Indeed, disciplinary epistemologies, the nature of the population of youth for whom the measure is intended, and the intended use of the measure can influence how transition readiness is conceptualized and operationalized. Thus, the intention is not to advance a particular perspective over another. Instead, the aim is to heighten awareness of challenges inherent in defining transition readiness and the resulting measurement implications, and to encourage researchers and clinicians to consider the implications of their choices for interpretability, utility, and the associated consequences.

A particular concern identified is the variations in operationalizations of the label *transition readiness* in relation to theory development. It is not that the construct of transition readiness itself is inherently problematic; however, by labeling very different operationalizations of transition readiness (e.g. medical self-management vs. holistic array of domains) in the same way, challenges in interpreting and comparing study results may arise. While abandoning the label of *transition readiness* would not be feasible or appropriate, an uncritical reliance on assumptions that this label denotes the same thing in every measure may limit higher-level theoretical development in the field. Composite scores on transition readiness measures may still be useful in clinical practice; however, in pursuit of theory construction, it may be a more fruitful endeavor to pay closer attention to individual domains. Such a shift has the potential to promote a clearer and more nuanced understanding of what it is that is actually being measured in transition readiness research and practice. In the meantime, clear definitions of transition readiness and any domains or subscales are essential to articulate in academic publications as well as

instructions for use of transition readiness measures. In doing so, researchers and clinicians can critically interrogate the conceptual focus, content of the measure, and to what extent items reflect the label of subdomains prior to incorporating into their own research and practice.

To date, transition readiness measurement studies have paid limited attention to important issues in measuring multidimensional constructs; more explicit attention to these issues could greatly benefit transition readiness measurement. If researchers use EFA to explore internal structure of the measure, close attention should be paid to labeling the resulting subscales. If the items in a subscale resulting from EFA are heterogeneous to the point challenges arise in naming the subscale, further item content review and revision or evaluation of internal structure using confirmatory factor analysis (CFA) may aid researchers in naming subscales. In addition, researchers using measures with distinct subscales should endeavor to explore subscale specificity if their aims are to make inferences based on subscale scores. For example, researchers could examine how much variance in scores for each subscale is attributable to the overall transition readiness score and how much variance is unique to determine whether the subscale can be viewed as a separate measure. Explicit attention to the type of measurement model implied in a conceptualization of transition readiness will also be essential for future validation work using methods based in classical test theory. Given that more holistic conceptualizations of transition readiness are more naturally aligned with formative relationships, more explicit attention to how factor analysis and hypothesis-testing methods are used with each sub-domain will be essential in future research.

Transition readiness measurement would also greatly benefit from research focused on exploring measurement invariance (MI) across time or between groups, such as ethnic, age, disease-related or geographic groups. Interested readers can refer to Schmitt and Kuljanin (2008) or Vandenberg and Lance (2000) for more detailed summaries of methods that have been used to explore MI. If a high degree of non-invariance is detected, several methods exist that could aid in addressing non-invariance or approximating invariance (Van De Schoot, Schmidt, De Beuckelaer, & Lek, 2015). Similarly, future research would benefit from explorations of change scores and responsiveness through mixed methods longitudinal studies with youth throughout the transition preparation process that address the structure of the measure and how youth process and respond to items over time. Such studies can enable analysis of responsiveness over time, MI over time, and any potential response shift.

Finally, a critical lens that draws attention to the values and assumptions embedded in conceptualizations and operationalizations of transition readiness and consequences of measurement (AERA et al., 2014; Hubley & Zumbo, 2013; Messick, 1990) can also aid researchers and clinicians in making judgements about the validity of generic transition readiness measures. Exploring the values and assumptions in conceptualizations and measures could involve asking questions throughout development and use, including: (1) what are the implications of defining what is means for youth to be “ready” in this way? (2) What does it mean to label a measure as “generic”? (3) How have individualist, developmentalist, and ableist discourses shaped how we conceptualize readiness and theorize the transition process? (4) What groups does this conceptualization privilege and what groups could it marginalize? Furthermore, attention to consequences of the uptake of specific conceptualizations and measures of transition readiness should include reflection on the impact on how the transition process is theorized and how policy-makers prioritize programming for young people in pediatric and adult health and social services or ethnographic or critically-informed research into transition readiness-focused programming.

Conclusion

Transition readiness has become an important construct in HCT research over the last decade and continues to occupy an important

place in HCT research and practice. The purpose of this analysis was to surface the taken-for-granted in construct conceptualization for transition readiness measurement and the resulting challenges in developing and validating transition readiness measures. Through this analysis, it was clear that significant variation in conceptualizations of transition readiness remain in the field of HCT. Moving forward in this field will require careful attention to what it is that is really being measured at all stages of HCT research, measurement development and validation to support successful transition for youth with chronic conditions and disabilities. It will also be essential to increase attention to other often overlooked aspects of construct conceptualization, including the implications of multidimensionality, relationships between transition readiness and its domains, processes of change in transition readiness, however defined, over time, and how values and assumptions can impact measurement of transition readiness in research and practice. Pediatric nurses, regardless of role in the HCT process, are well-positioned to attend to these elements of conceptualizing and operationalizing transition readiness in future research and practice.

CRedit authorship contribution statement

Elizabeth J. Straus: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing, Visualization.

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