Peer i-Coaching for Activated Self-Management Optimization in
Adolescents and Young Adults With Chronic Conditions

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Peer i-Coaching for Activated Self-Management Optimization (PICASO) in Adolescents and Young Adults with Chronic Conditions

Project Summary

Increases in life expectancy in almost all childhood-onset chronic conditions (COCC) has brought unique challenges for adolescents and young adults (AYA) who struggle to deal with the associated disease burden, manage therapies, and thrive as they develop independent self-management skills, and become active and engaged patients. The challenges that influence the lives of AYAs are largely adaptive, such as making lifestyle modifications, adhering to complex medication regimens, and learning to navigate the adult health system. Adding to this complexity is the need for AYAs to progressively take over greater self-management responsibilities from parents. Promoting activated self-management is critically important given that this shift in health care management from parents and health care providers to the AYA is identified as key to successful adult outcomes. Peer support interventions are well-suited to address challenges theorized as critical to AYAs given the importance of peer relationships during this time. We propose a mixed-methods, five-year randomized controlled trial, that will include 225 AYAs (16-22 years) with COCCs, to test the Peer i-Coaching for Activated Self-Management Optimization (PICASO) versus an attention control group. This novel, mobile health intervention utilizes an established telephone/text based secure interface to allow AYAs access knowledge, experience, and instrumental/emotional support from a trained peer coach (18-26 years), who has already developed independence and is an active self-manager. We will determine the efficacy of PICASO on self-management, patient activation, transition readiness, health-related quality, and emotional health of life across 12 months. We will explore whether age, sex, race/ethnicity, chronic condition, and/or disease severity moderate the trajectory of PICASO effects on self-management, patient activation, coping, emotional health and health-related quality of life. Lastly, we will explore mechanisms of the PICASO impact by describing AYA experiences with the intervention.

Project Narrative

Promoting improved chronic condition self-management skills is critically important for adolescents and young adults with childhood onset chronic conditions transitioning to adult based care. Peer support interventions are well-suited to address challenges theorized as critical to adolescents and young adults given the importance of peer relationships during this time. We propose a mixed-methods, 5-year randomized controlled trial, that will include 225 AYAs (16-22 years) with childhood onset chronic conditions, to test the Peer i-Coaching for Activated Self-Management Optimization (PICASO) versus an attention control group.

2. Specific Aims

Statement of the problem: An increasing appreciation of the growing burden of chronic illness has led to calls for a shift in care models from curative, provider-centered care to adaptive, patient-centered self-management models.[1] These models develop an individual's capacity to **engage actively** in the work required to manage their condition. Applying this approach to the development of self-management skills for adolescents and young adults (AYAs) with chronic conditions is critical because of (a) growing numbers surviving into adulthood requiring transfer from pediatric to adult care services;[2,3] (b) high rates of unsuccessful transfer to adult care due to poor preparation and low AYA activation;[4,5] (c) knowledge that the transition to adulthood is a period of particular medical and psychosocial fragility in which their condition worsens and affective disorders increase;[6,7] (d) general agreement that adolescence is a critical period for the development and activation of life-long chronic condition self-management skills;[2,8-12] (e) knowledge that they have remained more dependent on their parents than their peers, and often lack independence in self-advocacy and self-care management.[13,14]

The challenges that influence AYAs across this transition are largely adaptive, or those only the AYA can address, but for which they might not currently possess the capability[15] (e.g., making lifestyle modifications, adhering to complex medication regimens,[16] learning to navigate the adult health system). Adding to this complexity is the need for AYAs to progressively take over greater self-management responsibilities from parents as they prepare to transition from pediatric- to adult-based care systems. AYAs must navigate normal developmental transitions, develop <u>independent self-management skills</u>, and become active and <u>engaged patients</u> (patient activation), so that they can manage their health effectively and avoid the significant negative health outcomes that occur for many during this period. Promoting <u>activated self-management</u>, intrinsic motivation to actively manage their condition and related self-care, is critically important given that this shift in health management from parents and health care providers to the AYA is identified as key to successful adult outcomes.[17-19] There is a lack of scalable, theoretically guided interventions that build the adaptive capacity of AYAs to develop and implement chronic condition activated self-management behaviors.[14,20]

Peer support interventions are well-suited to address challenges theorized as critical to AYAs given the importance of peer relationships during this time.[21] Qualitative studies have indicated that AYAs with a range of conditions are interested in peer support.[22-26] Our systematic review of programs for AYAs with a peer support component found that most are not evidence-based, have not been rigorously evaluated, and few focus on adaptive skills required for activated self-management such as medication management, health care navigation, and symptom surveillance, critical to transition to adulthood and few can easily be disseminated across settings that serve AYAs with chronic conditions such as schools or medical home-modeled clinics.[27]

Potential solution: To develop of chronic condition activated self-management skills, we designed and pilot tested a peer-based coaching intervention - ***Peer i-Coaching for Activated Self-Management Optimization (PICASO)*** - for AYAs with childhood onset chronic conditions.[28,29] This novel, mobile health intervention utilizes an established telephone/text based secure interface to allow AYAs access knowledge, experience, and instrumental/emotional support from a trained peer coach who has already developed independence an active self-manager. Peers with shared experiences provide instrumental (e.g., health maintenance skills) and emotional support that likely lead to improvements in quality of life.[30-33] Involving peers in supporting AYAs with chronic conditions to promote self-management and patient activation disrupts the typical over-reliance on the parent and health care provider that often impedes developing independence. Thus, we propose a five-year randomized controlled trial that will include 225 AYAs (16-22 years) with childhood onset chronic conditions to address these **specific aims**:

<u>Aim 1</u>: Determine the efficacy of PICASO on primary outcomes (self-management, patient activation) and secondary outcomes (transition readiness, health-related quality of life, emotional health) across 12 months. *Hypothesis:* Compared to an attention control group, the PICASO group will report greater improvement in primary and secondary outcomes.

<u>Aim 2</u>: Explore age, sex, race/ethnicity, chronic condition, and disease severity as moderators of trajectory of PICASO effects on self-management, patient activation, transition readiness, health-related quality of life and emotional health. *Approach:* Explore the moderating effects of patient characteristics on PICASO outcomes.

<u>Aim 3</u>: Explore mechanisms of PICASO impact by describing AYA experiences with the intervention to characterize how they may be related to intervention components and contexts, with the goal of understanding intervention mediators and barriers to future large-scale implementation. *Approach*: Using mixed methods, qualitative interview data will be integrated with quantitative coaching data (e.g., coach/participant alliance).

Long-term goals: Our next step is to take advantage of PICASO platform interoperability to conduct a pragmatic, multi-site, clinical trial. We aim to develop an efficient, generalizable, and scalable peer coach transition self-management product that will optimize AYA, parent, pediatric and adult chronic condition provider collaboration across care sites, venues, and transitions.

3. Research Strategy
3.A. Significance

Adolescent development, self-management, and patient activation. Adolescence and young adulthood, a phase in the life-course between 13 and 29 years[34], is associated with significant biopsychosocial change and brings negotiations of new statuses and abandonment of old ones. Family dependency decreases for adolescents and young adults (AYAs) as they gain new freedoms and are expected to accept greater responsibilities.[35,36] Managing increased independence and establishing self-determination, or control over their own lives, are critical developmental tasks of adolescence. For AYAs living with a childhood onset chronic condition (COCC) (e.g., sickle cell disease, lupus) the stakes are higher as they must navigate the normal developmental transitions and also develop independent self-management skills and become active and engaged patients (patient activation), so that they can manage their health effectively and avoid the significant negative outcomes that occur for many during this period.[7] To achieve this goal of developing more autonomous chronic condition self-management, the AYA must have both the opportunity to develop competency in the domains of self-management and be activated to take on these responsibilities. Growing evidence links patient activation levels to health outcomes. Self-management and patient activation are two concepts that together capture the set of critical skills and motivations needed for the AYA to become independent and effective managers of their chronic condition.

Figure 1. Development of activated self-management

Given that the American Academy of Pediatrics supports medical transfer from pediatric to adult care as taking place between 18- to 21-years of age[37], for the purposes of this study, **our population of focus is 16- to 22-years of age** to capture the developmental period most imminently involved in planning for transition to adult care.[20] While preparation should begin several years earlier, the cooperative program between the Maternal and Child Health Bureau and The National Alliance to Advance Adolescent Health, *'Got Transition'[38]* (www.gottransition.org), which aims to improve transition to adult health care, has also recommended 16-22 years as the critical window in which AYAs must move into active transition preparation and are likely to require the highest level of support.

Self-management[39] is the ability to manage the symptoms, treatments, lifestyle changes, and psychosocial, cultural and spiritual consequences of living with a chronic condition, and requires dynamic, daily engagement.[40,41] For AYAs with COCC, self-management entails the ability to monitor their condition and develop cognitive, behavioral and emotional strategies to maintain optimal growth and development and preventative strategies to promote or maintain health.[40] This daily work brings unremitting reminders of how AYAs are different from their peers. In a review of 81 self-management interventions for 7 to 25 year-olds with a chronic condition, most were aimed solely at medical management and lacked theoretical specification.[42] Only five studies examined interventions for AYAs over 18 years of age, consistent with the significant absence of interventions for this age group. The literature on the medical transition from pediatric to adult health care providers, a distal outcome of AYAs developing self-management skills, focuses mainly on systems to help AYAs navigate the health care system, with few focused on the acquisition of self-management skills.[20,27]

Approximately 750,000 AYAs with COCC turn 18 years old each year in the U.S., and multiple medical organizations and national programs have indicated that improving the transition to adulthood for this vulnerable population is a priority.[7,37,43-45] Yet, too often AYAs with chronic conditions are unprepared to take on components of self-management because the a) health care team has not provided them with adequate preparation[46]; b) parents are often afraid to allow the opportunity to practice self-management for fear of the AYA making a mistake[47]; and c) AYA is focused on other important developmental tasks and not motivated to become an activated, independent self-manager.[48] Failure to develop independent self-management during this vulnerable time has significant negative consequences. For example, AYAs with diabetes often have worse metabolic control, AYAs with kidney transplants are at greater risk of losing their transplanted kidney due to noncompliance, and youth with a wide range of chronic conditions are unable to navigate the healthcare system and drop out of care. [7-12,49-51] Interventions are needed that change the status quo and disrupt the dynamic between AYAs and parents/medical providers that result in AYAs being unprepared to become active partners in their own self-management. AYAs require guidance and ongoing support to promote motivation and engagement to become activated self-managers.

Self-management competencies have been divided into four core components: 1) Knowledge; 2) Healthcare navigation/partnership in treatment; 3) Recognition and management of symptoms; and 4) Coping.[52] In order to be a fully activated self-manager an AYA needs the requisite knowledge of their condition (1), and be able to activate the skills to manage their condition and maintain their health and well-being (2-4). Often, they may have strengths in one domain, and yet struggle in others.[53] For example, an AYA with diabetes might have knowledge about how to deliver insulin (1) and cope with the social stress of having a chronic condition (4) but may still have poor overall self-management because they are not able to navigate the health system (2) or recognize a specific scenario in which they need to apply their knowledge (3). These competencies are often disease-agnostic and AYAs across conditions struggle to fully implement all four domains. They also tend to be tied to developmental experiences as opposed to chronological age. For example, the 22-year-old who struggles with healthcare navigation has much in common with the 16-year-old who does not know how to make a doctor's appointment.

Patient activation is associated with positive outcomes among adults with chronic conditions including decreased ED visits, hospitalizations, and increased adherence.[18,54,55] In order to be an activated self-manager, AYAs must have self-management skills including those listed above (knowledge, healthcare navigation, recognition/management of symptoms, coping).[14] Patient activation is the ability to act on the knowledge and effectively communicate and advocate for themselves within the health system. The Patient Activation Measure (PAM) is the only validated tool for measuring this construct and has been used across a range of chronic conditions to assess patient activation.[56-58] Patient activation has been divided into four stages of activation based on level of confidence and ability to act to address health (Table 1). Higher scores on the PAM are tied to these higher stages of patient activation. For AYA with chronic conditions, moving from stage 1 to 4 is a goal for becoming an independent, effective self-manager. Patient activation has been measured in a few studies of adolescent and young adults with chronic conditions,[59,60] but in only one study was found to be significantly improved following participation in a text-messaging intervention with providers.[19] Patient activation is distinct from self-management as it focuses on the specific approach to communication with providers and being motivated to participate in self-management. For AYA with chronic conditions to become fully independent they must become activated to maintain their health as well as have the necessary self-management skills.

Table 1. Patient activation stages		
Stage	Summary	Description
1	Disengaged & overwhelmed	Does not feel able to take active role in health care
2	Becoming aware, but still struggling	Lacks knowledge & confidence to take action
3	Taking action	Beginning to take action but lacks confidence & support to change
4	Maintaining behavior & pushing further	Learned to adopt new behaviors but may not maintain under stress

Factors that influence development of activated self-management. The factors that shape the ability of an AYA to develop activated self-management include 1) individual characteristics, and 2) ecological features of their physical and social environment. Regardless of the etiology, symptoms, treatment regime or type of condition many AYAs with COCC face a common set of challenges and burdens.[61] While it is often easier to focus on activated self-management within a particular condition, there is power in focusing on the common challenges related to the development of self-management faced by all AYAs and approaching this problem as a developmental challenge that is similar across conditions. This approach to examining the common features across conditions is often described as a non-categorical approach[61,62] to the study of chronic condition self-management and has gained acceptance to address the common developmental challenges. This non-categorical approach to studying COCC has proved valuable as often the factors related to positive or negative outcomes are not directly related to the specific condition, but instead to other more general factors.

Individual characteristics found to be important to the development of activated self-management include neurocognitive status, condition features (symptom burden, treatment burden, degree of impairment), age, gender, and psychosocial functioning. Neurocognitive status is particularly salient as individuals with intellectual disabilities are likely unable to become full independent self-managers and so modifications to their goals would be needed. While the development of self-management broadly is similar across conditions, there relevant features of each condition that must be considered as an individual AYA works towards independent self-management. More complex medication regimens may require more time to master and conditions requiring more medical specialists may require more organizational work to be able to effectively navigate the health system and partner with providers. Another important individual characteristic to consider is psychosocial function, which would include factors such as psychiatric conditions like depression or anxiety, as well as coping style, and educational attainment.

From an ecological perspective the development of activated self-management skills is related to the environment in which an individual is situated. Relevant ecological factors include key features of the healthcare system in which an individual must seek care, as well as the relationship with parents and other

social relationships, and socioeconomic factors. Access to care, proximity to care, relationships with providers, frequency of appointments, and the cost of care are all aspects of the health system that are relevant. For example, if an AYA loses insurance they will struggle with self-management because of a lack of resources and health care partners, even if they have the knowledge and appropriate skills and are coping well. To become independent self-managers AYAs must navigate the relationship with their parents or other care-givers. Where AYA live and the degree of social support available are also relevant, as are financial factors such as insurance status, income, and financial stability.

3.B. Theoretical Framework

Self-Determination Theory and AYA self-management. While knowledge of the components of self-management and stages of activation informed our ability to design an intervention that targets key concepts, systematically across levels, self-determination theory[63] (SDT) assisted in framing the behavior change necessary for an AYA to become an activated self-manager. SDT specifies two types of motivation: extrinsic and intrinsic. Extrinsic, or controlled motivation, describes behavior that is a result of external sources or pressures. Intrinsic, or autonomous motivation, describes behavior chosen freely that aligns with self-identity and values. Autonomous motivation has been shown to result in health behaviors sustained over longer periods of time, when compared to that of controlled motivation.[64-66] Intrinsic motivation in SDT can be promoted by meeting three psychological needs: (a) autonomy (being in charge of one's own choices), (b) competence (believing in one's ability to attain goals and control outcomes), and (c) relatedness (feeling closely connected and supported by others). SDT-based health behavior models have been shown to be effective at promoting smoking cessation, weight loss, medication adherence, and other important health behavior outcomes.[65,67,68] Providing AYAs with a supportive peer aligns with the promotion of relatedness, and allows for development of intrinsic motivation. For example, motivational interviewing, when used by a trained peer-coach can foster intrinsic motivation to promote health.[64] SDT has particular salience to interventions with AYAs with chronic conditions who need to take on increasing responsibility for their condition and generally lack the motivation to do so. SDT provides an empirically supported health behavioral framework to promoting the intrinsic motivation necessary for AYAs to acquire the activated self-management skills needed.

Peer support is well suited to promote activated self-management in AYAs through the provision of social support that can

Table 2. Key functions of peer support align with activated self-management				
Components of Activated Self-Management	**Four Key Functions of Peer Support**			
	Assistance in Daily Management	**Social & Emotional Support**	**Linkage to Clinical & Comm Resources**	**Ongoing Availability of Support**
Knowledge	■			■
Navigate care system Partner with providers			■	■
Recognition of symptoms Respond to symptoms	■			■
Coping		■		■

promote intrinsic motivation, following the Self-Determination Theory. Peer support through peer coaching has been most extensively studied in adults with diabetes[33], and is now well-established as a tool to help adults develop self-management capacity.[69] Co-I Fisher has extensive experience studying the effectiveness of peer support in improving adult chronic illness self-management through his global program of research '*Peers for Progress*'. His work has extended the evidence base for peer support interventions, helped establish peer support as an accepted, core component of health care, and promoted peer support programs and networks on a global scale (peersforprogress.org).[33,70,71] Specifically, Fisher's peer coaching model focuses on promoting healthy self-management behavior through focusing on 1) assistance in daily management, 2) social and emotional issues,[72] 3) linkages to clinical care, and having the coach available to support 4) ongoing self-management.[33] There is scant research utilizing peer coaches to deliver these four key features of peer support to promote the acquisition of self-management skills by AYA with COCC. Thus we developed and pilot tested our "Peer i-Coaching for Activated Self-Management Optimization (PICASO) for AYAs with COCC (see Section 3.D.2 Preliminary Studies).

Reaching AYA through mobile devices is an established way to involve this often hard to engage population.[73] Cell phone ownership has proliferated in recent years with approximately 93% of 18-29-year-olds in the U.S. owning a smart phone. SMART phones are the main form of communication for AYAs[74], and for those who use a cell phone, 91% use text messaging to communicate.[75] Well-designed mobile-based, self-management and healthcare navigation interventions have been shown to be an effective method for engaging AYAs with COCC.[75,76] We employed an informatics-based platform, using a novel telephone/text-based interface to deliver the PICASO intervention. This platform has been used successfully in our randomized controlled pilot study with AYAs with COCC (see Section 3.D.2 Preliminary Studies),[28] and has been deployed for parent to parent coaching[77], and a range of commercial peer coaching programs developed by Co-I Patel,

including the National Kidney Foundation and health system based peer coaching programs. Through the web-based portal, the participant and peer coach can securely communicate via phone and text message. The software arranges a time for the two parties to speak, sends reminders for upcoming phone calls, and provides systematic tracking of phone- and text-based interactions.[75,76,78] In order for an intervention to be broadly disseminated to AYA with chronic condition, it must utilized mobile technology to engage them and provide a convenient mechanism by which they can receive support.

Summary of Significance

AYAs with chronic conditions remain more dependent on their parents and health care providers than their healthy peers, and lack independence in activated self-management. This over-reliance on parents and health care providers often impedes developing the independence necessary for successful transition to young adulthood and adult health care services. There is a lack of scalable, theoretically guided interventions that build the capacity of AYAs to develop and implement chronic condition activated self-management behaviors. Non-directive peer coaching, delivered using an informatics-based platform, can promote intrinsic motivation and is well suited to promote activated self-management in AYAs through the provision of social support in a format well-designed for engaging AYA.

3.C. Innovation

Our Peer i-Coaching for Activated Self-Management Optimization (PICASO) intervention is innovative in several important ways.

1. First, it conceptually and practically couples **self-management skill development with patient activation**. Together, these two concepts synthesize the set of critical skills and motivations needed for the AYA to become engaged and effective managers of their chronic condition.

2. Second the PICASO intervention is designed to promote the development of activated self-management by AYAs with COCC using nondirective peer coaching. This novel approach provides AYAs with the opportunity to develop intrinsic motivation and competence to take control of their healthcare within the **nonjudgmental, nondirective environment established by a peer with a shared experience of living with a COCC**.

3. Third, **PICASO uses a proven informatics technology interface** (InquisitHealth Mentor 1:1™ Web Based Portal[79]) that harnesses mobile technology to allow AYAs to be able to access their peer coach by phone or by text. Use of mobile technology to deploy the intervention decreases engagement barriers, allows AYAs from rural and urban areas and with varying schedules to participate, and employs a communication format that aligns with AYAs preferences for interpersonal interaction.

4. Fourth, **PICASO's technological innovation enhances scalability and allows for broad dissemination** across settings that serve AYAs such as schools, camps, or medical clinics. InquisitHealth Mentor 1:1™ Web Based Portal has been deployed commercially across multiple settings for peer support.

3.D. Approach

3.D.1 Overview. We propose a 5-year mixed-methods, randomized controlled trial that tests the Peer i-Coaching for Activated Self-Management Optimization (PICASO) versus an attention control group in an academic health center setting.

3.D.2. Preliminary Studies

3.D.2.a. The investigators and environment are ideal because of proven content expertise, collaboration on preliminary data, and strong institutional support. Co-PI Sharron Docherty is a nurse scientist, pediatric nurse practitioner, and has led inpatient, outpatient, and community-based studies of chronic condition self-management, intervention development, and interventions integrated with technology. She has expertise in mixed-methods, has led large multidisciplinary studies, and studies involving interviews with AYAs with chronic conditions, their parents and health care providers. Co-PI Gary Maslow is a child and adolescent psychiatrist and pediatrician with over 15 years of experience developing and implementing mentor-based peer support programs for AYAs with chronic conditions across academic medical centers. He has experience recruiting AYA for studies including recruiting 170 AYA with a range of chronic conditions from Duke pediatric clinics for a study examining positive youth development. Co-I, McLean Pollock is an epidemiologist and clinical social worker with over 10 years of experience as a children therapist working with at risk children and families. She has collaborated on several mixed-methods studies with her focus on the evaluation of the impact of interventions on child and family well-being. Co-I Edwin Fischer is a renowned public health researcher, clinical psychologist and the global director of Peers for Progress a program focused on accelerating the availability of best practices in peer support. He has led many large research studies focused on chronic disease prevention, management and quality of life in those with asthma, cancer, cardiovascular disease, smoking and weight management. Co-I Susan Silva is a cognitive neuropsychologist and biostatistician, with expertise in the analysis of longitudinal data and moderator/mediator effects in multi-

center clinical trials. She served as the Statistical PI for the NIMH-sponsored Treatment for Adolescent Depression Study. <u>Co-I Ashwin Patel</u> is the Chief Medical Officer of InquisitHealth and the developer of the web-based peer support interface currently being deployed for several chronic conditions and has worked extensively with the Co-PIs to adapt the platform as part of pilot work. He is the PI of active NIH grants using this portal for peer support for diabetes self-management and to reduce asthma hospitalizations in children. Drs. Maslow and Docherty have worked together for over 10 years in the Duke Children's Hospital and the Duke University School of Nursing's P30 Center of Excellence in Adaptive Leadership for Cognitive/Affective Symptom Science and have co-authored manuscripts. Drs. Maslow and Fisher have published a review together of peer support interventions and have collaborated on a study of social support of adolescents in a summer camp setting. Dr. Silva has worked with the Dr. Docherty on several of the P30 projects and the preliminary study for the proposed study.

3.D.2.b. The PICASO was found to be feasible and acceptable and showed preliminary efficacy trends suggesting improvements in transition readiness and internal self-regulation.[80] Using a randomized controlled trial with a 3-month waitlist control group, we piloted PICASO in four of the sub-specialty ambulatory care clinics at Duke Children's Hospital. We enrolled 25 AYAs, 16 to 22 years, over a 9-month period (Intervention N=13; Wait-list control N=12) from four diagnostic categories: cancer (N=6), inflammatory bowel disease (N=6), lupus (N=7), sickle cell disease (N=6). The attrition rate at month 3, 23% in the intervention group and 25% in the wait-list control group, was consistent with that reported in other adolescent clinical trials.[81-83] Reasons for withdrawal following randomization included: time constraints (n=3), medical crisis (n=1), unable to contact (n=1), and difficulty completing surveys due to low cognitive ability (n=1). Content analysis of post-intervention completion interviews supported high acceptability and satisfaction with PICASO. Themes with data samples included: Shared Experiences (e.g., *"He was just..I can't even explain it in words…but just he was also a fellow Hodgkin's survivor so just kind of having that connection and just having someone there. He was very encouraging and that was very meaningful to me."*); Motivation Sharing (e.g., *"I knew that I had this goal. She gave me motivation to get up and pursue it."*); Progress Towards Goals (e.g., *"I definitely feel like we accomplished a lot. A lot in a little bit of time."*); Usefulness of Coaching (e.g., *"I think that it's something that every cancer patient needs because you know you're just looking at having cancer and your like, okay I just got through this but life goes on after having cancer so this was really a big part of putting that into perspective."*). Clinically meaningful improvement for outcomes was defined as a median baseline to month 3 improvement per AYA of 5% or greater for the group. We found clinically meaningful improvement in transition readiness in the intervention group but not in the control group (median improvement 7.5% vs 3.9% respectively). Clinical improvement was also found in intentional self-regulation in both the intervention and waitlist control groups (median improvement 14.3% vs 12.5% respectively). A clinically meaningful improvement on the Patient Activation Measure (PAM) has been defined in previous studies as a 2-point or greater increase.[54,55] Among the 19 participants (10 intervention, 9 controls) who completed the 3-month assessment, a clinically significant improvement was observed in five (50%) of those receiving the intervention and five(55.6%) of those in the waitlist control group.

3.D.3 Experimental Approach
3.D.3.a. Overview of aims, design, analyses, and timeline (Table 3).

Aims	Design & participants	Analyses
Aim 1: Test efficacy of PICASO versus attention control group on primary and secondary outcomes across 12 months	• **Randomized controlled trial (RCT):** • AYA PICASO intervention group (N=150) • AYA attention control group (N=75) • **Primary Outcomes:** self-management and patient activation • **Secondary Outcomes:** transition readiness, health-related quality of life, emotional health • **Assessments:** baseline, 3,6,9,12 months	**Trajectory Analyses:** Hierarchical mixed-effect models for longitudinal data with *a posteriori* comparisons at each assessment point to compare the trajectory of change in each outcome across 12 months in the PICASO intervention group compared to the attention control group
Aim 2: Explore moderating effects of AYA characteristics on primary and secondary outcomes across 12 months	• **Same design and participants as above** • **Candidate baseline moderators:** age, race/ethnicity, biological sex, type of chronic condition, and disease severity	**Exploratory Moderator Analyses:** Trajectory analysis approach; Core trajectory model for each outcome as described in Aim 1 plus inclusion of each candidate moderator and its two-way and three-way interactions
Aim 3: Characterize user experiences with the intervention.	• Purposive stratified sample from RCT • AYA PICASO intervention (n=50) • Post-intervention	**Mixed methods:** Identify intervention responder typologies; identify themes

3.D.3.b. Setting. The 12-month PICASO intervention will be tested at the Duke Children's Health Center, a large multi-specialty ambulatory children's hospital caring for over one thousand AYAs each year with a range

of COCC. Co-PI Maslow has successfully recruited over 170 youth[84] through the Duke Children's Health Center for other studies and has dedicated support from each of the clinics that would serve as recruitment sites. Based on these and other prior recruitment efforts by both Co-PIs, we anticipate that 70-80% of youth approached will consent to participate with a 90% retention rate.[47,85,86]

3.D.3.c. Description of study population. The usefulness of diagnostic groupings in studies of chronic condition self-management has been called into question since the landmark studies conducted by Stein, Jessup and colleagues. [61,62,87] Since then, a range of studies on adaptation to COCC have supported the view that there is more variability within diagnostic groupings than between, suggesting that diagnosis is not a helpful categorization in the examination of adaptation.[3,87-92] The only area in which differences are found is family interaction with the health system.[62] Considering these findings, and our focus on outcomes that are not disease-oriented, we have adopted a modified noncategorical approach to defining the population. The list of chronic conditions included in this study is broad and includes conditions that require frequent hospital-based treatment (sickle cell disease, chronic kidney disease, systemic lupus erythematous), have specific daily management tasks and episodic periods of worsening/flares (type 1 diabetes, inflammatory bowel disease, severe asthma) and survivorship conditions in which participants have gone through some form of intense treatment and continue to deal with distressing symptoms and self-management tasks (stem cell transplantation, organ transplantation, childhood cancer survivor). For the purposes of peer coach matching, we created categories of chronic conditions based upon burden of condition attributed to chronicity and impairment (See Table 5). Peer coaches will be matched to AYAs based upon shared condition category. Eligibility criteria (detailed in Human Subjects and Clinical Trials Information Section 2.2) apply to participants in all Aims and are shown in Table 6.

Table 5. Sample			
Condition Category	**Diagnoses**	**N**	**Peer Coach**
1. Frequent Hospitalizations or ED visits	Sickle Cell Disease; Chronic Kidney Disease, Lupus	50 PICASO 25 control	4-5
2. High daily management with intermittent flares	Type 1 Diabetes Mellitus; Inflammatory Bowel Disease; Severe Asthma	70 PICASO 35 control	5 -6
3. Survivor of life-threat condition requiring ongoing symptom mgm	Stem Cell Transplant, Organ Transplant, Cancer Survivor	30 PICASO 15 control	3-4
Total: 150 PICASO / 75-control 2:1 ratio			**12-15**

Table 6. Overview of eligibility criteria
Inclusion
1. AYA 16 to 22 years
2. Childhood onset chronic condition from 1 of 3 condition categories (see Table Y).
3. Read and speaks English
4. Access to internet via computer or Smart Phone
4. Access to telephone (Smart Phone not required as text feature can be accessed via internet)
Exclusion
1. Diagnosed cognitive dysfunction
2. Need for English translator

3.D.3.d. Outcome measures. Study outcomes are described in detail in Human Subjects and Clinical Trials Information Section 4.3. All outcomes have been piloted by our team and chosen based on the conceptual model, expert recommendations, and psychometrics. Response burden will be minimized with short instruments and online data entry via REDCap survey. Pilot testing confirmed completion times ranging from 15-20 minutes.

Primary outcome measures. The constructs of (a) self-management and (b) patient activation will be assessed at baseline, 3-, 6-, 9-, and 12-months post randomization. Self-management will be measured using the Partners in Health Scale (PIH)[52,93,94], assessing chronic condition self-management knowledge, partnership in treatment, recognition and management of symptoms, and coping. Patient activation will be measured using the Patient Activation Measure (PAM)[56-58]. The PAM measures patient activation through self-reports of knowledge, skills, and confidence related to self-management of one's own health care.

Secondary outcome assessments. The following constructs will be assessed as secondary outcomes at baseline, 3-, 6-, 9-, and 12-months post randomization: (a) transition readiness, (b) health related quality of life, and (c) emotional health. Transition readiness will be measured by the Transition Readiness Assessment Questionnaire (TRAQ).[95,96] The TRAQ assesses transition readiness in youth with COCC in domains of self-advocacy (communication and use of resources in the community and school) and chronic disease self-management (scheduling appointments, asking questions of health care providers, filling prescriptions). Health related quality of life will be measured using the Short-Form 12 (SF-12)[97,98] which produces weighted subscales on physical and mental components of quality of life. Emotional health will be measured using the Brief Symptom Inventory (BSI)[99-101] which assesses emotional symptom experience (depression, anxiety, somatization) over the previous week.

3.D.3.e. Data management plan for all aims. Human Subjects and Clinical Trials Information Sections 3.1.b. & 3.3.3 detail data management and security. Briefly, all study data will be entered by participants and the

study Clinical Research Coordinator (CRC) via REDCap data system residing on a Duke University RHEL Server. Leveraging a unique password system, only the Study Manager will be unblinded to study group in the data system. Weekly reports will be reviewed to monitor enrollment, retention, safety, and missing data.

3.D.4.a. Study Procedures by Specific Aim

Aim 1: Determine the efficacy of the PICASO on primary outcomes (self-management, patient activation) and secondary outcomes (transition readiness, health-related quality of life, emotional health) across 12 months.

Aim 2: Explore moderators of trajectory of PICASO effects on self-management, patient activation, transition readiness, health-related quality of life and emotional health across 12 months.

Overview and design: We will test the hypothesis that compared to an attention control group, the PICASO group will improve self-management and patient activation as well as improve secondary outcomes (transition readiness, HRQoL, emotional health) in a RCT over 12-months with 225 AYAs with COCC. The primary outcomes are the post-intervention scores on the Partners in Health Scale and the Patient Activation Measure.

Recruitment plan: Our detailed Recruitment and Retention Plan is provided in Human Subjects and Clinical Trials Information Section 2.5; a brief summary follows. Participants will be recruited by the study CRC in partnership with the Duke Children's Health Center ambulatory clinic staff (attending physicians, fellows, and nurse practitioners - see Letters of Support from Clinic Medical Directors). At the end of each week clinic staff and the CRC will review lists of AYAs scheduled for appointments the following week. Eligible AYA will be identified and flagged to be provided with basic information about the study by the clinic staff the following week. If an AYA and parent/guardian (for those less than 18 years) express an interest in the study, the CRC will meet with them at the same appointment for study introduction. Once questions have been answered the informed consent process will be conducted by the CRC in a confidential manner.

Randomization and data collection (detail in Human Subjects and Clinical Trials Information Section 4.2.a.7 & 4.2.a.11): On completion of baseline data collection, AYAs will be randomized using a stratified randomization with permuted block sizes of four to either the PICASO intervention (N=150) or attention control group (N=75). While stratifying on condition category, a 2:1 treatment allocation will be applied to ensure as an intervention sample size that is sufficient to provide robust findings and increase the precision of the outcome parameter estimates for the PICASO intervention. A RedCAP data base platform will be used to administer the randomization scheme prepared by the study statistician.

Peer coach recruitment and training (details in Human Subjects and Clinical Trials Information Sections 4.3.a.): Peer coaches are young adults (18-26 years) with a COCC who have been identified by clinic staff (attending physicians, fellows, nurse practitioners) as having exemplary activated self-management skills and, based upon their interpersonal skills, having the potential to be trained as a peer coach. Those young adults who are recommended will undergo a screening process and interview by the study investigators (Maslow, Docherty, Pollock). If they express interest in training and employment as a peer coach they will be hired and trained following the training protocol described below. We plan to employ 12- 15 peer coaches who represent the condition categories (see Table 5). Peer coaches will receive training from Co-I Pollock (Coach Supervisor) using a health and wellness curriculum designed by Dr. Pollock who is an Integrative Health Coach, and previously tested by the study investigators.[28,29] Training is composed of a five-day program and ongoing semi-monthly supervisory sessions. Training content includes a review of the coaching framework including social support and self-determination theories, motivational interviewing techniques and information about health behavior change. Training sessions focus on the coach-AYA relationship and use of motivational interviewing techniques. Various role-playing sequences are used throughout the training program to provide coaches with the opportunity to test their skills. Semi-monthly supervisory sessions will be conducted with coaches and the research team including continued education and support. Supporting AYAs with a similar condition as oneself can be emotionally distressing at times, and both Gary Maslow, MD who is a licensed pediatrician and pediatric psychiatrist, and McLean Pollock, LCSW who is a licensed clinical social worker, can consult and refer coaches experiencing problems.

Peer i-Coaching for Activated Self-Management Optimization (PICASO) (details in Human Subjects and Clinical Trials Information Sections 4.2.a.12-15): The PICASO intervention is a peer coaching intervention based upon self-determination theory.[66,102,103] The intervention is delivered by young adults (18-26 years) with a COCC and trained using a tested curriculum that includes motivational interviewing techniques and the benefits of peer relationships over a shared experience such as a COCC. The peer coach supports the AYA to to identify their own goals and feel a sense of success in making change towards goals within a supportive environment. This peer-centric process involves goal-setting, the development of self-discovery and provides accountability for changes in health behavior.[104] The peer coach elicits the AYA's vision of optimal health and identifies the AYAs values; both necessary for behavior change. As the AYAs identify a vision of wellness and

develop goals and action steps to progress towards that vision, the peer coach elicits the AYA's intrinsic motivation and activates skill development in self-advocacy and communication and empowers the AYA to take leadership in managing their condition.

Peer coaching is tailored to the AYA's developmental level and designed to address the four key functions of peer support that have been found to be associated with increased self-management:[33] 1) participation in daily management, 2) support for social and emotional issues, 3) linkage to clinical care, and 4) ongoing support. The peer coaches work consistently over time, using nondirective approaches, to guide the AYA to address goals around daily management, navigation of the health care system, communication with health care providers, and emotional coping. Figure 2 identifies characteristics of
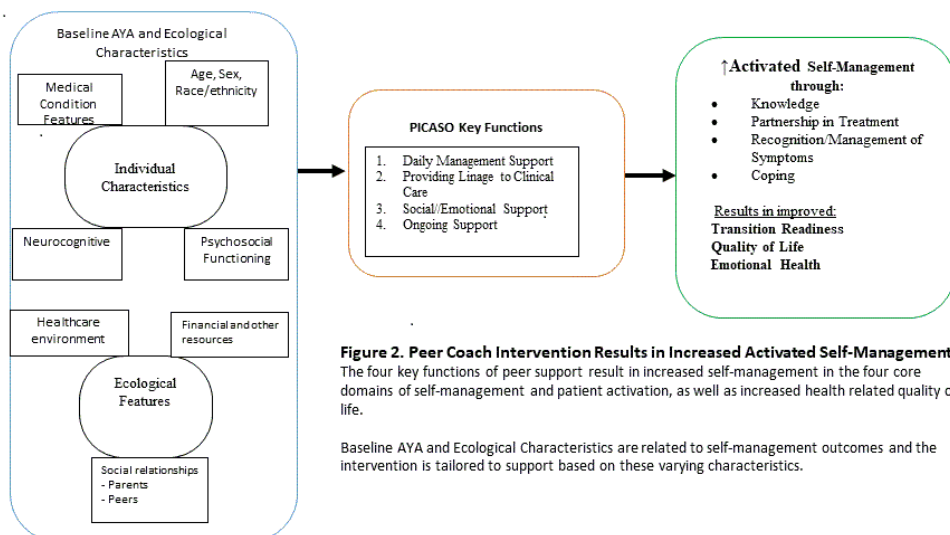

Figure 2. Peer Coach Intervention Results in Increased Activated Self-Management
The four key functions of peer support result in increased self-management in the four core domains of self-management and patient activation, as well as increased health related quality of life.

Baseline AYA and Ecological Characteristics are related to self-management outcomes and the intervention is tailored to support based on these varying characteristics.

the AYA that are known to be related to the development of independent self-management. The intervention is designed to address a range of these characteristics and to have flexibility to support AYAs based on known variations. For example, the intervention can be tailored so that younger AYAs receive support targeting earlier stages of the development of activation and self-management. Each AYA will be matched with a coach, based on membership in 1 of 3 condition categories (see Table 5), who will provide support using the InquisitHealth Mentor 1:1™ Web Based Portal mobile telephone/text platform and the curriculum that guides them to assess AYA goals and provide support in addressing these goals.

To enact the four key functions of peer support, the coaches develop a relationship over time with their assigned AYAs. The first phase of the intervention involves an assessment and goal setting call during which the peer coach learns about the AYA's experience with their COCC, how they view their current self-management skills and how they envision their ideal health in adulthood. Through this initial call the coach and AYA will identify specific goals to work towards their vision of health. Throughout the process of coaching, the coach and AYA identify action steps towards the health and self-management goals, draw upon the AYA's strengths and existing skills, examine potential barriers to successful progression towards their goals and develop plans for addressing those barriers. The curriculum for the intervention is nondirective but allows coaches to help AYAs identify areas to work on within the four domains of self-management – knowledge, partnership in treatment, recognition/management of symptoms, and coping – as they relate to the AYA's personal health goals and vision for their future. Table 1 provides examples of the ways in which a peer coach would provide support to an AYA participant utilizing a nondirective approach.

Table 7. Components of peer support intervention, AYA challenges, and peer coach support			
Components of Peer Support	Self-management challenge	Standard medical system approach	Nondirective peer coaching approach
Daily Management	Difficulty adhering to medication schedule	Provider instructs when and how to take medication	Coach helps explore daily routines; how medication schedules can link into daily routines; barriers to adherence
Social/emotional support	Following self-management plan when with peers	Altering therapy for flexibility (e.g. switching insulin pump in diabetes)	Coach helps explore fears of being different than peers; provides emotional support; role plays plan to talk to friends about condition
Providing linkage to clinical care	Attending regular clinic appointments	Clinic schedules appointments at regular intervals with reminders	Coach explores navigation of clinic system; how to reach out to schedule appointments; developing differing relationships with adult-care team
Providing ongoing support	Consistently follow self-management plan over time	Regular clinic visits with doctor and care team to monitor symptoms	AYA speaks with coach on regular basis over time; coach provides support to help consistently follow self-management plan and cope with stressors.

The peer coach will discuss daily management tasks (Key Function 1) during intake assessment and as part of the ongoing coaching process. The peer coach will also discuss the AYA's healthcare team and their ability to navigate the healthcare system. The peer coach will provide indirect linkage to clinical care by providing support to participants around goals related to healthcare navigation, while also communicating directly with the clinical team should the need arise. The circumstances by which the coach would share information with the clinical team are primarily related to safety concerns. The clinical team can also provide the coach with information regarding symptoms, treatments, and other relevant health information (Key Function 3). By providing support around daily management and the linkage to clinical care the peer coach promotes an increase in all the self-management domains and patient activation.

The social and emotional support (Key Function 2) and ongoing support (Key Function 4) are critical components within PICASO. AYAs will identify goals and through the coaching process may choose to focus on the social consequences or emotional challenges of coping with a COCC. The coach will use the nondirective supportive tools gained in their training to promote active coping and to provide nondirective emotional support. This type of support is associated with positive coping and with lower rates of depression/anxiety in response to an emotional stressor. In addition, the nondirective emotional support is expected to be related to the outcome of improved health-related quality of life.

The peer coaching interactions will occur using the InquisitHealth Mentor 1:1™ Web Based Portal.[79] This platform designed by InquisitHealth and deployed commercially across multiple settings in which peer support is activated,[79] facilitates interactions using telephone and a web-based peer-support interface. This informatics technology interface has been used successfully in a preliminary study of AYA with COCC[28,29], as well as for adults with chronic conditions.[79] Through the software interface, the AYA and coach arrange times to speak according to the protocol schedule. They can exchange secure communication via phone and text messages, and coaches can send them monthly educational newsletters. The coaches will track the AYA's progress over time using the InquisitHealth web-based software. This database includes progress on key health behaviors discussed and notes the coaches submit after each session. Peer coaches and AYA will communicate by phone and text twice weekly over the first 16 weeks of the active relationship building phase. This will be followed by 18 weeks of weekly communication in the goal-focused phase. Last, peer coaches will have twice monthly communication for the final 18 weeks of the maintenance phase.

In general, calls last 20-30 minutes. During the first call, the coach and AYA have the opportunity to learn about one another's experiences with living with a chronic condition. During subsequent calls, the coach focuses primarily on the specific sub-behavior elected by the AYA. The coaching process model described in figure 2, helps the coach guide behavior change, beginning with assessing the participant's vision for the future, establishing focus, readiness to change, and then pursuit and maintenance of identified goals. As goal progress is made, the coach and AYA work to identify a new goal, or in the case of no progress, they discuss barriers and strategies, with an option to move on to another goal. Between sessions the coach and participant can exchange text messages including an update on progress towards a goal. At the end of the intervention the final call involves an opportunity for closure and for the coach and AYA to review progress on goals and future steps.

Attention Control: Over 12 months the attention control group participants will receive a monthly electronic newsletter with educational content about COCC management and the differences between pediatric and adult health care systems, as well as a monthly phone call from study staff to ensure receipt of the newsletter and to answer questions regarding content, and an opportunity to link them to other resources. If participants report health concerns they will be directed to contact their health care team.

Treatment fidelity and protocol adherence: See Human Subjects and Clinical Trials Information Section 4.2.a.13 and 4.3 for complete details on intervention fidelity, participant adherence, and adherence measurement. The NIH Treatment Fidelity Workgroup statement will guide our fidelity plan[105] and Co-PI Docherty has experience implementing these guidelines in a previous RCT intervention with adolescents undergoing blood and marrow transplant.[106] Fidelity will be enhanced by the InquistHealth Mentor1to1™ platform which enables masked, direct voice communication; facilitates continuity of relationship between the AYA and peer coach; and allows for the systematic tracking of phone- and text-based interactions. After the call, the platform facilitates scheduling upcoming calls, automates text message and e-mail reminders, and allows for user-initiated text messaging between calls. Since all calls are facilitated through the platform, the system automatically tracks call length and frequency, and records these interactions. AYA engagement will be tracked and quantified by the number of contacts and average length of contacts time per week. These two numbers will be aggregated and plotted for each AYA. Together with weekly content analyses of a random selection of two calls and text messages from each coach, we will monitor AYA engagement and during biweekly coach training sessions address problems that arise. Fidelity will be assessed by examining peer

coach engagement and content of the call recordings. Peer coach engagement will be evaluated using the aggregated number of contacts and length of contact time for each of the 12-15 coaches. This will allow us to assess the extent to which coaches are engaged and to explore the reasons for increases or decreases in engagement. These evaluations will be performed weekly and feedback given to the peer coaches at the biweekly training sessions so that adjustments to the content/direction of the calls and text messages may be made by the caoch at the subsequent call. A log will be kept of these assessments and any subsequent adjustments.

Aim 1 and 2 Analysis Plan
Descriptive statistics will be used to detail the sample characteristics of the (a) coaches and randomized AYAs and (b) detail the study outcomes for the AYAs at the five-assessment point (baseline, 3-, 6-, 9-, 12-months post randomization). Non-directional statistical tests will be performed, with the significance level set at 0.05 for each test. The significance level will not be adjusted for multiple outcomes and tests (see Power section below). Estimated effect sizes and their 95% confidence intervals (CI) will be reported to address magnitude of effect and clinical significance for the efficacy and moderator analyses (Aims 1 and 2, respectively).

AYA Sample Characteristics. Chi-square/Fisher's Exact Tests for categorical variables and General Linear Models (GLM) for continuous measures will be used to test for group (PICASO vs attention control) differences in the baseline demographic and clinical characteristics as well as baseline outcome measures for the AYAs. A GLM approach, which calculates least square means to adjust for unequal sample sizes, will be used to test for between-group differences in the means for continuous measures. Any significant between-group difference in a baseline characteristic detected will be evaluated as a potential covariate in the efficacy analyses

Aim 1 Efficacy Analyses. To test the efficacy of the PICASO compared to the attention control condition on the primary and secondary outcomes across the five assessment points (time), we will use a type of hierarchical mixed-effect model for longitudinal data known as random coefficients regression models (RRM) to evaluate group differences in the trajectory of change in each outcome across time. Fixed effects will be group, time, group-by-time, while random effects will be participant and participant-by-time. Potential covariates will be included as fixed effects and will be retained in the final model only if significant at the 0.05 level. When needed, the model will be fitted for any non-linear temporal effects observed. The assumption of data missing at random will be evaluated, and imputation for missing data will be applied when appropriate. Descriptive statistics will be used summarize the unadjusted and adjusted means at each assessment point. If there is a significant group-by-time interaction, *a posteriori* contrasts will be performed to compare the two groups at each time point. For each outcome, the primary analysis will an intention-to-treat (ITT) analysis in which all AYAs randomized will included in the analysis. Supplemental analyses will be conducted on those AYAs who complete the 12-month assessment. Both ITT and completers' results will be reported.

Aim 2 Moderator Analyses. To explore whether age, biological sex, race/ethnicity, chronic condition, and/or disease severity moderate the trajectory of PICASO effects on the primary and secondary outcomes, the trajectory analysis approach described in Aim 1 will be used to evaluate the moderating effects of each candidate moderator on each outcome. Each candidate moderator will be evaluated separately by incorporating the variable (e.g., age) and its interaction with group and time as fixed effects in the model for each outcome. By definition[107], a significant candidate moderator-by-group-by-time interaction would indicate that the variable moderates the effects of the PICASO compared to the control group over time. If a moderator interaction is significant at the 0.05 level, the RRM core model applied in Aim 1 will be fitted for subgroups of the moderator to better determine the differential trajectory of change from baseline to 12-month within each moderator subgroup. This analytic method will be applied in accordance with recommended approaches[107,108] for assessing moderator effects in trajectory and/or growth models.

Aim 3: Explore mechanisms of PICASO impact by describing AYA experiences with the intervention and the InquisitHealth Mentor 1:1™ Web Based Portal. Aim 3's goal is to understand intervention mediators by characterizing how intervention components, as well as the unique case context of their use, may (a) target (or miss) within-case needs, (b) address variability across chronic condition and age contexts, and (c) impact patterns in outcome measures. *Approach & goal*: We will integrate findings from qualitative interviews with AYA outcomes. This mixed methods analysis will provide insight into intervention mediators (mechanisms of action) and highlight how outcomes may be related to unique case contexts; both of which will lead to future intervention optimization through enhanced personalization, replicability, and scalability.

Aim 3 Mixed Methods Analyses. We will explore AYA experiences with the PICASO using a mixed methods approach to characterize participants' experiences with the intervention to understand mechanisms of action, how outcomes may be related to unique case contexts, and if barriers to broader implementation and dissemination are perceived. This knowledge will also guide future intervention optimization through enhanced

personalization, replicability, and scalability.[109-111] Interview transcripts will be analyzed using a content qualitative analysis technique that combines structural (e.g., intervention component, transition barriers) and magnitude coding (e.g., theme intensity) with inductive coding (e.g., variations in outcomes not captured by instruments).[112] Drs. Docherty and Pollock will separately code 10 interviews, discuss the generated codes, and create an initial code book by consensus. The code book will then be used by CRC coders for the next 10 transcribed interviews (with Dr. Docherty coding each 5th interview), with further refinements made as needed. The final code book will be organized into categories used to generate themes of mechanistic and process elements. The qualitative content analysis findings within each case will then be integrated with the relevant quantitative questionnaire- and informatics-based data. A matrix will be constructed to display case findings (qualitative data in relation to quantitative data) in relation to every other case. This will allow a cross-case comparative analysis, with the possibility of conducting an even wider range of theoretically driven analyses.[113] For example, case comparisons could be made by diagnostic category or mentor condition match. Next, process tracing will be used to explore how particular case outcomes (e.g., self-management, coping, self-esteem) may have been related to intervention components (e.g., goal selection, strategies).[114,115] Dr. Docherty will use ATLAS.ti software to aid in coding and organizing transcribed interviews and field notes.

3.C.8. Sample Size and Power Considerations
A target sample size of 225 AYAs (PICASO: N=150; control: N=75) will be provide at least 80% statistical power to address the efficacy of PICASO compared to the attention control condition (Aim 1) and will provide sufficient heterogeneity to obtain reliable estimates of effect sizes for the exploratory moderator analyses. Using PASS software (NCSS LLC, Kaysville, UT), the sample size determination for the two primary outcomes was based on the following assumptions: (a) mixed-effects trajectory analyses using RRMs; (b) two-tailed tests with significance set at 0.05 per test; and (c) medium effects (Cohen d equivalent of 0.50); and (d) unstructured within-subjects correlation patterns over time. The significance level of 0.05 will not be adjusted for evaluating two primary outcomes. Although the mixed-effects models allow for data missing at random, the sample size of 225 takes into account an attrition rate of up to 20% over time, and thus, should provide 80% power for both the ITT and completers' analyses of the two primary outcomes.

3.C.9. Methodological Considerations Relevant to a Robust, Unbiased, Reproducible Approach.
   Intervention: Peer coaches will receive an initial five-day training on the process of coaching, which includes didactic sessions on the stages of coaching, motivational interviewing skill development, and opportunities to practice coaching skills. Practice sessions are observed by the coach supervisor, who developed the peer coaching curriculum, and feedback is provided in order to assess intervention fidelity. In addition, coaches receive ongoing, semi-monthly group supervision to provide ongoing training on the peer coaching process, facilitate additional practice sessions to advance skill development, troubleshoot coaching challenges, and maintain intervention fidelity. The coach supervisor also provide individual supervision as needed for coaches experiencing difficulties with the coaching process. During these sessions, the peer coach role plays a scenario that they may encounter with their participants with the supervisor in the role of the AYA. After the 10-minute practice, the supervisor and coach review the interaction and provide feedback on strengths and areas for improvement in order to implement coaching with fidelity.
   Generalizability: We believe that the external validity of the proposed PICASO trial is very high. First, our approach to sampling using a modified noncategorical approach with a broad list of COCCs (sickle cell disease, chronic kidney disease, systemic lupus erythematous, type 1 diabetes, inflammatory bowel disease, severe asthma, stem cell transplantation, organ transplantation, and childhood cancer survivor, increases the likelihood that the results will be applicable across conditions most often experiencing self-management challenges during the critical window of transition. Our focus on outcomes that are not generally found to have disease-specific ramifications, also strengthens the external validity of the potential findings.
   Replicability is an intervention strength. Technology: As described in Innovation, replicability and scalability across future sites is ensured by the ability of InquisitHealth Mentor 1:1™ Web Based Portal to capture data directly from coaching sessions. Our multidisciplinary research team assists in protecting against bias that may be inserted by virtue of disciplinary lenses.

3.C.10. Timeline
See Human Subjects and Clinical Trials Information Section 4.2.a.13 for detailed description of timeline.

Specific timeline	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Aims 1 & 2: RCT																				
Subcontracts finalized with programmers	X																			
Web app finalized	X																			
Digital case report forms (ePRO) final	X	X																		
DSMB formation & charter	X	X																		
Regulatory documentation: IRB approval, human subjects training	X	X																		
Registration on ClinicalTrials.gov			X																	
Staff training		X	X																	
Peer Coach Recruitment & Hiring	X	X																		
Investigator / team meetings	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Aim 1 randomization & all subject assessments																				
0-25% (n=62 cumulative)			X	X	X	X														
26-50% (n=125 cumulative)							X	X	X	X										
51-75% (n=187 cumulative)											X	X	X	X						
76-100% (n=225 cumulative)															X	X				
Data collection complete																		X		
Data cleaning			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Database lock																	X			
Statistical analyses																		X		
Submit primary manuscript																				X
Progress reports to NIH			X					X				X			X					X
Data to DSMB; DSMB mtgs.		X				X			X			X			X			X		X
Update ClinicalTrials.gov			X			X		X		X		X		X		X		X		X
Submit grant application for multi-center pragmatic trial																				X
Aim 3: Participant experiences																				
Aim 3 accrual & subject assessments						X	X	X	X	X	X	X	X	X	X	X	X	X		
Aim 3 data analysis									X				X				X	X		

3.C.11. Future Steps
Our next step is to take advantage of PICASO platform interoperability to conduct a pragmatic, multi-site, clinical trial. We aim to develop an efficient, generalizable, and scalable peer coach transition self-management product that will optimize AYA, parent, pediatric and adult chronic condition provider collaboration across care sites, venues, and transitions. The ultimate goal is to be broadly deploy this intervention in a range of settings that currently include AYA with COCC, but do not currently address self-management. Deployment of an evidence based peer support in these settings could provide thousands of youth with COCC the opportunity to develop self-management skills to successfully and safely transition to adult medical care and adulthood.

References

1. Huber M, Knottnerus JA, Green L, et al. How should we define health? *BMJ (Clinical research ed).* 2011;343:d4163.
2. Stinson J, Kohut SA, Spiegel L, et al. A systematic review of transition readiness and transfer satisfaction measures for adolescents with chronic illness. *International journal of adolescent medicine and health.* 2014;26(2):159-174.
3. Beal SJ, Riddle IK, Kichler JC, et al. The Associations of Chronic Condition Type and Individual Characteristics With Transition Readiness. *Academic pediatrics.* 2016;16(7):660-667.
4. Hazel E, Zhang X, Duffy CM, Campillo S. High rates of unsuccessful transfer to adult care among young adults with juvenile idiopathic arthritis. *Pediatric rheumatology online journal.* 2010;8:2.
5. Nakhla M, Daneman D, To T, Paradis G, Guttmann A. Transition to adult care for youths with diabetes mellitus: findings from a Universal Health Care System. *Pediatrics.* 2009;124(6):e1134-1141.
6. Ersig AL, Starkweather AR. An Integrative Review of Biological Variants and Chronic Stress in Emerging Adults With Chronic Conditions. *Journal of nursing scholarship : an official publication of Sigma Theta Tau International Honor Society of Nursing.* 2017;49(2):185-193.
7. Rachas A, Tuppin P, Meyer L, et al. Excess mortality and hospitalizations in transitional-age youths with a long-term disease: A national population-based cohort study. *PloS one.* 2018;13(3):e0193729.
8. Hersh A, von Scheven E, Yelin E. Adult outcomes of childhood-onset rheumatic diseases. *Nature reviews Rheumatology.* 2011;7(5):290-295.
9. Scal P, Davern M, Ireland M, Park K. Transition to adulthood: delays and unmet needs among adolescents and young adults with asthma. *The Journal of pediatrics.* 2008;152(4):471-475, 475.e471.
10. Northam EA, Lin A, Finch S, Werther GA, Cameron FJ. Psychosocial well-being and functional outcomes in youth with type 1 diabetes 12 years after disease onset. *Diabetes care.* 2010;33(7):1430-1437.
11. Newman C, Persson A, Miller A, Cama E. Bridging worlds, breaking rules: Clinician perspectives on transitioning young people with perinatally acquired HIV into adult care in a low prevalence setting. *AIDS patient care and STDs.* 2014;28(7):381-393.
12. Fegran L, Hall EO, Uhrenfeldt L, Aagaard H, Ludvigsen MS. Adolescents' and young adults' transition experiences when transferring from paediatric to adult care: a qualitative metasynthesis. *International journal of nursing studies.* 2014;51(1):123-135.
13. Margolis R, Wiener L, Pao M, Malech HL, Holland SM, Driscoll P. Transition From Pediatric to Adult Care by Young Adults With Chronic Granulomatous Disease: The Patient's Viewpoint. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine.* 2017.
14. Cai RA, Beste D, Chaplin H, et al. Developing and Evaluating JIApp: Acceptability and Usability of a Smartphone App System to Improve Self-Management in Young People With Juvenile Idiopathic Arthritis. *JMIR mHealth and uHealth.* 2017;5(8):e121.
15. Anderson RA, Bailey DE, Jr., Wu B, et al. Adaptive leadership framework for chronic illness: framing a research agenda for transforming care delivery. *ANS Advances in nursing science.* 2015;38(2):83-95.
16. Rapoff M. *Adherence to pediatric medical regimens.* New York, NY: Springer; 2010.
17. Williams GC, McGregor HA, Zeldman A, Freedman ZR, Deci EL. Testing a self-determination theory process model for promoting glycemic control through diabetes self-management. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 2004;23(1):58-66.

18. Greene J, Hibbard JH, Sacks R, Overton V, Parrotta CD. When patient activation levels change, health outcomes and costs change, too. *Health affairs (Project Hope).* 2015;34(3):431-437.

19. Huang JS, Terrones L, Tompane T, et al. Preparing adolescents with chronic disease for transition to adult care: a technology program. *Pediatrics.* 2014;133(6):e1639-1646.

20. Campbell F, Biggs K, Aldiss SK, et al. Transition of care for adolescents from paediatric services to adult health services. *The Cochrane database of systematic reviews.* 2016;4:Cd009794.

21. Guan S-S, Fuligni A. Changes in Parent, Sibling, and Peer Support During the Transition to Young Adulthood. *Journal of Research on Adolescence.* 2015;26(2):286-299.

22. Morgan S, Davies S, Palmer S, Plaster M. Sex, drugs, and rock 'n' roll: caring for adolescents and young adults with cancer. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology.* 2010;28(32):4825-4830.

23. Lu Y, Pyatak EA, Peters AL, et al. Patient perspectives on peer mentoring: type 1 diabetes management in adolescents and young adults. *The Diabetes educator.* 2015;41(1):59-68.

24. Perry EE, Zheng K, Ferris ME, Torres L, Bickford K, Segal JH. Invited manuscript poster on renal-related education American Society of Nephrology, Nov. 16-21, 2010. Adolescents with chronic kidney disease and their need for online peer mentoring: a qualitative investigation of social support and healthcare transition. *Renal failure.* 2011;33(7):663-668.

25. Stewart M, Letourneau N, Masuda JR, Anderson S, McGhan S. Online support for children with asthma and allergies. *Journal of family nursing.* 2013;19(2):171-197.

26. Stewart M, Letourneau N, Masuda JR, Anderson S, McGhan S. Impacts of online peer support for children with asthma and allergies: It just helps you every time you can't breathe well". *Journal of pediatric nursing.* 2013;28(5):439-452.

27. Chu PY, Maslow GR, von Isenburg M, Chung RJ. Systematic Review of the Impact of Transition Interventions for Adolescents With Chronic Illness on Transfer From Pediatric to Adult Healthcare. *Journal of pediatric nursing.* 2015;30(5):e19-27.

28. Docherty SL, Pollock MD, Franklin CE, Brotkin SM, Cho E, Maslow GR. Development and testing PICASO: Peer i-Coaching for Activated Self-Management Optimization in Adolescents and Young Adults with Chronic Conditions. *Journal of Pediatric Health Care.* Under Review.

29. Brotkin SM, Pollock MD, Schilstra CE, et al. The development of a one-to-one telephone-based peer coaching intervention for adolescents and young adults with chronic illness to promote healthcare transition outcomes. . *Journal of pediatric nursing.* Under Review.

30. Gidugu V, Rogers ES, Harrington S, et al. Individual peer support: a qualitative study of mechanisms of its effectiveness. *Community mental health journal.* 2015;51(4):445-452.

31. Gillard S, Gibson SL, Holley J, Lucock M. Developing a change model for peer worker interventions in mental health services: a qualitative research study. *Epidemiology and psychiatric sciences.* 2015;24(5):435-445.

32. Naslund JA, Aschbrenner KA, Marsch LA, Bartels SJ. The future of mental health care: peer-to-peer support and social media. *Epidemiology and psychiatric sciences.* 2016;25(2):113-122.

33. Fisher EB, Ballesteros J, Bhushan N, et al. Key Features Of Peer Support In Chronic Disease Prevention And Management. *Health affairs (Project Hope).* 2015;34(9):1523-1530.

34. Hoff KA, Briley DA, Wee CJM, Rounds J. Normative changes in interests from adolescence to adulthood: A meta-analysis of longitudinal studies. *Psychological bulletin.* 2018;144(4):426-451.

35. Furlong A. The changing landscapeof youth and young adulthood. In: Furlong A, ed. *Routledge handbook of youth and young adulthood*. New York, NY: Routledge; 2016:3-11.

36. Arnett J. Emerging adulthood: What is it, and what is it good for? *Child Development Perspectives.* 2007;1(2):68-73.

37. Cooley WC, Sagerman PJ. Supporting the health care transition from adolescence to adulthood in the medical home. *Pediatrics.* 2011;128(1):182-200.

38. Maternal and Child Health Bureau, The National alliance to Advance Adolescent Health: Got Transition. 2018; www.gottransition.org. Accessed April 13, 2018, 2018.
39. Lorig KR, Holman H. Self-management education: history, definition, outcomes, and mechanisms. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine.* 2003;26(1):1-7.
40. Richard AA, Shea K. Delineation of self-care and associated concepts. *Journal of nursing scholarship : an official publication of Sigma Theta Tau International Honor Society of Nursing.* 2011;43(3):255-264.
41. Ryan P, Sawin KJ. The Individual and Family Self-Management Theory: background and perspectives on context, process, and outcomes. *Nursing outlook.* 2009;57(4):217-225.e216.
42. Sattoe JN, Bal MI, Roelofs PD, Bal R, Miedema HS, van Staa A. Self-management interventions for young people with chronic conditions: A systematic overview. *Patient education and counseling.* 2015;98(6):704-715.
43. McManus MA, Pollack LR, Cooley WC, et al. Current status of transition preparation among youth with special needs in the United States. *Pediatrics.* 2013;131(6):1090-1097.
44. Brown LW, Camfield P, Capers M, et al. The neurologist's role in supporting transition to adult health care: A consensus statement. *Neurology.* 2016;87(8):835-840.
45. Bryant R, Porter JS, Sobota A, Association of Pediatric Hematology/Oncology N, American Society of Pediatri Hematology O. APHON/ASPHO Policy Statement for the Transition of Patients With Sickle Cell Disease From Pediatric to Adult Health Care. *Journal of pediatric oncology nursing : official journal of the Association of Pediatric Oncology Nurses.* 2015;32(6):355-359.
46. Nguyen T, Henderson D, Stewart D, Hlyva O, Punthakee Z, Gorter JW. You never transition alone! Exploring the experiences of youth with chronic health conditions, parents and healthcare providers on self-management. *Child: care, health and development.* 2016;42(4):464-472.
47. Kayle M, Tanabe P, Shah NR, Baker-Ward L, Docherty SL. Challenges in Shifting Management Responsibility From Parents to Adolescents With Sickle Cell Disease. *Journal of pediatric nursing.* 2016;31(6):678-690.
48. Lansing AH, Berg CA. Adolescent self-regulation as a foundation for chronic illness self-management. *Journal of pediatric psychology.* 2014;39(10):1091-1096.
49. Heldman MR, Sohn MW, Gordon EJ, et al. National survey of adult transplant hepatologists on the pediatric-to-adult care transition after liver transplantation. *Liver transplantation : official publication of the American Association for the Study of Liver Diseases and the International Liver Transplantation Society.* 2015;21(2):213-223.
50. Bollegala N, Nguyen GC. Transitioning the Adolescent with IBD from Pediatric to Adult Care: A Review of the Literature. *Gastroenterology research and practice.* 2015;2015:853530.
51. Javalkar K, Fenton N, Cohen S, Ferris M. Socioecologic factors as predictors of readiness for self-management and transition, medication adherence, and health care utilization among adolescents and young adults with chronic kidney disease. *Preventing chronic disease.* 2014;11:E117.
52. Smith D, Harvey P, Lawn S, Harris M, Battersby M. Measuring chronic condition self-management in an Australian community: factor structure of the revised Partners in Health (PIH) scale. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation.* 2017;26(1):149-159.
53. Gray WN, Schaefer MR, Resmini-Rawlinson A, Wagoner ST. Barriers to Transition From Pediatric to Adult Care: A Systematic Review. *Journal of pediatric psychology.* 2017.
54. Hibbard JH, Mahoney ER, Stock R, Tusler M. Do increases in patient activation result in improved self-management behaviors? *Health services research.* 2007;42(4):1443-1463.
55. Remmers C, Hibbard J, Mosen DM, Wagenfield M, Hoye RE, Jones C. Is patient activation associated with future health outcomes and healthcare utilization among patients with diabetes? *The Journal of ambulatory care management.* 2009;32(4):320-327.

56.   Hibbard JH, Greene J, Tusler M. Improving the outcomes of disease management by tailoring care to the patient's level of activation. *The American journal of managed care.* 2009;15(6):353-360.

57.   Hibbard JH, Mahoney ER, Stockard J, Tusler M. Development and testing of a short form of the patient activation measure. *Health services research.* 2005;40(6 Pt 1):1918-1930.

58.   Hibbard JH, Stockard J, Mahoney ER, Tusler M. Development of the Patient Activation Measure (PAM): conceptualizing and measuring activation in patients and consumers. *Health services research.* 2004;39(4 Pt 1):1005-1026.

59.   Schmidt S, Herrmann-Garitz C, Bomba F, Thyen U. A multicenter prospective quasi-experimental study on the impact of a transition-oriented generic patient education program on health service participation and quality of life in adolescents and young adults. *Patient education and counseling.* 2016;99(3):421-428.

60.   Betz CL, Smith K, Macias K. Testing the transition preparation training program: A randomized controlled trial. *International journal of child and adolescent health.* 2010;3(4):595-607.

61.   Perrin EC, Newacheck P, Pless IB, et al. Issues involved in the definition and classification of chronic health conditions. *Pediatrics.* 1993;91(4):787-793.

62.   Stein RE, Jessop DJ. A noncategorical approach to chronic childhood illness. *Public health reports (Washington, DC : 1974).* 1982;97(4):354-362.

63.   Ryan RM, Patrick H, Deci EL, Williams GC. Facilitating health behaviour change and its maintenance: Interventions based on Self-Determination Theory *The European Health Psychologist.* 2008;10(March):2-5.

64.   Deci EL, Ryan RM. Self-determination theory in health care and its relations to motivational interviewing: a few comments. *The international journal of behavioral nutrition and physical activity.* 2012;9:24.

65.   Ng JY, Ntoumanis N, Thogersen-Ntoumani C, et al. Self-Determination Theory Applied to Health Contexts: A Meta-Analysis. *Perspectives on psychological science : a journal of the Association for Psychological Science.* 2012;7(4):325-340.

66.   Deci EL, Ryan RM. Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie Canadienne.* 2008;49(3):182-185.

67.   Silva MN, Marques MM, Teixeira PJ. Testing theory in practice: The example of self-determination theory-based interventions. *European Health Psychologist.* 2014;16(5):171-180.

68.   Silva MN, Vieira PN, Coutinho SR, et al. Using self-determination theory to promote physical activity and weight control: a randomized controlled trial in women. *Journal of behavioral medicine.* 2010;33(2):110-122.

69.   Fisher EB, Ayala GX, Ibarra L, et al. Contributions of Peer Support to Health, Health Care, and Prevention: Papers from Peers for Progress. *Annals of family medicine.* 2015;13 Suppl 1:S2-8.

70.   Fisher EB, Boothroyd RI, Elstad EA, et al. Peer support of complex health behaviors in prevention and disease management with special reference to diabetes: systematic reviews. *Clinical diabetes and endocrinology.* 2017;3:4.

71.   Fisher EB, Coufal MM, Parada H, et al. Peer support in health care and prevention: cultural, organizational, and dissemination issues. *Annual review of public health.* 2014;35:363-383.

72.   Kowitt SD, Urlaub D, Guzman-Corrales L, et al. Emotional support for diabetes management: an international cross-cultural study. *The Diabetes educator.* 2015;41(3):291-300.

73.   Miller AS, Cafazzo JA, Seto E. A game plan: Gamification design principles in mHealth applications for chronic disease management. *Health informatics journal.* 2016;22(2):184-193.

74.   Lenhart A. Teens, social media & technology overview 2015: Smartphones facilitate shifts in communicaiton landscape for teens. 2015; http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/.

75.   Haas K, Martin A, Park KT. Text Message Intervention (TEACH) Improves Quality of Life and Patient Activation in Celiac Disease: A Randomized Clinical Trial. *The Journal of pediatrics.* 2017;185:62-67.e62.

76.   Casillas J, Goyal A, Bryman J, et al. Development of a text messaging system to improve receipt of survivorship care in adolescent and young adult survivors of childhood cancer. *Journal of cancer survivorship : research and practice.* 2017;11(4):505-516.

77.   InquisitHealth. InquisitHealth: Peer-to-Peer Support. 2017; http://www.inquisithealth.com/peersupport.php. Accessed September 14, 2017.

78.   Lenhart A, Ling R, Campbell S, Purcell K. Teens and mobile phones: Text messaging explodes as teens embrace it as the centerpiece of their communication strategies with friends. 2010; https://eric.ed.gov/?id=ED525059. Accessed March 25, 2018.

79.   Inquisithealth. Inquisithealth: Peer to peer support. 2018; http://inquisithealth.com/. Accessed 01/21/18, 2018.

80.   Docherty SL, Pollock M, Franklin M, Brotkin S, Silva S, Maslow G. Peer health coaching for adolescents and young adults with childhood-onset chronic conditions. *Journal of Pediatric Health Care.* Under Review (2018).

81.   Palermo TM, Wilson AC, Peters M, Lewandowski A, Somhegyi H. Randomized controlled trial of an Internet-delivered family cognitive-behavioral therapy intervention for children and adolescents with chronic pain. *Pain.* 2009;146(1-2):205-213.

82.   Stinson JN, McGrath PJ, Hodnett ED, et al. An internet-based self-management program with telephone support for adolescents with arthritis: a pilot randomized controlled trial. *The Journal of rheumatology.* 2010;37(9):1944-1952.

83.   Karlson CW, Rapoff MA. Attrition in randomized controlled trials for pediatric chronic conditions. *Journal of pediatric psychology.* 2009;34(7):782-793.

84.   Maslow GR, Hill SN, Pollock MD. Comparison of Positive Youth Development for Youth With Chronic Conditions With Healthy Peers. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine.* 2016;59(6):716-721.

85.   Robb SL, Burns DS, Stegenga KA, et al. Randomized clinical trial of therapeutic music video intervention for resilience outcomes in adolescents/young adults undergoing hematopoietic stem cell transplant: a report from the Children's Oncology Group. *Cancer.* 2014;120(6):909-917.

86.   Hendricks-Ferguson VL, Cherven BO, Burns DS, et al. Recruitment strategies and rates of a multi-site behavioral intervention for adolescents and young adults with cancer. *Journal of pediatric health care : official publication of National Association of Pediatric Nurse Associates & Practitioners.* 2013;27(6):434-442.

87.   Stein RE, Jessop DJ. What diagnosis does not tell: the case for a noncategorical approach to chronic illness in childhood. *Social science & medicine (1982).* 1989;29(6):769-778.

88.   Seid M, Dellal G, Peterson LE, et al. Co-Designing a Collaborative Chronic Care Network (C3N) for Inflammatory Bowel Disease: Development of Methods. *JMIR human factors.* 2018;5(1):e8.

89.   Haapala EA, Lankhorst K, de Groot J, et al. The associations of cardiorespiratory fitness, adiposity and sports participation with arterial stiffness in youth with chronic diseases or physical disabilities. *European journal of preventive cardiology.* 2017;24(10):1102-1111.

90.   Raphael JL, Rueda A, Lion KC, Giordano TP. The role of lay health workers in pediatric chronic disease: a systematic review. *Academic pediatrics.* 2013;13(5):408-420.

91.   McGrady ME, Hommel KA. Medication adherence and health care utilization in pediatric chronic illness: a systematic review. *Pediatrics.* 2013;132(4):730-740.

92.   Woodward JF, Swigonski NL, Ciccarelli MR. Assessing the health, functional characteristics, and health needs of youth attending a noncategorical transition support program. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine.* 2012;51(3):272-278.

93.   Petkov J, Harvey P, Battersby M. The internal consistency and construct validity of the partners in health scale: validation of a patient rated chronic condition self-management measure. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation.* 2010;19(7):1079-1085.

94. Lenferink A, Effing T, Harvey P, et al. Construct Validity of the Dutch Version of the 12-Item Partners in Health Scale: Measuring Patient Self-Management Behaviour and Knowledge in Patients with Chronic Obstructive Pulmonary Disease. *PloS one.* 2016;11(8):e0161595.

95. Stewart KT, Chahal N, Kovacs AH, et al. Readiness for Transition to Adult Health Care for Young Adolescents with Congenital Heart Disease. *Pediatric cardiology.* 2017;38(4):778-786.

96. Sawicki GS, Lukens-Bull K, Yin X, et al. Measuring the transition readiness of youth with special healthcare needs: validation of the TRAQ--Transition Readiness Assessment Questionnaire. *Journal of pediatric psychology.* 2011;36(2):160-171.

97. Harju E, Roser K, Dehler S, Michel G. Health-related quality of life in adolescent and young adult cancer survivors. *Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer.* 2018.

98. Gandek B, Ware JE, Aaronson NK, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. *Journal of clinical epidemiology.* 1998;51(11):1171-1178.

99. Racine NM, Khu M, Reynolds K, Guilcher GMT, Schulte FSM. Quality of life in pediatric cancer survivors: contributions of parental distress and psychosocial family risk. *Current oncology (Toronto, Ont).* 2018;25(1):41-48.

100. Derogatis LR. *Brief Symptom Inventory (BSI) 18: Administration, scoring, and procedures manual.* Minneapolis, MN: NCS Pearson; 2000.

101. Derogatis LR, Melisaratos N. The Brief Symptom Inventory: an introductory report. *Psychological medicine.* 1983;13(3):595-605.

102. Roth G, Shahar BH, Zohar-Shefer Y, et al. Benefits of emotional integration and costs of emotional distancing. *Journal of personality.* 2017.

103. Deci EL, Ryan RM, Schultz PP, Niemiec CP. Being aware and functioning fully: Mindfulness and interest-taking within self-determination theory. In: Brown KW, Creswell JD, Ryan RM, eds. *Handbook of mindfulness: theory, research, and practice.* New York, NY: Guilford Press; 2015:112-129.

104. Wolever RQ, Simmons LA, Sforzo GA, et al. A Systematic Review of the Literature on Health and Wellness Coaching: Defining a Key Behavioral intervention in Healthcare. *Global advances in health and medicine.* 2013;2(4):38-57.

105. Bellg AJ, Borrelli B, Resnick B, et al. Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the NIH Behavior Change Consortium. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association.* 2004;23(5):443-451.

106. Robb SL, Burns DS, Docherty SL, Haase JE. Ensuring treatment fidelity in a multi-site behavioral intervention study: implementing NIH Behavior Change Consortium recommendations in the SMART trial. *Psycho-oncology.* 2011;20(11):1193-1201.

107. Kraemer HC, Wilson GT, Fairburn CG, Agras WS. Mediators and moderators of treatment effects in randomized clinical trials. *Archives of general psychiatry.* 2002;59(10):877-883.

108. Stice E, Marti N, Shaw H, O'Neil K. General and program-specific moderators of two eating disorder prevention programs. *The International journal of eating disorders.* 2008;41(7):611-617.

109. Sandelowski M. Unmixing mixed-methods research. *Research in nursing & health.* 2014;37(1):3-8.

110. Bazeley P. Integrative analysis strategies for mixed data sources. *American Behavioral Scientist.* 2012;56(8):814-828.

111. Guetterman TC, Fetters MD, Creswell JW. Integrating Quantitative and Qualitative Results in Health Science Mixed Methods Research Through Joint Displays. *Annals of family medicine.* 2015;13(6):554-561.

112. Saldana J. *The coding manual for qualitative researchers.* 3rd ed. Thousand Oaks, CA: Sage Publications; 2015.

113. Beach D, Rohlfing I. Integrating cross-case analyses and process tracing in set-theoretic research strategies and parameters of debate. *Sociological Methods & Research.* 2015;47(1):3-36.

114. Bennett A, Checkel JT. *Process tracing: From metaphor to analytic tool.* Cambridge, UK: Cambridge University Press; 2014.

115. Bennett A. Process tracing: a Bayesian perspective. In: Box-Steffensmeier JM, Brady HE, Collier D, eds. *The Oxford Handbook of Political Methodology*. Oxford, UK: Oxford; 2009:702-721.