

Diabetes Resilience: A Model of Risk and Protection in Type 1 Diabetes

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Abstract Declining diabetes management and control are common as children progress through adolescence, yet many youths with diabetes do remarkably well. Risk factors for poor diabetes outcomes are well-researched, but fewer data describe processes that lead to positive outcomes such as engaging in effective diabetes self-management, experiencing high quality of life, and achieving in-range glycemic control. Resilience theory posits that protective processes buffer the impact of risk factors on an individual's development and functioning. We review recent conceptualizations of resilience theory in the context of type 1 diabetes management and control and present a theoretical model of pediatric diabetes resilience. Applications to clinical care and research include the development of preventive interventions to build or strengthen protective skills and processes related to diabetes and its management. The ultimate goal is to equip youths with diabetes and their families with the tools to promote both behavioral and health-related resilience in diabetes.

Keywords Resilience · Risk · Quality of life · Adherence · Glycemic control · Diabetes · Protection

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Introduction

Some youths who face challenges struggle, while others excel. This phenomenon is evident across academic, social, and developmental domains [1•]. For youths with a chronic medical or physical condition, the dichotomy between those who do and do not overcome challenges is evident in terms of health outcomes, including disease management and control and health-related quality of life (HRQOL) [2••, 3••]. From those individuals who flourish despite facing challenges, we can learn lessons about resilience that may be applied to support those individuals who struggle [4••]. The purpose of this article is to present a conceptual model of resilience in youths with type 1 diabetes to serve as a framework for clinical research and practice.

We begin by introducing the construct of resilience and defining the key components. Next, we review the history of risk and resilience research in pediatrics. Finally, we present a new conceptual model of behavioral and health-related resilience among youths with type 1 diabetes. We summarize supporting research, identify areas for future study, and discuss considerations for applying the diabetes resilience model to research and clinical practice.

The Components of Resilience: Definitions

Resilience is defined as the achievement of one or more positive outcomes despite exposure to significant risk or adversity. Resilient youths are those who surmount challenges that would be expected to derail them from their expected course and demonstrate competence at or above ordinary levels of functioning [5–7]. Resilience is not an overarching personal trait but a class of outcomes that are more positive than would be expected for an individual exposed to serious adversity. Because resilience is defined

by whether performance or achievements reach a specified threshold of success, individuals may demonstrate resilience in one domain (e.g., emotional well-being) but not another (e.g., academic achievement) [5, 8].

Adversity and protection are two necessary components of resilience. Adversity is defined by exposure to risk factors that demonstrate statistical associations with suboptimal outcomes [9]. In addition to adverse experiences (e.g., exposure to natural disasters, war, abuse) and social or demographic characteristics linked with poorer outcomes (e.g., lower socioeconomic status, ethnic minority status), the diagnosis and management demands of a chronic or terminal medical condition are known risk factors for poor emotional and behavioral outcomes [10, 11, 12]. On the other end of the spectrum are protective factors, or assets, that are linked with positive outcomes [13]. A consistent set of assets linked with resilient outcomes in children has emerged, including intelligence, sense of humor, and supportive parents [7].

Resilience is achieved through a dynamic process of engagement with and surmounting of risk factors [8, 13–15, 16••]. While some youths become sensitized to the risks they encounter and have poor outcomes, others experience a “steeling effect” and develop skills or processes that neutralize or reduce the risk factors’ impact [16••]. For example, a child who has learned to use his intelligence to reason through potential solutions to a problem may develop more effective strategies to overcome future challenges. An optimistic teen may adapt to a difficult situation by reframing it in a positive light or eliciting support from others. It is this engagement with risk, rather than simply possessing an asset (e.g., intelligence, wit), that defuses danger and leads to resilient outcomes [16••]. The most powerful mechanisms of resilience are those processes that closely relate to the specific risk factor and that are salient and enduring for the individual, yet modifiable through intervention. Processes that create opportunities for future protective processes to occur are particularly important [4••, 13].

Risks, assets, and protective processes occur at the individual, interpersonal, and social/contextual (i.e., community and cultural) levels, suggesting that the achievement of resilient outcomes is multifactorial and multisystemic [1, 17–19]. Given developmental and physiological changes from early childhood through early adulthood, the factors and processes that influence resilience evolve over this period [20]. Moreover, factors and processes that promote resilience during one stage can have cascading effects that set the stage for continued resilience in later stages or other domains [4••, 13]. For these reasons, to fully grasp the phenomenon of resilience, we must understand the multidimensional processes that individuals engage in to achieve resilient outcomes within specific domains, circumstances, and developmental periods [8, 13, 16••].

Risk and Resilience in Pediatrics

Youths with chronic health conditions, including type 1 diabetes, are at risk for poor physical and mental health and poor behavioral outcomes [21]. However, many do quite well across developmental domains, raising the question about what promotes resilience among youth exposed to significant health-related adversity. Several conceptualizations of pediatric risk and resilience have emerged over the past 25 years [2••, 3••, 12, 22–27]. These models provide a foundational understanding of the factors linked with health and psychosocial functioning among youths with health conditions and their families. In addition to risks and assets linked with adaptive outcomes, important individual and family processes have been identified, including balancing the family’s needs with the needs of the condition, communicating effectively with family members and health professionals, using a systematic approach to problem solving, and employing a positive outlook regarding difficult medical situations [26, 28].

However, there are limitations to the existing models. Several models emphasize risks and assets but not the dynamic interactions with health-related self-management processes that lead to resilient health outcomes. Few acknowledge contextual influences outside the immediate family. Several focus on parents’ psychosocial well-being as the primary outcome, with less attention to the prediction and promotion of objective indices of children’s health status. Models of risk and resilience within specific populations, such as patients hospitalized for acute injuries or those with physical disabilities or cancer, may not be directly translatable to the issues facing youth with chronic health conditions that require daily medical management (e.g., diabetes, asthma). To address this need in pediatric asthma, Koinis-Mitchell and colleagues [27] developed a resilience model tailored to the risks and protective processes of urban children with asthma and emphasized disease management and morbidity as indicators of asthma resilience [2••].

Within pediatric diabetes, the factors and processes that promote resilient outcomes have likewise gained empirical attention [25, 29, 30•, 31–35]. Whittemore and colleagues’ [3••] model of adaptation in pediatric type 1 diabetes summarizes several psychosocial and behavioral responses to common challenges in this population. Building on Whittemore’s adaptation model, in the following pages, we present a model of resilience specific to youths with type 1 diabetes. This updated, process-oriented model of behavioral and health-related resilience aims to be a unifying framework for the mounting research in this area. The diabetes resilience model encompasses multiple domains of diabetes-specific resilience in the context of the unique, multidimensional, and evolving management needs of children, adolescents, and emerging adults with type 1 diabetes.

Diabetes Resilience Model

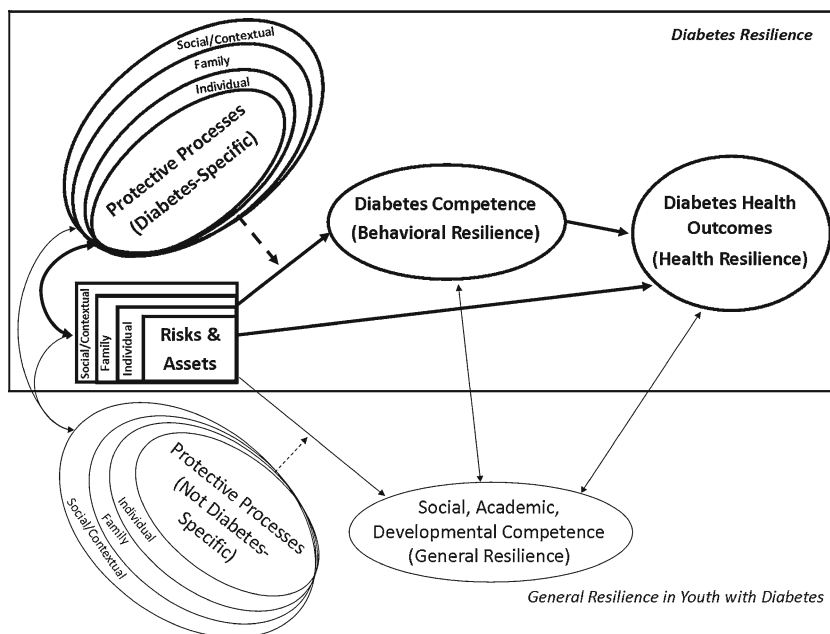
The complex management of type 1 diabetes makes it difficult for youths and their families to adhere to treatment recommendations, putting them at risk for short- and long-term health complications. Youths with type 1 diabetes are also at increased risk for poor behavioral and psychological outcomes, including depression [10, 11•]. Despite these risks, the degree to which youths with diabetes experience problematic outcomes such as deteriorating diabetes management and control varies [36–39], making type 1 diabetes an exemplar condition in which to model pathways to resilience in the context of a demanding pediatric chronic condition.

The diabetes resilience model is illustrated in Fig. 1. The top half of the figure represents the model’s emphasis on diabetes-specific resilient outcomes. At the far left, the “Risks & Assets” box represents the individual, family, and social/contextual characteristics and circumstances that are associated with positive or negative health outcomes. The circles at the middle and right of the diagram represent two domains of resilient outcomes among youths with type 1 diabetes: behavioral and health-related. Youths with behavioral resilience (center circle, “Diabetes Competence”) execute prescribed disease management behaviors and experience positive HRQOL, and those with health resilience (far right circle, “Diabetes Health Outcomes”) achieve adequate or better indices of diabetes-related health, including in-range glycemic control (i.e., HbA1c) and lack of medical complications (e.g., no hospital admissions for diabetic ketoacidosis [DKA]). The two domains of resilience are interrelated yet distinct, given robust evidence that aspects

of behavioral resilience in diabetes (e.g., more frequent blood glucose monitoring) influence aspects of health resilience (e.g., HbA1c within target range) [40]. Thus, this model includes direct links of risks and assets with health resilience and indirect links through behavioral resilience. The far left circle, “Diabetes-Specific Protective Processes,” represents the individual, family, and social/contextual processes by which youths overcome risks and achieve behavioral and health-related diabetes resilience. Each component is described in more detail in the following sections.

The bottom half of the model represents the non-diabetes-specific aspects of the lives of youths with type 1 diabetes [1•]. Social, academic, and other developmental milestones (“General Resilience” circle, bottom of figure) not only are important to teens with diabetes and their families, but also may have direct links with diabetes-specific domains of resilience [11•]. For example, a child with type 1 diabetes with blood glucose levels that are chronically above target or widely variable may be at risk for attentional or behavioral disruptions that interfere with academic functioning. Becoming licensed to drive a car may hinge on a teen’s engagement in careful diabetes self-management behind the wheel. The achievement of resilient outcomes in these domains may be influenced by similar risks and assets as those that influence diabetes outcomes, although the protective processes are not necessarily specific to diabetes. Although our emphasis is resilience specific to type 1 diabetes, normative developmental issues also merit careful research, since they are important to youths with diabetes and their families and may have close links with diabetes outcomes.

Fig. 1 Diabetes resilience model



Resilient Diabetes Outcomes

The diabetes resilience model includes two domains of positive diabetes-related outcomes: behavioral resilience, or “Diabetes Competence,” and health resilience, or “Diabetes Health Outcomes.” The diabetes health outcomes domain is the ultimate goal of clinical diabetes management, since it represents physiologic indicators of overall diabetes control, including blood glucose levels and variability and hemoglobin A1c, as well as consequences of glycemic control outside of the target range, including hospitalizations for DKA or signs of complications. The diabetes competence domain includes behavioral aspects of diabetes resilience, including engagement in the recommended tasks to manage diabetes (e.g., blood glucose monitoring, insulin adjustment and administration) and having good HRQOL. HRQOL represents subjective well-being, including the impact that an illness and its treatment have on an individual’s physical, psychological, and social functioning [41]. The behavioral resilience domain is a critical patient-related outcome and is also conceptualized as a mediator linking risks and assets with resilient diabetes health outcomes.

Risks and Assets in Diabetes

A large body of literature has catalogued individual, family, social, and contextual risks to diabetes management and control [11, 42, 43]. Assets associated with better diabetes outcomes have gained attention in the literature, yet still lag behind risk factors.

On an individual level, “diabetes burnout” and distress, symptoms of mood or anxiety, and behavioral problems are risk factors for suboptimal diabetes management and control [10, 44–47]. On the other hand, prosocial characteristics and having greater general well-being are assets [11, 31, 48]. Given that stronger cognitive abilities, including better diabetes knowledge, memory, and executive functioning, are protective [45, 49], it is not surprising that youths whose diabetes self-care responsibilities exceed their cognitive capacities or maturity are at risk for poorer outcomes [50].

Family relationships characterized by conflict and hostility are associated with poorer HRQOL and diabetes management and control [51–53], while cohesive, supportive family environments are associated with positive outcomes [31, 54, 55]. Similarly, having two involved caregivers is protective [56], while youths with a single caregiver are at risk for poorer outcomes [57, 58]. Parental characteristics including warmth and empathy are assets [59, 60], and

parental risk factors include maternal depression [61, 62], parenting stress [63], and feeling burdened by diabetes [64].

Social and contextual factors, including school and peer issues, community resources, cultural norms, and demographic characteristics are also relevant. Children who report school-related stress or concerns about teachers being unaccommodating or misunderstanding diabetes tend to have poorer diabetes management and control, while perceptions of supportive school staff are linked with better outcomes [65, 66]. Peer influences can be both positive and negative [67–71]. Cultural norms and community resources have demonstrated associations with risk and protection among youths with and without chronic conditions [19, 72], but less is known about their roles within a type 1 diabetes population. Demographic characteristics such as age, socioeconomic status, and ethnic minority status are also linked with risk or protection [57, 58, 73].

Diabetes-Specific Protective Processes

To understand why this catalogue of risks and assets impacts diabetes outcomes, we must understand the processes in which youths and their families engage to capitalize on their assets and overcome risks to achieve good outcomes. The Pediatric Self-Management Model [74] and the Revised Childhood Adaptation Model to Chronic Illness: Diabetes Mellitus [3••] emphasize the roles of coping and self-management processes in linking risks and assets with disease-specific treatment adherence and health outcomes. Consistent with these models, the diabetes resilience model posits that active, behavioral, diabetes-specific processes build on one’s assets to buffer risk and enhance behavioral and health-related resilience. For each risk or asset linked with negative or positive diabetes outcomes, there is a protective process by which risk is surmounted and resilient outcomes are achieved. While some of these processes have been established empirically, many remain at the theoretical level. Ongoing research is needed to determine the individual, family, social, and contextual processes that are most effective in buffering risk.

Individually, the processes by which diabetes burnout, distress, and psychological symptoms interfere with diabetes management and, ultimately, control include feeling less efficacious about diabetes management, using less adaptive coping skills to manage challenges, and experiencing decreased motivation or concentration [30, 54, 75, 76]. On the other hand, resilient youths use emotional processing [77] and adaptive coping skills, including benefit-finding, optimism, and hopefulness, to interpret challenging situations or events [30, 32, 33, 54, 60]. These processes can build youths’ self-efficacy to engage in self-care behaviors [29, 78, 79]. Many of the challenges encountered in day-to-day

diabetes management require careful calculations and making decisions based on anticipated consequences, all of which employ sophisticated thought processes. Thus, cognitive abilities may impact resilient diabetes outcomes by facilitating effective problem-solving and by equipping youths with the executive functioning skills necessary to conduct complex diabetes management tasks [77, 80].

On a family level, the benefits of a cohesive, supportive family environment likely encompass better family communication, more frequent and helpful parental participation in diabetes care, and receiving tangible and emotional support or empathy from parents [52, 53, 81]. Similarly, having two involved caregivers facilitates greater parental monitoring. Parents' efforts to monitor or assist with diabetes management in a positive, supportive manner can impact teens' self-efficacy and promote effective self-management, which ultimately enhance glycemic control [36, 53, 78, 82, 83]. On the other hand, the risks associated with single-caregiver status or parental psychopathology may reflect limitations on families' resources or abilities to effectively monitor or execute the multiple components of diabetes care [57, 58, 62].

With regard to social processes, when youths perceive that their teachers understand and support diabetes management, they may feel more at ease completing self-management tasks during the school day without worry of being challenged or having to explain themselves. This can buffer potential barriers such as feeling embarrassed or uncomfortable [65, 66]. Social competence [30•, 68] may facilitate emotional or instrumental support from friends [67, 69] and may help youths to confidently engage in diabetes management tasks in social settings without fearing rejection or teasing.

On a cultural and contextual level, there is a growing appreciation of the roles of cultural influences and community support in the achievement of resilient outcomes across domains [19] and, specifically, within children's and families' appraisals of and coping with chronic conditions [72]. However, less is known about the degree to which these processes buffer risk in youth with type 1 diabetes or how these protective processes unfold. Furthermore, the processes by which demographic characteristics are buffered to promote positive outcomes are not fully understood. For example, while hormonal changes related to pubertal status pose risks to glycemic outcomes due to a link with insulin resistance [84], protective processes related to age or gender remain unclear. Youths who are not of ethnic minority status and those from higher socioeconomic strata may be protected by historical and societal processes that increase their access to resources and high-quality health care. More research is needed in this area to determine what processes may be implemented with youths who are exposed to demographic risks that are not directly modifiable.

Resilience Research Considerations

Study Design and Data Analysis

The diabetes resilience model is a theoretical model based in the existing body of literature. Rigorous research is needed to validate the model and identify the fundamental processes that promote resilient outcomes in youths with type 1 diabetes. A key consideration for future research relates to the range of risk experienced by study participants. Including participants with both higher and lower risk levels allows for examination of the interactions, or moderating relationships, between degree of risk and protective processes [5, 16••] and, thus, allows for identification of protective processes that work better at lower versus higher levels of risk [18].

Dimensional or variable-centered analytic approaches are well-suited for study designs that include all risk levels [5–7, 14]. Resilience is quantified as a continuous outcome (or outcomes) and the main and interactive effects of risks or assets on specific outcomes are evaluated. For example, Berg and colleagues [82] found that parents' use of persuasive strategies regarding adolescents' diabetes self-care behaviors benefited glycemic control. However, these strategies interacted with self-efficacy such that teens with higher (but not lower) self-efficacy reported reduced diabetes-related confidence following parents' attempts to persuade, suggesting that the use of this protective process may be protective only for a particular subset of teens and confer unintended risk for others.

An alternative is to include only youths who are at markedly elevated risk, allowing for a focused examination of diabetes resilience among those youths most likely to have poor outcomes. Given the burdens of having and managing a chronic illness [12, 21], as well as elevated rates of depression [10] and evidence of declining self-management even among youths with type 1 diabetes whose glycemic control is at or near targets [36, 37], it may be reasonable to classify all youths with diabetes as "at elevated risk," as compared with youths without a chronic condition. Depending on the specific outcomes of interest, researchers will need to determine what constitutes the risk categories for each study.

Group- or person-centered approaches are categorical in nature and are well-suited for studies focusing on youths at elevated risk [6, 7, 13, 14, 18]. In this approach, the researcher uses predetermined thresholds for outcome scores to classify individuals into categories of "resilient" or "not resilient." For example, to be classified as resilient in the diabetes health domain, a teen may need to achieve an HbA1c below the American Diabetes Association guideline of 7.5 %. The criteria for a resilient categorization are determined by the researcher, who should consider how

many positive outcomes are needed, in which domains, and what evidence guides the selection of score thresholds indicating resilience [7]. Once categorized, the risks, assets, and protective processes for youths in each category are compared to determine which predictors are linked with resilient versus not resilient outcomes among those youth most likely to struggle.

Both methodological and analytic approaches have their merits and can grow our understanding of diabetes resilience, yet decisions about sample composition and analytic strategies should be carefully considered in the context of each study's aims [7, 13].

Scope, Timing, and Duration of Study

Prospective cohort designs will be critical to understanding the dynamic nature of resilience in youths with diabetes [15]. Development across the pediatric age range means that risks, assets, and protective processes may change over time, particularly during vulnerable developmental stages and transitions [4•, 15, 18, 43, 52]. For example, parental and family environment factors may be more influential in childhood, as compared with social issues, autonomy, and executive functioning in adolescence. It will be important to study how the diabetes resilience model framework is applied to predict positive outcomes during vulnerable periods of transitions in development (e.g., early childhood, transition to adolescence, emerging adulthood) and in diabetes management (e.g., at diagnosis, during the honeymoon phase, with changes in insulin regimen). Growing awareness of the challenges, diabetes-related and otherwise, during emerging adulthood [17, 20, 85, 86] makes this a period in which resilience research may have particularly important implications for lifelong health.

Like the influences on diabetes management and control, resilient outcomes are not static but, rather, fluctuate over time and development. It may be that it is the pattern of an individual's diabetes management behaviors and control that matters more than a snapshot of these outcomes at any single point in time. Recent advances in resilience theory suggest that the process of attaining resilient outcomes at one developmental stage can set in motion a cascade of beneficial processes that lead to future resilience [4•], further emphasizing the need for longitudinal studies that begin in early childhood and track progress over developmental periods. Cascading effects on resilience may be of particular relevance to prevention-oriented clinicians, researchers, and policy-makers.

Finally, the diabetes resilience model presented here emphasizes potentially modifiable social and behavioral processes, as well as the cultural context in which diabetes management and control occur. However, mounting evidence for genetic, biological, and physiological factors

related to both resilience and diabetes control argues for consideration of protective factors and processes in these domains as well [13, 15, 87–90].

Implications for Intervention

The diabetes resilience model has implications for both clinical intervention and prevention programs. A number of well-supported existing interventions for youths with diabetes target such risk factors as depressive symptoms and diabetes-specific family conflict and communication problems [91–94]. Fewer interventions explicitly target the prevention of poor diabetes outcomes via the promotion of protective skills and processes [95–97]. Integrating or adapting interventions that target specific risk factors with those that enhance critical protective processes [4•] may be an effective approach to extending the impact of existing interventions for youths at-risk for poor HRQOL or diabetes management and control. For example, Behavioral Family Systems Therapy for Diabetes (BFST-D) [90] teaches strategies for supportive, effective family communication and Coping Skills Training (CST) [93] teaches teens and families adaptive strategies to manage diabetes-related stressors. Adaptations of BFST-D and CST to promote behavioral and health-related resilience among those at highest risk may include targeting youth with elevated depressive symptoms, families experiencing more diabetes-related conflict, or those without convenient access to mental health professionals, such as via eHealth technologies.

Prevention programs not specific to health conditions, such as the Penn Resiliency Program (PRP) [98], promote psychosocial resilience by equipping youth with skills that are known to protect against the development of depression. Adaptations of programs like PRP to address common risks and build known protective processes in diabetes hold potential to improve diabetes outcomes by preparing youths to manage the diabetes-related risks that are they are likely to face.

Observational research will help identify the most salient processes to emphasize in resilience-promotion programs for youths with diabetes. Modifiable processes and skills are better targets than risk factors that are more difficult to impact clinically [4•, 8, 9]. Extant research would point to modules that build such skills as executive functioning and problem solving [80, 99], parent–child and family–provider communication [26, 28, 92, 93], and using benefit-finding strategies, optimism, or positive affect to cope with diabetes-related burdens or challenges [26, 28, 33, 98, 100]. By proactively enhancing skills like these, negative outcomes may be avoided in favor of cascading protective processes that ultimately lead to resilient outcomes [4•].

Considerations for clinicians and intervention researchers include timing (i.e., at or before vulnerable transitions), scope of domains to address (i.e., single or multiple/comprehensive), treatment targets (i.e., risks and assets, protective processes, both), and degree of individualization (i.e., universal/common factors or individual/tailored modules) [4•, 9, 24, 87].

Conclusions

Diabetes resilience is an emerging concept that can provide insights about why and how certain youths do well with diabetes management, control, and HRQOL, while others faced with similar risk profiles struggle. The diabetes resilience model posits that impact of risks and assets on resilient diabetes-related outcomes may be attenuated or enhanced by salient diabetes-specific protective processes, many of which remain to be identified. There exists a strong foundation of understanding the risks and assets that predict diabetes management and control, and future research is needed to identify the key processes by which these factors influence critical diabetes outcomes. From resilient youths, we can learn practical, clinically relevant lessons and strategies to support those that struggle. Through a synergistic emphasis on both risk reduction and the promotion of protective processes in clinical care and research, we may prepare youths with type 1 diabetes to respond well to disease-related challenges and, ultimately, set the stage for resilient behavioral and health outcomes.

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References

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

1. • Kia-Keating M, Dowdy E, Morgan ML, Noam GG. Protecting and promoting: an integrative conceptual model for healthy development of adolescents. *J Adolesc Health*. 2011;48:220–8. *This recent paper coherently integrates related yet distinct bodies of literature addressing factors and processes that achievement of positive outcomes across multiple, important domains of functioning in adolescence.*
2. •• Koinis-Mitchell D, McQuaid AL, Jandasek B, et al. *J Pediatr Psychol*. 2012;37:424–37. *This paper is an exemplar application of a model of resilience specific to a chronic pediatric health condition, asthma. The use of both self-management behaviors and quality of life informed the “diabetes competence” concept underlying the behavioral resilience outcome in the diabetes resilience model.*
3. •• Whitemore R, Jaser S, Guo J, Grey M. A conceptual model of childhood adaptation to type 1 diabetes. *Nurs Outlook*. 2010;58:242–51. *This recent conceptual model of adaptation in type 1 diabetes provides a well-researched review of behaviors that youth with diabetes and their families engage in to respond to common risk factors. The emphasis on processes linked with adaptive outcomes was one foundational idea upon which the diabetes resilience model was guided.*
4. •• Masten AS. Resilience in children threatened by extreme adversity: frameworks for research, practice, and translational synergy. *Dev Psychopathol*. 2011;23:493–506. *This paper is a comprehensive overview of basic resilience concepts, recent and emerging conceptualizations of resilience, and implications for the application of resilience research. The paper is authored by a well-respected expert with decades of experience in this area of research.*
5. Luthar SS. Methodological and conceptual issues in research on childhood resilience. *J Child Psychol Psychiatry*. 1993;34:441–53.
6. Masten AS, Hubbard JJ, Gest SD, Tellegen A, Garmezy N, Ramirez M. Competence in the context of adversity: pathways to resilience and maladaptation from childhood to late adolescence. *Dev Psychopathol*. 1999;11:143–69.
7. Masten AS. Ordinary magic: resilience processes in development. *Am Psychol*. 2001;56:227–38.
8. Olsson CA, Bond L, Burns JM, Vella-Brodrick DA, Sawyer SM. Adolescent resilience: a concept analysis. *J Adolesc*. 2003;26:1–11.
9. Sandler I. Quality and ecology of adversity as common mechanisms of risk and resilience. *Am J Community Psychol*. 2001;29:19–61.
10. Grey M, Whitemore R, Tamborlane W. Depression in type 1 diabetes in children: natural history and correlates. *J Psychosom Res*. 2002;53:907–11.
11. • 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;33:1430–7. *This paper is a good example of recent, prospective research efforts to understand the factors linked with positive outcomes (both diabetes-related and not) among youth with type 1 diabetes.*
12. Patterson JM, Blum RW. Risk and resilience among youth with disabilities. *Arch Pediatr Adolesc Med*. 1996;150:692–8.
13. Luthar SS, Sawyer JA, Brown PJ. Conceptual issues in studies of resilience: past, present, and future research. *Ann N Y Acad Sci*. 2006;1094:105–15.
14. Luthar SS, Cicchetti D, Becker B. The construct of resilience: a critical evaluation and guidelines for future work. *Child Dev*. 2000;71:543–62.
15. Masten AS. Regulatory processes, risk, and resilience in adolescent development. *Ann N Y Acad Sci*. 2004;1021:310–9.
16. •• Rutter M. Resilience as a dynamic concept. *Dev Psychopathol*. 2012;24:335–44. *Rutter is an established expert in resilience research, and this recent paper reviews his emphasis on dynamic processes to overcome risk. This is a central tenet of current resilience conceptualizations and strongly informed the diabetes resilience model.*

17. Burt KB, Paysnick AA. Resilience in the transition to adulthood. *Dev Psychopathol.* 2012;24:493–505.
18. Vanderbilt-Adriance E, Shaw DS. Conceptualizing and re-evaluating resilience across levels of risk, time, and domains of competence. *Clin Child Fam Psychol Rev.* 2008;11:30–58.
19. Arrington EG, Wilson MN. A re-examination of risk and resilience during adolescence: incorporating culture and diversity. *J Child Fam Stud.* 2000;9:221–30.
20. Obradovic J, Burt KB, Masten AS. Pathways of adaptation from adolescence to young adulthood: antecedents and correlates. *Ann N Y Acad Sci.* 2006;1094:340–4.
21. Pinquart M, Teubert D. Academic, physical, and social functioning of children and adolescent with chronic physical illness: a meta-analysis. *J Pediatr Psychol.* 2012;37:376–89.
22. Wallander JL, Varni JW, Babani L, et al. The social environment and the adaptation of mothers of physically handicapped children. *J Pediatr Psychol.* 1989;14:371–87.
23. Wells RD, Schwebel AI. Chronically ill children and their mothers: predictors of resilience and vulnerability to hospitalization and surgical stress. *J Dev Behav Pediatr.* 1987;8:83–9.
24. Haase JE. The adolescent resilience model as a guide to interventions. *J Pediatr Oncol Nurs.* 2004;21:289–99.
25. Hauser ST, Vieyra MAB, Jacobson AM, Wertlieb D. Vulnerability and resilience in adolescence: views from the family. *J Early Adolesc.* 1985;5:81–100.
26. Rolland JS, Walsh F. Facilitating family resilience with childhood illness and disability. *Curr Opin Pediatr.* 2006;18:527–38.
27. Koinis-Mitchell D, Murdock KK, McQuaid EL. Risk and resilience in urban children with asthma: a conceptual model and exploratory study. *Child Health Care.* 2004;33:275–97.
28. Patterson JM. A family systems perspective for working with youth with disability. *Pediatrics.* 1991;18:129–41.
29. Herge WM, Streisand R, Chen R, et al. Family and youth factors associated with health beliefs and health outcomes in youth with type 1 diabetes. *J Pediatr Psychol.* 2012. doi:10.1093/jpepsy/jss067.
30. Jaser SS, White LE. Coping and resilience in adolescents with type 1 diabetes. *Child Care Health Dev.* 2010;37:335–42. *This recent paper is a good example of the growing body of research in type 1 diabetes focusing on the identification of factors and processes that promote positive diabetes outcomes.*
31. Mackey ER, Hilliard ME, Berger SS, Streisand R, Chen R, Holmes C. Individual and family strengths: an examination of the relation to disease management and metabolic control in youth with type 1 diabetes. *Fam Syst Health.* 2011;29:314–26.
32. Mednick L, Cogen F, Henderson C, Rohrbeck CA, Kitessa D, Streisand R. Hope more, worry less: hope as a potential resilience factor in mothers of very young children with type 1 diabetes. *Child Health Care.* 2007;36:385–96.
33. Tran V, Wiebe DJ, Fortenberry KT, Butler JM, Berg CA. Benefit finding, affective reactions to diabetes stress, and diabetes management among early adolescents. *Health Psychol.* 2011;30:212–9.
34. Yi JP, Vitalino PP, Smith RE, Yi JC, Weinger K. The role of resilience on psychological adjustment and physical health in patients with diabetes. *Br J Health Psychol.* 2008;13:311–25.
35. Yi-Frazier YP, Smith RE, Vitaliano PP, et al. A person-focused analysis of resilience resources and coping in patients with diabetes. *Stress Heal.* 2010;26:51–60.
36. Helgeson VS, Snyder PR, Seltman H, Escobar O, Becker D, Siminerio L. Trajectories of glycemic control over early to middle adolescence. *J Pediatr Psychol.* 2010;35:1161–7.
37. Hilliard ME, Wu YP, Rausch J, Dolan LM, Hood KK. Predictors of deteriorations in diabetes management and control in adolescents with type 1 diabetes. *J Adolesc Health.* 2012. doi:10.1016/j.jadohealth.2012.05.009.
38. Luyckx K, Seiffge-Krenke I. Continuity and change in glycemic control trajectories from adolescence to emerging adulthood. *Diabetes Care.* 2009;32:797–801.
39. Rohan JM, Delamater A, Pendley JS, Dolan L, Reeves G, Drotar D. Identification of self-management patterns in pediatric type 1 diabetes using cluster analysis. *Pediatr Diabetes.* 2011;12:611–8.
40. Hood KK, Peterson CM, Rohan JM, Drotar D. Association between adherence and glycemic control in pediatric type 1 diabetes: a meta-analysis. *Pediatrics.* 2009;124:e1171–9.
41. Varni JW, Burwinkle TM, Jacobs JR, Gottschalk M, Kaufman F, Jones KL. The PedsQL™ in type 1 and type 2 diabetes: reliability and validity of the Pediatric Quality of Life Inventory™ generic core scales and type 1 diabetes module. *Diabetes Care.* 2003;26:631–7.
42. Kovacs M, Goldston D, Obrosky S, Iyengar S. Prevalence and predictors of pervasive noncompliance with medical treatment among youths with insulin-dependent diabetes mellitus. *J Am Acad Child Adolesc Psychiatry.* 1992;31:1112–9.
43. Weissberg-Benchell J, Glasgow AM, Tynan WD, Wirtz P, Turek J, Ward J. Adolescent diabetes management and mismanagement. *Diabetes Care.* 1995;18:77–82.
44. Herzer M, Hood KK. Anxiety symptoms in adolescents with type 1 diabetes: associations with blood glucose monitoring and glycemic control. *J Pediatr Psychol.* 2010;35:415–25.
45. Holmes CS, Chen R, Streisand R, et al. Predictors of youth diabetes care behaviors and metabolic control: a structural equation modeling approach. *J Pediatr Psychol.* 2006;31:770–84.
46. Hood KK, Huestis S, Maher A, Butler D, Volkening L, Laffel LMB. Depressive symptoms in children and adolescents with type 1 diabetes: association with diabetes-specific characteristics. *Diabetes Care.* 2006;29:1389–91.
47. Polonsky W. Diabetes burnout: what to do when you can't take it anymore. *American Diabetes Association;* 1999.
48. Hoey H, Aanstoot H, Chiarelli F, et al. Good metabolic control is associated with better quality of life in 2,101 adolescents with type 1 diabetes. *Diabetes Care.* 2001;24:1923–8.
49. Soutor SA, Chen R, Streisand R, Kaplowitz P, Holmes CS. Memory matters: developmental differences in predictors of diabetes care behaviors. *J Pediatr Psychol.* 2004;29:493–505.
50. Wysocki T, Taylor A, Hough BS, Linscheid TR, Yeates KO, Naglieri JA. Deviation from developmentally appropriate self-care autonomy: association with diabetes outcomes. *Diabetes Care.* 1996;19:119–25.
51. Anderson BJ. Family conflict and diabetes management in youth: clinical lessons from child development and diabetes research. *Diabetes Spectr.* 2004;17:22–6.
52. Harris MA. Dogs, cats, and diabetes. *Diabetes Spectr.* 2006;19:187–9.
53. Weissberg-Benchell J, Nansel T, Holmbeck G, et al. Generic and diabetes-specific parent-child behaviors and quality of life among youth with type 1 diabetes. *J Pediatr Psychol.* 2009;34:977–88.
54. Grey M, Boland EA, Yu C, Sullivan-Bolyai S, Tamborlane WV. Personal and family factors associated with quality of life in adolescents with diabetes. *Diabetes Care.* 1998;21:909–14.
55. Hanson CL, Henggeler SW, Harris MA, Burghen GA, Moore M. Family system variables and the health status of adolescents with insulin-dependent diabetes mellitus. *Health Psychol.* 1989;8:239–53.
56. Wysocki T, Nansel TR, Holmbeck GN, et al. Collaborative involvement of primary and secondary caregivers: associations with youth's diabetes outcomes. *J Pediatr Psychol.* 2009;34:869–81.
57. Harris MA, Greco P, Wysocki T, Elder-Danda C, White NH. Adolescents with diabetes from single-parent, blended, and intact families: health-related and family functioning. *Fam Syst Health.* 1999;17:181–96.

58. Swift EE, Chen R, Hershberger A, Holmes CS. Demographic risk factors, mediators, and moderators in youths' diabetes metabolic control. *Ann Behav Med.* 2006;32:355–65.
59. Butler DA, Zuehlke JB, Tovar A, Volkening LK, Anderson BJ, Laffel LMB. The impact of modifiable family factors on glycemic control among youth with type 1 diabetes. *Pediatr Diabetes.* 2008;9:373–81.
60. Lloyd SM, Cantell M, Pacaud D, Crawford S, Dewey D. Hope, perceived maternal empathy, medical regimen adherence, and glycemic control in adolescents with type 1 diabetes. *J Pediatr Psychol.* 2009;34:1025–9.
61. Eckshtain D, Ellis DA, Kolmodin K, Naar-King S. The effects of parental depression and parenting practices on depressive symptoms and metabolic control in urban youth with insulin dependent diabetes. *J Pediatr Psychol.* 2010;35:426–35.
62. Wiebe DJ, Gelfand D, Butler JM, et al. Longitudinal associations of maternal depressive symptoms, maternal involvement, and diabetes management across adolescence. *J Pediatr Psychol.* 2011;36:837–46.
63. Streisand R, Mackey ER, Elliot BM. Parental anxiety and depression associated with caring for a child newly diagnosed with type 1 diabetes: opportunities for education and counseling. *Patient Educ Couns.* 2008;73:333–8.
64. Cunningham NR, Vesco AT, Dolan LM, Hood KK. From caregiver psychological distress to adolescent glycemic control: the mediating role of perceived burden around diabetes management. *J Pediatr Psychol.* 2011;36:196–205.
65. Hains AA, Berlin KS, Davies WH, et al. Attributions of teacher reactions to diabetes self-care behaviors. *J Pediatr Psychol.* 2009;34:97–107.
66. Sato AF, Berlin KS, Hains AA, et al. Teacher support of adherence for adolescents with type 1 diabetes: preferred teacher support behaviors and youths' perceptions of support. *Diabetes Educ.* 2008;34:866–73.
67. La Greca AM, Auslander WF, Greco P, Spetter D, Fisher EB, Santiago JV. I get by with a little help from my family and friends: adolescents' support for diabetes care. *J Pediatr Psychol.* 1995;20:449–476.
68. Hanson CL, Henggeler SW, Burghen GA. Social competence and parental support as mediators of the link between stress and metabolic control in adolescents with insulin-dependent diabetes mellitus. *J Consult Clin Psychol.* 1987;55:529–33.
69. Hains AA, Berlin KS, Davies WH, Smothers MK, Sato AF, Alemzadeh R. Attributions of adolescents with type 1 diabetes related to performing diabetes care around friends and peers: The moderating role of friend support. *J Pediatr Psychol.* 2007;32:561–70.
70. Drew LM, Berg C, Wiebe DJ. The mediating role of extreme peer orientation in the relationships between parent-adolescent relationship and diabetes management. *J Fam Psychol.* 2010;24:299–306.
71. Helgeson VS, Reynolds KA, Escobar O, Siminerio L, Becker D. The role of friendship in the lives of male and female adolescents: does diabetes make a difference? *J Adolesc Health.* 2007;40:36–43.
72. MCCubbin HI, Thompson EA, Thompson AI, MCCubbin MA, Kaston AJ. Culture, ethnicity, and the family: critical factors in childhood chronic illness and disabilities. *Pediatrics.* 1993;91:1063–70.
73. Gallegos-Macias AR, Macias SR, Kaufman E, Skipper B, Kalishman N. Relationship between glycemic control, ethnicity, and socioeconomic status in Hispanic and white non-Hispanic youth with type 1 diabetes. *Pediatr Diabetes.* 2003;4:19–23.
74. Modi AC, Pail AL, Hommel KA, et al. Pediatric self-management: a framework for research, policy, and practice. *Pediatrics.* 2012;129:e473–85.
75. McGrady ME, Laffel L, Drotar D, Repaske D, Hood KK. Depressive symptoms and glycemic control in adolescents with type 1 diabetes: mediational role of blood glucose monitoring. *Diabetes Care.* 2009;32:804–6.
76. Graue M, Wentzel-Larsen T, Bru E, Hanestad BR, Sovik O. The coping styles of adolescents with type 1 diabetes are associated with degree of metabolic control. *Diabetes Care.* 2004;27:1313–7.
77. Hughes AE, Berg CA, Wiebe DJ. Emotional processing and self-control in adolescents with type 1 diabetes. *J Pediatr Psychol.* 2012. doi:10.1093/jpepsy/jss062.
78. Berg CA, King PS, Butler JM, et al. Parental involvement and adolescents' diabetes management: the mediating role of self-efficacy and externalizing and internalizing behaviors. *J Pediatr Psychol.* 2011;36:329–39.
79. Johnston-Brooks CH, Lewis MA, Garg S. Self-efficacy impacts self-care and HbA1c in young adults with type 1 diabetes. *Psychosom Med.* 2002;64:43–51.
80. Hill-Briggs F, Gemmell L. Problem solving in diabetes self-management and control: a systematic review of the literature. *Diabetes Educ.* 2007;33:1032–50.
81. Ellis DA, Podolski C, Frey M, Naar-King S, Wang B, Moltz K. The role of parental monitoring in adolescent health outcomes: impact on regimen adherence in youth with type 1 diabetes. *J Pediatr Psychol.* 2007;32:907–17.
82. Berg CA, Butner JE, Butler JM, et al. Parental persuasive strategies in the face of daily problems in adolescent type 1 diabetes management. *Health Psychol.* 2012. doi:10.1037/a0029427.
83. Hilliard ME, Holmes CS, Chen R, et al. Disentangling the roles of parental monitoring and family conflict in adolescents' type 1 diabetes self-care. *Health Psychol.* 2012. doi:10.1037/a0027811.
84. Amiel SA, Sherwin RS, Simonso DC, Lauritano AA, Tamborlane WV. Impaired insulin action in puberty. *NEJM.* 1986;315:215–9.
85. Weissberg-Benchell J, Wolpert H, Anderson BJ. Transitioning from pediatric to adult care: a new approach to the post-adolescent young person with type 1 diabetes. *Diabetes Care.* 2007;30:2441–6.
86. Peters A, Laffel L, American Diabetes Association Transitions Working Group. Diabetes care for emerging adults: recommendations for transition from pediatric to adult diabetes care systems. *Diabetes Care.* 2011;34:2477–85.
87. Rutter M. Some research considerations on intergenerational continuities and discontinuities: comment on special section. *Dev Psychol.* 1998;34:1269–73.
88. Cichetti D, Rogosch FA. Gene x environment interaction and resilience: effects of child maltreatment and serotonin, corticotrophin releasing hormone, dopamine, and oxytocin genes. *Dev Psychopathol.* 2012;24:411–27.
89. Obradovic J. How can the study of physiological reactivity contribute to our understanding of adversity and resilience processes in development? *Dev Psychopathol.* 2012;24:371–87.
90. Feder A, Nestler EJ, Charney DS. Psychobiology and molecular genetics of resilience. *Nat Rev Neurosci.* 2009;10:446–57.
91. Harris MA, Freeman KA, Duke DC. Getting (the most) out of the research business: interventions for youth with T1DM. *Curr Diab Rep.* 2010;10:406–14.
92. Wysocki T, Harris MA, Buckloh LM, et al. Randomized, controlled trial of behavioral family systems therapy for diabetes: maintenance and generalization of effects on parent-adolescent communication. *Behav Ther.* 2008;39:33–46.
93. Anderson BJ, Brackett J, Ho J, Laffel LMB. An office-based intervention to maintain parent-adolescent teamwork in diabetes management: impact on parent involvement, family conflict, and subsequent glycemic control. *Diabetes Care.* 1999;22:713–21.
94. Ellis DA, Frey MA, Naar-King S, Templin T, Cunningham P, Cakan N. Use of multisystemic therapy to improve regimen

- adherence among adolescents with type 1 diabetes in chronic poor metabolic control: a randomized controlled trial. *Diabetes Care*. 2005;28:1604–10.
95. Grey M, Boland EA, Davidson M, Li J, Tamborlane WV. Coping skills training for youth with diabetes mellitus has long-lasting effects on metabolic control and quality of life. *J Pediatr*. 2000;137:107–13.
 96. De Wit M, Delemarre-van de Waal HA, Bokma JA, et al. Monitoring and discussing health-related quality of life in adolescents with type 1 diabetes improves psychosocial well-being: a randomized controlled trial. *Diabetes Care*. 2008;31:1521–1526.
 97. Fogel NR, Weissberg-Benchell J. Preventing poor psychological and health outcomes in pediatric type 1 diabetes. *Curr Diab Rep*. 2010;10:436–43.
 98. Gillham J, Reivich K. Cultivating optimism in childhood and adolescence. *Ann Am Acad Pol Soc Sci*. 2004;591:146–63.
 99. Greenberg MT. Promoting resilience in children and youth: preventive interventions and their interface with neuroscience. *Ann N Y Acad Sci*. 2006;1094:139–50.
 100. Beaver BR. A positive approach to children's internalizing problems. *Prof Psychol Res Pract*. 2008;39:129–36.