Nursing Management of Type 1 Diabetes in Children

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Abstract:

Nursing management of Type 1 diabetes in children involves a comprehensive approach aimed at achieving optimal glycemic control while promoting growth and development. Key activities include educating the child and family about the disease, carbohydrate counting, and the importance of regular blood glucose monitoring. Nurses should work closely with families to create individualized care plans that encompass routine insulin administration, recognition of hypo- and hyperglycemia symptoms, and strategies for managing these conditions. Additionally, providing resources and support groups can empower families to manage diabetes effectively and make informed decisions regarding their child's health. Coordinating care among a multidisciplinary team is essential in supporting the physical, psychological, and social aspects of diabetes management in children. Regular follow-up appointments are crucial to monitor the child's growth, diabetes management, and any potential complications, such as diabetic ketoacidosis or long-term vascular effects. Nurses should also address the emotional needs of both the child and their family, helping to reduce anxiety and improve adherence to treatment. Encouraging active participation in diabetes management fosters independence and can help children develop positive self-management skills as they grow.

Keywords: Type 1 Diabetes, Nursing Management, Children's Health, Glycemic Control, Insulin Administration, Blood Glucose Monitoring, Family Education, Karbohydrate Counting, Multidisciplinary Care, Complication Monitoring, Emotional Support, Self-management Skills.

Introduction:

Type 1 diabetes (T1D) is a chronic metabolic disorder characterized by the autoimmune destruction of insulin-producing beta cells in the pancreas, leading to absolute insulin deficiency. This condition typically manifests during childhood or adolescence, making effective management crucial not only for immediate health outcomes but also for long-term quality of life. According to the International Diabetes Federation, an estimated 1.1 million children and adolescents are living with T1D worldwide, highlighting its significant prevalence and the ongoing challenges faced by healthcare systems in managing this complex disease. The role of nursing management in the care of pediatric patients with T1D is critical, as it encompasses both clinical intervention and education to empower patients and their families in the self-management of this lifelong condition [1].

The nursing management of T1D in children requires a multidisciplinary approach that integrates the clinical expertise of nurses with the psychosocial support needed to help families navigate the emotional and educational challenges associated with diabetes management. Nurses serve as the frontline caregivers in the diabetes care team, tasked with conducting assessments, implementing treatment plans, and providing essential education

on blood glucose monitoring, insulin administration, dietary management, and the recognition of hypoglycemic and hyperglycemic episodes. Furthermore, nursing professionals play an essential role in creating a supportive environment that promotes the development of self-efficacy and autonomy among young patients, which is vital for fostering adherence to treatment regimens [2].

Effective nursing management involves not only the technical aspects of diabetes care but also the understanding of the unique psychosocial factors that influence health outcomes in children and their families. Pediatric patients may experience fear, anxiety, and disruption in daily routines due to their diagnosis. The diabetes nurse educator's role becomes pivotal in addressing these emotional aspects through counseling and support strategies, assisting families in setting realistic goals, and navigating the complexities of school life and social interactions. Moreover, cultural competence and sensitivity are paramount as diabetes management may vary significantly among different cultural groups, necessitating tailored approaches to education and support [3].

Research has demonstrated that early and consistent nursing interventions can lead to improved glycemic control, reduced incidence of diabetes-related complications, and enhanced quality of life for children living with T1D. For instance, studies have shown that children who receive structured diabetes education from nursing professionals are more likely to demonstrate better adherence to treatment protocols, manage their diabetes more effectively, and experience fewer hospitalizations. The implementation of standardized diabetes management protocols and the utilization of new technologies, such as continuous glucose monitors and insulin pumps, further underscore the advancements in nursing management of T1D. However, these innovations also require nurses to remain well-versed in the latest guidelines and practices to provide optimal care [4].

Pathophysiology of Type 1 Diabetes in Children:

Type 1 diabetes mellitus (T1DM) is a chronic metabolic disorder that predominantly affects children and adolescents and is characterized by the autoimmune destruction of insulin-producing beta cells in the pancreas. Unlike Type 2 diabetes, which is often associated with obesity and insulin resistance, T1DM has an autoimmune etiology and is often diagnosed in childhood or early adulthood. Understanding the pathophysiology of T1DM is essential for comprehensively addressing its healthcare needs, impacts, and management strategies in pediatric populations [5].

The pathophysiology of T1DM begins with a complex interplay between genetic predisposition and environmental triggers. Twin and family studies indicate a strong genetic component to the disease, with various immunological and genetic factors implicated. Genes within the Human Leukocyte Antigen (HLA) region on chromosome 6 are particularly significant, with certain alleles associated with increased susceptibility to autoimmune conditions, including T1DM. Specifically, the HLA-DR3 and HLA-DR4 haplotypes are commonly found in affected individuals, indicating a genetic predisposition to the development of autoimmunity against pancreatic beta cells [6].

In addition to genetic factors, environmental triggers play a vital role in the onset of T1DM. These triggers may include viral infections, dietary factors, and other environmental influences. For instance, infections with enteroviruses, particularly coxsackievirus B, have been identified in numerous studies as possible triggers that may initiate the autoimmune response. The relationship between viral infection and the onset of diabetes suggests a molecular mimicry phenomenon, where viral antigens resemble beta cell antigens and confuse the immune system, leading to an attack on the body's own cells [7].

Once the autoimmune process has been triggered, the immune system erroneously identifies the insulin-producing beta cells as foreign. This process involves both cellular and humoral immunity. In T1DM, T lymphocytes, particularly CD4+ and CD8+ T cells, infiltrate the pancreatic islets (islets of Langerhans) and initiate the destruction of beta cells. The depletion of beta cells leads to a significant decrease in insulin production, resulting in hyperglycemia and the characteristic symptoms of diabetes, such as polyuria, polydipsia, and weight loss [8].

The process of beta-cell destruction can be gradual or rapid; however, most children present with severe hyperglycemia and need for insulin therapy at the

time of diagnosis. Once insulin deficiency occurs, the body is unable to effectively regulate blood glucose levels. High levels of glucose persist in the bloodstream, leading to a state of metabolic dysregulation. Increased glucose in the blood cannot be taken up by cells, which subsequently switch to fat metabolism, leading to the production of ketone bodies. This phenomenon can result in diabetic ketoacidosis (DKA), a serious complication often observed in new-onset cases [9].

The acute metabolic consequences of insulin deficiency in T1DM are profound. Hyperglycemia leads to osmotic diuresis, causing excessive urination and dehydration, and is accompanied by increased thirst and electrolyte imbalances. The reliance on fat metabolism results in ketosis, and consequently, ketoacidosis may ensue if not properly managed. DKA is a medical emergency that can lead to severe complications, including coma and death, highlighting the urgent need for effective diabetes management [10].

Long-term, the absence of insulin has deleterious effects on various organ systems. Chronic hyperglycemia leads to vascular complications due to glycosylation of proteins and altered endothelial function. Children and adolescents with T1DM are at an increased risk of long-term complications, including retinopathy, nephropathy, and neuropathy. This early onset of potential complications emphasizes the importance of rigorous glycemic control and monitoring in the pediatric population [11].

Beyond the physiological implications, the diagnosis of T1DM carries considerable psychosocial ramifications for children and their families. Children living with diabetes grapple with the burden of daily blood glucose monitoring, insulin administration, dietary restrictions, and disease management. This can impact their quality of life, self-esteem, and social interactions. Adolescents may be particularly challenged by the need to balance diabetes management with the desire for independence and normalcy.

Family dynamics also shift as caregivers take on the responsibility for managing the child's condition, which can lead to stress and anxiety within the household. Support from healthcare providers, diabetes educators, and psychosocial support systems is crucial in mitigating the emotional and psychological hurdles associated with living with T1DM [11].

Clinical Presentation and Diagnosis:

Type 1 diabetes (T1D) is a chronic autoimmune condition characterized by the destruction of insulin-producing beta cells in the pancreas. Unlike type 2 diabetes, which has both lifestyle and genetic factors contributing to its onset, type 1 diabetes primarily results from an autoimmune response that mistakenly targets and destroys these crucial cells, leading to little or no insulin production. This condition predominantly affects children and adolescents, although it can occur at any age. The clinical presentation and diagnosis of type 1 diabetes in children are crucial for ensuring timely management and preventing acute and long-term complications [12].

Clinical Presentation

The clinical presentation of type 1 diabetes in children can be relatively acute, with symptoms manifesting over a short period ranging from several days to weeks. Parents and caregivers may initially notice symptoms that are commonly misattributed to other common childhood illnesses. Recognizing the hallmark symptoms is vital for early diagnosis and intervention [13].

1. **Polyuria**: One of the first signs of type 1 diabetes is frequent urination. High blood glucose levels lead to increased osmotic pressure within the renal tubules, causing glucose to spill into the urine. This results in an increased volume of urine production, often noted when children require more frequent toilet visits or have accidents at night [14].
2. **Polydipsia**: Due to the volume of urine produced, children often experience excessive thirst (polydipsia). This compensatory mechanism leads to increased fluid intake, and parents may observe their child drinking large amounts of water or other beverages.
3. **Polyphagia**: Despite consuming increased amounts of food and drinks, children with T1D may experience persistent hunger (polyphagia). This occurs due to the body's inability to utilize glucose effectively for energy because of insulin deficiency,

leading to a state of relative energy deficiency.

4. **Weight Loss**: In many cases, children with type 1 diabetes lose weight despite eating normally or even more than usual. This phenomenon is caused by the body breaking down fat and muscle as alternative energy sources in the absence of glucose, resulting in unintentional weight loss [14].
5. **Fatigue and Weakness**: Children may exhibit signs of fatigue or lethargy as the energy supply to cells is compromised, leading to decreased physical activity and overall lethargy.
6. **Ketoacidosis**: In some cases, children may present with diabetic ketoacidosis (DKA), a serious and potentially life-threatening complication. DKA occurs when the body produces excess ketones due to a lack of insulin, resulting in a metabolic state of acidosis. Children with DKA may exhibit symptoms such as abdominal pain, nausea, vomiting, rapid breathing (Kussmaul respirations), fruity-smelling breath, and confusion or altered consciousness. This is often the first indication that prompts families to seek emergency medical care [14].

Diagnosis

Diagnosing type 1 diabetes in children involves a combination of clinical evaluation and laboratory tests. Early recognition of signs and symptoms, combined with appropriate testing, is essential to confirm the diagnosis and initiate prompt treatment.

1. **Clinical History and Physical Examination**: Initial assessment includes a comprehensive clinical history to document symptomatic presentation, duration of symptoms, and family medical history. The physical examination may reveal signs such as dehydration and weight loss [15].
2. **Blood Glucose Testing**: The cornerstone of diagnosis for type 1 diabetes is blood glucose testing. The American Diabetes Association (ADA) recommends that diabetes be diagnosed in children with any one of the following criteria:
    - A fasting plasma glucose level ≥126 mg/dL (7.0 mmol/L) after no caloric intake for at least 8 hours [16].
    - A random plasma glucose level ≥200 mg/dL (11.1 mmol/L) in a child with classic symptoms of hyperglycemia or hyperglycemic crisis.
    - A 2-hour plasma glucose level ≥200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test (OGTT).
    - A hemoglobin A1c (HbA1c) level of ≥6.5% (48 mmol/mol) in the absence of conditions that may falsely elevate A1c results [16].

In children presenting with significant symptoms or signs of DKA, a random blood glucose measurement is often the most immediate and decisive indicator of diabetes [16].

3. **Additional Testing**: While blood glucose testing provides a preliminary diagnosis, specific autoantibody testing can help confirm the diagnosis of type 1 diabetes. The presence of certain autoantibodies, such as GAD65 (glutamic acid decarboxylase), IA-2 (insulinoma-associated antigen 2), and islet cell antibodies, supports the diagnosis of type 1 diabetes and helps differentiate it from type 2 diabetes, particularly in cases of atypical presentation.
4. **C-peptide Testing**: C-peptide levels can also be assessed to evaluate endogenous insulin production. In type 1 diabetes, low or undetectable C-peptide levels suggest diminished islet cell function [17].

Implications for Management

Early diagnosis and treatment of type 1 diabetes are critical in preventing acute complications associated with hyperglycemia and maintaining metabolic balance. Once diagnosed, children typically require insulin therapy immediately to manage blood glucose levels effectively. Treatment protocols may

involve multiple daily injections or the use of an insulin pump, along with comprehensive education for patients and caregivers about carbohydrate counting, blood glucose monitoring, and recognizing signs of both hyperglycemia and hypoglycemia.

Additionally, routine follow-up care, including regular monitoring of HbA1c levels and screening for diabetes-related complications, is essential for the long-term management of type 1 diabetes in children [18].

Clinical Presentation and Diagnosis:

Insulin management in children, particularly those diagnosed with diabetes mellitus, is a critical component of pediatric healthcare. As rates of childhood diabetes continue to rise globally, nursing staff play a vital role in ensuring optimal insulin management, education, and support not only to the young patients but also to their families [19].

Diabetes is categorized into two main types: Type 1 diabetes (T1D) and Type 2 diabetes (T2D). T1D, more prevalent in children, is an autoimmune condition where the pancreas ceases to produce insulin. Insulin is a hormone crucial for glucose metabolism, allowing cells to utilize sugar for energy. Children with T1D require lifelong administration of insulin via injections or infusion pumps. T2D, previously seen mostly in adults, is increasingly diagnosed in children and is often associated with obesity, lifestyle factors, and genetic predisposition.

The management of diabetes in pediatric patients entails careful monitoring of blood glucose levels, dietary planning, physical activity, and the administration of insulin. Given the intrinsic challenges of managing diabetes in children—who may have difficulty understanding their condition or adhering to treatment regimens—effective nursing care becomes paramount [20].

Role of Nursing in Insulin Management

1. **Assessment and Monitoring**

Nurses play a critical role in the initial assessment and ongoing monitoring of children with diabetes. This includes measuring blood glucose levels, assessing the child's growth and development, and evaluating the psychosocial impact of diabetes on both the child and their family. Nurses are trained to identify signs of hypo- or hyperglycemia and must be vigilant in preventing complications such as diabetic ketoacidosis (DKA) or long-term sequelae from poorly managed diabetes. Regular check-ups by nursing staff allow for the timely adjustment of insulin doses based on individual needs, reinforcing individualized patient care [21].

2. **Administration of Insulin**

The administration of insulin is a complex skill that nurses help instill in both children and their caregivers. Nurses educate families on various insulin delivery methods, such as syringes, insulin pens, and pumps. They are responsible for teaching proper techniques for storage, preparation, and administration of insulin. Bearing in mind the need for a child's comfort and ability, nurses adapt their approach based on each child's developmental stage, ensuring that the patient feels involved and empowered in their care [22].

3. **Patient Education and Counseling**

One of the primary responsibilities of nurses in pediatric diabetes care is patient and family education. This involves providing in-depth knowledge about insulin management, carbohydrate counting, understanding the glycemic index of foods, and recognizing the signs of hyperglycemia and hypoglycemia. Education extends beyond the hospital setting and often includes guidance on lifestyle modifications, such as diet and exercise.

Nurses are also crucial in teaching families how to manage diabetes during special circumstances, like illness, travel, or changes in routine. By fostering an understanding of the necessity for consistent insulin management, nurses can help mitigate anxiety around diabetes management and improve adherence to treatment plans [23].

4. **Support for Behavioral and Emotional Challenges**

Living with diabetes can be emotionally taxing for children, which can lead to anxiety, depression, or diabetic burnout. Nurses offer psychosocial support, providing a safe space for children and families to express concerns and frustrations. Nurses play a mediating role, encouraging open dialogue about the emotional aspects of diabetes management and facilitating access to psychological support when necessary [24].

5. **Collaboration within the Healthcare Team**

Effective insulin management requires a multidisciplinary approach. Nurses frequently collaborate with physicians, dietitians, endocrinologists, and social workers to develop comprehensive care plans tailored to each child's needs. Regular meetings and consultations ensure that all team members are informed about the child's progress and challenges, allowing for timely adjustments in treatment. This collaborative effort is essential in addressing not only physiological but also psychological and social aspects of diabetes management [25].

Role of Nursing in Insulin Management:

Insulin management, particularly in pediatric patients with diabetes mellitus, is a critical component of healthcare that requires a multifaceted approach. Nurses play a vital role in this specialized area, acting as educators, caregivers, and advocates for children with diabetes. Their involvement in the management of insulin therapy encompasses various responsibilities, including education on disease management, administration of insulin, monitoring of blood glucose levels, and emotional support for both patients and their families [26].

Diabetes is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. In children, the most prevalent form is Type 1 diabetes mellitus (T1DM), an autoimmune disease where the body's immune system attacks insulin-producing beta cells in the pancreas. This condition often necessitates lifelong insulin replacement therapy to enable glucose metabolism and prevent acute and chronic complications. In contrast, Type 2 diabetes, often associated with obesity and a sedentary lifestyle, is increasingly observed in the pediatric population. Regardless of type, managing diabetes in children is complex and demands comprehensive care tailored to the unique developmental and psychological needs of pediatric patients [26].

The Role of Nurses in Insulin Management

Nurses are pivotal in the continuum of care for children with diabetes. Their role encompasses various domains:

1. **Education and Skills Training**: Education stands at the forefront of nursing responsibilities in insulin management. Nurses provide crucial training to children and their families about the disease, the importance of managing blood glucose levels, recognizing signs of hypo- and hyperglycemia, and the proper techniques for insulin administration. Utilizing teach-back methods, nurses ensure that both children and their caregivers understand the administration of insulin injections and the use of insulin pumps or pens. This education empowers families to take an active role in managing their child's condition [27].
2. **Monitoring and Assessment**: Regular monitoring of blood glucose levels and assessment of carbohydrate intake are critical in managing pediatric diabetes. Nurses assess children's blood glucose readings, interpret the data in conjunction with the child's insulin regimen, and make necessary recommendations for dosing adjustments. They also assess the child's growth and development, nutritional needs, and psychosocial aspects of living with diabetes [28].
3. **Insulin Administration**: Nurses are trained to administer insulin via various methods, including subcutaneous injections, insulin pumps, and continuous glucose monitors (CGMs). They ensure that the administration is performed correctly to reduce the risk of complications such as hypoglycemia or injection site reactions. When using insulin pumps, nurses may also assist in programming the device and ensuring its appropriate function, as well as educating families about troubleshooting and management [29].
4. **Coordination of Care**: Effective insulin management requires a coordinated multi-disciplinary approach. Nurses collaborate with physicians, dietitians, and endocrinologists to create individualized care plans that address the specific medical and emotional needs of each child. Additionally, nurses often serve as the

primary point of contact for families, navigating referrals to other specialists and coordinating follow-up appointments [30].

5. **Emotional and Psychological Support**: Children with diabetes often face emotional and psychological challenges, including anxiety, depression, and a sense of isolation. Nurses provide necessary emotional support, encouraging open communication about the child's feelings regarding their condition. By fostering a supportive and non-judgmental environment, nurses help children develop coping strategies and improve their self-management skills.
6. **Advocacy and Community Engagement**: Nurses advocate for their patients by ensuring that they receive appropriate resources and support services. This advocacy may extend beyond individual care, as nurses often engage in community outreach, promoting awareness about diabetes and its management in schools and other community settings. They play a crucial role in educating school staff about how to support students with diabetes, ensuring safe and effective management during school hours [30].

Challenges in Insulin Management

While nurses are integral to the management of insulin therapy in pediatric patients, they face several challenges. One significant challenge is the variability in child behavior and adherence to treatment regimens. Young children may lack the cognitive ability to understand their diagnosis fully, while adolescents may struggle with adherence due to lifestyle choices and social pressures. Additionally, the emotional burden that comes with managing a chronic illness can lead to diabetes burnout, where both children and families experience fatigue in the relentless management of the disease [31].

Moreover, technological advancements in diabetes management, such as CGMs and insulin pumps, require ongoing education and training for both families and healthcare providers. Nurses must stay current with these developments to provide the best possible care. Economic barriers also exist, as access to diabetes supplies and medications may be limited for some families, complicating insulin management [31].

Monitoring and Assessment Strategies:

Type 1 diabetes (T1D) is a chronic autoimmune condition characterized by the destruction of insulin-producing beta cells in the pancreas. This condition typically manifests in childhood or adolescence, leading to lifelong implications for patients and their families. The management of T1D in children requires a multifaceted approach involving comprehensive monitoring and evaluation strategies to maintain optimal glycemic control, prevent acute complications, and enhance the overall quality of life.

In children, the onset of T1D can be sudden and presents unique challenges regarding disease management. Symptoms often include excessive thirst, frequent urination, fatigue, and unintended weight loss. The unpredictable nature of blood glucose levels necessitates rigorous monitoring to prevent both hyperglycemia (high blood sugar) and hypoglycemia (low blood sugar), both of which can be life-threatening. Thus, nursing professionals play a crucial role in the ongoing assessment and management of children with T1D [32].

The Role of Nursing in Diabetes Management

Nurses specializing in pediatric endocrinology are often at the forefront of T1D care. Their responsibilities extend beyond just monitoring blood glucose levels. They engage in patient education, provide emotional support, facilitate dietary management, and coordinate with a multidisciplinary team to ensure comprehensive care for the child. Effective communication between the nurse, the child, and the family is fundamental for fostering adherence to treatment plans and achieving favorable outcomes [33].

Monitoring Strategies

1. **Blood Glucose Monitoring**: At the primary level, regular blood glucose monitoring is essential. Children with T1D typically require multiple finger-stick tests or the use of continuous glucose monitors (CGMs) to track their blood sugar levels throughout the day. Nurses educate families on how to interpret blood glucose readings, recognize patterns, and make

necessary adjustments to insulin dosing based on these results [34].

2. **Insulin Administration**: Accurate administration of insulin, matching the dose with food intake and physical activity, is crucial for effective diabetes management. Nurses oversee the training of parents and children in self-administration techniques, whether through injections or pump therapy. They also monitor for signs of insulin resistance or hypoglycemic episodes, adjusting care strategies accordingly [34].
3. **Dietary Evaluation**: A well-balanced diet is integral in managing T1D. Nurses collaborate with dietitians to create individualized meal plans that account for carbohydrate counting, glycemic index considerations, and appropriate caloric intake. Regular follow-ups can help ensure adherence to dietary guidelines and address any challenges the child or family encounters.
4. **Physical Activity Monitoring**: Regular physical activity has beneficial effects on blood glucose control, but it must be carefully monitored to prevent exercise-induced hypoglycemia. Nurses assess the child's activity levels, educating families on how to manage blood glucose before, during, and after exercise. Teaching the child to carry fast-acting carbohydrates can be part of an effective strategy to handle potential hypoglycemic events during or after physical activity.
5. **Routine Health Assessments**: Children with T1D require regular medical evaluations to monitor for complications such as diabetic ketoacidosis (DKA), neuropathy, nephropathy, and retinopathy. Nurses play a vital role in facilitating routine screenings, assessing neurological and cardiovascular health, and ensuring that vaccinations are up to date [34].

Evaluation Strategies

1. **Adjustment of Treatment Plans**: Evaluation goes hand in hand with monitoring. By regularly analyzing blood glucose trends, insulin regimens, and dietary adherence, nurses can provide feedback that guides the adjustment of treatment plans in collaboration with the healthcare team. Using software programs or logs to track blood glucose readings can facilitate this process [35].
2. **Education and Skill Assessment**: Continuous education is a pillar of effective T1D management. Nurses assess the knowledge base of both the patient and the family regarding diabetes management and provide education tailored to their individual needs. Ensuring that children understand their condition enhances their capacity for self-management and promotes independence [35].
3. **Psychosocial Evaluation**: The emotional and psychological impact of living with T1D can be significant. Nurses are in a position to recognize signs of diabetes burnout, anxiety, or depression in both children and their parents. Regularly assessing mental health and well-being allows nurses to provide resources, connect families with support groups, or refer them to mental health professionals as needed.
4. **Quality of Life Assessments**: The ultimate goal of T1D management is not just to maintain optimal blood glucose levels but also to enhance the quality of life. Evaluation strategies should include assessing the child's school performance, social interactions, and overall well-being. Tools like the Diabetes Quality of Life scale can be used to gauge how diabetes affects a child's daily experiences [35].

Education and Health Promotion for Families:

Type 1 diabetes (T1D) is a chronic condition resulting from the autoimmune destruction of insulin-producing beta cells in the pancreas. It primarily affects children and young adults, although it can occur at any age. The diagnosis of T1D introduces several challenges not only for the affected individuals but also for their families. Effective management of the disease requires comprehensive education and supportive health promotion strategies tailored to children and their families [36].

Type 1 diabetes manifests when the immune system mistakenly targets and destroys the insulin-producing cells in the pancreas. As a result, individuals with T1D require lifelong insulin therapy to regulate their blood glucose levels. Symptoms of T1D can include excessive thirst, frequent urination, extreme hunger, fatigue, and blurred vision. If left untreated, T1D can lead to severe complications ranging from neuropathy and kidney damage to cardiovascular diseases.

For children, the management of T1D involves a multidimensional approach that encompasses blood glucose monitoring, insulin administration, dietary management, exercise, and emotional support. Continuously changing needs throughout development, coupled with the varying degrees of understanding and acceptance of the disease, means that education and ongoing support are paramount [36].

The Role of Education

Education serves as the cornerstone of successful diabetes management. It is crucial that both children with T1D and their family members understand the disease and how to manage it effectively. Education should encompass several key aspects:

1. Disease Knowledge

Understanding type 1 diabetes is the first step toward effective management. Families should be educated about the pathophysiology of T1D, its symptoms, potential complications, and the importance of insulin and blood sugar monitoring. This foundational knowledge empowers parents and siblings to recognize changes in the child's health and respond accordingly [37].

2. Monitoring and Insulin Administration

Families must learn how to use devices and techniques for monitoring blood glucose levels. This includes understanding how to read glucose meters, use continuous glucose monitors (CGMs), and administer insulin via injections or insulin pumps. Regular monitoring and appropriate adjustments to insulin therapy are vital for preventing hypoglycemia and hyperglycemia [37].

3. Nutrition Education

A balanced diet tailored to the child's needs is integral to T1D management. Families should receive guidance on carbohydrate counting, glycemic index, portion control, and healthy food choices. Understanding how food affects blood glucose levels will help in making informed dietary decisions and managing diabetes during daily activities and special occasions [38].

4. Physical Activity

Regular physical activity is beneficial for all children, including those with T1D. Families should learn how exercise influences blood sugar levels and how to adjust insulin dosages accordingly. Knowledge about managing physical activities, including pre- and post-exercise blood glucose monitoring, can help minimize risks associated with exercise and enhance the child's overall quality of life [38].

The Importance of Family Involvement

Family involvement is a crucial component in the successful management of T1D in children. Engaging the family in the educational process creates a supportive environment that fosters adherence to treatment plans and encourages healthy lifestyle choices. Here are some aspects of family involvement:

1. Emotional Support

The emotional implications of a T1D diagnosis can be significant for both children and their families. Anxiety, fear, and feelings of isolation may arise. Open communication about managing diabetes can help mitigate these feelings. Families should work together to establish routines, address concerns, and celebrate successes. Such an environment promotes resilience and coping strategies that can enhance the child's emotional well-being [39].

2. Team Approach to Management

The management of T1D should be viewed as a team effort, involving the child, family members, healthcare providers, and educators. Families should collaborate with healthcare teams to develop personalized management plans that meet specific needs. Regular follow-ups with endocrinologists, nutritionists, and diabetes educators can provide ongoing support and necessary adjustments to care plans [39].

3. Community Resources and Support Groups

Connecting with community resources, such as local diabetes associations and support groups, can

provide additional education and emotional support for families. These organizations often offer workshops, webinars, and social events that can empower families and provide them with connections to others facing similar challenges [40].

4. Advocacy

Families can engage in advocacy efforts to raise awareness about type 1 diabetes at school and in their communities. Educating peers, teachers, and school staff about T1D can create a more inclusive and understanding environment for children with the condition. This can help dispel myths and stigma while fostering a supportive atmosphere for the child [40].

Psychosocial Considerations and Support:

Type 1 diabetes (T1D) is an autoimmune condition that primarily affects the metabolic system by impairing the body's ability to produce insulin. Although it is often diagnosed in childhood, the implications of T1D extend far beyond the immediate medical concerns. Children living with this chronic condition face a plethora of psychosocial challenges that can affect their emotional, social, and developmental well-being. In this context, the role of nursing in providing psychosocial support and considerations becomes paramount [41].

Understanding Psychosocial Challenges

The diagnosis of Type 1 diabetes often signifies a radical change in a child's lifestyle, creating feelings of confusion, fear, and anxiety. Unlike other health conditions, T1D necessitates an ongoing and rigorous management regime, including blood sugar monitoring, dietary restrictions, and insulin administration. These frequent interventions can lead to feelings of embarrassment or social isolation, as children may feel "different" from their peers. Common psychosocial challenges faced by children with T1D include emotional disturbances such as depression, anxiety, and low self-esteem; social implications, including peer relationships and family dynamics; and developmental concerns that may arise due to the demands of disease management [42].

1. **Emotional Disturbances**: Children diagnosed with T1D may experience a range of emotional issues. The constant need to monitor blood glucose levels and manage insulin can lead to stress and anxiety. Research has indicated that children with chronic conditions are at a higher risk for depression compared to their healthy counterparts. The potential for frequent hospital visits and medical emergencies can create a heightened sense of fear, leading to anxiety disorders [43].
2. **Social Implications**: Social interactions can become challenging for children with T1D. The need to watch what they eat, take medications, and manage their diabetes in social settings can make them feel different from their peers. These feelings can manifest into social withdrawal, which may affect friendships and lead to feelings of isolation. Additionally, the stigma associated with chronic illness may deter children from participating in physical activities or attending social gatherings.
3. **Developmental Concerns**: The management of T1D also has implications for a child's development. For instance, the cognitive load associated with regular blood sugar monitoring and insulin administration can interfere with academic performance and concentration in school. The emotional burden of managing a chronic condition may hinder a child's developmental milestones, including social competencies and emotional regulation [43].

The Role of Nursing in Psychosocial Support

Nurses are integral to the multidisciplinary team caring for children with T1D. Their role extends beyond clinical responsibilities and encompasses providing comprehensive psychosocial support. This involves direct patient care, education, and advocacy for psychosocial well-being. The following points elaborate on the multifaceted role of nurses in addressing the psychosocial needs of children with T1D:

1. **Assessment and Screening**: One of the crucial responsibilities of nurses is the ongoing assessment of a child's psychosocial well-being. Regular screenings for depression, anxiety, and social issues should be integrated into routine diabetes care. By employing

validated tools and frameworks, nurses can identify potential psychosocial problems early, enabling timely interventions [44].

2. **Education and Empowerment**: A significant aspect of T1D self-management is education. Nurses play a pivotal role in educating both children and their families about the condition, including its management and potential psychological impacts. Empowering children with knowledge about their health can boost their confidence and reduce feelings of helplessness. Teaching techniques for managing stress and anxiety, including coping strategies and relaxation exercises, can also be beneficial [45].
3. **Support for Families**: T1D affects not only the child but also their entire family system. Nurses can provide counseling and resources for families to navigate the emotional and social challenges of caring for a child with T1D. This includes facilitating family meetings, offering support groups for parents, and providing resources that promote understanding of the condition's complexities [45].
4. **Facilitating Peer Support**: Peer support can be transformative for children with chronic conditions. Nurses can facilitate connections between children with T1D through support groups or social events where they can share experiences, foster friendships, and develop a sense of community. This sense of belonging can counteract feelings of isolation and improve overall mental health.
5. **Advocacy and Resource Connection**: Nurses serve as advocates for children with T1D, ensuring they receive appropriate psychosocial resources and interventions. This may involve connecting families with mental health professionals, social workers, or other healthcare providers who specialize in chronic illness management. Additionally, nurses can work to advocate for school accommodations like a supportive environment for diabetes management during school hours, which can alleviate the burden of feeling different [46].
6. **Ongoing Follow-Up and Communication**: Continuous follow-up is crucial in managing T1D and its psychosocial implications. Nurses should maintain open lines of communication with children and their families, fostering an environment where they feel comfortable discussing their struggles and achievements. Regular check-ins can help ensure that no psychosocial issues are overlooked and that appropriate support measures are in place [46].

Long-term Management and Complications Prevention:

Type 1 diabetes (T1D) is an autoimmune disorder characterized by the destruction of insulin-producing beta cells in the pancreas, which leads to chronic hyperglycemia. This condition commonly manifests during childhood or adolescence, placing a significant burden not only on the affected individuals but also on their families and healthcare systems. Effective long-term management and prevention of complications require a comprehensive understanding of the disease, regular monitoring, and a collaborative approach involving healthcare professionals, patients, and families [47].

T1D is distinguished from type 2 diabetes by its causative mechanisms and management needs. While type 2 diabetes often develops due to insulin resistance in the context of obesity and inactivity, T1D results from an autoimmune attack on pancreatic beta cells, leading to an absolute insulin deficiency. Symptoms of T1D typically emerge swiftly, and include excessive thirst, frequent urination, extreme hunger, weight loss, and fatigue. If left untreated, T1D can lead to diabetic ketoacidosis (DKA), a life-threatening condition that requires immediate medical attention [48].

The primary goals of long-term management of T1D are to maintain blood glucose levels within the target range, minimize the risk of acute and chronic complications, and promote overall physical and emotional well-being. The American Diabetes Association (ADA) recommends that children with T1D achieve an HbA1c level below 7.5% without significant hypoglycemia, while also taking into account individual variations and developmental

stages. This goal underscores the need for flexible management approaches tailored to each child's growing body and lifestyle [49].

Effective management of T1D hinges on continuous monitoring of blood glucose levels and the administration of exogenous insulin. Children with T1D rely on rapid-acting insulin to manage postprandial (after meal) blood glucose levels and long-acting insulin to maintain baseline glucose control. Insulin regimens must be individualized, considering factors such as the child's age, weight, diet, levels of physical activity, and pubertal changes, which can affect insulin sensitivity [50].

Advancements in technology, such as continuous glucose monitors (CGMs) and insulin pumps, have revolutionized the management of T1D. CGMs provide real-time glucose readings and trends, allowing for proactive adjustments in insulin therapy and dietary choices. Insulin pumps facilitate more precise delivery of insulin, mimicking physiological insulin secretion more closely than traditional injections [51].

Proper nutrition and physical activity play crucial roles in the management of T1D. A well-balanced diet that includes carbohydrates, proteins, and fats is essential for maintaining energy levels and controlling blood glucose. Carbohydrate counting, a method of estimating insulin needs based on carbohydrate intake, has gained popularity and enables families to make informed dietary choices [52].

Physical activity also has profound effects on glycemic control. Regular exercise improves insulin sensitivity and promotes cardiovascular health. However, exercise can lead to fluctuations in blood glucose levels, necessitating careful planning to prevent hypoglycemia during and after physical activities. Parents, caregivers, and children should collaborate with healthcare teams to create exercise plans that integrate safety and efficacy [53].

Education is a cornerstone of effective long-term management of T1D. Children and their families must understand the pathophysiology of the disease, the role of insulin, the importance of monitoring blood glucose levels, and strategies for managing hypoglycemia and hyperglycemia. Diabetes management courses and programs designed for children can empower young patients, giving them age-appropriate knowledge and skills to navigate their condition [54].

Additionally, the psychosocial aspects of managing a chronic illness like T1D cannot be overlooked. Children with diabetes often face emotional challenges, including anxiety, depression, and feelings of isolation. The process of monitoring blood glucose and administering insulin can be burdensome, leading to potential burnout. Ongoing psychosocial support, through counseling or diabetes support groups, can help children and families develop coping strategies and foster resilience [55].

Long-term complications of T1D can be severe and may include nephropathy, retinopathy, neuropathy, and cardiovascular diseases. Preventing these complications necessitates vigilant management of blood glucose levels, as chronic hyperglycemia is a key driver of microvascular and macrovascular damage [55].

Regular screenings are essential tools for early identification of potential complications. For instance, annual eye exams are recommended to monitor for retinopathy, while blood pressure, cholesterol, and kidney function should be regularly assessed. By adhering to these screening protocols, healthcare providers can intervene early, preventing progression to irreversible damage [56].

Research into type 1 diabetes continues to evolve, focusing on innovative treatments and approaches to prevention. Ongoing studies on immunotherapy aim to preserve remaining beta-cell function, potentially altering the disease course. Additionally, research into the psychosocial impacts of T1D acknowledges the importance of mental health in the overall management of the disease [57].

The advent of artificial pancreas systems holds the promise of improved glycemic control while reducing the burden of daily management. These devices automatically adjust insulin delivery based on real-time glucose readings, potentially offering a more seamless experience for children and their caregivers [58].

Conclusion:

In conclusion, effective nursing management of Type 1 diabetes in children is critical to ensuring optimal health outcomes and enhancing the quality of life for patients and their families. A

comprehensive approach that includes education, individualized care plans, and ongoing support is essential for fostering self-management skills and promoting adherence to treatment. By integrating knowledge of the disease's pathophysiology, monitoring strategies, and psychosocial considerations, nurses can play a pivotal role in managing the complexities of diabetes care. Furthermore, collaborating with multidisciplinary teams ensures a holistic approach, addressing not only the physical aspects of diabetes but also the emotional and developmental needs of the child. Emphasizing family education and support fosters an environment conducive to effective management, ultimately empowering children with Type 1 diabetes to lead fulfilling lives while managing their condition successfully.

References:

1. Lee JM, Wu EL, Tarini B et al. Diagnosis of diabetes using hemoglobin A1c: should recommendations in adults be extrapolated to adolescents? J Pediatr. 2011;158:947–952. e1–3. doi: 10.1016/j.jpeds.2010.11.026.
2. Støy J, Greeley SA, Paz VP et al. Diagnosis and treatment of neonatal diabetes: a United States experience. Pediatr Diabetes. 2008;9:450–459. doi: 10.1111/j.1399-5448.2008.00433.x.
3. Pettitt DJ, Talton J, Dabelea D et al. SEARCH for Diabetes in Youth Study Group. Prevalence of diabetes in US youth in 2009: the SEARCH for Diabetes in Youth Study. Diabetes Care. 2014;37:402–408. doi: 10.2337/dc13-1838.
4. Borushek A. CalorieKing calorie, fat and carbohydrate counter. 2013 ed. Hudsonville, MI: Family Health Publications; 2012.
5. Gungor N, Hannon T, Libman I et al. Type 2 diabetes mellitus in youth: the complete picture to date. Pediatr Clin North Am. 2005;52:1579–1609. doi: 10.1016/j.pcl.2005.07.009.
6. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2014;37(suppl 1):S14–S80. doi: 10.2337/dc14-S014.
7. Hamilton J, Cummings E, Zdravkovic V et al. Metformin as an adjunct therapy in adolescents with type 1 diabetes and insulin resistance: a randomized controlled trial. Diabetes Care. 2003;26:138–143. doi: 10.2337/diacare.26.1.138.
8. Dabelea D, Mayer-Davis E, Saydah S et al. SEARCH for Diabetes in Youth study. JAMA. 2014;311:1778–1786.
9. Silverstein J, Klingensmith G, Copeland K et al. Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. Diabetes Care. 2005;28:186–212. doi: 10.2337/diacare.28.1.186.
10. Copeland KC, Silverstein J, Moore KR et al. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. Pediatrics. 2013;131:364–382. doi: 10.1542/peds.2012-3494.
11. Bacha F, Gungor N, Lee S et al. Progressive deterioration of β-cell function in obese youth with type 2 diabetes. Pediatr Diabetes. 2013;14:106–111. doi: 10.1111/j.1399-5448.2012.00915.x.
12. Chiang JL, Kirkman MS, Laffel LMB. Type 1 diabetes through the life span: a position statement of the American Diabetes Association. Diabetes Care. 2014;37:2034–2054. doi: 10.2337/dc14-1140.
13. American Dietetic Association. Pediatric Weight Management Evidence-Based Nutrition Practice Guideline. Chicago: American Dietetic Association; 2007.
14. Lawrence JM, Imperatore G, Pettitt DJ. Incidence of diabetes in US youth by type, race/ethnicity, and age, 2008–2009. Diabetes. 2014;63(suppl.1):A407. et al.; SEARCH for Diabetes in Youth Study Group.
15. Neithercott T. The basics of insulin pumps. Diabetes Forecast. 2014;67:58–63.
16. Berg E. Insulin pens. These devices bring grab-and-go convenience to taking shots. Diabetes Forecast. 2014;67:68–69.

17. Bangstad HJ, Danne T, Deeb LC et al. International Society for Pediatric and Adolescent Diabetes. ISPAD clinical practice consensus guidelines 2006–2007. Insulin treatment. Pediatr Diabetes. 2007;8:88–102. doi: 10.1111/j.1399-5448.2007.00233.x.

18. Moran A, Dunitz J, Nathan B et al. Cystic fibrosis-related diabetes: current trends in prevalence, incidence, and mortality. Diabetes Care. 2009;32:1626–1631. doi: 10.2337/dc09-0586.

19. Medication, insulin, diabetes clinical mastery series issue. Assessed October 30, 2014.

20. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2014;37(suppl 1):S14–S80. doi: 10.2337/dc14-S014.

21. Wherrett DK, Chiang JL, Delamater AM, et al.; Type 1 Diabetes TrialNet Study Group. Defining pathways for development of disease-modifying therapies in children with type 1 diabetes: a consensus report. Diabetes Care 2015;38:1975–1985.

22. Dabelea D, Rewers A, Stafford JM, et al.; SEARCH for Diabetes in Youth Study Group. Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for Diabetes in Youth Study. Pediatrics 2014;133:e938–e945.

23. Libman IM, Pietropaolo M, Arslanian SA, LaPorte RE, Becker DJ. Changing prevalence of overweight children and adolescents at onset of insulin-treated diabetes. Diabetes Care 2003;26:2871–2875.

24. Cowie CC, Rust KF, Byrd-Holt DD, et al. Prevalence of diabetes and high risk for diabetes using A1C criteria in the U.S. population in 1988–2006. Diabetes Care 2010;33:562–568.

25. Silverstein J, Klingensmith G, Copeland K, et al.; American Diabetes Association. Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. Diabetes Care 2005;28:186–212.

26. Mayer-Davis EJ, Lawrence JM, Dabelea D, et al.; SEARCH for Diabetes in Youth Study. Incidence trends of type 1 and type 2 diabetes among youths, 2002–2012. N Engl J Med 2017;376:1419–1429.

27. Vehik K, Cuthbertson D, Boulware D, et al.; TEDDY, TRIGR, Diabetes Prevention Trial–Type 1, and Type 1 Diabetes TrialNet Natural History Study Groups. Performance of HbA1c as an early diagnostic indicator of type 1 diabetes in children and youth. Diabetes Care 2012;35:1821–1825.

28. Dabelea D, Mayer-Davis EJ, Saydah S, et al.; SEARCH for Diabetes in Youth Study. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. JAMA 2014;311:1778–1786.

29. Nadeau KJ, Anderson BJ, Berg EG, et al. Youth-onset type 2 diabetes consensus report: current status, challenges, and priorities. Diabetes Care 2016;39:1635–1642.

30. Quinn M, Fleischman A, Rosner B, Nigrin DJ, Wolfsdorf JI. Characteristics at diagnosis of type 1 diabetes in children younger than 6 years. J Pediatr 2006;148:366–371.

31. Schatz DA, Kowa H, Winter WE, Riley WJ. Natural history of incidental hyperglycemia and glycosuria of childhood. J Pediatr 1989;115:676–680.

32. American Diabetes Association. Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes—2018. Diabetes Care 2018;41(Suppl. 1):S13–S27.

33. American Diabetes Association. Introduction: Standards of Medical Care in Diabetes—2018. Diabetes Care 2018;41(Suppl. 1):S1–S2.

34. Nowicka P, Santoro N, Liu H, et al. Utility of hemoglobin A1c for diagnosing prediabetes and diabetes in obese children

and adolescents. Diabetes Care 2011;34:1306–1311.

35. Ehehalt S, Gauger N, Blumenstock G, et al.; DIARY-Group Baden-Wuerttemberg. Hemoglobin A1c is a reliable criterion for diagnosing type 1 diabetes in childhood and adolescence. Pediatr Diabetes 2010;11:446–449.
36. Lorini R, Alibrandi A, Vitali L, et al.; Pediatric Italian Study Group of Prediabetes. Risk of type 1 diabetes development in children with incidental hyperglycemia: a multicenter Italian study. Diabetes Care 2001;24:1210–1216.
37. Gregg EW, Li Y, Wang J, et al. Changes in diabetes-related complications in the United States, 1990–2010. N Engl J Med 2014;370:1514–1523.
38. DuBose SN, Hermann JM, Tamborlane WV, et al.; Type 1 Diabetes Exchange Clinic Network and Diabetes Prospective Follow-up Registry. Obesity in youth with type 1 diabetes in Germany, Austria, and the United States. J Pediatr 2015;167:627–632.e4.
39. Herskowitz-Dumont R, Wolfsdorf JI, Jackson RA, Eisenbarth GS. Distinction between transient hyperglycemia and early insulin-dependent diabetes mellitus in childhood: a prospective study of incidence and prognostic factors. J Pediatr 1993;123:347–354.
40. Dabelea D, Rewers A, Stafford JM, et al.; SEARCH for Diabetes in Youth Study Group. Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for Diabetes in Youth Study. Pediatrics 2014;133:e938–e945.
41. Vaidyanathan J, Choe S, Sahajwalla CG. Type 2 diabetes in pediatrics and adults: thoughts from a clinical pharmacology perspective. J Pharm Sci. 2012;101:1659–1671.
42. Orsini-Federici M, Akwi JA, Canonico V et al. Early detection of insulin deprivation in continuous subcutaneous insulin infusion-treated patients with type 1 diabetes. Diabetes Technology Ther. 2006;8:67–75.
43. Yeh GY, Eisenberg DM, Davis RB et al. Use of complementary and alternative medicine among persons with diabetes mellitus: results of a national survey. Am J Public Health. 2002;92:1648–1652.
44. Nadeau KJ, Chow K, Alam S et al. Effects of low dose metformin in adolescents with type 1 diabetes mellitus: a randomized, double-blinded placebo-controlled study. Pediatr Diabetes. 2015;16:196–203.
45. White NH, Cleary PA, Dahms W et al. Beneficial effects of intensive therapy of diabetes during adolescence: outcomes after the conclusion of the Diabetes Control and Complications Trial (DCCT). J Pediatr. 2001;139:804–812.
46. Cryer PE. Hypoglycemia in Diabetes: Patho-physiology, Prevalence, and Prevention. 1st ed. Alexandria, VA: American Diabetes Association; 2009.
47. Beck RW, Tamborlane WV, Bergenstal RM et al. The T1D Exchange Clinic Registry. J Clin Endocrinol Metab. 2012;97:4383–4389.
48. Sarnblad S, KIroon M, Aman J. Metformin as additional therapy in adolescents with poorly controlled type 1 diabetes: randomized placebo-controlled trial with aspects on insulin sensitivity. Eur J Endocrinol. 2003;149:323–329.
49. Diabetes Control and Complications Trial Research Group. Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. J Pediatr. 1994;125:177–188.
50. Aly H, Gottlieb P. The honeymoon phase: intersection of metabolism and immunology. Curr Opin Endocrinol Diabetes Obes. 2009;16:286–92.
51. Choudhary P, Shin J, Evans ML et al. Insulin pump therapy with automated insulin suspension in response to

hypoglycemia. Diabetes Care. 2011;34:2023–2025.

52. Konrad K, Datz N, Engelsberger I for the German/Austrian DPV Initiative. Current use of metformin in addition to insulin in pediatric patients with type 1 diabetes mellitus: an analysis based on a large diabetes registry in Germany and Austria. Pediatr Diabetes. 2014.

53. Geil P, Shane-McWhorter L. Dietary supplements in the management of diabetes: potential risks and benefits. J Am Diet Assoc. 2008;108(suppl 1):S59–S65.

54. 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: A position statement of the American Diabetes Association. Diabetes Care. 2011;34:2477–2485.

55. Miller JL, Dingcai C, Miller JG et al. Correlates of complementary and alternative medicine use in Chicago area children with diabetes. Prim Care Diabetes. 2009;3:149–156.

56. Kessler RC, Davis RB, Foster DF et al. Long-term trends in the use of complementary and alternative medical therapies in the United States. Ann Intern Med. 2001;135:262–268.

57. Chase HP. Understanding Diabetes: a Handbook for People Who Are Living With Diabetes. Denver, CO: Paros; 2006.

58. Haas L, Maryniuk M, Beck J et al. National standards for diabetes self-management education and support. Diabetes Care. 2012;35:2393–2401.