

**Elisa Civitani Monzón.**

Expert Nurse in Therapeutic Education for Diabetes.
Unidad Diabetes Pediátrica. Hospital Universitario Miguel Servet. Zaragoza. Spain.



Technology and Adolescence in Diabetes Management

DIABETES IN ADOLESCENCE:

The word “adolescence” derives from the Latin “adolesco-adolescere”, meaning “to grow despite difficulties.” It is a stage of life marked by profound physical, psychological, emotional, and social changes, leading to adulthood with the full development of one’s capacities and aspirations. At the same time,

it is a period of life when individuals typically enjoy the most robust health. But what happens when they are diagnosed with diabetes?

Diabetes is a chronic disease affecting millions of people worldwide and is now considered a significant public health issue. Type 1 and type 2 diabetes mellitus are the most com-»

» mon forms in children and adolescents. According to the 10th edition of the IDF (International Diabetes Federation) Diabetes Atlas, nearly 150,000 individuals younger than 20 years are diagnosed with type 1 diabetes mellitus each year (www.diabetesatlas.org) (Table 1).

During adolescence, young people face unique challenges and significant risks, such as nutritional imbalances, mental health issues, and substance abuse, which can impact their quality of life. When these factors are compounded by the need for glucose monitoring, constant insulin management, carbohydrate counting at every meal, continuous decision-making for proper diabetes control, and transition from parental to self-management of diabetes, we can begin to understand the challenges of living with diabetes during adolescence and the difficulty in adhering to therapeutic treatment to avoid acute and long-term complications (1).

The complexity of daily diabetes management routines, along with the typical challenges of adolescence, means that < 25% of young people with diabetes achieve the recommended glycated hemoglobin (HbA1c) target of < 7% set by the ISPAD (International Society for Pediatric and Adolescent Diabetes) (2).

TECHNOLOGY APPLIED TO DIABETES DURING ADOLESCENCE:

Each individual responds to life situations uniquely, and this is where technology can

play a decisive role in helping young people better manage their diabetes.

Diabetes technology refers to any device that includes specific software to facilitate diabetes management.

The use of current diabetes technology has grown exponentially, and for its proper implementation, structured educational programs targeting adolescents are essential, along with the support of their families.

The mere use of technology does not guarantee optimal results on its own. The best outcomes are achieved with greater education, training, and appropriate psychosocial support in managing various devices. Therefore, educational needs should be periodically assessed, especially during technological updates and when set goals are not being met.

To maximize the effectiveness of technology for young people with diabetes, two crucial aspects should be considered (3):

- **Having health care professionals trained in these technologies**, therapeutic education, and who can communicate in the same language as the adolescents.
- **Incorporating the opinions of young people** to set realistic expectations and address individual educational and training needs. This is a Grade A recommendation by the American Diabetes Association (ADA), indicating high-quality evidence from meta-analyses and randomized clinical trials.

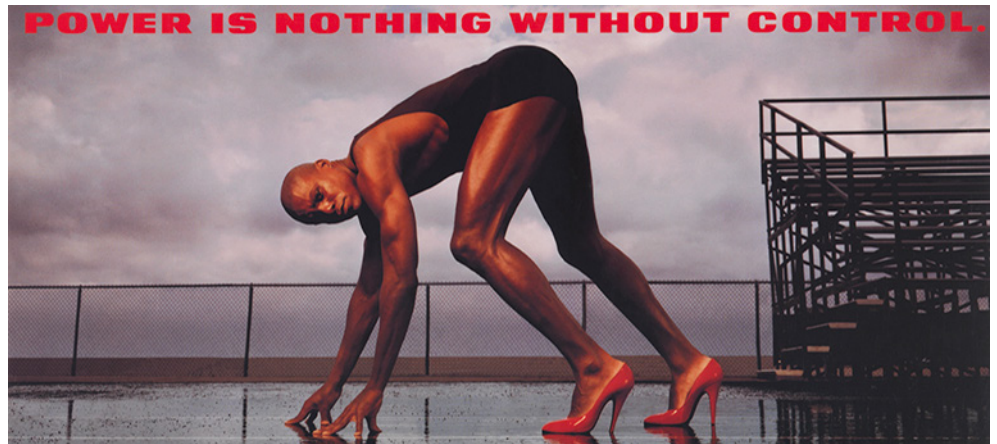
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TABLE 1. Global Estimates of Type 1 Diabetes in Children and Adolescents (Ages 0–14 and 0–19) in 2021

Global population (ages 0–14)	1.99 billion
Global population (ages 0–19)	2.61 billion
Type 1 diabetes in children and adolescents (ages 0–14)	
Existing cases (prevalence) of type 1 diabetes	651,700
New cases per year (incidence) of type 1 diabetes	108,300
Type 1 diabetes in children and adolescents (ages 0–19)	
Existing cases (prevalence) of type 1 diabetes	1,211,900
New cases per year (incidence) of type 1 diabetes	149,500

THE COMPLEXITY OF DAILY DIABETES MANAGEMENT ROUTINES, ALONG WITH THE CHALLENGES OF ADOLESCENCE, RESULTS IN < 25% OF YOUNG PEOPLE WITH DIABETES ACHIEVING THE ISPAD-RECOMMENDED GLYCATED HEMOGLOBIN TARGET OF < 7%

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The greatest benefits of technology are achieved through educational programs that train young people in its use.

» TECHNOLOGICAL TOOLS FOR DIABETES MANAGEMENT:

Technology is a highly motivating tool for young people with type 1 diabetes mellitus due to several key factors that facilitate the management of their condition and improve their quality of life. However, some barriers still pose challenges (*Table 2*).

Most barriers can be overcome through meaningful learning, using individualized therapeutic education, and adequate psy-

choemotional support (4). Facilitators can help integrate technology into their daily lives effectively, reducing the burden of living with diabetes.

The most widely used devices by young people today are:

1. Interstitial Glucose Monitoring:

Improvements in these devices (accuracy, size, ease of use) and their funding by the National Health System since 2018 have re- >>

TABLE 2. Facilitators and barriers

FACILITATORS	BARRIERS
Reduction in the number of pricks; better glycemic control and insulin administration	Technical issues (inaccuracy, signal loss, catheter blockages, etc.)
Automation simplifies complex tasks and reduces decision-making	Overconfidence (skipping boluses, delayed boluses, failure to activate exercise mode, etc.)
Improved nighttime rest	Alarm fatigue
Sense of security due to remote monitoring by parents	Feeling of excessive control from follower apps
Facilitates integration into school activities	Schools need to "learn" how to manage the technology
Positive influence of friends using technology in diabetes management	Concern about body image Skin reactions to adhesives
Facilitates self-management of diabetes	

» volutionized their use. They often replace the need for finger pricks, making them the preferred glucose monitoring system among young people. They also provide alerts about glucose levels, helping them make decisions about physical activity, diet, or hypoglycemia management. However, these alerts are sometimes seen as a nuisance, interrupting leisure time or school hours, leading some to silence them and underuse the devices.

2. Insulin Pumps:

These now feature AI-based algorithms capable of automated insulin delivery (AID) based on continuous glucose monitor readings to maintain glucose within a stable range.

They provide more precise glucose control, reduce the burden of multiple daily insulin injections, and minimize constant decision-making related to diabetes, thereby improving health outcomes. They have been shown to reduce HbA1c levels in adolescents with type 1 diabetes mellitus but do not significantly impact overall quality of life. Further studies are needed to evaluate their long-term effectiveness and quality-of-life impact (4).

3. Connected Pens or Caps:

These reusable pens or caps use insulin

cartridges and allow for insulin dose monitoring, even linking to glucose monitoring apps. Proper use and data download to various platforms can aid in decision-making, such as managing hypoglycemia, missed boluses, ineffective physical activity management, or insulin dosing. This information fosters responsibility in managing their condition.

4. Mobile Applications:

These allow users to record glucose levels, food intake, physical activity, and insulin doses, and even provide reminders. Some are specifically designed to help adolescents and their parents manage diabetes.

All these devices, regardless of which one is used, provide extensive data and variables that require “translation” into meaningful actions to impact glucose levels effectively.

Technology has succeeded in reducing the number of hypoglycemic episodes, ketoacidosis cases, and increasing the proportion of young people achieving HbA1c targets (5). Despite technological advancements, many still fail to meet the metabolic control goals set by ISPAD, suggesting the need to analyze unmet and “hidden” needs among adolescents. **D**

CONCLUSIONES:

- Advanced diabetes technologies offer an opportunity to help young people become more independent in managing their diabetes, achieve glucose targets with less effort, and reduce the burden of self-care.

- Assessing competencies in diabetes technology is crucial for both professionals and adolescents, as well as their parents, during this transition to self-management.

- Therapeutic education in technology use will help recognize and overcome potential barriers to the adoption and continued use of technology in young people with type 1 diabetes mellitus.

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