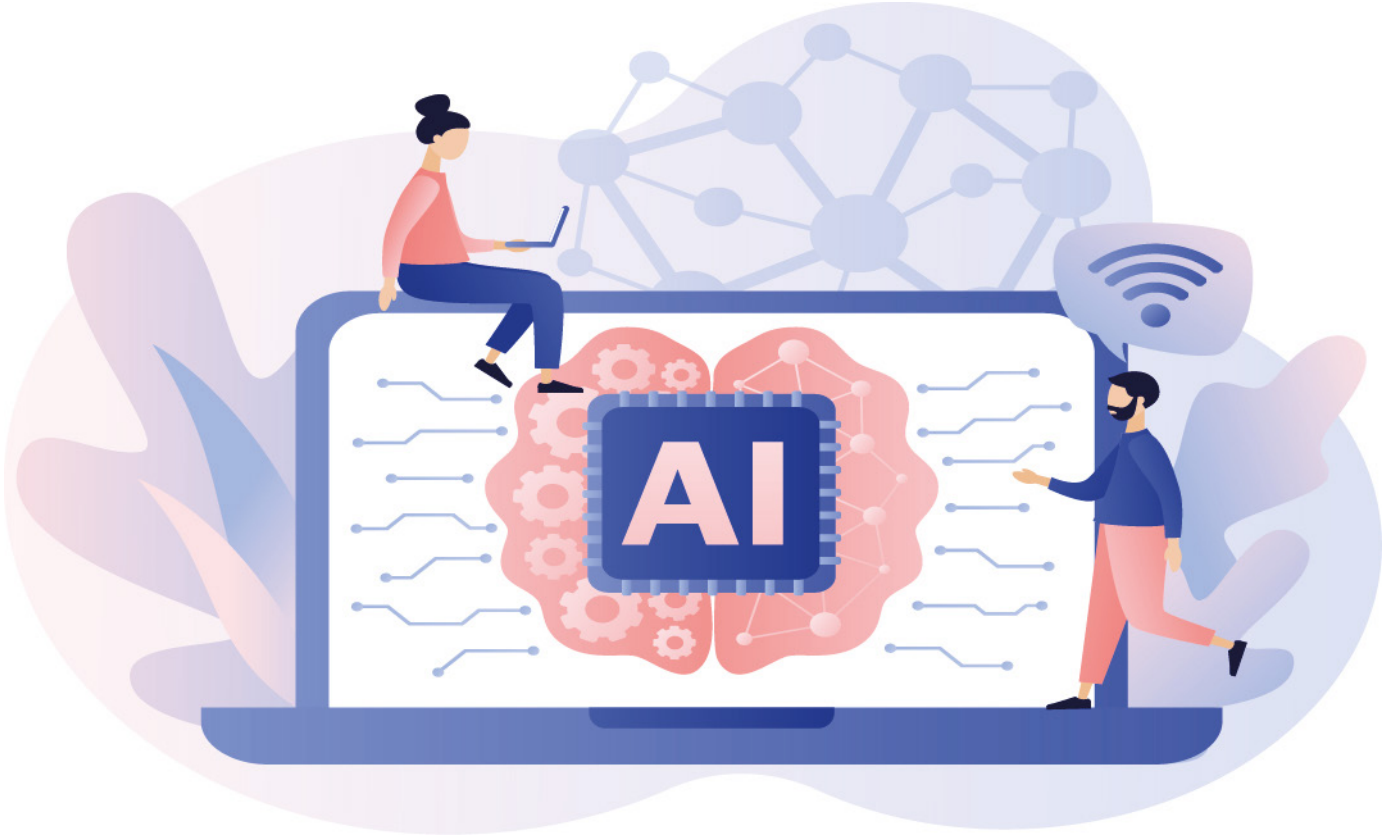
Marisa Amaya Baro.
Advanced Practice Nurse in Diabetes. Algeciras, Cádiz, Spain.

Ángeles Beatriz Álvarez Hermida.
Specialist Family and Community Nurse.
Alcalá de Guadaira Health Center, Madrid, Spain.



Artificial intelligence disrupts therapeutic education in diabetes: new perspectives for self-care

Artificial intelligence disrupts therapeutic education in diabetes: new perspectives for self-care

Artificial Intelligence (AI) is a powerful tool that allows us to equip a machine with the expertise of a specialist in a specific field based on the data we provide. Among the vast field of research is machine learning, consisting of a set of algorithms that do not operate based on pre-established rules but are capable of creating decision rules based on acquired experience using data. Machine learning is proving to be highly useful for generating new knowledge from these data

THERAPEUTIC EDUCATION AND DISEASE SELF-MANAGEMENT

The mission of therapeutic education in diabetes (TED) is to facilitate self-management of the disease by the patient and/or their environment. To achieve this, professionals use various pedagogical techniques, including **active learning**, which enables and empowers the patient to solve practical scenarios similar to those encountered in everyday life. Interpreting an ambulatory glucose profile (AGP), calculating a corrective insulin bolus, or carbohydrate portions in a meal are typical "subjects" in educational programs. This learning serves the numerous decisions a person with diabetes must make daily (safely) regarding their treatment. Given this reality, it is easy to deduce that AI and its possibilities could have a crucial impact on the self-management of diabetes treatment. AI emerges as a powerful tool to revolutionize therapeutic education in diabetes. Its ability to analyze data, personalize learning, and provide continuous support opens new possibilities for self-care.

Active learning and machine learning: are they destined to understand each other or do they cross each other out?

Active learning is characterized by including motivating and challenging activities aimed at deepening knowledge. It develops students/patients' skills in searching, analyzing, and synthesizing information, and promotes active adaptation to problem-solving (critical thinking). However, traditional education does not always adapt to the individual needs of each person with diabetes, limiting its effectiveness. While AI encompasses the idea of a machine imitating human intelligence, machine learning does not. The goal of machine learning is to teach a machine to perform a specific task and provide precise and personalized results by identifying patterns.

AI AS AN ALLY IN THERAPEUTIC EDUCATION/TRANSFORMING THERAPEUTIC EDUCATION

- **Data Analysis:** AI can analyze large datasets from people with diabetes, including glucose levels, physical activity, diet, lifestyle habits, and learning preferences. This allows the identification of patterns and specific risks of each individual, thus personalizing recommendations and laying the groundwork for precise and tailored education.
- **Pattern Identification:** From data analysis, AI can identify patterns and areas for improvement in diabetes management.
- **Personalization of Learning:** AI can create personalized learning plans, adapting content, presentation style, pace, and difficulty to the needs, preferences, capabilities, and goals of each person with diabetes. Content, presentation style, and difficulty are adjusted in real-time, optimizing the learning experience and maximizing information retention.
- **Content Adaptation:** AI can adapt educational content to the needs and preferences of each person with diabetes, using different formats (text, images, videos, games) and channels (mobile apps, chatbots, virtual reality).
- **Continuous Support:** AI can offer ongoing support and monitoring to people with diabetes, answering their questions, providing personalized advice, motivating them to maintain a healthy lifestyle, and alerting them to potential risks and complications. AI chatbots or mobile apps can provide this continuous support, reinforcing self-care.

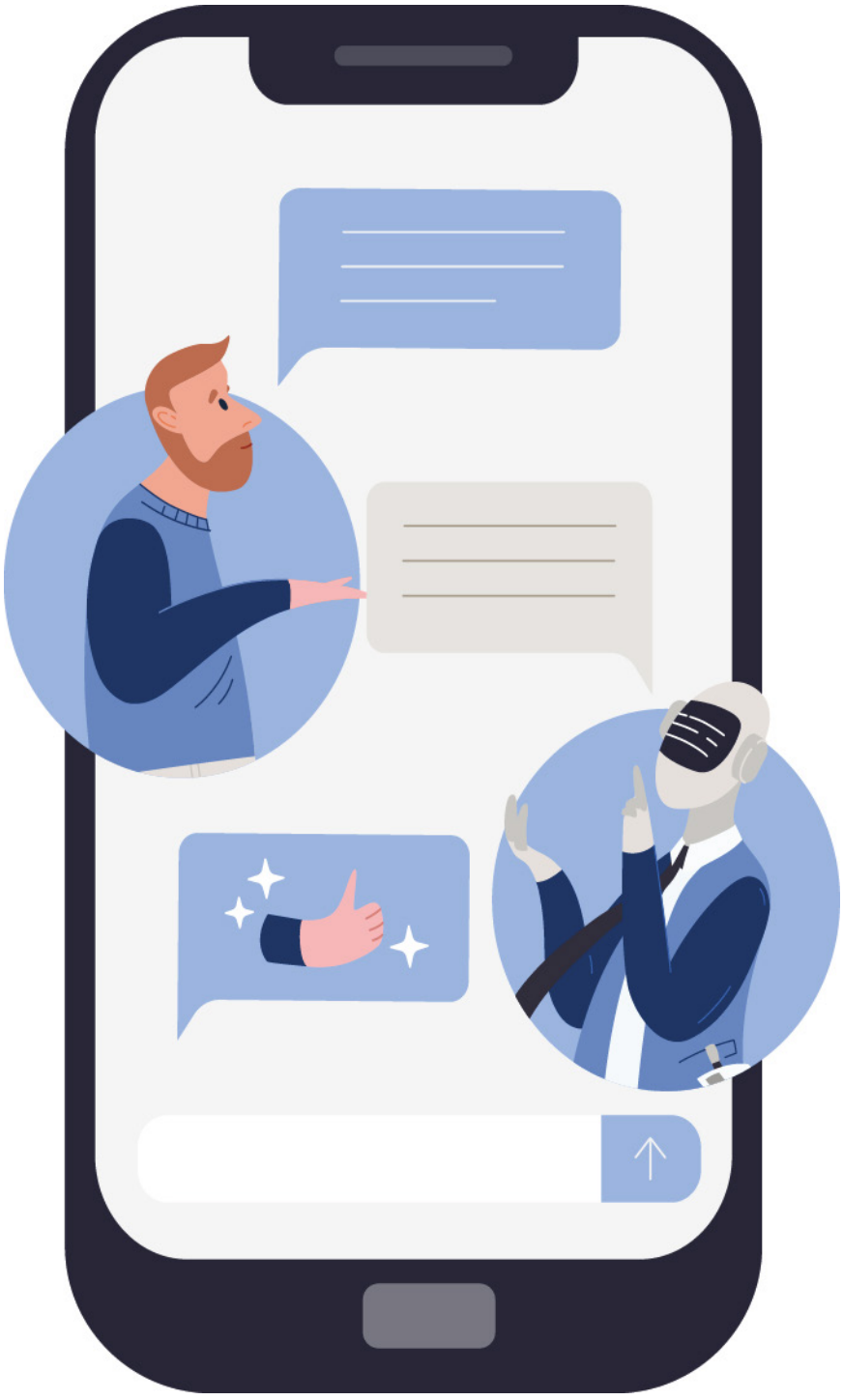
USEFUL AI APPLICATIONS IN THERAPEUTIC EDUCATION

1. ***Mobile apps:*** Some apps use AI to analyze diabetes data and provide personalized recommendations on diet, exercise, and drug management. They can also send reminders for drug or glucose measurements.

»

THERAPEUTIC EDUCATION IN DIABETES (TED) AIMS TO PROMOTE SELF-MANAGEMENT OF THE DISEASE BY THE PATIENT AND/OR THEIR ENVIRONMENT. TO ACHIEVE THIS, PROFESSIONALS USE VARIOUS EDUCATIONAL TECHNIQUES, INCLUDING ACTIVE LEARNING, WHICH ENABLES AND EMPOWERS PATIENTS TO SOLVE SIMILAR PRACTICAL SCENARIOS TO THOSE THEY FACE IN THEIR EVERYDAY LIVES

ARTIFICIAL INTELLIGENCE (AI) IS A POWERFUL TOOL THAT ALLOWS TRANSFERRING THE EXPERTISE OF A SPECIALIST IN A SPECIFIC FIELD TO A MACHINE USING THE DATA WE PROVIDE



» 2. ***Virtual assistants:*** AI chatbots can answer frequently asked questions about diabetes, provide personalized advice, offer emotional support, and track progress.

Chatbots for general information and support:

- **Florence:** A chatbot developed by the International Diabetes Federation offering information, support, and follow-up for people with diabetes.
- **Ada:** A chatbot by Wellpepper that helps people with type 2 diabetes manage their condition.
- **Ellie:** A chatbot by Glooko providing information and support for people with diabetes.

Chatbots for the management of type 1 diabetes:

- **SugarBot:** A chatbot by Tidepool assisting with insulin dosage calculations for type 1 diabetes.
- **Diabuddy:** A chatbot by Diasend offering support and advice for managing type 1 diabetes.
- **BlueLoop:** A chatbot by Bigfoot Biomedical helping with type 1 diabetes management through an artificial pancreas system.

Chatbots for the management of type 2 diabetes:

- Livongo Health: A chatbot offering personalized coaching and support for people with type 2 diabetes.
- Virta Health: A chatbot helping with type 2 diabetes control through lifestyle changes.
- Omada Health: A chatbot providing a be- »

» havioral intervention program for type 2 diabetes management.

Chatbots for general diabetes ducation:

- **Glucopedia:** A chatbot by Sanofi offering information about diabetes and its management.
- **Diabetes.co.uk:** A chatbot providing information and advice about diabetes.
- **American Diabetes Association:** A chatbot offering information and resources on diabetes.

3. ***Recommendation systems:*** AI can recommend personalized foods, physical activities, and diabetes management strategies based on individual characteristics and needs. It can also suggest specific educational resources (articles, videos, podcasts).

Food recommendation systems:

- **Carb DM:** An app helping with carbohydrate calculation in meals and choosing healthy foods.
- **SugarSync:** An app that scans food barcodes and provides detailed nutritional information, including sugar content.
- **Nutrino:** An app using AI to analyze nutritional needs and recommend personalized recipes.

Physical activity recommendation systems:

- **Fitbit:** A fitness tracker offering personalized activity recommendations.
- **Strava:** A fitness tracking app providing personalized training plans for various goals.
- **Nike Run Club:** A fitness app offering personalized training and motivation for runners.

Drug recommendation systems:

- **UpToDate:** A medical information resource providing personalized treatment recommendations for diabetes.
- **DynaMed:** A medical information platform »

» offering evidence-based recommendations for diabetes management.

- **Micromedex:** A system providing comprehensive information about diabetes drugs.

Self-care tools recommendation systems:

- **Dario:** A glucose monitoring system offering personalized recommendations for diabetes management.
- **One Drop:** A glucose monitoring system providing a personalized coaching program for people with diabetes.
- **Livongo:** A diabetes management program offering personalized self-care tools and professional support.

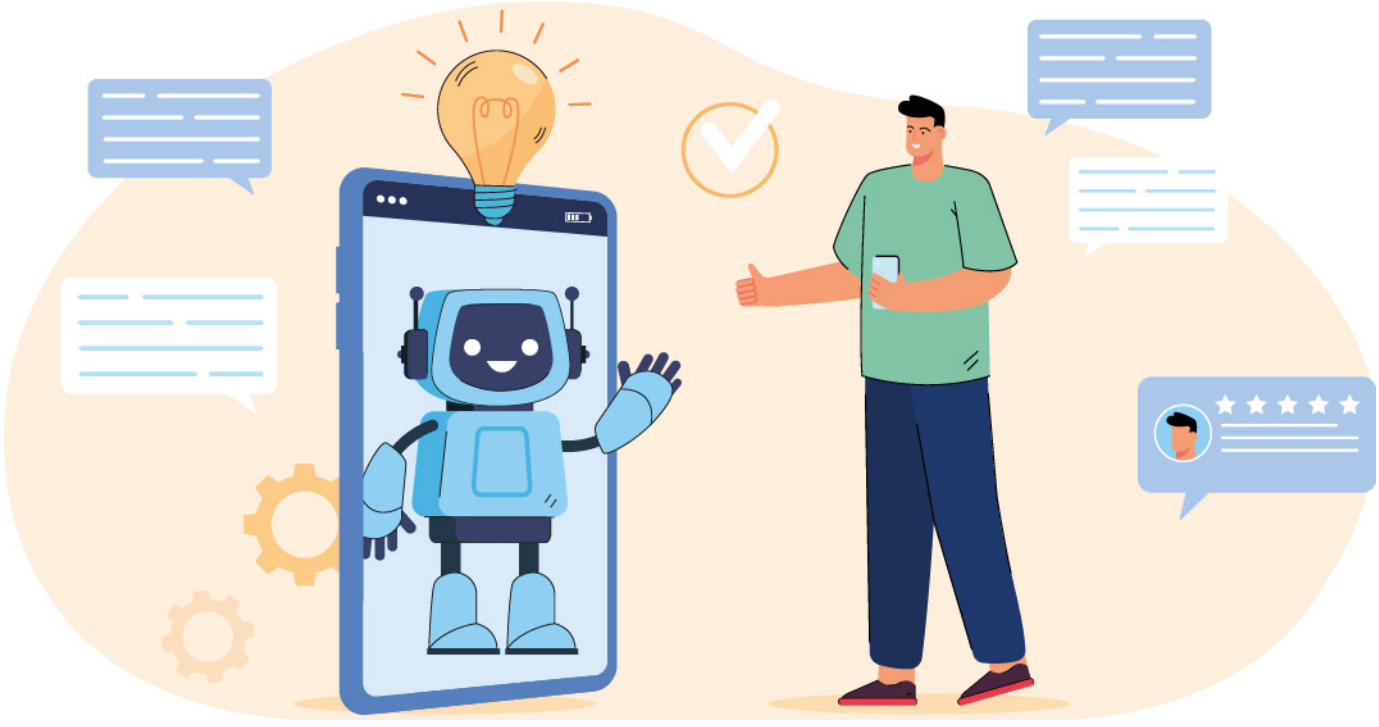
4. Virtual and augmented reality: AI can be used to create simulated scenarios and interactive environments to help people with diabetes learn to manage their condition in real-life situations. Examples include:

- **DiabSim VR:** A virtual reality simulation helping people with diabetes learn to manage their condition in various everyday situations.
- **GlucoMedic VR:** A virtual reality app helping people with diabetes understand and relate to human anatomy, physiology, and diabetes.

As people with diabetes increasingly engage with their condition, seeking more information and updates, there are movements like DIY (do-it-yourself) through which individuals with diabetes have begun to implement self-created algorithms without oversight from medical agencies to self-manage insulin infusion systems. Nonetheless, interaction between individuals with diabetes and health care professionals remains essential, highlighting the need for diabetes education guidelines to adapt to new technologies.

In TED, active learning can benefit from machine learning by PERSONALIZING the learning experience for each patient, adapting content and resources according to progress and individual needs. Machine learning can also be used by professionals to effectively establish educational intervention agendas. For instance, an experienced professional needs an average of 8 minutes to analyze an AGP download from a patient. This time is the minimum required to establish a personalized care plan, prioritizing areas for improvement (e.g., reducing hypoglycemia time and/or optimal alert management). AI systems analyze thousands of data points in record time. This would allow educators to devote more time to patients who need it most, creating alerts and saving time on these selective tasks.

The data provided by these systems will be important for deepening and making decisions on how to facilitate effective learning for our patients. Educational program designs will likely need to account for all these aspects. Many questions remain to be formulated and resolved. »



» Challenges and ethical considerations:

Despite the great possibilities offered by AI, there are also challenges to consider:

- **Access and Equity:** It is important to make sure that AI is accessible to all people with diabetes, regardless of income level, education, or technological skills.
- **Privacy and Data Security:** Protecting the privacy and security of personal data for people with diabetes is fundamental.
- **Algorithmic Bias:** It is necessary to ensure that AI algorithms are not biased to avoid discrimination against certain groups.
- **Professional Competencies:** Training and education are required for health care professionals to use AI effectively and ethically in therapeutic education.

The challenge for professionals is determining how to incorporate this technology into their routine clinical practice quickly and flexibly once refined. Measures such as transforming diabetes units into more technological units with the inclusion of IT specialists, engineers, and, importantly, expert patients, would aid in this process. D

BIBLIOGRAFÍA

● Scott C. Mackenzie, Chris A. R. Sainsbury, Deborah J. Wake. Diabetes and artifcial intelligence beyond the closed loop: a review of the landscape, promise and challenges. Diabetologia (2024) 67:223–235 https://doi.org/10.1007/s00125-023-06038-8
● American Diabetes Association. (2023). Artificial intelligence in diabetes care: Standards of medical care in diabetes—2023. Diabetes Care, 46(Suppl. 1), S143–S150.
● Chatterjee, S., & Hollingsworth, A. (2022). Artificial intelligence in diabetes education and self-management: A systematic review. Journal of Diabetes Science and Technology, 16(5), 1017–1027.
● Gómez-Huelgas, A., & Pérez-Cárceles, M. D. (2022). Aplicaciones de la inteligencia artificial en el manejo de la diabetes mellitus tipo 2. Revista Clínica de Medicina Interna, 33(1), 54–62.
● Rusell, S. J., Norvig, P. (2004), «Inteligencia Artificial. Un enfoque moderno», Pearson Educación (Segunda edición) (Madrid), ISBN 978-84-205-4003-0.
● Sudo, Kyoko et al. Machine Learning–Based Screening of Healthy Meals From Image Analysis: System Development and Pilot Study. JMIR Formative Research 4 10(2020): e18507.
● Aguilera, Adrián et al. mHealth app using machine learning to increase physical activity in diabetes and depression: clinical trial protocol for the DIAMANTE Study.pen 10 8 (2020): e034723.