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Management of Type 1 Diabetes with Advanced Technology

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ABSTRACT

The understanding and treatment of type 1 diabetes (T1D) is advancing with technological advances. The discovery of insulin in 1921 revolutionized diabetes treatment and paved the way for the development of insulin pumps (IP) continuous glucose monitors (CGMs) and artificial pancreas (AP) systems, which have significantly improved diabetes management. IP provides continuous insulin delivery, offering benefits, such as adaptability, precise dosing, and improved glycemic control. The CGMs enable real-time glucose monitoring, leading to enhanced glycemic management and reduced hypoglycemia risk. The AP systems combine CGM and IP technologies to automate insulin delivery, resulting in improved outcomes and potential dual hormone systems using insulin and glucagon. Despite the potential of these technologies, challenges exist in utilizing them in India, including cost, insurance coverage, availability, awareness, healthcare infrastructure, trained professionals, cultural barriers, and data management issues. However, ongoing research and advanced research utilizing cutting-edge technologies offer hope for new therapies and ultimately a cure for T1D.

Keywords: Artificial pancreas, blood glucose self-monitoring, hypoglycemia, insulin infusion system, type 1 diabetes mellitus



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INTRODUCTION

The technological evolution strongly influenced – and indeed reshaped – the landscape of Type 1 Diabetes (T1D) comprehension.^[1] The turning point finally came in 1921 and with the great invention of insulin an era whose influence on all aspects of diabetes treatment proved to be revolutionizing. This achievement led the way for further developments that went on to spawn new technologies, proving significant in improving the existence of those struggling with T1D.

At the leading edge of this technological wave are insulin pumps (IP), which administer precise doses of insulin without needing to be injected and give patients a greater degree of control over their blood sugar.^[2] This is supported by the advent of continuous glucose monitors (CGM) that have completely changed how we are able to follow blood sugars in real-time with instantaneous feedback for both patients and providers so they can act on information quickly. The epitome of this advancement comes in the embodiment of an artificial pancreas (AP): a miracle concoction combining IP and CGM to automatically manage insulin administration relative to present glucose levels, allowing for optimal blood glucose control. It is almost a prestige to show the old lifestyle to kids all around T1D being live now, making this age witness cutting-edge diabetes management thanks in part from the tech power equals healthier

being won with our gradually knowing people who are T1D better than ever period into which their evolution has synergistically intertwined. This takes us on an enlightening journey that describes the scientific breakthroughs and technological changes that have revolutionized the lives of people living with T1D.

IP

IP are pager-sized computerized devices that convey basal and bolus insulin throughout the day, as per pancreatic discharge.^[3] Their pump technology also connects to a cannula that is inserted under the skin and delivers insulin directly into adipose tissue. IP therapy has been demonstrated to improve quality of life as compared with multiple daily insulin injections, providing increased dosing flexibility in response to day-to-day variations and offering better glycemic control. Better blood glucose control is made possible by easily adjusting their insulin dosage with the use of IP. In addition, they give small doses of insulin to help individuals who experience sensitivity or highs and lows in blood glucose. Continuous insulin infusion improves glycaemic control and reduces hypoglycemia.

CGM

The CGM comprises a technique for measuring glucose levels in real-time, conducted through an implantable sensor placed under the skin that reads concentrations of glucose present within interstitial fluid from patients with T1D.^[4] This is sent to a glucose values display/alert device. These advantages include superior glycaemic control compared to customary monitoring, reduced risk of hypoglycemia, and heightened glucose fluctuation awareness.^[5] Studies have shown a considerable decrease in glycated hemoglobin levels and time of hypoglycemia among patients operating CGM systems over conventional routines.^[6]

AP

The AP or closed-loop system is a new technology using CGM devices integrated with IP that stabilizes glucose into target-range values for subjects.^[7] While basal-bolus therapy requires significant patient input, an automated system might ultimately reduce the work that patients need to do while improving outcomes. Automatic modulation of both basal and bolus insulin delivery within fully closed-loop systems has demonstrated efficacy in early research. Dual hormone systems: Dual hormone systems are another important advancement that employs insulin and glucagon to maintain blood glucose levels in a more controlled way

by simulating the pancreas's natural operation. However, the research indicates that these advances could be instrumental in enhancing diabetes control to potentially improve the quality of life for individuals with diabetic issues.

CONCLUSION

Managing T1D in India faces challenges such as high costs, limited insurance, restricted availability, lack of awareness, inadequate infrastructure, professional shortages, cultural barriers, and data issues. Despite a weak regulatory framework, technological advancements offer hope for new treatments and understanding, with ongoing research promising future therapies and a potential cure.

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