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COMMENTARY

Algorithms for a Closed-Loop Artificial Pancreas: The Case for Proportional-Integral-Derivative Control

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Abstract

Closed-loop insulin delivery continues to be one of most promising strategies for achieving near-normal control of blood glucose levels in individuals with diabetes. Of the many components that need to work well for the artificial pancreas to be advanced into routine use, the algorithm used to calculate insulin delivery has received a substantial amount of attention. Most of that attention has focused on the relative merits of proportional-integral-derivative versus model-predictive control. A meta-analysis of the clinical data obtained in studies performed to date with these approaches is conducted here, with the objective of determining if there is a trend for one approach to be performing better than the other approach. Challenges associated with implementing each approach are reviewed with the objective of determining how these approaches might be improved. Results of the meta-analysis, which focused predominantly on the breakfast meal response, suggest that to date, the two approaches have performed similarly. However, uncontrolled variables among the various studies, and the possibility that future improvements could still be effected in either approach, limit the validity of this conclusion. It is suggested that a more detailed examination of the challenges associated with implementing each approach be conducted.

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Abbreviation: (eCTR) enhanced control-to-range, (IQR) interquartile range, (MPC) model-predictive control, (PID) proportional integral derivative, (PD) pharmacodynamic, (PID_{IFB}) proportional integral derivative with insulin feedback, (PK) pharmacokinetic, (RLS) recursive least squares, (sCTR) standard control-to-range

Keywords: artificial pancreas, closed-loop insulin delivery, continuous glucose monitoring, continuous subcutaneous insulin infusion

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