An automated meal detector and bolus calculator in combination with closed-loop blood glucose control

The aim of this study is to develop an algorithm for detection of unannounced meals and an insulin bolus calculator (BC) to work in combination with the meal detector. The input of the meal detector are the continuous glucose monitoring (CGM) data and the insulin infusion rate. During daytime, the automated meal detector and the BC control the blood glucose concentration. During nighttime, a model predictive control (MPC) algorithm regulates the basal insulin rate. The meal detector detects the occurrence of a meal, estimates the amount of carbohydrate (CHO) in the meal, and estimates the meal onset time. The BC computes a bolus dose to cover the detected meal. We test the meal detector and the BC on nine virtual type 1 diabetes (T1D) patients. The meal detection algorithm, applied on the virtual patients, has a median detection delay of 40 min, detection sensitivity of 80% and a median meal onset estimation bias of 15 min. The algorithm does not have false positive.