State Machine Diagrams Explanation

1. Manage Personal Profiles (CRUD Operations)

The Manage Personal Profiles state machine begins in an idle waiting state, where a user can choose from various profile management actions such as creating, deleting, duplicating, activating, or updating a profile. Each action triggers specific checks—like verifying that the maximum profile limit is not exceeded, confirming deletions, merging duplicated content, or validating data ranges. Successful operations result in new states (e.g., profile created, deleted, copied, activated, or updated), which then transition to an end state. Suppose any checks fail or the user cancels the operation. In that case, the system returns to an appropriate intermediate state (like confirming deletion or reporting invalid ranges) before completing the operation or reverting to the idle waiting state.

2. Manual Bolus Delivery

The manual bolus delivery state machine begins in an idle waiting state, where the user can initiate a manual bolus delivery. If the user decides not to deliver a bolus, the system remains idle. Otherwise, the user enters blood glucose (BG) and carbohydrate information, which the system uses to calculate a recommended dose. If the BG level is low, the system issues a warning, prompting the user to confirm or correct the dose before proceeding. Once confirmed, the user selects either a standard bolus, which delivers the dose immediately, or an extended bolus, which splits the dose into an initial amount and a remainder delivered over time. After the selected bolus type is administered, the process ends.

3. Basal Insulin Management with Control IQ

This state machine depicts how a closed-loop insulin delivery system (Control IQ) transitions between different operational states based on continuous glucose monitor (CGM) readings. It starts through a manual override or automatic profile switching and remains idle until new CGM data arrives. Once data is received, the system predicts future blood glucose (BG) levels. Depending on the forecasted BG range, it selects the most appropriate basal mode—suspending insulin, decreasing basal, keeping it regular, increasing basal, or administering an auto-correction bolus. Finally, the chosen adjustment is reflected in the user interface before

the cycle concludes or repeats, allowing the system to refine insulin delivery in response to real-time glucose data continually.

4. **View Pump History & Data Visualization**

   Outlines the user's path for viewing insulin pump history and related data visualizations. From an idle waiting state, the user chooses to access history and data review, prompting the system to query stored pump data. Once retrieved, the system displays a list of historical events, and the user may switch to a graphical view for more detailed analysis. In this graph view, additional features—such as exporting data, zooming in on the graph, or viewing an average BG—are available. Finally, the user can exit and return to the home screen, concluding the process.

5. **Pump Malfunction Handling**

   The Pump Malfunction Handling state machine illustrates how a pump system identifies and responds to malfunctions. The process begins with the pump in an idle state, periodically checking for errors. When a malfunction is detected, a warning is issued and displayed, requiring the user's acknowledgment. Depending on the outcome, the issue may be fixed—after which the event is logged, and the pump returns to regular operation—or, if the problem remains unresolved, the alert is escalated. The event is recorded before resuming standard functionality.

6. **Bolus Safety Measures**

   This state machine diagram, "Bolus Safety Measures," illustrates the decision-making process for administering a bolus insulin dose while ensuring safety measures are met. The process starts with initiating a bolus and checking the blood glucose (BG) level. If the BG level is below the target, a reduced bolus is suggested; a warning is issued if hypoglycemia risk is detected. If the BG level is expected, the system checks if the bolus amount exceeds the maximum limit—if above the limit, the user is alerted, and the bolus is capped; if within the limit, the bolus progresses. The bolus type is then checked—if extended, it is canceled; otherwise, the standard bolus continues. All actions, including alerts, warnings, and bolus cancellations, are logged before the process ends. The diagram ensures safe bolus administration by preventing excessive dosing and reducing hypoglycemia risks.

7. Control IQ Safety Operations

This state machine diagram, "Control IQ Safety," illustrates the automated insulin delivery system's response to glucose monitoring and sensor connectivity. The process begins with a continuous monitoring state. If the system predicts that blood glucose (BG) will drop below 3.9 mmol/L, it transitions to the "Suspend Basal" state, temporarily stopping insulin delivery. The basal suspension can end either by user intervention (leading to a "Manual Override" state, which terminates the process) or after a preset time elapses, triggering "Auto-Resume" to restore insulin delivery and return to monitoring. If the continuous glucose monitor (CGM) signal is lost, the system switches to "Default Basal," delivering a pre-set insulin rate until the CGM reconnects, at which point it resumes monitoring. The diagram ensures safe insulin management by preventing hypoglycemia and maintaining insulin delivery in case of sensor disruptions.