1. Use Case: Initial Pump Setup

Name: Initial Pump Setup
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: wants a correctly configured and fully charged pump ready for insulin delivery.
- **Healthcare Provider**: relies on correct initial setup to ensure patient safety and effective treatment.

Pre-condition(s):

1. Pump hardware (or simulation interface) is available.
2. USB cable and power source are accessible if charging is required.
3. The user is familiar with basic touchscreen interactions and has proper instructions from healthcare professionals.

Success Guarantee(s) (Post-conditions):

1. The pump is powered on, sufficiently charged, and has correct date/time settings.
2. The pump's measurement units (mmol/L for BG, insulin units, etc.) match user/clinic standards.
3. Security settings (PIN lock) are optionally configured.
4. Control IQ Technology is enabled (if applicable) so that predictive insulin adjustments are active.

Main Success Scenario:

1. **User** connects the pump to a power source (USB) if battery is low; the battery indicator shows charging progress.
2. **User** presses and holds the power button to turn on the pump.
3. Pump displays the startup screen and prompts for initial settings (language, time/date).
4. **User** configures date/time and units (mmol/L for BG).
5. (Optional) **User** sets a PIN lock to prevent accidental or unauthorized inputs.
6. **User** verifies that Control IQ is enabled (if desired), confirming the pump is ready to make automatic adjustments once personal profiles are configured.
7. The system confirms successful setup and transitions to the Home screen.

Extensions:

- 2a. **Battery Too Low**: The system displays a critical low battery alert; user must continue charging before proceeding.
- 5a. **PIN Setup Skipped**: System warns user about security implications but allows skipping.
- 6a. **Control IQ Disabled**: If the user chooses not to enable Control IQ initially, the system clarifies that only manual adjustments will be performed.

2. Use Case: Manage Personal Profiles (CRUD)

Name: Manage Personal Profiles
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: needs flexible profile configurations for different daily routines.
- **Healthcare Provider**: reviews and possibly recommends adjustments for effective insulin dosing.

Pre-condition(s):

1. Pump is powered on, with the user at the Home screen or in the Options menu.
2. User has knowledge of desired basal rates, carb ratios, correction factors, etc.
3. Control IQ functionality is available and will use these personal profile settings for automated dosing decisions.

Success Guarantee(s) (Post-conditions):

1. Personal profiles (basal rates, carb ratios, correction factors, target BG, and any time segments) are accurately created, read, updated, or deleted.
2. The system stores and uses updated profile data to calculate boluses and predictive basal adjustments.

Main Success Scenario:

1. **User** navigates: **Options** → **My Pump** → **Personal Profiles**.
2. **User** selects an action: **Create New Profile**, **View (Read) Existing Profile**, **Edit Profile**, or **Delete Profile**.
3. For **Create**:
    a. **User** taps the plus icon (**+**) to create a new profile.
    b. **User** enters a profile name (e.g., "Weekday" or "Exercise") – up to 16 characters.
    c. **User** taps **Press to set up** for each setting (Basal Rate, Correction Factor, Carb Ratio, Target BG).
    d. **User** enters each numeric value using the on-screen keypad (e.g., 1.0 units/hr basal, 1:10 carb ratio, 6.0 mmol/L target BG, etc.).
    e. **User** confirms the values with the blue/green checkmark.
    f. **User** may add additional time segments by tapping the plus icon again and specifying the start time + any changed settings (e.g., new basal rate at 6:00 AM).
    g. The user taps **back arrow** to set Bolus Settings (e.g., insulin duration, max bolus).
    h. **User** saves and returns to the Home screen.
4. For **Read/View**:
    a. **User** selects an existing profile from the list.
    b. **System** displays current settings (basal rates, carb ratio, correction factor, target BG, segments).
5. For **Update**:
    a. **User** chooses an existing profile and edits the relevant fields.

    b. **System** validates ranges and stores updates.
6. For **Delete**:
    a. **User** chooses an existing profile and selects **Delete**.
    b. **System** prompts for confirmation.
    c. **User** confirms deletion, and the system removes the profile.
7. **User** returns to the Home screen after completing the profile management tasks.

Extensions:

- 3a. **Duplicating an Existing Profile**: The user may tap "Duplicate" to clone an existing profile, then make only minor edits (e.g., changing basal rates for nighttime).
- 3b. **Invalid or Out-of-Range Values**: The pump prompts the user to re-enter valid numbers (e.g., 0.05–15.0 units/hr basal).
- 5a. **User Cancels Before Saving**: The system discards changes and retains the old profile values.

3. Use Case: Deliver Manual Bolus (Including Extended Bolus)

Name: Deliver Manual Bolus
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: needs to deliver a mealtime or correction bolus.
- **Healthcare Provider**: ensures correct dosage settings are used to avoid hypo-/hyperglycemia.

Pre-condition(s):

1. Pump is on, with the user on the Home screen or able to access the bolus button.
2. At least one personal profile with valid insulin delivery parameters is available.
3. Sufficient insulin is loaded in the cartridge.
4. (Optional) A CGM session is active, providing real-time BG values for bolus calculations or auto-population.

Success Guarantee(s) (Post-conditions):

1. Correct bolus dose is delivered to the user, logged with relevant info (time, amount, reason).
2. The user can opt for an extended or partial extended bolus if desired.

Main Success Scenario:

1. **User** taps **Bolus** from the Home screen.
2. The system displays the **Bolus** screen.
3. **User** enters carbohydrate amount:
    a. Taps "0 grams" → enters the carb value (ensuring "grams" is displayed above the keypad).
4. If BG data is not auto-populated from CGM, **User** may tap **Add BG** to enter current BG in mmol/L.
    a. If BG is below the user's target but ≥ 3.9 mmol/L, the pump may offer a **reduced** bolus suggestion.
5. The system calculates a suggested bolus using the active profile (insulin sensitivity, IOB, etc.).

6. **User** reviews the suggested dose:
    a. (Optional) modifies the dose if needed; the system logs a manual override.
7. **User** decides how to deliver the bolus:
    a. **Immediate** (all insulin now): taps the blue checkmark icon to deliver.
    b. **Extended Bolus**: toggles **Extend**, sets "Deliver Now" portion vs. "Duration" (e.g., 50% now, 50% over 2 hours).
    c. Confirms the extended bolus setup with the checkmark icon.
8. The system initiates bolus delivery, displaying a progress indicator.
9. Once complete (or once extended delivery starts), the system returns to the Home screen showing a bolus in progress if extended.

Extensions:

- 4a. **Auto-Populated BG**: If Dexcom G6 CGM is active, the current BG might appear automatically.
- 4b. **BG < 3.9 mmol/L**: The system warns that a bolus may risk hypoglycemia; user must confirm or cancel.
- 7a. **Bolus Cancelled Mid-Delivery**: User taps the **X** next to the bolus indicator on the Home screen; system asks for confirmation, cancels remaining bolus, and logs partial delivery.
- 7b. **Extended Bolus**:
    - **User** can set how much insulin is delivered upfront vs. how much is extended, and for how long (e.g., 2 hours).
    - User may cancel the undelivered portion anytime.

4. Use Case: Start/Stop/Resume Basal Insulin Delivery (with Control IQ Automatic Adjustments)

Name: Start/Stop/Resume Basal Insulin Delivery
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: relies on continuous basal insulin for stable glucose control.
- **Healthcare Provider**: monitors basal settings and Control IQ performance.

Pre-condition(s):

1. Pump is powered on, with at least one personal profile set.
2. Sufficient insulin is in the cartridge.
3. Control IQ Technology is enabled (if the user wishes to allow automatic adjustments).

Success Guarantee(s) (Post-conditions):

1. Basal insulin is delivered continuously according to the user's profile and/or Control IQ adjustments.
2. Suspensions, resumes, and adjustments (including automatic correction boluses) are logged.

Main Success Scenario:

1. **User** navigates to **Basal Settings** or the **Options** menu to confirm or change the active personal profile.
2. **User** chooses to **Start** or **Resume** basal insulin if it is currently stopped.
    a. **System** begins delivering insulin at the profile's specified rate.
3. **User** may **Stop** basal insulin manually (Suspend Insulin) if needed (e.g., addressing low BG).
    a. The pump halts basal insulin.
4. **Control IQ Automatic Adjustments** occur in the background based on Dexcom G6 CGM predictions (30 minutes ahead):
    a. **Normal Rate (Gray Diamond)**: If predicted BG is 6.25–8.9 mmol/L, basal insulin is delivered at the user's profile rate.
    b. **Decreased Rate (Orange Diamond)**: If predicted BG ≤ 6.25 mmol/L, Control IQ lowers basal below the profile rate.
    c. **Basal Stopped (Red Diamond)**: If predicted BG < 3.9 mmol/L, the system suspends basal insulin entirely (though boluses can still be given).
    d. **Increased Rate (Blue Diamond)**: If predicted BG > 8.9 mmol/L, Control IQ increases basal delivery above the profile rate.
    e. **Automatic Correction Bolus (White Droplet in Blue Square)**: If predicted BG ≥ 10 mmol/L and the system is already at or near maximum basal, Control IQ delivers an automatic correction bolus.
5. The Home screen icons (diamond color and pump status icon) reflect the current state of insulin delivery, letting the user see if basal is suspended, reduced, normal, or increased.
6. **User** returns to the Home screen; the system continuously logs events, including times when basal was suspended or automatically increased.

Extensions:

- 2a. **Insufficient Insulin for Basal**: System warns user to refill if cartridge is nearly empty.
- 4a. **User Overrides Control IQ**: The user can manually suspend insulin even if Control IQ is trying to deliver more or less; the system logs the manual override.
- 4b. **Predictive Adjustments**: Detailed display of predicted BG and real-time CGM data, letting the user review how the pump is automatically adjusting basal.

5. Use Case: View Pump History and Data Visualization

Name: View Pump History and Data Visualization
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: needs to review insulin deliveries, CGM trends, basal adjustments, and error logs.
- **Healthcare Provider**: uses these logs to adjust therapy and provide guidance.

Pre-condition(s):

1. Pump is on and has stored data (basal/bolus deliveries, CGM readings, Control IQ interventions).
2. User can access the Home screen or Options menu to see history.

Success Guarantee(s) (Post-conditions):

1. User can see a log of insulin deliveries, CGM readings, Control IQ auto-boluses or suspensions, and errors/alerts.
2. Graphical trends (BG over time, insulin usage) are displayed or can be generated.
3. Data can be used to identify patterns (e.g., recurrent lows around mealtimes).

Main Success Scenario:

1. **User** selects "History" or "Data Review" from the pump's **Options** menu.
2. The system shows a chronological list of past events:
    a. Bolus deliveries (manual vs. Control IQ auto-corrections).
    b. Basal adjustments (e.g., "Basal decreased," "Basal stopped," "Basal increased").
    c. CGM readings (trend graph).
    d. Alerts or errors (e.g., occlusion, low battery).
3. **User** taps on a date/time or event to view details (insulin units, BG level, how long basal was suspended, etc.).
4. The system provides a **Graph View**, overlaying BG trends (mmol/L) with insulin deliveries, highlighting in color:
    a. Red shaded areas for times when basal was stopped.
    b. Indicators for correction boluses, extended boluses, etc.
5. **User** can scroll or filter data (by date range or by event type).
6. **User** optionally exports or saves data for healthcare review.
7. **User** taps the **Home** or **Back** button to exit.

Extensions:

- 2a. **No Logged Data**: If the user has not run the pump or cleared history, the system shows "No data available."
- 5a. **Data Export (Optional)**: User can export the data to a USB file or local system for analysis.
- 4a. **Detailed CGM Graph**: The user can zoom in/out or see average glucose in a certain timeframe (e.g., daily, weekly).

6. Use Case: Handle Pump Malfunctions or Errors

Name: Handle Pump Malfunctions or Errors
Primary Actor(s): User (Patient)
Stakeholders:

- **Patient/User**: must be alerted to potential issues for safety and proper insulin dosing.
- **Healthcare Provider**: may need error logs to troubleshoot or adjust therapy.
- **Pump Manufacturer Support**: may assist with critical failures.

Pre-condition(s):

1. Pump is in normal operation or in use before encountering an error.

2. Error-handling features (visual/audible alerts, logs) are active.

Success Guarantee(s) (Post-conditions):

1. User is alerted to any malfunction promptly, with recommended actions displayed.
2. Insulin delivery is automatically suspended if the error is critical (e.g., occlusion, pump shutdown).
3. System logs errors, so repeated or ongoing issues can be investigated.

Main Success Scenario:

1. **System** detects an error or malfunction (low battery, occlusion, CGM disconnection).
2. The pump triggers an alert (visual and/or audible) and displays an error message (e.g., "Occlusion Detected," "Low Battery").
3. **User** acknowledges the alert by tapping the message or pressing an acknowledgment button.
4. The system provides **Recommended Steps**:
    a. For **Low Battery**: recharge pump.
    b. For **Occlusion**: check tubing, infusion site, clear blockage.
    c. For **CGM Disconnection**: re-establish signal or replace sensor.
5. **User** follows the recommended steps. The pump may suspend insulin automatically if the error is critical.
6. Once the user resolves the issue (and the system verifies normal conditions), basal insulin (and Control IQ features) can resume.
7. **User** returns to normal pump operation, or contacts support if the issue persists.

Extensions:

- 1a. **Critical Pump Failure**: The pump suspends delivery and instructs the user to contact support.
- 3a. **User Ignores Alert**: If the condition is severe, the pump continues to alarm or suspends insulin to prevent unsafe dosing.
- 4a. **Error Log**: The user can view a separate "Error History" that time-stamps each malfunction and recommended resolution.

Use cases diagram