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(54) **INFUSION PUMP ASSEMBLY AND METHOD**

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CPC ***A61M 5/1723*** (2013.01); ***A61M 5/1413*** (2013.01); ***A61M 5/14244*** (2013.01); ***G06F 19/00*** (2013.01); ***G06F 19/3468*** (2013.01); ***G16H 20/17*** (2018.01); ***G16H 40/63*** (2018.01); *A61M 2005/14208* (2013.01);
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See application file for complete search history.

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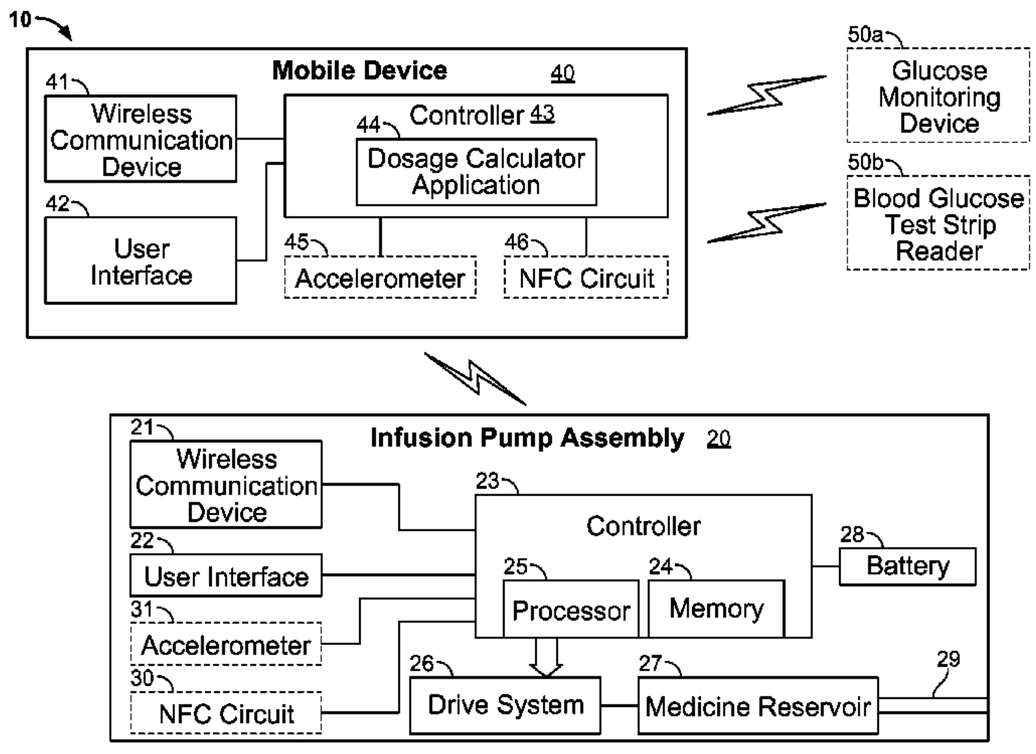
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(57) **ABSTRACT**

Some embodiments of an infusion pump assembly may be equipped with one or more components to facilitate wireless operation of an infusion pump via a user-operated mobile device. In some embodiments, the mobile device and/or the infusion pump may prompt the user to confirm acceptance of a wirelessly communicated command to prevent an operation by the infusion pump (e.g., a dispensation of medicine) that is not desired by the user.

21 Claims, 12 Drawing Sheets



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(52) **U.S. Cl.**

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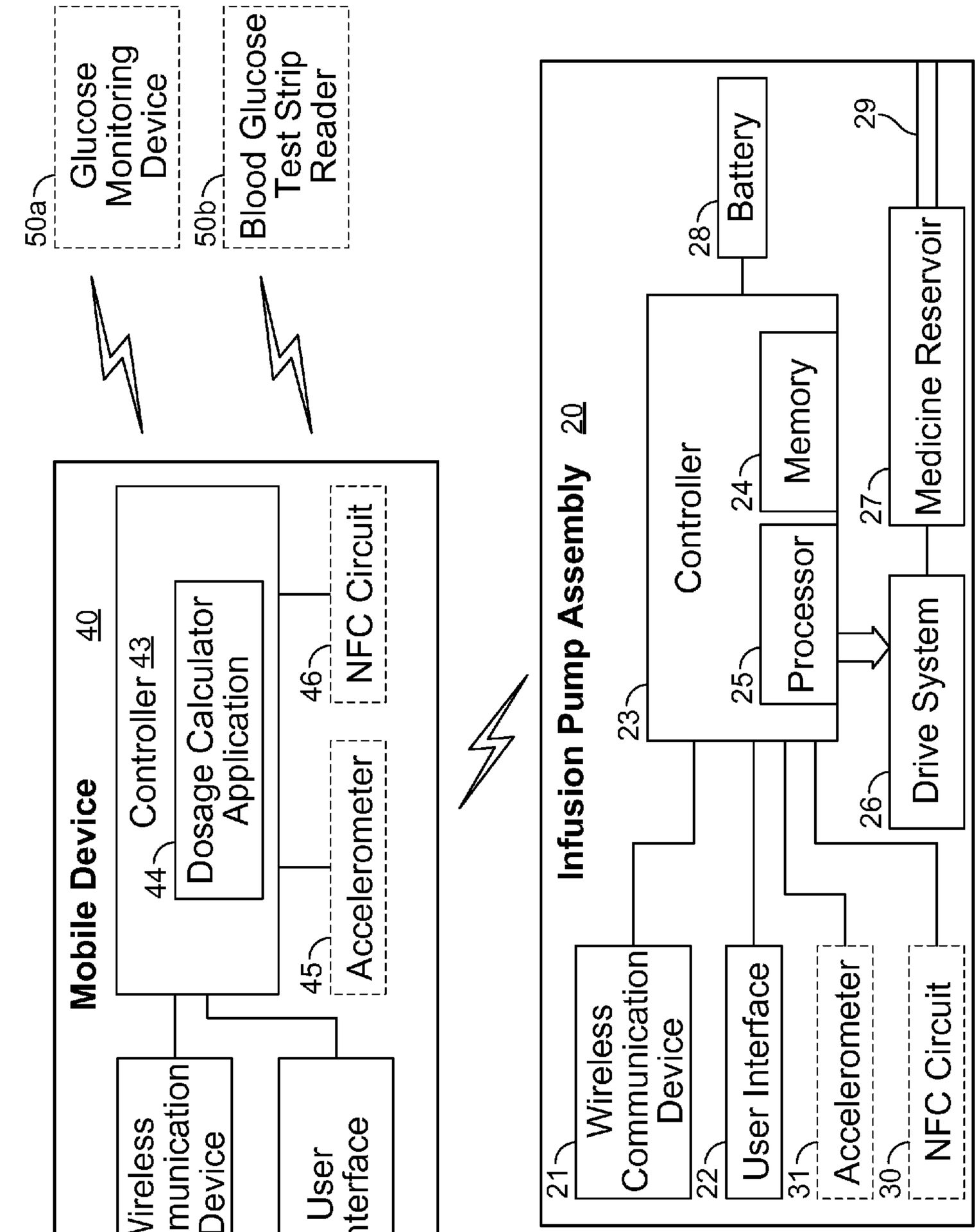

Glucose Monitoring Device
50a
Blood Glucose Test Strip Reader
50b
Mobile Device
40
Controller 43
Dosage Calculator Application
44
NFC Circuit
46
Accelerometer
45
Wireless Communication Device
41
User Interface
42
10
Infusion Pump Assembly
20
Battery
28
29
Controller
23
Memory
24
Processor
25
Medicine Reservoir
27
Drive System
26
Wireless Communication Device
21
User Interface
22
Accelerometer
31
NFC Circuit
30

FIG. 1

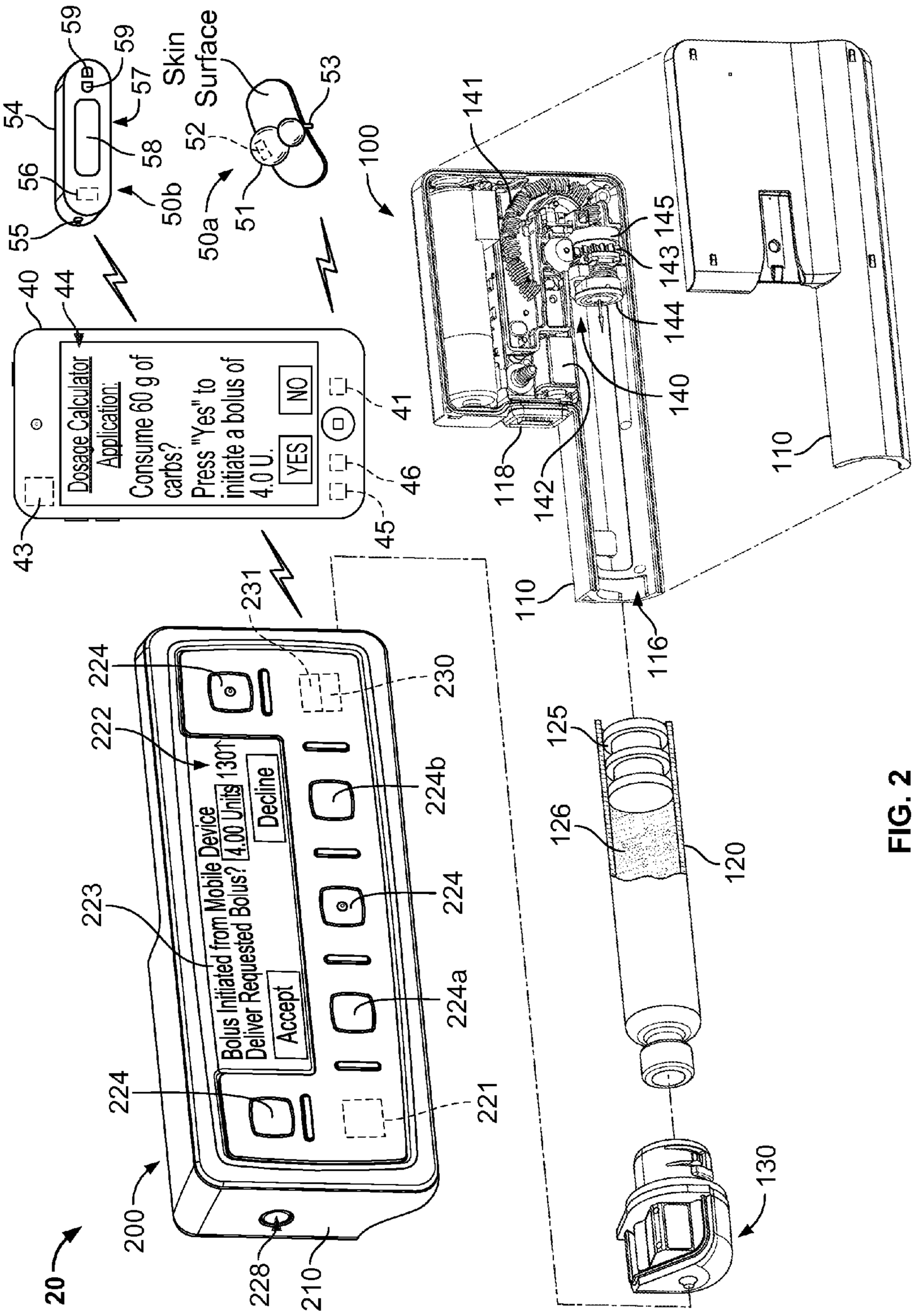

59
59
57
54
Skin Surface
52
53
58
56
50b
50a
51
55
100
141
145
143
144
140
40
44
Dosage Calculator Application:
Consume 60 g of carbs?
Press "Yes" to initiate a bolus of 4.0 U.
YES
NO
41
46
45
43
118
142
110
110
116
231
224
222
230
Bolus Initiated from Mobile Device
Deliver Requested Bolus? 4.00 Units 130
Accept
Decline
223
224b
224
224a
224
221
125
126
120
130
200
228
210
20

FIG. 2

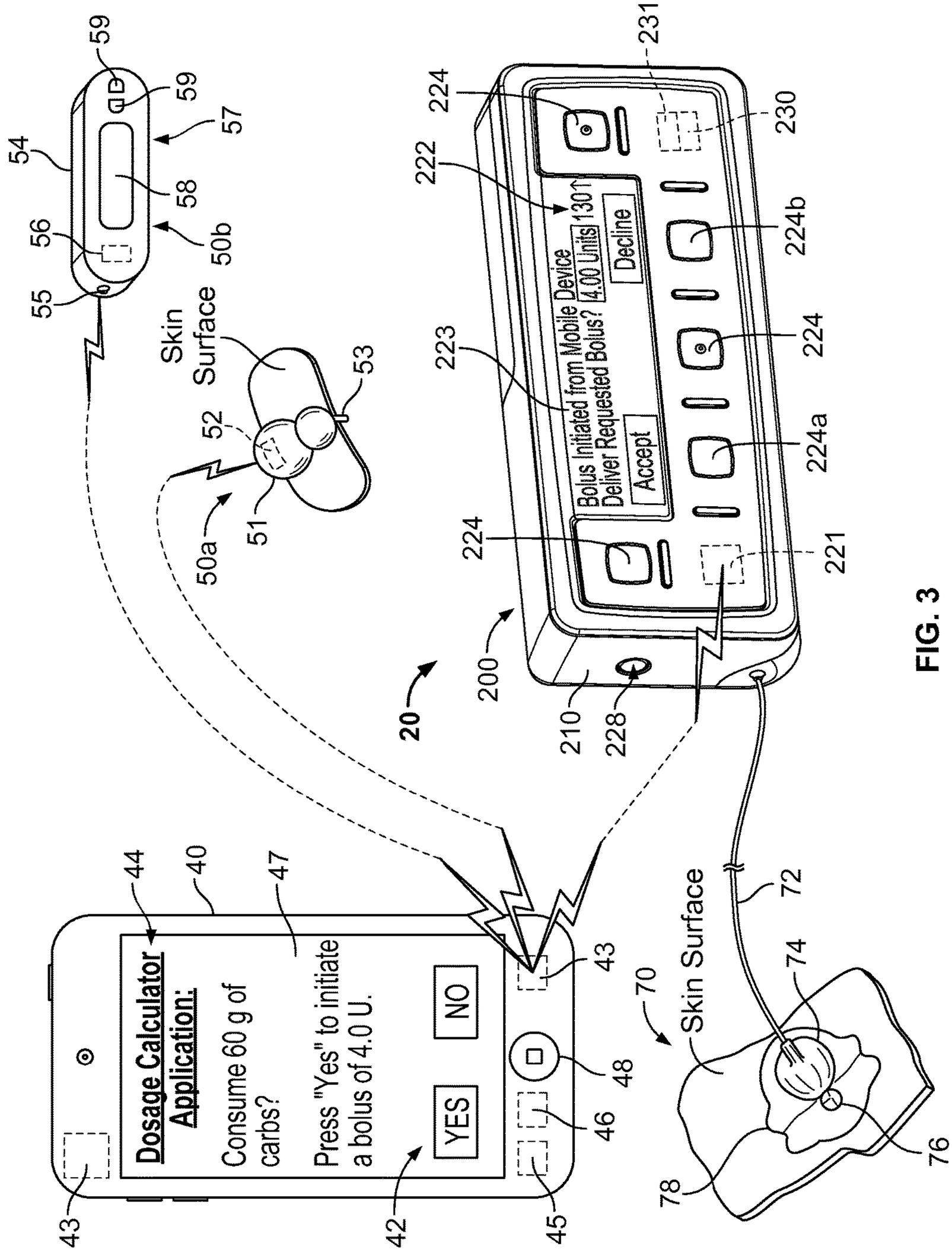

59
59
57
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58
56
50b
55
Skin Surface
52
53
51
50a
231
224
230
222
224b
Bolus Initiated from Mobile Device
Deliver Requested Bolus? 4.00 Units
Accept
Decline
1301
223
224
224a
224
221
200
20
210
228
Dosage Calculator Application:
Consume 60 g of carbs?
Press "Yes" to initiate a bolus of 4.0 U.
YES
NO
44
40
47
43
42
45
46
48
43
70
Skin Surface
72
74
76
78

FIG. 3

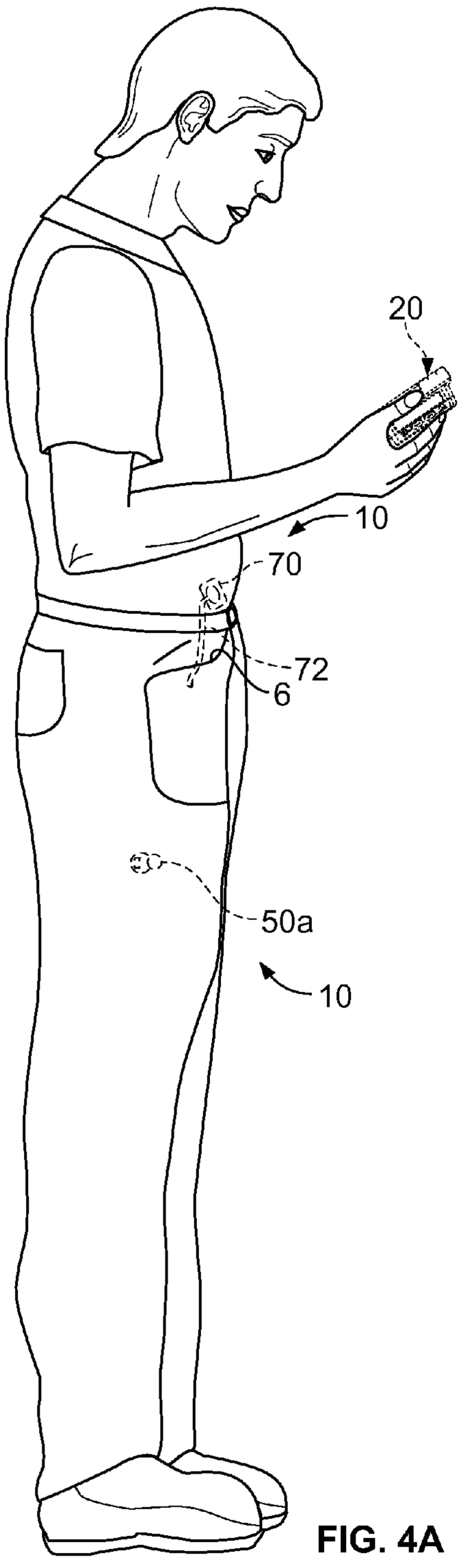


FIG. 4A

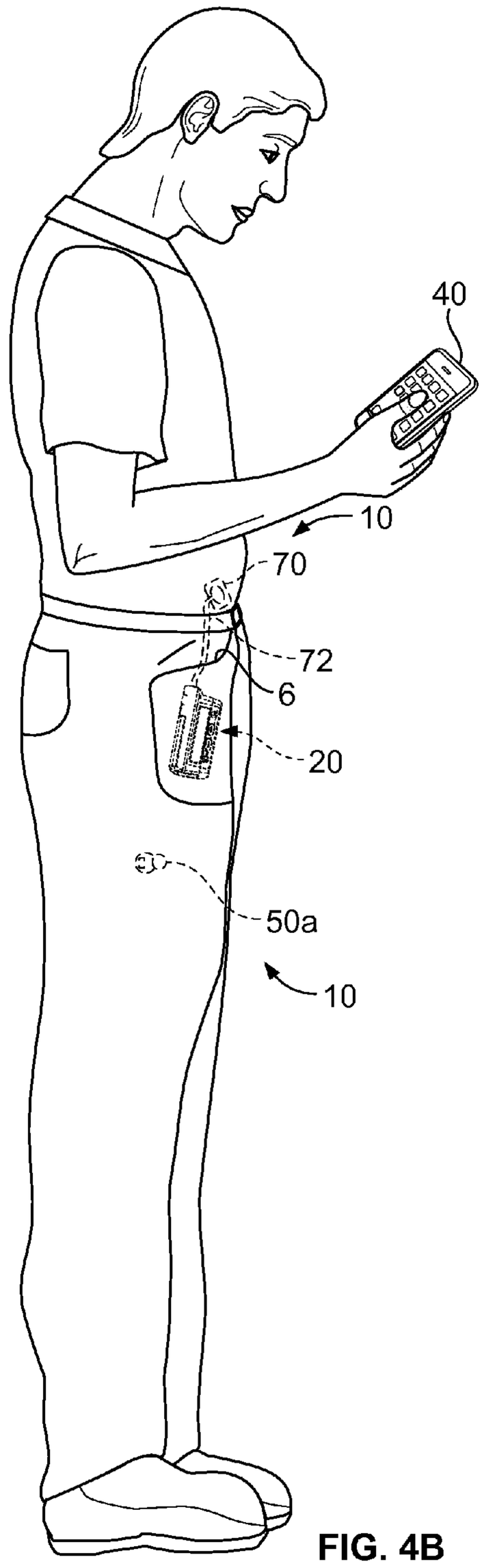


FIG. 4B

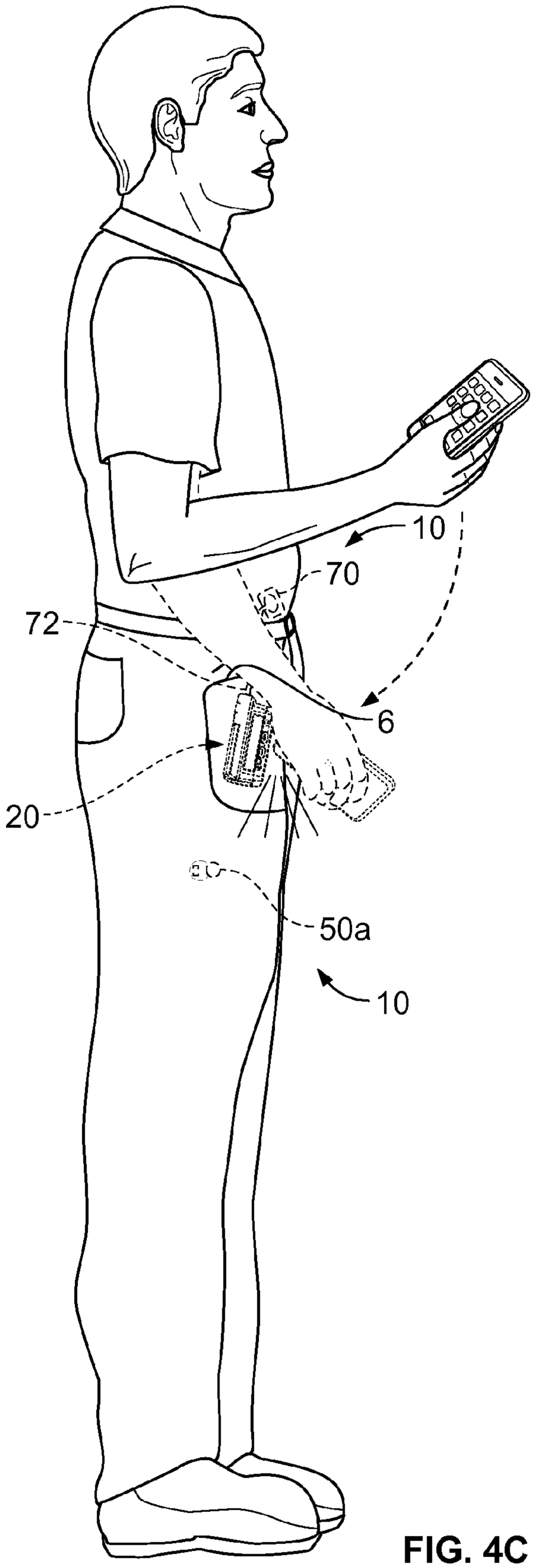


FIG. 4C

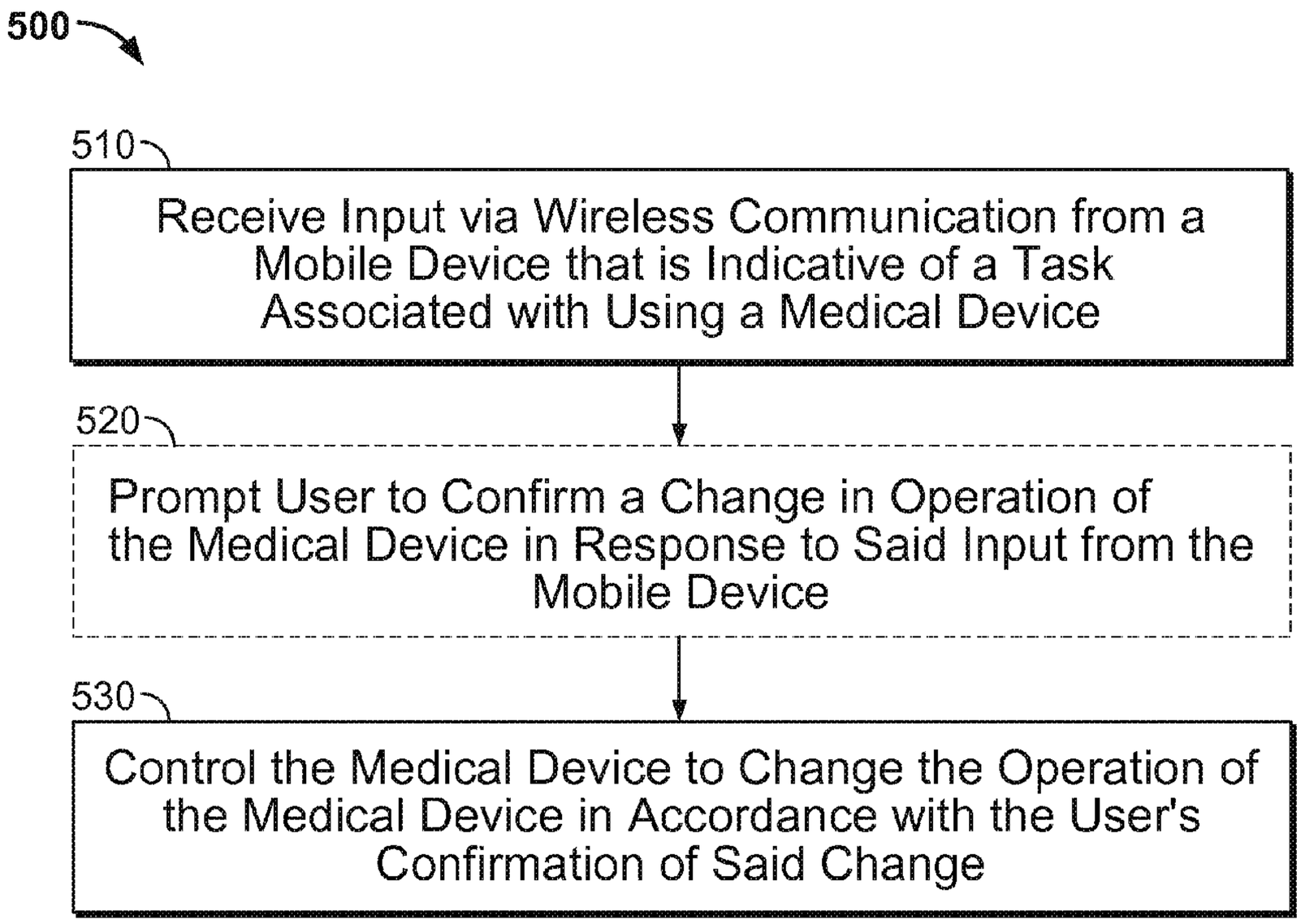

500
510
Receive Input via Wireless Communication from a Mobile Device that is Indicative of a Task Associated with Using a Medical Device
520
Prompt User to Confirm a Change in Operation of the Medical Device in Response to Said Input from the Mobile Device
530
Control the Medical Device to Change the Operation of the Medical Device in Accordance with the User's Confirmation of Said Change

FIG. 5

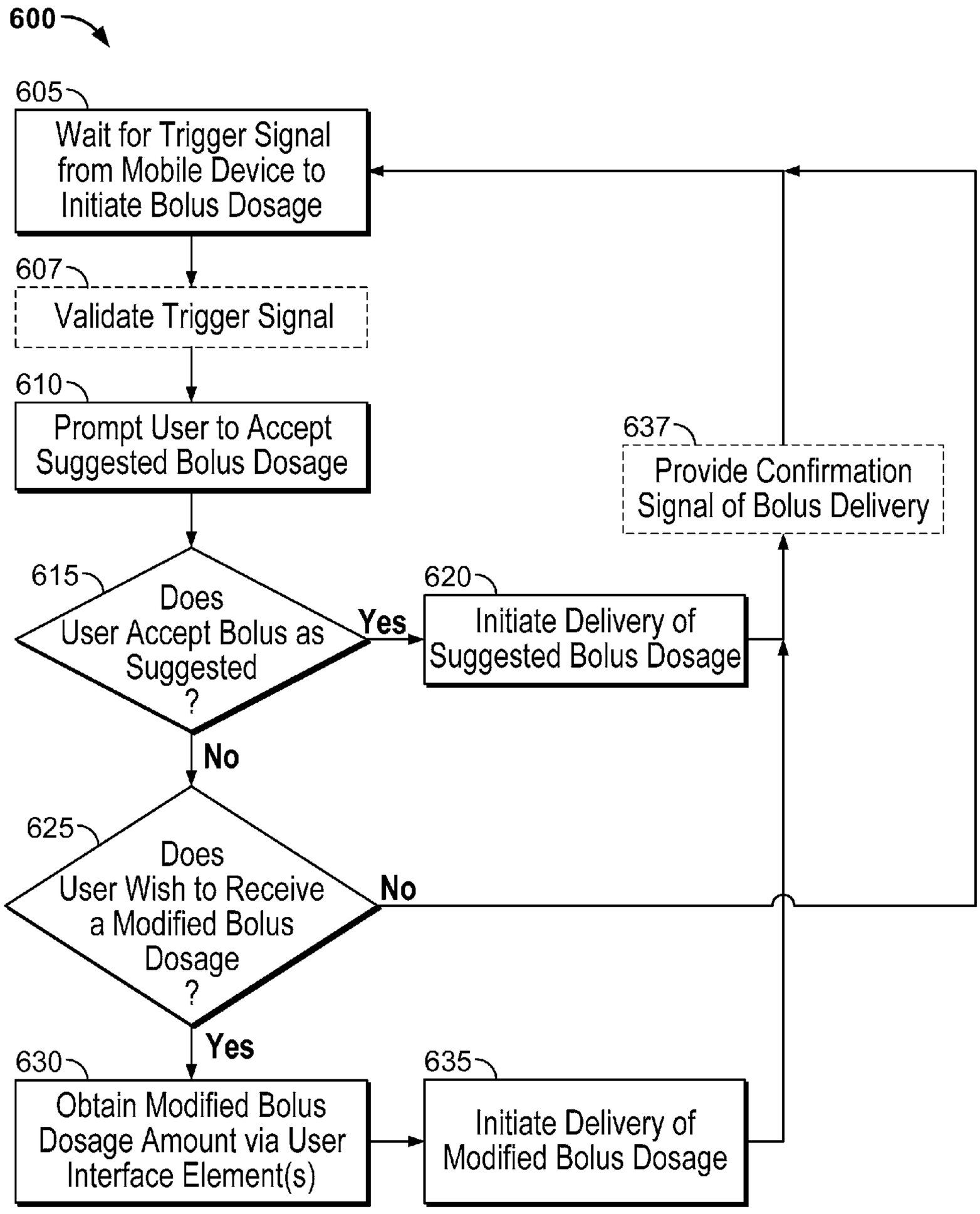

600
605
Wait for Trigger Signal from Mobile Device to Initiate Bolus Dosage
607
Validate Trigger Signal
610
Prompt User to Accept Suggested Bolus Dosage
615
Does User Accept Bolus as Suggested ?
Yes
620
Initiate Delivery of Suggested Bolus Dosage
637
Provide Confirmation Signal of Bolus Delivery
No
625
Does User Wish to Receive a Modified Bolus Dosage ?
No
Yes
630
Obtain Modified Bolus Dosage Amount via User Interface Element(s)
635
Initiate Delivery of Modified Bolus Dosage

FIG. 6

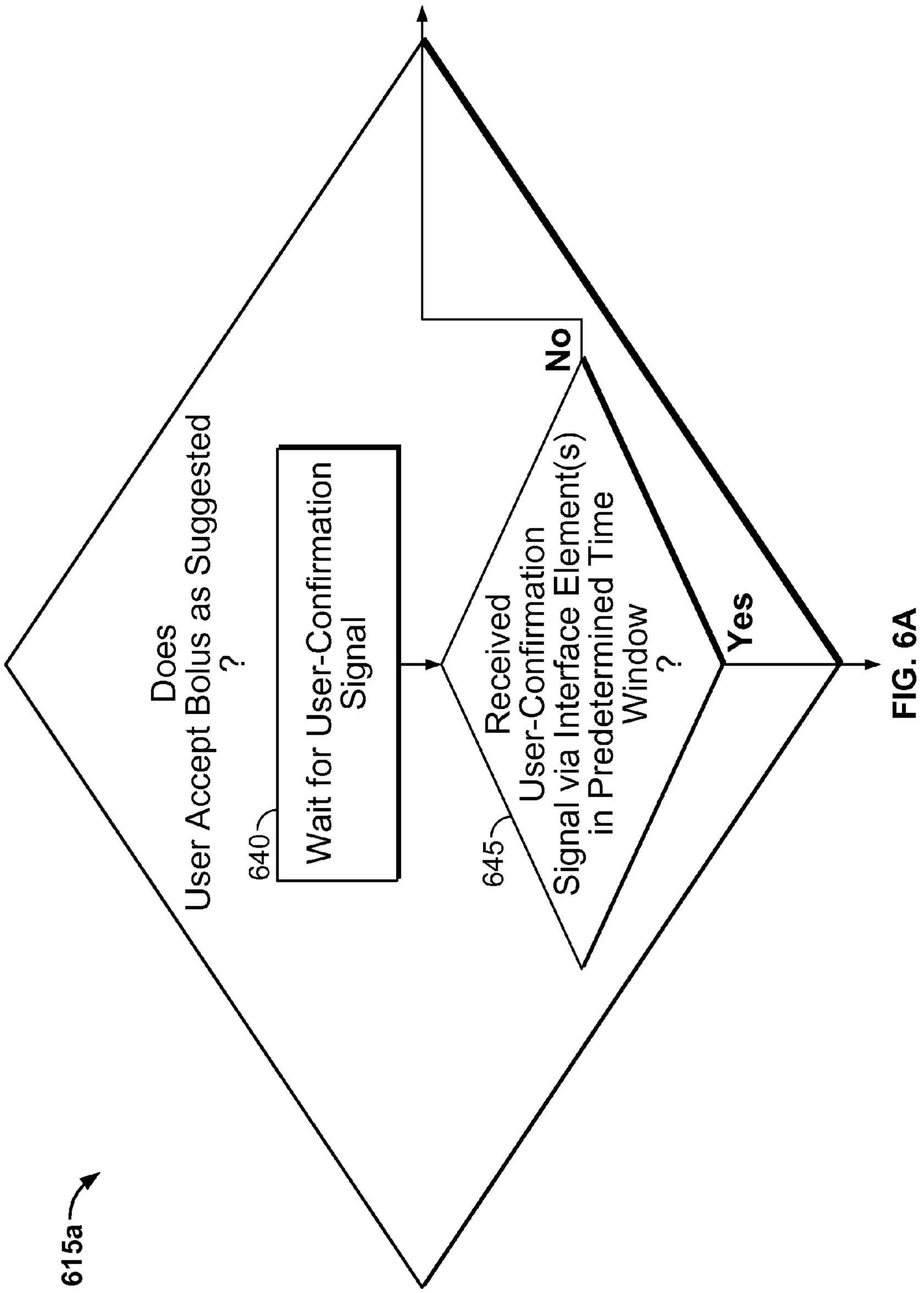

615a
Does User Accept Bolus as Suggested ?
No
640
Wait for User-Confirmation Signal
645
Received User-Confirmation Signal via Interface Element(s) in Predetermined Time Window ?
Yes

FIG. 6A

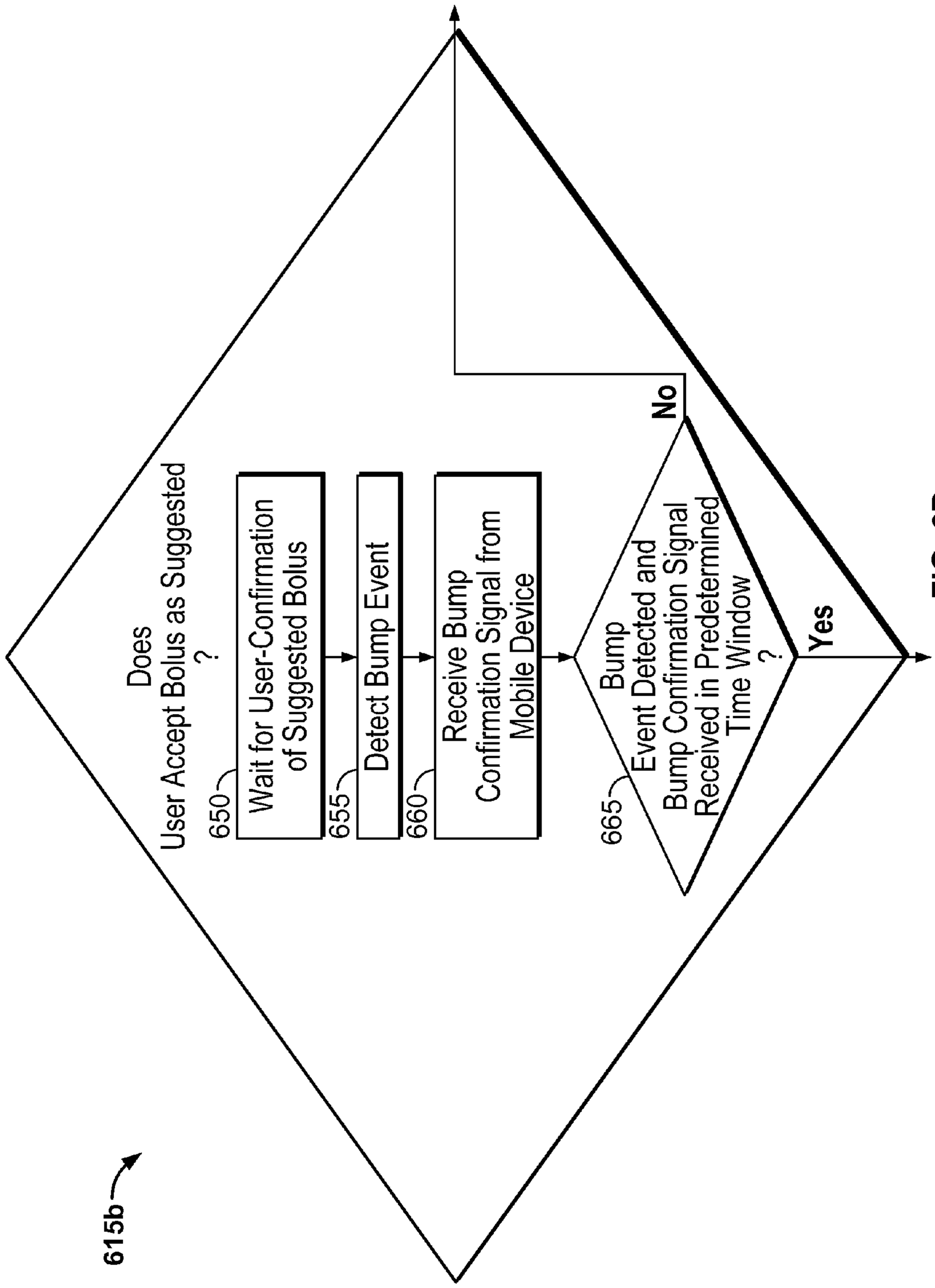

Does
User Accept Bolus as Suggested
?
No
650
Wait for User-Confirmation of Suggested Bolus
655
Detect Bump Event
660
Receive Bump Confirmation Signal from Mobile Device
665
Bump Event Detected and Bump Confirmation Signal Received in Predetermined Time Window
?
Yes
615b

FIG. 6B

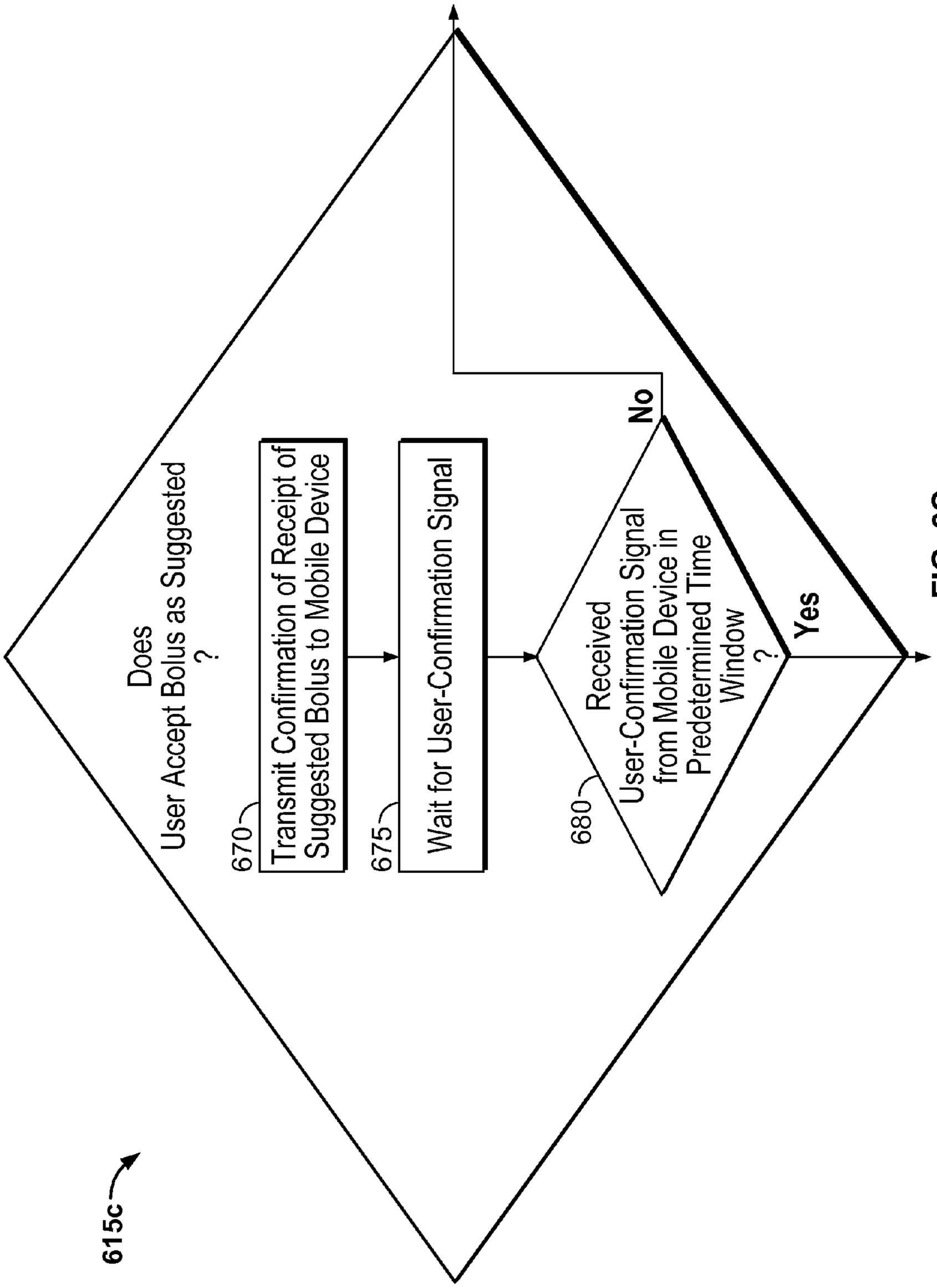

615c
Does User Accept Bolus as Suggested ?
No
670
Transmit Confirmation of Receipt of Suggested Bolus to Mobile Device
675
Wait for User-Confirmation Signal
680
Received User-Confirmation Signal from Mobile Device in Predetermined Time Window ?
Yes

FIG. 6C

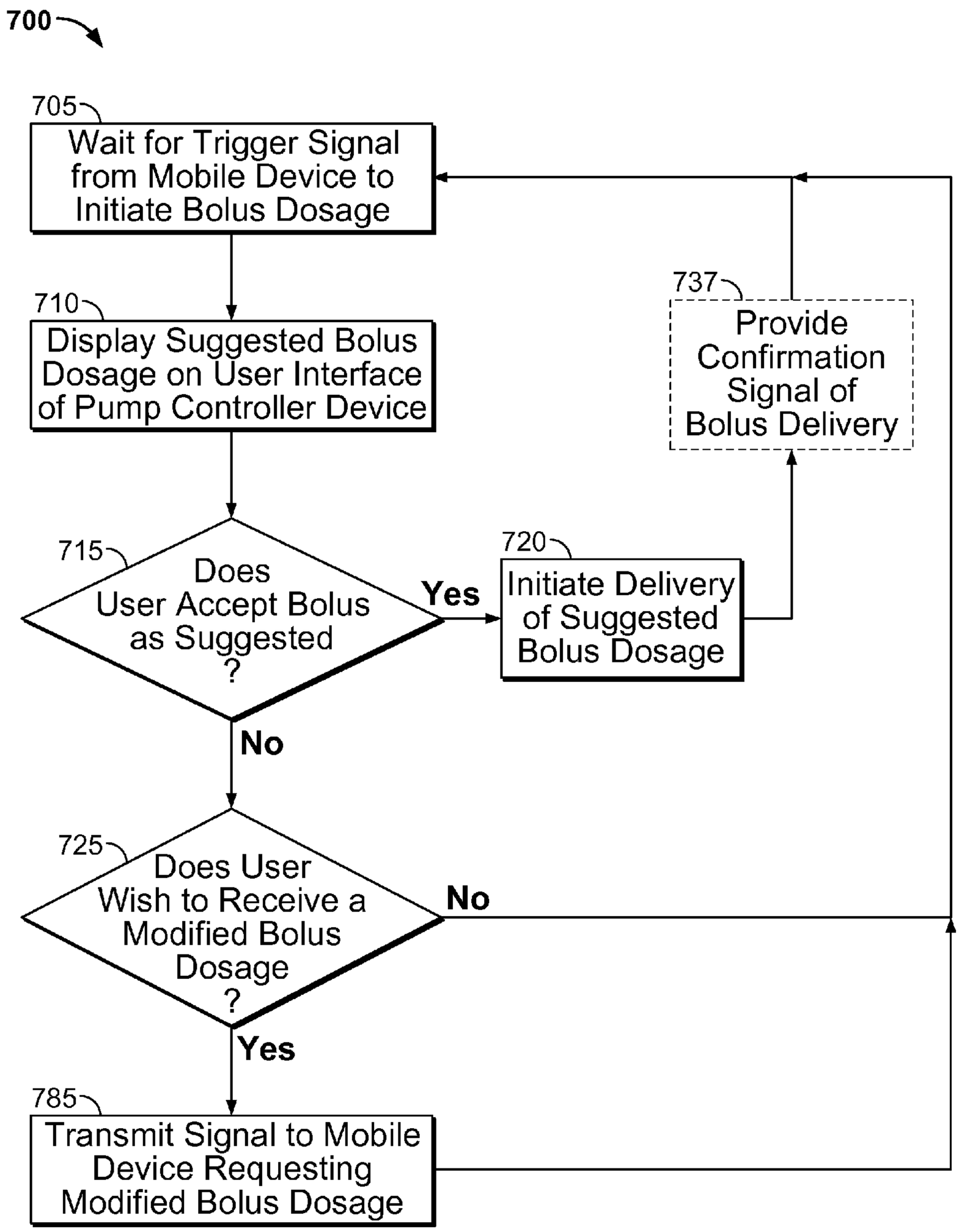

700
705
Wait for Trigger Signal from Mobile Device to Initiate Bolus Dosage
710
Display Suggested Bolus Dosage on User Interface of Pump Controller Device
715
Does User Accept Bolus as Suggested ?
Yes
720
Initiate Delivery of Suggested Bolus Dosage
737
Provide Confirmation Signal of Bolus Delivery
No
725
Does User Wish to Receive a Modified Bolus Dosage ?
No
Yes
785
Transmit Signal to Mobile Device Requesting Modified Bolus Dosage

FIG. 7

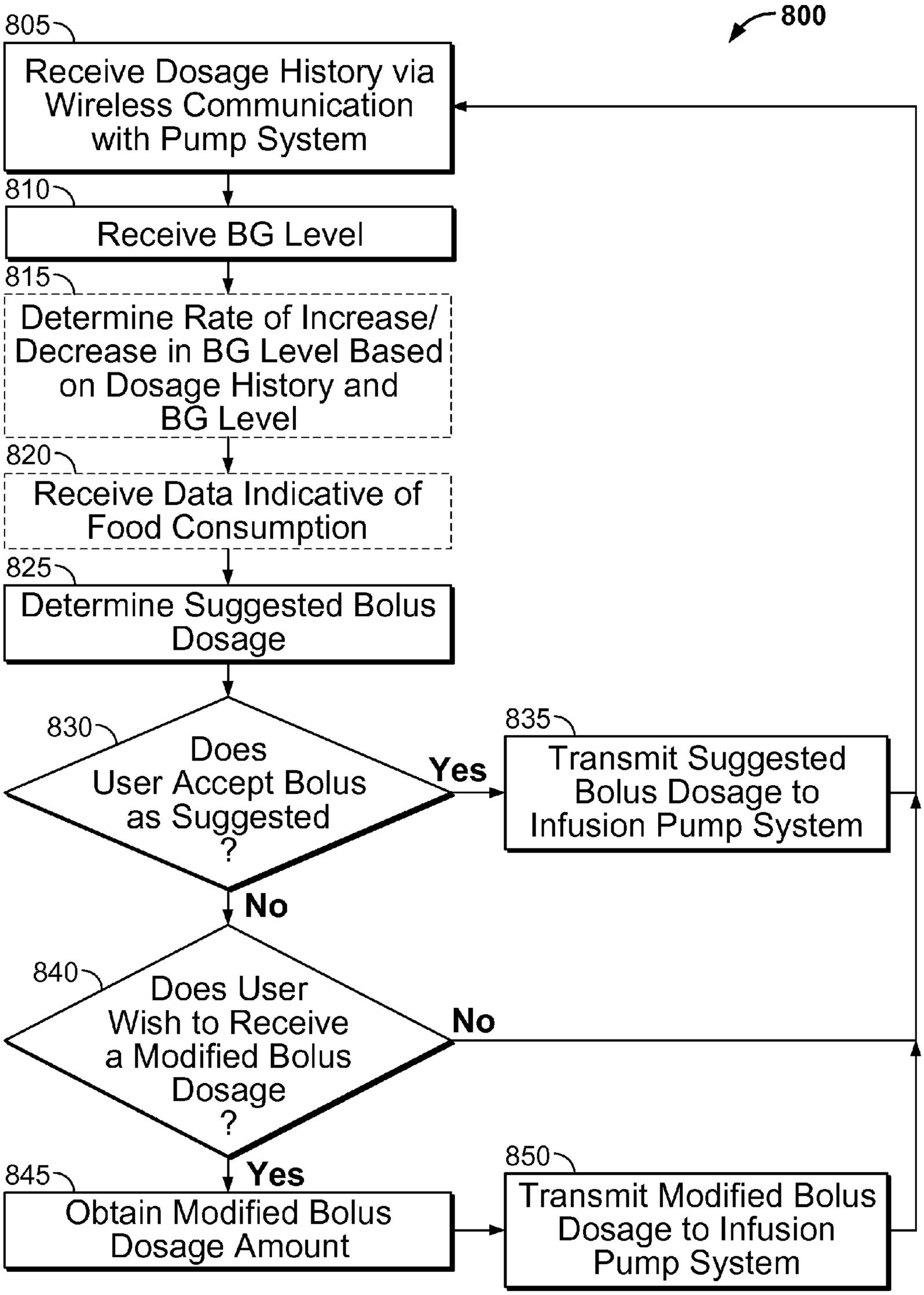

800
805
Receive Dosage History via Wireless Communication with Pump System
810
Receive BG Level
815
Determine Rate of Increase/ Decrease in BG Level Based on Dosage History and BG Level
820
Receive Data Indicative of Food Consumption
825
Determine Suggested Bolus Dosage
830
Does User Accept Bolus as Suggested ?
Yes
835
Transmit Suggested Bolus Dosage to Infusion Pump System
No
840
Does User Wish to Receive a Modified Bolus Dosage ?
No
Yes
845
Obtain Modified Bolus Dosage Amount
850
Transmit Modified Bolus Dosage to Infusion Pump System

FIG. 8

INFUSION PUMP ASSEMBLY AND METHOD

TECHNICAL FIELD

This document relates to an infusion pump assembly, such as a portable infusion pump assembly for dispensing a medicine.

BACKGROUND

Pump systems are commonly used to deliver one or more fluids to a targeted individual. For example, a medical infusion pump system may be used to deliver a medicine to a patient as part of a medical treatment. The medicine that is delivered by the infusion pump system can depend on the condition of the patient and the desired treatment plan. For example, infusion pump systems have been used to deliver insulin to the vasculature of diabetes patients so as to regulate blood-glucose levels.

Users of infusion pump devices often need to communicate with the infusion pump via a user interface to control the operations of the infusion pump in a safe and effective manner. For example, a user may press a series of buttons on the user interface to enter food intake data into the infusion pump, such as a number of grams of carbohydrates that is indicative of a recently or soon-to-be consumed meal. The food intake data can be combined by the infusion pump assembly with other parameters to calculate a suggested dosage of insulin based on the grams of carbohydrates entered by the user. In another example, a user may enter information into the infusion pump assembly via a user interface that indicates that the user is going to perform a level of physical exercise. In some circumstances, the infusion pump system may reduce the amount of a planned dispensation of insulin in response to the exercise information entered by the user.

In some systems, a wireless remote controller is provided to facilitate wireless and operation of an infusion pump assembly. Wireless remote control of the pump assembly, however, introduces two primary concerns regarding patient safety: 1) A concern that a third-party could control the pump assembly by hijacking the wireless connection between the pump assembly and the remote controller; and 2) A concern that a virus, programming error, or a third-party application interfering with the remote controller could adversely affect operation of the pump assembly.

SUMMARY

Some embodiments of an infusion pump system may be equipped with one or more components to facilitate wireless communication between a mobile communication device and an infusion pump assembly. In some embodiments, the mobile device (e.g., a smartphone) can wirelessly transfer data to the infusion pump assembly that may cause the pump assembly to execute a particular sequence of operations (e.g., operations to provide a controlled dispensation of medicine). In particular, the mobile device may communicate one or more user input commands to the infusion pump assembly (e.g., user input commands that might otherwise be input via a series of menu selections and data entry steps on the user interface of the infusion pump assembly) to initiate a suggested bolus dosage of insulin (or another medication). In some embodiments, the smartphone device is operable to execute a dosage calculator application that determines the suggested bolus dosage based on information indicative of the user's blood glucose level. In some embodiments, the smartphone device and/or the infusion pump assembly may prompt the user to confirm acceptance of the suggested bolus dosage to prevent a dispensation of medicine that is not desired by the user.

Particular embodiments described herein provide a medical infusion pump system including a portable pump housing configured to receive insulin for dispensation to a user, a controller communicatively coupled with the pump drive system, and a wireless communication device configured to receive a suggested dosage amount from a mobile device. The pump housing may at least partially contain a pump drive system to dispense the insulin through a flow path to the user, and the controller can be operable to cause controlled dispensation of the insulin from the portable pump housing by the pump drive system. In some embodiments, the controller may, in response to receiving the suggested dosage amount from the mobile device, prompt the user for confirmation of acceptance of the suggested dosage.

In some optional aspects, the system may further include the mobile device, and the mobile device may include a memory device that stores a mobile application configured to receive blood glucose information of the user and food consumption information of the user. The mobile device may be a smartphone device. The controller may be configured to prompt the user for confirmation of acceptance of the suggested bolus dosage by transmitting a confirmation signal to the mobile device indicating receipt of the suggested dosage amount to cause the mobile device to prompt the user to provide at least one of a security code and a biometric validation to confirm acceptance of the suggested bolus dosage. The system may further include a glucose monitoring device configured to be worn by the user and configured to wirelessly communicate blood glucose information of the user. The system may further include a blood strip reader device configured to determine a blood glucose level of the user. The blood strip reader device may be configured to wirelessly communicate blood glucose information of the user.

Other embodiments described herein provide a method that includes receiving input via wireless communication from a mobile device, such as smartphone device, that is indicative of a task to be performed by a portable infusion pump system. The may also include prompting a user to confirm, via interaction with the portable infusion pump system, a change in operation of the portable infusion pump system according to the input received from the smartphone device.

In some optional aspects, the method may further include activating the change in operation of the portable infusion pump system in response to the user's confirmation via interaction with the portable infusion pump system. The user's confirmation via interaction with the portable infusion pump system may include bumping the smartphone device in proximity to the portable infusion pump system such that both the smartphone device and the portable infusion pump system detect a bump motion. The user's confirmation via interaction with the portable infusion pump system may include input via a touchscreen or button of the portable infusion pump system. The method may also optionally include rejecting the change in operation of the portable infusion pump system after lapse of a predetermined period of time in which no use confirmation is received. The method may further include rejecting the change in operation of the portable infusion pump system after receiving input from the user, via interaction with the portable infusion pump system, indicative of a rejection of the change in operation. The input received from the smartphone device

may include information indicative of a calculated bolus dosage. The input received from the smartphone device may include information indicative of a temporary basal rate. The smartphone device may execute a mobile application configured to output a suggested change in operation of the portable infusion pump.

In some embodiments described herein, a system may include a smartphone device including a memory device (e.g., a RAM memory module, another computer-readable memory device, or the like) storing computer-readable instructions that cause the smartphone to access a dosage calculator application, and a wireless communication device of the smartphone device configured to wirelessly communicate with a portable infusion pump system. Optionally, the dosage calculator application is configured to calculate a suggested bolus dosage that is wirelessly communicated to the portable infusion pump system, and the smartphone device wirelessly receives information indicative of a user's confirmation of the suggested bolus dosage.

In some optional aspects, the system may further include the portable infusion pump system, and the portable infusion pump system may be configured to prompt the user for confirmation of acceptance of the suggested bolus dosage. The system may also optionally include a glucose monitoring device configured to be worn by the user and configured to wirelessly communicate blood glucose information of the user to the smartphone device. The system may optionally include a blood strip reader device configured to determine a blood glucose level of the user and configured to wirelessly communicate blood glucose information of the user to the smartphone device.

In some embodiments described herein, a medical infusion pump system may include a portable pump housing configured to receive insulin for dispensation to a user. The system may also include a controller communicatively coupled with the pump drive system. Also, the system may include a mobile device communicatively coupled with the controller to provide a trigger signal via a wireless connection to initiate dispensation of the insulin according to a bolus dosage. The pump housing at least partially contains a pump drive system to dispense the insulin through a flow path to the user, and the controller is operable to cause controlled dispensation of the insulin from the portable pump housing by the pump drive system. In some circumstances, in response to receiving the trigger signal, the controller prompts the user for confirmation of acceptance of the bolus dosage.

In some embodiments described herein, a method may include receiving input from a mobile device that is indicative of a task to be performed by a portable infusion pump system. The method may further include receiving, via near field communication (NFC) from a NFC device (e.g., an NFC tag or an NFC circuit) incorporated in the mobile device, a signal indicative of a user's confirmation of acceptance of a change in operation of the portable infusion pump system according to the input received from the mobile device. The method may also include, in response to receiving the signal, controlling the portable infusion pump system according to the user-confirmed change in operation.

In other embodiments described herein, a method may include transmitting input via wireless communication from a smartphone device that is indicative of a task to be performed by a portable infusion pump system. The method may also include prompting a user to confirm, via interaction with the smartphone device, a change in operation of the portable infusion pump system according to the input transmitted from the smartphone device.

Some or all of the embodiments described herein may provide one or more of the following advantages. First, some embodiments of the infusion pump system may be configured to send and receive data communications wirelessly using NFC and/or short-range wireless communication technology implemented on a mobile device and an infusion pump assembly, thereby providing convenient wireless communications while also reducing the likelihood of long-range hijacking of the wireless communications to the infusion pump assembly. Second, some embodiments of an infusion pump system may provide safe and reliable wireless control of an infusion pump assembly by a mobile device. Third, some embodiments of the infusion pump system may facilitate user confirmation of a pump-assembly operation initiated wirelessly via the mobile device to prevent such operations that are unintended by the user. Fourth, some embodiments of an infusion pump system may facilitate convenient user input of information to the infusion pump assembly via a smartphone operated by the user. Fifth, some embodiments of an infusion pump system equipped with wireless communication capabilities may be configured to be portable, wearable, and (in some circumstances) concealable. For example, a user can conveniently wear one or more components of the infusion pump system on the user's skin under clothing or can carry such components in the user's pocket (or other portable location) while receiving medicine dispensed from an infusion pump device. Sixth, in some embodiments of an infusion pump system, the user can wirelessly operate an infusion pump assembly without removing the pump assembly from a portable and concealed location. Seventh, in some embodiments of an infusion pump system, a mobile device configured to wirelessly operate the infusion pump assembly can include a dosage calculator software application that accurately calculates a suggested bolus dosage based on data indicative the user's blood glucose level. Eight, in some embodiments of the infusion pump system, the software application may utilize the bolus calculation feature in combination with a glucose monitoring device and/or a blood glucose test strip reader that wirelessly transmits blood glucose information to the mobile device.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIG. **1** is a block diagram of an infusion pump system in accordance with some embodiments.

FIG. **2** is a schematic diagram of an infusion pump system including a perspective exploded view of an infusion pump assembly in accordance with some embodiments.

FIG. **3** is a schematic diagram of the infusion pump system including a perspective assembled view of the infusion pump assembly in accordance with some embodiments.

FIGS. **4**A-C are a side views of the infusion pump system of FIGS. **2**A-B in which the infusion pump assembly is worn on clothing of a user and operated wirelessly in accordance with particular embodiments.

FIG. **5** is a flowchart of an example process for operating a medical device with wireless communication capabilities in accordance with some embodiments.

FIG. **6** is a flowchart of an example process for using an infusion pump assembly equipped with wireless communication capabilities in accordance with some embodiments.

FIG. **6**A is a flowchart of a first example process for determining whether a user as accepted a suggested bolus dosage.

FIG. **6**B is a flowchart of a second example process for determining whether a user as accepted a suggested bolus dosage.

FIG. **6**C is a flowchart of a third example process for determining whether a user as accepted a suggested bolus dosage.

FIG. **7** is a flowchart of an alternative example process for using an infusion pump assembly equipped with wireless communication capabilities in accordance with some embodiments.

FIG. **8** is a flow chart of an example process for using a mobile device equipped with wireless communications capabilities in accordance with some embodiments.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Referring to FIG. **1**, an infusion pump system **10** can include an infusion pump assembly **20** and a mobile device **40**, such as a smartphone device configured to connect with the internet and to execute mobile applications. The pump assembly **20** and the mobile device **40** are communicatively coupled to one another. The pump assembly **20** is configured to controllably dispense dosages of medicine to be infused into the tissue or vasculature of a targeted individual, such as a human or animal patient. For example, as described below, the infusion pump assembly **20** can be used to deliver insulin or another medicinal fluid for purposes of regulating the user's blood glucose levels. However, numerous other types of medicines can be used in some embodiments, including: pain relief drugs, hormone therapy, blood pressure treatments, anti-emetics, osteoporosis treatments, or other injectable medicines. As described below, the mobile device **40** can wirelessly communicate (e.g., via near field communication (NFC), Bluetooth connectivity, or another short-range wireless connection, or via radio frequency (RF) or Wi-Fi connectivity, or another wireless connection) with the pump assembly **20** to facilitate remote control of the pump assembly **20** by a user operating the mobile device **40**.

In this embodiment, the pump assembly **20** includes a wireless communication device **21**, a user interface **22**, and a controller **23**. The wireless communication device **21** is operable to send and receive data signals (e.g., discrete data packets or a continuous data stream) to and from a corresponding wireless communication device **41** of the mobile device **40**. For example, the wireless communication device **21** may receive a trigger signal from the wireless communications device **41** of the mobile device **40** to initiate a suggested dosage of medicine. The user interface **22** can be engaged by a user to control the operation of the pump assembly **20**. For example, in some embodiments, the user can engage the user interface **22** to confirm acceptance, decline acceptance, or modify a dosage of medicine suggested by the mobile device **40**.

The controller **23** is operable to generate control signals that are transmitted to various other components of the pump assembly **20**, and to receive feedback signals from one or more of those components. The controller **23** includes a memory **24** that stores data and computer-readable instructions for processing/execution by a processor **25**. The processor **25** receives program instructions and feedback data from the memory **24**, executes logical operations called for by the program instructions, and generates command signals for operating the various components of the pump assembly **20**. For example, the controller **23** can cause a suggested dosage received by the wireless communication device **21** to be presented to the user via the user interface **22** (e.g., by display or audible speech output). Further, the controller **23** can cause a drive system **26** of the pump assembly **20** to dispense the suggested dosage of medicine from the medicine reservoir **27**. The controller is electrically powered by a battery **28**.

In some embodiments, the medicine reservoir **27** can be provided in the form of a pre-filled cartridge slidably received within a housing of the pump assembly **20**. In such embodiments, the drive system **26** can advance a plunger into the reservoir **27** so as to dispense medicine therefrom, which causes the medicine to be dispensed through tubing **29** of an infusion set. As described in more detail below, the medicine reservoir **27** can be received within a cavity in the infusion pump assembly **20**. In some embodiments, the reservoir **27** is a replaceable reservoir such that, when the replaceable reservoir is exhausted, the replaceable reservoir can be removed from the infusion pump assembly **20** and replaced with another new pre-filled reservoir. In other embodiments, the reservoir **27** may be non-removably received in the pump assembly **20** such that, when the medicine reservoir **27** is exhausted, the portion of the pump assembly **20** that retains reservoir **27** is discarded along with the reservoir **27** (refer, for example, to FIG. **2**). For example, as described in more detail below, the infusion pump assembly **20** may optionally comprise multiple readily detachable portions, with various components of the infusion pump assembly **20** residing in different detachable portions. In one example described in FIG. **2** below, at least the controller **23**, the user interface **22**, and the wireless communication device **21** can be contained within a first (reusable) detachable portion while the drive system **26**, and the medicine reservoir **27** are contained within a second (disposable, single-use) detachable portion.

In some optional embodiments, the pump assembly **20** may further include a NFC circuit **30** responsive to an optional NFC circuit **46** incorporated in the mobile device **40**. NFC provides particularly short-range wireless communication. In some embodiments, the maximum working distance for NFC is less than 12 inches, about 8 inches or less, and about 4 inches or less. NFC allows sharing of relatively small packets of data between devices equipped with NFC functionality. In some embodiments, wireless NFC data transmission can be a two-way wireless communication. In other words, two interfacing NFC circuits can pass data packets back and forth between one another. The data communicated via NFC can be written in a variety of formats. One example format is called the NFC Data Exchange Format ("NDEF"). The NFC circuit **30** of the pump assembly **20** can be implemented as a separate structure from the wireless communication device **21**, or can be implemented as part of the wireless communication device **21**. Likewise, the NFC circuit **46** of the mobile communications device **40** can be implemented as a separate structure from the wireless communication device **41**, or can be implemented as part of the wireless communication device **41**.

Further, although one or more embodiments described herein involve NFC communication via two intercommunicating NFC circuits, various other embodiments may incorporate one or more NFC tags. For example, the NFC circuit **46** of the mobile device could be replaced by an NFC tag. An NFC tag can store about a kilobyte of data or less, although NFC tags that store a greater quantity of data can also be used in the embodiments described herein. The NFC

tags can be configured with a shape that is small and lightweight (e.g., a maximum dimension of about 1 inch or less), particular because the NFC tags described the embodiment of FIG. **1** do not have an integral power source such as a battery. Instead, a coil in the NFC tag inductively receives magnetic field energy that is emitted from a coil in NFC circuit housed in the portable infusion pump **66**. Accordingly, energy and data can be wirelessly transmitted between the coils of the NCF tag and the device with NFC functionality.

The NFC circuits **30** and **46** may facilitate particularly short-range wireless communications between the pump assembly **20** and the mobile device **40** when the NFC circuits **30** and **46** are in a NFC proximity range. The NFC circuit **30** can be electrically connected with the controller **23** to transfer data communicated by the corresponding NFC circuit **46** of the mobile device **40** to the controller **23**. The NFC proximity range may be preferably within a range four inches or less, including for example, a physical "bump" between the pump assembly **20** and the mobile device **40**. In some embodiments, the NFC circuit **30** can communicate data to the controller **23** indicating that the user has confirmed acceptance of a suggested medicine dosage provided by the mobile device **40**. For example, as described in detail below, the user can bump the mobile device **40** against the pump assembly **20** to confirm that the suggested medicine dosage is accepted by the user and therefore should be dispensed (FIGS. **4**C and **6**B).

In some optional embodiments, the pump assembly **20** may include at least one accelerometer **31** electrically connected with the controller **23**. In some embodiments, feedback from the accelerometer **31** (or from a set of accelerometers) can be used by the controller **23** to execute NFC communications when accelerated movement at or above the threshold level is detected. Further in some embodiments, the controller **23** can utilize movement information provided by the accelerometer **31** as independent detection of a bump between the pump assembly **20** and the mobile device **40**.

The mobile device **40** includes the wireless communications device **41**, the NFC circuit **46**, or both so as to facilitate communications with the pump assembly **20** (as described above) and a user interface **42** to facilitate user operation of the mobile device **40**. The wireless communications device **41** and the user interface **42** are electronically coupled to a controller **43** that controls and receives feedback data from the various components (including the accelerometer **45** and the NFC circuit **46**) of the mobile device **40**. As noted above, the mobile device **40** can facilitate remote operation of the pump assembly **20**. For example, a user can input an insulin dosage (e.g., a bolus dosage or a temporary basal rate dosage) to the controller **43** via the user interface **42**, and the controller **43** can cause the wireless communications device **41** to transmit a data signal including the suggested dosage to the pump assembly **20**. As shown, the controller **43** includes a dosage calculator application **44** provided in the form of computer-readable software program instructions configured, in this example, to calculate a suggested dosage of medicine based upon data related to the user's blood glucose level. The calculated dosage can also be communicated wirelessly to the pump assembly **20** (refer, for example, to FIG. **6**).

In some embodiments, the infusion pump system **10** may optionally include a glucose monitoring device **50***a* and/or a blood glucose test strip reader **50***b* that communicate(s) with the mobile device **40** (e.g., via the wireless communication device **41**) for the purpose of supplying data indicative of a user's blood glucose level to the controller **43**. As noted above, the dosage calculator application **44** can utilize the data indicative of a user's blood glucose level in the calculation of a dosage. For example, the dosage calculator application **44** can calculate the recent rate of change in the user's blood glucose level and can use this rate-of-change information as a parameter in the calculation of a suggested bolus dosage of insulin (or another medication) for the user.

In some embodiments, the dosage calculator application **44** can be configured to determine basal rate dosages of insulin (or another medication) along with user-initiated bolus dosages. The basal delivery rate can be determined so as to maintain a user's blood glucose level in a targeted range during normal activity when the user is not consuming food items. The user-selected bolus deliveries may provide substantially larger amounts of insulin in particular circumstances in which the user's blood glucose level requires a significant correction or when the user has recently consumed (or is about to consume) food items. In some embodiments, the dosage calculator application **44** can determine a bolus dosage for the user in a manner that accounts for some of all of: the user's food intake, the user's recent blood glucose level (e.g., input by the user via the user interface **42**, or received from the glucose monitoring device **50***a* or the blood glucose test strip reader **50***b*), the rate of change in the user's blood glucose level, and previously delivered insulin that has not acted on the user. For example, a user can enter a carbohydrate value indicative of a meal into the mobile device **40** via the user interface **42**, and in response thereto, the dosage calculator application **44** can calculate a suggested bolus dosage, which is wireless communicated to the infusion pump assembly **20** (which then awaits confirmation from the user for purposes of additional security and accuracy).

For example, when a suggested dosage of medicine is calculated by the dosage calculator application **44**, the controller **43** can cause the suggested dosage to be communicated to the pump assembly **20** by the wireless communication device **41** (or by the NFC communication circuit **46**). The wireless communication device **21** (or the NCF circuit **30**) of the pump assembly **20** can receive information indicative of the suggested dosage, and the controller **23** can cause the suggested dosage to be presented to the user via the user interface **22**, with a prompt for the user to accept or reject the dosage amount for dispensation. If the user accepts the recommended dosage, the controller **23** can generate control signals to cause the drive system **26** to dispense the suggested dosage of glucagon from the medicine cartridge **27**. If the user rejects the recommended dosage, the controller **23** can provide the user with an option to modify the dosage amount to a value different from the suggested dosage or to reject any bolus dosage at the present time.

Referring now to FIGS. **2-3**, some embodiments of the infusion pump assembly **20** includes a pump device **100** and a removably attachable controller device **200** that are used together for purposes of supplying insulin or another medication to a user. Also, in this embodiment of the system **10**, the mobile device **40** is provided in the form of a smartphone device configured to connect with the internet and to execute mobile applications. As described above with reference to FIG. **1**, the smartphone device **40** receives data indicative of a user's blood glucose level from the glucose monitoring device **50***a* and the blood glucose test strip reader **50***b*. In this embodiment, the smartphone device **40** is depicted as executing an example implementation of the dosage calculator application **44** (FIG. **1**) that utilizes the data indicative of a user's blood glucose level in the calculation of a dosage.

Similar to the embodiment of FIG. **1**, the smartphone device **40** includes the wireless communication device **41** and the controller **43** executing the dosage calculator application **44**. The smartphone device **40** further includes at least one accelerometer **45** and the NFC circuit **46**. In this embodiment, the user interface **42** of the smartphone **40** includes a touchscreen **47** and at least one button **48**, and the user interface **42** is configured to allow a user to remotely control the infusion pump assembly **20**. As described below, the user interface **42** may include various other components, e.g., one or more biometric recognition sensors and/or face recognition hardware). In various alternative embodiments, the mobile device **40** can be other types of devices such as a tablet computer, laptop computer, a PDA, a custom remote device manufactured specifically for interfacing with the pump assembly **20**, and the like.

Still referring to FIGS. **2-3**, the glucose monitoring device **50***a* can include a housing **51**, a wireless communication device **52**, and a sensor element **53**. The wireless communication device **52** can be contained within the housing **51** and the sensor element **53** can extend outward from the housing **51**. In use, the sensor element **53** can penetrate the skin surface of a user to make measurements indicative of characteristics of the user's blood (e.g., the user's blood glucose level or the like). In some embodiments, the glucose monitoring device **50***a* can include one or more electronic circuits that permit sensor signals (e.g., data from the sensor element **53**) to be communicated to the communication device **52**. Thus, in response to the measurements made by the sensor element **53**, the glucose monitoring device **50***a* can employ the wireless communication device **52** to transmit data to the mobile device **40** via its wireless communication device **41**.

In some embodiments, the monitoring device **50***a* can employ other methods of obtaining information indicative of a user's blood characteristics. For example, an alternative monitoring device may employ a micropore system in which a laser porator creates tiny holes in the uppermost layer of a user's skin, through which interstitial glucose is measured using a patch. Alternatively, the monitoring device can use iontophoretic methods to non-invasively extract interstitial glucose for measurement. In other examples, the monitoring device can include non-invasive detection systems that employ near IR, ultrasound or spectroscopy, and particular embodiments of glucose-sensing contact lenses. Invasive methods involving optical means of measuring glucose could also be added. In yet another example, the monitoring device can include an optical detection instrument that is inserted through the skin for measuring the user's glucose level.

The blood glucose test strip reader **50***b* can include a housing **54**, a wireless communication device **55**, a test-strip port **56**, and a user interface **57** including a display **58** and user-selectable buttons **59**. In use, a user can deposit a test strip carrying a blood sample into the test-strip port **56**. The blood glucose test strip reader **50***b* can analyze the test strip and present data indicative of characteristics of the user's blood (e.g., the user's blood glucose level or the like) on the display **58**. In some embodiments, the blood glucose test strip reader **50***b* can include one or more electronic circuits that permit sensor signals (e.g., data from the test-strip port **56**) to be communicated to the communication device **55**. Thus, using the user-selectable buttons **59**, the user can cause the wireless communication device **55** to transmit the data to the mobile device **40** via its wireless communication device **41**.

It should be understood that in some alternative embodiments, the glucose monitoring device **50***a* and the blood glucose test strip reader **50***b* may be operable to communicate data indicative of characteristics of the user's blood by a wired connection. Further, in some embodiments, such data can be entered directly into the mobile device **40** via the user interface **42**.

In some embodiments, the controller device **200** of the infusion pump assembly **20** is equipped with wireless communication capabilities, and the controller device **200** is configured to mechanically mount together with the removable pump device **100** (exploded view shown in FIG. **2**) so as to electrically communicate with the pump device **100**. The pump device **100** in this embodiment includes a housing structure **110** that defines a cavity **116** in which a fluid cartridge **120** can be received. The pump device **100** can also include a cap device **130** to retain the fluid cartridge **120** in the cavity **116** of the housing structure **110**. The pump device **100** can include a drive system **140** that advances a plunger **125** in the fluid cartridge **120** so as to dispense fluid **126** therefrom. In some embodiments, the dispensed fluid exits the fluid cartridge, passes through a flexible tube **72** of an infusion set **70** to a cannula housing **74** retained to the user's skin by a skin adhesive patch **78** (FIG. **3**). The dispensed fluid can enter through the skin via a cannula **76** attached to the underside of the cannula housing **74** (FIG. **3**).

In some embodiments, the controller device **200** communicates with the pump device **100** to control the operation of the drive system **140**. When the controller device **200**, the pump device **100** (including the cap device **130**), and the fluid cartridge **120** are assembled together, the user can (in some embodiments) conveniently wear the infusion pump assembly **20** on the user's skin under clothing, in a pouch clipped at the waist (e.g., similar to a cell phone pouch), or in the user's pocket while receiving the fluid dispensed from the pump device **100** (see FIGS. **4**A-C). Optionally, the controller device **200** may be configured as a reusable component that provides electronics and a user interface to control the operation of the pump device **100**. In such circumstances, the pump device **100** can be a disposable component that is disposed of after a single use. For example, the pump device **100** can be a "one time use" component that is thrown away after the fluid cartridge **120** therein is exhausted, and the pump device **100** can be equipped with one or more structures that physically hinder reuse of the pump device **100** with a subsequent cartridge **120** (e.g., such as one or more anchors that penetrate and retain the medicine cartridge **120** to hinder removal, the cap device **130** being non-reversibly attached to the pump housing **110**, or the like). Thereafter, the user can removably attach a new pump device **100** (having a new medicine cartridge **120**) to the reusable controller device **200** for the dispensation of fluid from a new fluid cartridge **120**. Accordingly, the user is permitted to reuse the controller device **200** (which may include complex or valuable electronics, as well as a rechargeable battery) while disposing of the relatively low-cost pump device **100** after each use. Such a pump assembly **20** can provide enhanced user safety as a new pump device **100** (and drive system therein) is employed with each new fluid cartridge **120**.

Briefly, in use, the pump device **100** is configured to removably attach to the controller device **200** in a manner that provides a secure fitting, an overall compact size, and a reliable electrical connection that can be resistant to water migration. For example, the controller device **200** can include a housing **210** having a number of features that mate with complementary features of the pump housing structure

110. In such circumstances, the controller device **200** can removably attach with the pump device **100** in a generally side-by-side configuration. The compact size permits the infusion pump assembly **20** to be discrete and portable. Moreover, at least one of the pump device **100** or the controller device **200** can include a release member that facilitates an easy-to-use detachment and replacement process.

As shown in FIG. **2**, the pump device **100** can include an electrical connector **118** (e.g., having conductive pads, pins, and the like) that is exposed to the controller device **200** and that mates with a complementary electrical connector (not shown) on the adjacent face of the controller device **200**. The electrical connection between the pump device **100** and the controller device **200** provides the electrical communication between the control circuitry housed in the controller device **200** and at least a portion of the drive system **140** or other components of the pump device **100**. For example, in some embodiments, the electrical connection between the pump device **100** and the controller device **200** can permit the transmission of electrical control signals to the pump device **100** and the reception of feedback signals (e.g., sensor signals) from particular components within the pump device **100**. The electrical connection between the pump device **100** and the controller device **200** may similarly facilitate transmission of one or more power signals for sharing electrical power therebetween.

The pump device **100** may include a drive system **140** that is controlled by the removable controller device **200**. Accordingly, the drive system **140** can accurately and incrementally dispense fluid from the pump device **100** in a controlled manner. The drive system **140** may include a flexible piston rod **141** that is incrementally advanced toward the medicine cartridge **120** so as to dispense the medicine from the pump device **100**. At least a portion of the drive system **140** is mounted, in this embodiment, to the pump housing structure **110**. In some embodiments, the drive system **140** may include a number of components, such as an electrically powered actuator (e.g., reversible motor **142** or the like), a drive wheel **143**, a bearing **145**, the flexible piston rod **141**, and a plunger engagement device **144**. In this embodiment, the reversible motor **142** drives a gear system to cause the rotation of the drive wheel **143** that is coupled with the bearing **145**. The drive wheel **143** may include a central aperture with an internal thread pattern, which mates with an external thread pattern on the flexible piston rod **141**. The interface of the threaded portions of the drive wheel **143** and flexible piston rod **141** may be used to transmit force from the drive wheel to the piston rod **141**. Accordingly, in the embodiment of FIG. **2**, the drive wheel **143** is the driver while the flexible piston rod **141** is the driven member. The rotation of the drive wheel **143** can drive the flexible piston rod **141** forward in a linear longitudinal direction to cause the plunger engagement device **144** to nudge the plunger **125** within the fluid cartridge **120** so as to dispense fluid **126** therefrom.

Still referring to FIG. **2**, the controller device **200** can include a user interface **222** that permits a user to monitor and control the operation of the pump device **100**. In some embodiments, the user interface **222** can include a display device **223** and one or more user-selectable buttons (e.g., several buttons **224** including buttons **224***a* and **224***b* are shown in the embodiment of FIG. **2**). Additionally or alternatively, the user interface **222** can include a touch-screen display device. The display device **223** can include an active area in which numerals, text, symbols, images, or a combination thereof can be displayed. For example, the display device **223** can be used to communicate a number of settings or menu options for the infusion pump assembly **20**. In this embodiment, the user may press one or more of the buttons **224** to shuffle through a number of menus or program screens that show particular settings and data (e.g., review data that shows the medicine dispensing rate, the total amount of medicine dispensed in a given time period, the amount of medicine scheduled to be dispensed at a particular time or date, the approximate amount of medicine remaining in the cartridge **120**, or the like). In some embodiments, the user can adjust the settings or otherwise program the controller device **200** by pressing one or more buttons **224** of the user interface **222**. For example, in embodiments of the infusion pump assembly **20** configured to dispense insulin, the user may press one or more of the buttons **224** to change the dispensation rate of insulin or to request that a bolus of insulin be dispensed immediately or at a scheduled, later time. In some implementations, the display device **223** may also be used to communicate information regarding remaining battery life. Further, in this embodiment, the user can accept or decline a suggested dosage of medicine by pressing either of buttons **224***a* and **224***b* of the user interface **222**.

The controller device **200** can also be equipped with an inspection light device **228**. The inspection light device **228** can provide the user with a tool to illuminate and inspect a targeted location. For example, the inspection light device **228** can be directed at the infusion site on the user's skin to verify that the infusion set is properly embedded, or the inspection light device **228** can be directed at the pump device **100** to illuminate the cavity **116** or other areas. The inspection light device **228** can also be used to notify the user to an alert condition of the pump assembly **20**. An activation of the inspection light device **228** can thereby provide a visual notification (as an alternative to, or in addition to, the visual notification provided on the display device **223**) to the user that attention to the infusion pump assembly **20** is warranted.

The controller device **200** of the pump assembly **20** also includes a wireless communication device **221**, an NFC circuit **230**, and an accelerometer **231**. Each of these components can be in electrical communication with the control circuitry of the controller device **200**. The wireless communication device **221** can facilitate wireless communications between the pump assembly **20** and the mobile device **40**. As noted above, the wireless communication device **221** can send and receive data signals to and from the corresponding wireless communication device **41** of the mobile device **40** via a short-range wireless connection (e.g., RF, Wi-Fi, or Bluetooth connectivity). For example, the controller device **200** can receive a trigger signal to initiate a bolus dosage of insulin from the mobile device **40** via the communication devices **221** and **41**.

In some embodiments, wireless communications between the controller device **200** and the mobile device **40** can incorporate one or more security measures to inhibit signal hijacking. As one example, a secure communications protocol involving security-coded wireless data packets can be implemented in wireless communications between the controller device **200** and the mobile device **40**. As another example, the controller device **200** and the mobile device **40** can execute a wireless pairing routine to establish a one-to-one wireless connection. In some embodiments, the pairing may involve an exchange of unique information relating to the user (e.g., a passcode established by the user) of the devices.

In some embodiments, the trigger signal can include a suggested dosage amount. The suggested dosage amount can be determines by a dosage calculator application **44** executed by a controller **43** of the mobile device **40**. In some embodiments, the dosage calculator application **44** determines the suggested dosage amount based on data indicative of a user's blood glucose level received from the glucose monitoring device **50***a* or the blood glucose test strip reader **50***b*. In some embodiments, the dosage calculator application **44** also utilizes data indicative of the rate of change in the user's blood glucose level and/or data indicative of the user's food consumption in determining the suggested medicine dosage amount.

In this example, the dosage calculator application **44** determines a suggested bolus dosage of insulin of 4.0 units. The suggested bolus dosage is presented to the user via the touchscreen **47** of the user interface **42**. The user can accept or decline the suggested bolus dosage by interacting with the user interface **42** (e.g., by selecting the "YES" or "NO" option on the touchscreen **47**). If the user accepts the suggested bolus dosage, the wireless communication device **41** can transmit a trigger signal to initiate the suggested bolus dosage to the controller device **200** of the pump assembly **20**. The wireless communication device **221** of the controller device **200** can receive the trigger signal. The controller device **200** can provide a notification to the user indicating that a suggested bolus dosage has been received. The notification can be visual, audible, tactile, and a combination thereof. For instance, as depicted in this embodiment, the controller device can present the suggested bolus dosage to the user via the display device **223**.

In some embodiments, the controller device **200** is configured to wait for confirmation at the pump assembly **20** that the suggested bolus dosage is acceptable to the user before initiating dispensation. As discussed below with reference to FIGS. **4**A-C, user confirmation at the pump assembly **20** of an accepted bolus dosage may be provided in a variety of ways. If the user confirms acceptance of the bolus dosage via the user interface **222**, the controller device **200** can cause the pump device to initiate dispensation of the suggested bolus dosage. In some embodiments, the controller device **200** may transmit a confirmation signal to the mobile device **40** to indicate that the suggested bolus dosage has been initiated. In some embodiments, if the user declines or chooses to modify the suggested bolus dosage, the controller device **200** may transmit a signal to the mobile device **40** to indicate the rejection or modification.

Referring to FIGS. **4**A-C, in some embodiments, the infusion pump assembly **20** is pocket-sized so that the pump device **100** and controller device **200** can be worn in the user's pocket **6** or in another portion of the user's clothing. For example, the pump device **100** and the controller device **200** can be attached together and form the pump assembly **20** that comfortably fits into a user's pocket **6**. The user can carry the portable infusion pump assembly **20** and use the tube **72** of the infusion set **70** to direct the dispensed medicine to the desired infusion site. In some circumstances, the user may desire to wear the pump assembly **20** in a more discrete manner. Accordingly, the user may pass the tube **72** from the pocket **6**, under the user's clothing, and to the infusion site where the adhesive patch **78** is positioned. As such, the pump system **10** can be used to deliver medicine to the tissues or vasculature of the user in a portable, concealable, and discrete manner. Furthermore, the monitoring device **50***a* can be worn on the user's skin while the pump assembly **20** is carried by the user (e.g., in a pocket). As such, the monitoring device **50***a* can communicate information indicative of the user's blood glucose level to the pump assembly **20** via a wireless connection while the pump assembly **20** is used to deliver medicine through the infusion set **70**. In this embodiment, the monitoring device **50***a* may be arranged on the user's skin at a location that is spaced apart from the infusion set **70**.

FIG. **4**A depicts a first user confirmation technique, where the user interfaces directly with the pump assembly **20**. In this example, the user can respond to an alert (e.g., an audible chime or a vibration) from the pump assembly **20** indicating that a suggested bolus dosage has been received by removing the pump assembly **20** (at least the controller device **200** if detachable) from his/her pocket **6** and engaging the user interface **222** of the controller device **200**. In some embodiments, the user can confirm acceptance, decline acceptance, or request a modification of the suggested bolus dosage via the user-selectable buttons **224** of the controller device **200**. In response to receiving the confirmation of acceptance, the pump assembly **20** can initiate dispensation of the suggested bolus dosage.

FIG. **4**B depicts a second user confirmation technique, where the user interfaces directly with the mobile device **40**. In this example, the user can respond to the alert from the pump assembly **20** by engaging the user interface **42** of the mobile device **40**. In some embodiments, the user can confirm acceptance, decline acceptance, or request a modification of the suggested bolus dosage via the user interface **42** (e.g., by selecting an appropriate option presented on the touch screen **47**). In some embodiments, the user may be prompted to enter a security code to confirm acceptance of the suggested bolus dosage. In some embodiments, the user may be prompted to provide a biometric confirmation of acceptance, e.g., a fingerprint or facial recognition, via the user interface **42**. In response to receiving the confirmation of acceptance, the mobile device **40** can transmit a confirmation signal to the pump assembly **20** to initiate dispensation of the suggested bolus dosage.

FIG. **4**C depicts a third user confirmation technique, where the user can provide confirmation of an accepted suggested bolus dosage (wirelessly communicated from the mobile device **40** to the pump assembly **20**) without directly viewing the pump assembly **20**. In this embodiment, the user can respond to the alert from the pump assembly **20** by physically bumping the mobile device **40** against the pump assembly **20** (optionally, with one or more layers of clothing therebetween) while the pump assembly **20** remains in the user's pocket **6**. As described below in connection with FIG. **6**B, the pump assembly **20** can detect the bump and initiate dispensation of the suggested bolus dosage.

In some embodiments, the pump assembly **20** can detect a bump with the mobile device **40** via the NFC circuit **230** and/or the accelerometer **231**. As one example, the bump from the mobile device **40** against the pump assembly (e.g., directly or indirectly such that both devices undergo a detectable bump impact) can cause a simultaneous data exchange between the NFC circuit **230** integrated in the controller device of the pump assembly **20** and the NFC circuit **46** in the mobile device **40**. The data exchange may provide a confirmation signal to the pump assembly **20** indicating that the user has confirmed acceptance of the suggested bolus dosage. In some embodiments, the accelerometers **231** (in the pump assembly **20**) and **45** (in the mobile device **40**) can operate in conjunction with the NFC circuit **230** to supplement the criteria for activating communications between the NFC circuits **230** and **46**. In other words, while in some embodiments, NFC communications are initiated based merely on proximity between the NFC

circuits **230** and **46**, in other embodiments a threshold movement of the pump assembly **20** and/or the mobile device **40** must be detected to activate NFC communication. An objective for including this feature can be to more clearly ascertain that the user desires to accept the suggested bolus dosage via NFC when the NFC circuits **230** and **46** are in range of one another. That is, by requiring the user to physically bump the mobile device **40** against the pump assembly **20**, the user's intentions for accepting the suggested bolus dosage can be confirmed with a greater level of confidence.

In some embodiments, this optional feature of using the accelerometer **231** in conjunction with the NFC circuit **230** can function as follows. When a movement is detected by accelerometer **231**, the characteristics of the movement can be compared by to a predetermined threshold value (e.g., a threshold movement indicative of the aforementioned "bump" or tap movement). If the detected movement is greater than or equal to the threshold value, the NFC circuit **230** can potentially be activated. But, if no movement that is greater than or equal to the threshold value is detected, the NFC circuit **230** is not activated (even if the NFC circuit **230** is within the required proximity of the NFC circuit **46** such that NFC communications can potentially be performed). Therefore, in some embodiments this feature operates to enable NFC when the following two conditions are simultaneously met, or are both met within an establish time interval: (i) an acceleration or an acceleration profile that is greater than or equal to a threshold value is detected (indicating, e.g., a tap or other "bump" action between the pump assembly **20** and the mobile device **40**), and (ii) the NFC circuit **230** is in proximity with the NFC circuit **465** such that communications therebetween using NFC can occur. In some embodiments, the accelerometer **45** can be similarly operated in conjunction with the NFC circuit **46** of the mobile device **40**.

In some embodiments, the accelerometers **231** and **45** can be used to detect a bump independently of the NFC circuits **230** and **46**. For example, the pump assembly **20** can detect the bump by sensing a movement via the accelerometer **231** and receiving bump confirmation signal from the mobile device **40** via the wireless communication devices **221** and **41**. In some embodiments, the bump confirmation signal must be received within a predetermined time window (e.g., about 0.5 seconds to about 2 seconds) to be considered a detectable bump by the pump assembly **20**. In some embodiments, the pump assembly **20** is configured to delay dispensation until a pattern of bumps (e.g., two or more bumps) is detected. This feature may reduce the likelihood of inadvertent acceptance of the suggested bolus dosage by a false-positive bump. In some embodiments, the NFC circuits **230** and **46** can communicate a unique identifier (e.g., a serial number) to one another as a security code to establish a one-to-one NFC connection. This feature may reduce the likelihood of an inadvertent acceptance of the suggested bolus dosage, for example, if the user accidently bumps his/her infusion pump assembly into another user's mobile device.

In some embodiments, as similar bump technique for NFC as described above for user-confirmation of an accepted bolus dosage can be used to send the original trigger signal (described above as being implemented by short range wireless communication). For example, a suggested dosage determined by the dosage calculator application **44** could be coded into the NFC circuit **46** of the mobile device **40** and transmitted by an NFC-bump to the NFC circuit **230** (and therefore the control circuitry) of the pump assembly **20**.

Referring now to FIG. **5**, the control circuitry of a medical device (e.g., an infusion pump assembly) that includes wireless communication equipment can implement a process **500** of receiving commands from a mobile device, and controlling the medical device in accordance with received commands. Such a process **500**, for example, can be implemented by the control circuitry housed in the controller device **200** of an infusion pump assembly **20** (FIGS. **2-3**). However, this document is not necessarily limited to any particular medical device with respect to process **500**.

In operation **510**, the control circuitry of a medical device can receive input via wireless communication from a mobile device (e.g., a smartphone). The input can be indicative of a task associated with using the medical device. A medical device that can perform operation **510** is exemplified in FIGS. **2-3**, where a wireless communication device **221** and an NFC circuit **230** are in electrical communication with the control circuitry of a controller device **200** of an infusion pump assembly **20**. As explained above, the wireless communication device **221** and the NFC circuit **230** of the pump assembly **20** can function to receive and send communications from a corresponding wireless communication device **41** and NFC circuit **46** of the mobile device **40**. An example of operation **310** is provided in FIGS. **2-3**, where dosage calculator application **44** of the mobile device **40** determines a suggested bolus dosage of insulin (or another medication) and transmits a trigger signal to the pump assembly **20** via the wireless communication devices **41** and **221**.

In operation **520**, the control circuitry optionally provides a prompt for the user to confirm a change in the operation of the medical device in response to input received from the mobile device. Such a prompt may be advantageously used to confirm the user's intent to change the operation of the medical device before the control circuitry actually implements the change. An example of operation **520** is provided in FIGS. **2-3**, where the control circuitry of the controller device **200** of the pump assembly **20** generated the illustrated textual prompt on the display **223**. The prompt provides a description of the potential change in operation ("Bolus Initiated from Mobile Device; Deliver Requested Bolus? 4.00 Units"). Alternatively or additionally, other techniques can be used for prompting the user to confirm the user's intent to change the operation of the medical device. For example, the medical device can provide a visual (e.g., a flashing light), auditory (e.g., a chime) and/or tactile (e.g., vibration) alert. As described above, by pressing a button **224***a* of the user interface **222**, the user can confirm the user's intent to implement a change in the operation of the infusion pump assembly **20**. As described in connection with FIGS. **4**A-C, the user can provide confirmation by interacting directly with the pump assembly **20** and/or the mobile device **40** via a user interface, or by bumping the mobile device against the pump assembly **20**. In some embodiments, the user confirmation techniques of FIGS. **4**A-C can be modified or combined to achieve an acceptable level of security and reliability.

In operation **530**, after receiving confirmation from the user to implement the change associated with the input from the mobile device, the control circuitry can control the medical device to change the operation of the medical device in accordance with the user's confirmation of the change. Again in regard to the example of FIGS. **2-3**, when the user confirms the change to the infusion pump assembly **20** related to the suggested bolus dosage, the control cir-

cuitry of the controller device **200** can thereafter control the pump device **100** to deliver the corresponding bolus dispensation of insulin.

Referring now to FIG. **6**, the infusion pump assembly **20** can dispense a bolus dosage of medicine suggested by the mobile device **40** after receiving confirmation that the suggested bolus dosage is accepted by the user. For example, a process **600** for dispensing a suggested bolus dosage can be implemented by the controller device **200** of the pump assembly **20**. In operation **605**, the controller device **200** can wait for a trigger signal from the mobile device **40** to initiate a bolus dosage (e.g., a bolus dosage determined by the dosage calculator application **44**). The trigger signal may be received via short-range wireless communication or NFC. In operation **607**, the controller device **200** can optionally validate the trigger signal. In some embodiments, validating the trigger signal may include detecting a signal strength of the short-range wireless connection between the pump assembly **20** and the mobile device **40**, and comparing the signal strength to a predetermined threshold. The controller device **200** may only validate a trigger signal if the detected signal strength is greater than the threshold. An objective for this feature can be to verify that the mobile device **40** is close in proximity to the pump assembly **20**, which increases the reliability that the trigger signal originated from a mobile device in the user's possession. In some embodiments, validating the trigger signal may include applying a unique decryption key to trigger signal that has been encrypted.

In operation **610**, the user is prompted to accept the suggested bolus dosage indicated by the trigger signal. At operation **615**, the controller device **200** determines if the user accepts the suggested bolus dosage. In operation **620**, if the user accepts the suggested bolus dosage (**615**), the controller device **200** initiates delivery of the suggested bolus dosage via the pump device **100**. If the user declines the suggested bolus dosage (**615**), the controller device **200** can prompt the user for a modified bolus dosage (e.g., via a prompt script provided on the display device **223**). In operation **625**, the controller device determines if the user wishes to receive a modified bolus dosage. In operation **630**, if the user wishes to receive a modified bolus dosage (**625**), the controller device **200** can obtain the modified bolus dosage amount via the user interface elements (e.g., the user-selectable buttons **224**). And in operation **635**, the controller device **200** can initiate delivery of the modified bolus dosage via the pump device **100**. At operation **637**, the controller device **200** can optionally provide a confirmation signal indicative of an initiated bolus delivery. For example, the controller device **200** can provide a visual, auditory, or tactile alert perceptible by the user and/or transmit a confirmation signal to the mobile device **40**. After a suggested (**620**) or modified (**635**) bolus dosage is initiated, or after the suggested (**615**) and modified (**625**) dosages have been declined by the user, the process **600** can return to operation **605**, where the controller device **200** can wait for a subsequent trigger signal to initiate another bolus dosage.

Revisiting operation **615**, FIG. **6**A depicts a first example sub-process **615***a* executable by the controller device **200** for determining whether the user accepts the suggested bolus dosage. In operation **640**, the controller device **200** can wait for a user-confirmation signal indicating that the user has accepted the suggested bolus dosage. In operation **645**, the controller device can determine whether a user-confirmation signal has been received via one or more user interface elements (e.g., the user selectable buttons **624**) of the user interface **222** within a predetermined time window (e.g., between about 0.5 seconds and about 15 seconds). If the user-confirmation signal is not received within the time window (**645**), the controller device **200** can determine that the user does not accept the suggested bolus dosage. If the user-confirmation signal is received within the time window (**645**), the controller device **200** can determine that the user does accept the suggested bolus dosage. An example of the sub-process **615***a* is provided in FIGS. **2-3** and **4**A, where the user-confirmation signal is received when the user selects the button **224***a* corresponding to the "Accept" option presented on the display device **223**. If the user selects the button **224***a* within the predetermined time window, the controller device **200** can determine that the user accepts the suggested bolus dosage. However, if the user does not select the button **224***a* within the predetermined time window, or if the user selects the button **224***b* corresponding to the "Decline" option, the controller device **200** can determine that the user does not accept the suggested bolus dosage. In some embodiments, if the sub-process **615***a* times out (e.g., if the user confirmation signal is not received in the predetermined time window), the controller device **200** may provide a reminder alert to the user.

FIG. **6**B depicts a second example sub-process **615***b* executable by the controller device **200** for determining whether the user accepts the suggested bolus dosage. In operation **650**, the controller device **200** can wait for a user confirmation of the suggested bolus. In operation **655** the controller device **200** can detect a bump event. In operation **660**, the controller device **200** can receive a bump-confirmation signal from the mobile device **40**. In operation **665**, the controller device **200** can determine whether the bump-event confirmation signal was received within a predetermined time window (e.g., about 0.5 seconds to about 2 seconds) starting from the bump event detection. If the bump-confirmation signal is not received within the time window (**665**), the controller device **200** can determine that the user does not accept the suggested bolus dosage. If the bump-confirmation signal is received within the time window (**665**), the controller device **200** can determine that the user does accept the suggested bolus dosage.

An example of the sub-process is provided FIG. **4**C, where the controller device **200** is described as operable to detect a bump event using NFC communication via an NFC circuit **230** of the controller device **200**. As yet another example described in connection with FIG. **4**C, an accelerometer **231** integrated with the control circuitry of the controller device **200** can detect movement indicative of a bump event. If the mobile device **40** independently detects the bump event via its NFC circuit **46** and/or accelerometer **45** it can transmit a bump-confirmation signal the controller device **200**. In some embodiments, e.g., when the bump event is detected via NFC communication, the bump-confirmation signal may be received simultaneously with the bump event detection via two-way communication between the NFC circuits **230** and **46**.

FIG. **6**C depicts a third example sub-process **615***c* executable by the controller device **200** for determining whether the user accepts the suggested bolus dosage. In operation **670**, the controller device can transmit (e.g., via short-wireless connection or NFC connection) a confirmation signal to the mobile device **40** indicating receipt of the suggested bolus dosage via the trigger signal. In operation **675**, the controller device **200** can wait for a user-confirmation signal indicating that the user has accepted the suggested bolus dosage. In operation **680**, the controller device **200** can determine whether a user-confirmation signal has been received from the mobile device **40** within a predetermined time window (e.g., between about 0.5 seconds and

about 15 seconds). If the user-confirmation signal is not received within the time window (**680**), the controller device **200** can determine that the user does not accept the suggested bolus dosage. If the user-confirmation signal is received within the time window (**680**), the controller device **200** can determine that the user does accept the suggested bolus dosage. An example of the sub-process **615***a* is provided in FIG. **4**B, where the user engages the user interface **42** of the mobile device **40** to confirm acceptance, decline acceptance, or request a modification of the suggested bolus dosage. For example, in some embodiments, the user may be prompted to provide a security code to confirm acceptance or a biometric confirmation of acceptance, e.g., a fingerprint or facial recognition, via the user interface **42**. If the user confirms acceptance via the user interface **42** within the predetermined time window, the controller device **200** can determine that the user accepts the suggested bolus dosage. However, if the user does not confirm acceptance using the user interface **42** within the predetermined time window, or if the user declines the suggested bolus dosage (or request a modified dosage) using the user interface **42**, the controller device **200** can determine that the user does not accept the suggested bolus dosage.

Referring now to FIG. **7**, an alternative process **700** for dispensing a suggested bolus dosage can be implemented by the controller device **200** of the pump assembly **20**. Operations **705-725** are similar to operations of the process **600**. In operation **705**, the controller device **200** can wait for a trigger signal from the mobile device **40** to initiate a bolus dosage (e.g., a bolus dosage determined by the dosage calculator application **44**). The trigger signal may be received via short-range wireless communication or NFC. In operation **710**, the user is prompted to accept the suggested bolus dosage indicated by the trigger signal. In operation **720**, if the user accepts the suggested bolus dosage (**715**), the controller device **200** initiates delivery of the suggested bolus dosage via the pump device **100**. At operation **715**, the controller device determines if the user accepts the suggested bolus. If the user declines the suggested bolus dosage (**715**), the controller device can prompt the user for a modified bolus dosage. At operation **737**, the controller device **200** can optionally provide a confirmation signal indicative of an initiated bolus delivery. For example, the controller device **200** can provide a visual, auditory, or tactile alert perceptible by the user and/or transmit a confirmation signal to the mobile device **40**.

At operation **725**, the controller device determines if the user wishes to receive a modified bolus dosage. At operation **785**, if the user wishes to receive a modified bolus dosage (**725**), the controller device **200** can transmit a signal to the mobile device **40** requesting a modified bolus dosage. In some embodiments, the mobile device **40** can prompt the user, e.g., via the user interface **42**, to provide a modified dosage or to provide new data for the dosage calculator application **44** to consider in determining a suggested bolus dosage. After a suggested bolus dosage is initiated (**720**) or declined (**725**), or after a modified dosage has been requested (**785**), the process can return to operation **705**, where the controller device **200** can wait for a subsequent trigger signal to initiate another bolus dosage.

Referring now to FIG. **8**, the dosage calculator application **44** executed by the controller **43** of the mobile device **40** can determine a suggested bolus dosage based on data indicative of the user's blood glucose level. For example, a process **800** for determining a suggested bolus dosage and providing the suggested dosage to an infusion pump assembly **20** can be implemented by the mobile device **40**. As previously described, the pump assembly **20** can operate to deliver insulin to the user by basal dosages, selected bolus dosages, or a combination thereof. A basal rate of insulin can be delivered in an incremental manner (e.g., dispense 0.25 U every fifteen minutes for a rate of 1.0 U per hour) to help maintain the user's blood glucose level within a targeted range during normal activity, when the user is not consuming food items. The user may select one or more bolus deliveries, for example, to offset the blood glucose effects caused by food intake, to correct for an undesirably high blood glucose level, to correct for a rapidly increasing blood glucose level, or the like. In some circumstances, the basal rate pattern may be programmed by a health care professional during a clinical visit (or, optionally, by the user) and may remain at a substantially constant rate for a long period of time (e.g., a first basal dispensation rate for a period of hours in the morning, and a second basal dispensation rate for a period of hours in the afternoon and evening). In contrast, the bolus dosages can be dispensed in user-selected amounts based on calculations made by the dosage calculator application **44**. For example, the dosage calculator application **44** can determine that the user's blood glucose level is rapidly increasing (e.g., by interpreting data received from the glucose monitoring device **50***a* and/or the blood glucose test strip reader **50***b*, or the like) and can make a suggestion to the user to administer a bolus of insulin to correct for the rapid increase in blood glucose level. In another example, the user can request (via the user interface **42**) that the dosage calculator application **44** calculate and suggest a bolus dosage based, at least in part, on a proposed meal that the user plans to consume.

The basal and bolus insulin dispensed into the user's system may act over a period of time to control the user's blood glucose level. As such, the user can benefit from the embodiments of the infusion pump system **10** that can take into account different circumstances and information when determining the amount of a bolus dosage to suggest to the user. For example, the dosage calculator application **44** may be triggered to suggest a bolus dosage in response to the user's input of meal information (See FIGS. **2-3**). When calculating the bolus dosage, however, the user may benefit if the dosage calculator application **44** employed information, in addition to the meal information, when calculating the bolus dosage. In some embodiments, the dosage calculator application **44** can use information such as data indicative of the user's blood glucose level, food intake data recently submitted by the user via the user interface **42** of the mobile device **40**, the user's insulin load, and the like. Exemplary information that can be derived from the user's blood glucose information that can be used by the dosage calculator application **44** in determining a bolus dosage can include the user's current blood glucose level, the rate of change in the user's blood glucose level, the 2^{nd} derivative of the user's blood glucose data, the shape and/or appearance of the user's blood glucose curve, or the like. In some embodiments, the dosage calculator application **44** can use information from previously entered meals and previously delivered insulin dosages when calculating a suggested bolus dosage. In these embodiments, information regarding previously entered meals and previously delivered insulin dosages from 12 hours or more (e.g., 24 hours, 12 hours, 8 hours, 6 hours, 0.5 hours, or the like) can be used in the bolus dosage calculations.

In some embodiments, the controller device **200** may implement one or more operations of the process **800** (FIG. **8**) to determine and suggest an insulin bolus dosage which includes a food offsetting component, a blood glucose

correction component, and an insulin load correction component. The food offsetting component can represent an insulin bolus dosage to offset food intake data that have not previously been offset by an earlier bolus dosage. The blood glucose correction component can represent an insulin bolus dosage to maintain or return the user's blood glucose level to a targeted value within a predetermined range. This component can be derived from data indicative of a user's blood glucose level such as the user's current blood glucose level and the recent rate of change in the user's blood glucose level. The insulin load correction component can take into account insulin that has been previously received and food that has been previously consumed, but has not acted on the user. For example, the delay between a subcutaneous delivery of a bolus dosage of insulin and the peak plasma insulin level achieved from this bolus can be one hour or more. Additionally, the bolus dosage may not enter the subcutaneous tissue all at once. As such, the effect of the bolus can peak at about one to two hours and then decay in a predictable manner over as much as eight hours or. Due to the time decay effects of insulin activity, the user could be susceptible to request a subsequent bolus dosage while some insulin from a previously delivered bolus dosage has not yet acted upon the user (a scenario sometimes referred to as "bolus stacking"). To reduce the likelihood of undesirable bolus stacking, the insulin load information can be determined by dosage calculator application **44** on a periodic basis so that the user can be aware of the previously dispensed insulin which has not yet acted in the user's body. In a similar manner, food that has been previously consumed does not instantaneously act on the user and have its effects quickly decay. Depending on the type of food consumed, the effects of the food can be delayed and then slowly decay over time. In particular embodiments, the insulin load correction component may correct for the delayed effects of both previously delivered insulin and previously consumed food items.

Referring in more detail to FIG. **8**, the illustrative process **800** for determining a suggested bolus dosage and providing the suggested dosage to an infusion pump assembly **20** can include a number of operations performed by various components of the mobile device **40**. In operation **405**, the dosage calculator application **44** can wait for a trigger to initiate a bolus dosage calculation. Exemplary triggers that can cause the dosage calculator application **44** to initiate a bolus dosage calculation can include a user input of food intake data (e.g., via the user interface **42** of the mobile device **40**), an input of blood glucose data (e.g., as measured and transmitted wirelessly by the glucose monitoring device **50***a* and/or the blood glucose test strip reader **50***b*), a user request for a bolus dosage, the user's blood glucose level exceeding a predetermined threshold level, the user's blood glucose level increasing at a high rate greater than a predetermined threshold rate, or the like. In some embodiments, the suggested bolus dosage value can be calculated based on at least two of the three components as previously described: the food offsetting component, the blood glucose correction component, and the insulin load correction component. It should be understood from the description herein that the components can be contemporaneously calculated to provide the suggested bolus dosage value or, alternatively, calculated in discrete steps and then combined to provide the suggested bolus dosage value.

In operation **805**, a dosage history is a received via wireless communication (e.g., NFC or short-range wireless communication) with the pump assembly **20**. The dosage history may include data indicative of one or more previous bolus dosages initiated by the controller device **200** of the pump assembly **20**. In some embodiments, data included in the dosage history can include a date/time data point and a quantity data point corresponding to each of the previous bolus dosages. In operation **810**, the user's current blood glucose is received. As described above, the user's current blood glucose level can be received via wireless communication from the glucose monitoring device **50***a* and/or the blood glucose test strip reader **50***b*, or entered manually by the user via the user interface **42** of the mobile device **40**. In operation **810**, the dosage calculator application **44** can determine a rate of change (e.g., increase or decrease) based on the dosage history and the blood glucose level. Non-limiting examples of suitable techniques for determining the rate of change in the user's blood glucose level are described in U.S. application Ser. No. 12/348,162 filed on Jan. 2, 2009, the entirety of which is hereby incorporated by reference. Alternatively, the user may manually enter the rate-of-change information for his or her blood glucose level (rather than this information being determined by the dosage calculator application **44**). For example, when using a blood glucose test strip reader **50***b*, the test strip reader may store blood glucose measurements performed by the user, which can be used to determine the rate of change in the user's blood glucose level. When prompted by the dosage calculator application **44**, the user may enter the most recent rate of change data. In operation **820**, the user can optionally enter data indicative of food intake (e.g., a meal that is about to be consumed, a meal that has recently been consumed, or the like). For example, if the user is testing his or her blood glucose level before consuming a meal, the user may input such food intake information when inputting the blood glucose level.

After the user's blood glucose information is obtained (e.g., via operations **805**, **810**, **815**, and **820**), in operation **825**, the dosage calculator application **44** can determined a suggested bolus dosage based on the obtained data. As noted above, in some embodiments, the suggested bolus dosage value can be calculated by the dosage calculator application **44** based on at least two of the three components as previously described: the food offsetting component, the blood glucose correction component, and the insulin load correction component. Non-limiting examples of suitable techniques for determining a suggested bolus dosage are described in U.S. application Ser. No. 12/348,162 filed on Jan. 2, 2009, which (as described above) is incorporated herein by reference.

In operation **830**, the dosage calculator application **44** can determine if the user accepts the suggested bolus dosage. For example, illustrated in FIGS. **2-3**, the user can select the "YES" or "NO" option via the touchscreen user interface **42** of the mobile device **40** to accept or decline the suggested bolus dosage. In operation **835**, if the accepts the suggested bolus dosage (**830**), the dosage calculator application **44** can cause the suggested bolus dosage to be transmitted to the infusion pump assembly **20** (e.g., in the form of a trigger signal via NFC or short-range wireless communication). If the user declines the suggested bolus dosage (**840**), the dosage calculator application **44** can prompt the user for a modified dosage. In operation **840**, the dosage calculator application **44** can determine if the user wishes to receive a modified bolus dosage. In operation **845**, if the user wishes to receive a modified bolus dosage (**840**), the dosage calculator application **44** can obtain the modified bolus dosage. For example, the user can enter a modified bolus dosage or provide additional data that can be used to calculate a modified dosage via the user interface **42**. In operation **850**,

the dosage calculator application **44** can cause the modified bolus dosage to be transmitted to the pump assembly **20** (e.g., in the form of a trigger signal via NFC or short-range wireless communication). After a suggested (**835**) or modified (**850**) bolus dosage has been transmitted to the pump assembly, or after the user has declined the suggested and modified dosages (**840**), the process **800** can return to operation **802**, where the dosage calculator application can wait for a subsequent trigger to initiate a bolus dosage calculation.

Various embodiments described herein include the mobile device **40** in the form of a smartphone device. The smartphone device **40** may store or otherwise execute the previously described dosage calculator application **44**, and may further include other applications, computing sub-systems, and hardware. For example, a call handling unit may receive an indication of an incoming telephone call and provide a user the capability to answer the incoming telephone call. A media player may allow a user to listen to music or play movies that are stored in local memory of the smartphone device **40**. The smartphone device **40** may include a digital camera sensor, and corresponding image and video capture and editing software. An internet browser may enable the user to view content from a web page by typing in an addresses corresponding to the web page or selecting a link to the web page.

Additionally, the smartphone device **40** may include an antenna to wirelessly communicate information with one or more base stations of a mobile telephone cellular network that enables the smartphone device **40** to maintain communication with a network as the smartphone device **40** is geographically moved. The smartphone device **40** may alternatively or additionally communicate with the network through a Wi-Fi router or a wired connection (e.g., ETHERNET, USB, or FIREWIRE).

Also, the smartphone device **40** can connect with an application store to provide a user of the smartphone device **40** the ability to browse a list of remotely stored application programs (such as the dosage calculator application **44** or other mobile applications) that the user may download over the network and install on the mobile computing device. The application store may serve as a repository of applications developed by third-party application developers. An application program (such as the dosage calculator application **44**) that is installed on the smartphone device **40** may be able to communicate over the network with server systems that are designated for the application program. The smartphone device **40** may access cloud-based application programs, and the dosage calculator application **44** may be implemented as such as cloud-base application program. Cloud-computing provides application programs (e.g., a word processor or an email program) that are hosted remotely from the smartphone device **40**, and may be accessed by the smartphone device **40** using a web browser or a dedicated program. In the embodiment described above, the smartphone device **40** stores the computer readable instructions so as to activate the dosage calculator application **44**, which can be installed and run on the smartphone device **40** or can at least partially hosted at a server as part of a cloud-based application program. These and other services may be implemented in a server system. A server system may be a combination of hardware and software that provides a service or a set of services. For example, a set of physically separate and networked computerized devices may operate together as a logical server system unit to handle the operations necessary to offer a service to hundreds of computing devices.

A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A medical infusion pump system, comprising: a portable pump housing configured to receive insulin for dispensation to a user, the pump housing at least partially containing a pump drive system to dispense the insulin through a flow path to the user; a controller communicatively coupled with the pump drive system to cause dispensation of the insulin from the portable pump housing, the controller having computer memory for storing instructions, and one or more processors for executing the instructions stored in the computer memory; a first wireless communication device configured to receive a suggested bolus dosage amount from a mobile device, wherein the suggested bolus dosage amount has been calculated by a dosage calculator executing on the mobile device, the dosage calculator using at least one recent blood glucose measurement of the user to calculate the suggested bolus dosage amount; and a near field communication (NFC) circuit configured to receive NFC communications from the mobile device; wherein, the instructions stored in the computer memory, when executed by the one or more processors of the controller, cause the controller to perform operations comprising: in response to receiving the suggested bolus dosage amount from the mobile device, prompting the user for confirmation of acceptance of the suggested bolus dosage; receiving an NFC communication, via the NFC circuit, indicating confirmation of acceptance of the suggested bolus dosage; and in response to receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage, controlling the pump drive system to cause dispensation of the suggested bolus dosage.

2. The system of claim **1**, further comprising a glucose monitoring device configured to be worn by the user and configured to wirelessly communicate blood glucose information of the user.

3. The system of claim **1**, wherein the controller is adapted to reject the suggested bolus dosage after lapse of a predetermined period of time in which no use confirmation is received.

4. The system of claim **1**, wherein the NFC circuit has a communications range of less than 12 inches.

5. The system of claim **1**, wherein the NFC circuit has a communications range of less than 8 inches.

6. The system of claim **1**, wherein receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage includes receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage from an NFC tag of the mobile device.

7. The system of claim **1**, wherein receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage includes receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage from an NFC circuit of the mobile device.

8. The system of claim **1**, further comprising a blood strip reader device configured to determine a blood glucose level of the user.

9. The system of claim **8**, wherein the blood strip reader device is configured to wirelessly communicate blood glucose information of the user.

10. The system of claim **1**, further comprising the mobile device, wherein the mobile device comprises a memory device that stores a mobile application configured to receive blood glucose information of the user and food consumption information of the user.

11. The system of claim **10**, wherein the mobile device includes an NFC circuit, and wherein receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage includes receiving the NFC communication indicating confirmation of acceptance of the suggested bolus dosage from the NFC circuit of the mobile device.

12. The system of claim **10**, wherein the controller is configured to prompt the user for confirmation of acceptance of the suggested bolus dosage by transmitting a confirmation signal to the mobile device indicating receipt of the suggested bolus dosage amount to cause the mobile device to prompt the user to provide at least one of a security code and a biometric validation to confirm acceptance of the suggested bolus dosage.

13. The system of claim **12**, wherein the mobile device is a smartphone device.

14. The system of claim **13**, wherein the wireless communication device is further adapted to receive from the smartphone device information indicative of a temporary basal rate.

15. The system of claim **13**, wherein the controller is adapted to deliver the suggested bolus dosage in response to the user's confirmation via interaction with the controller.

16. The system of claim **15**, wherein the smartphone device and the controller are each adapted to detect a bump motion and the controller is adapted to receive the user's confirmation via interaction by detecting a bumping of the smartphone device in proximity to the controller such that both the smartphone device and the controller detect the bump motion.

17. The system of claim **15**, wherein the controller comprises a touchscreen or a button adapted to receive the user's confirmation.

18. The system of claim **17**, wherein the controller is adapted to reject the suggested bolus dosage after receiving input from the user, via interaction with the button or the touchscreen, indicative of a rejection of the change in operation.

19. A medical infusion pump system, comprising:

a portable pump housing configured to receive insulin for dispensation to a user, the pump housing at least partially containing a pump drive system to dispense the insulin through a flow path to the user;

a controller communicatively coupled with the pump drive system to cause dispensation of the insulin from the portable pump housing, the controller having computer memory for storing instructions, and one or more processors for executing the instructions stored in the computer memory; and

a mobile device communicatively coupled with the controller to provide a trigger signal via a wireless connection to initiate dispensation of the insulin according to a bolus dosage, the mobile device including one or more computer-readable memory devices storing computer-readable instructions that, when executed by one or more processors of the mobile device, cause the mobile device to execute a dosage calculator application, wherein the bolus dosage is calculated by the dosage calculator using at least one recent blood glucose measurement for the user;

wherein, the instructions stored in the computer memory, when executed by the one or more processors of the controller, cause the controller to perform operations comprising:

in response to receiving the trigger signal, prompting the user for confirmation of acceptance of the bolus dosage

receiving a near field communications (NFC) communication indicating confirmation of acceptance of the bolus dosage; and

in response to receiving the NFC communication indicating confirmation of acceptance of the bolus dosage, controlling the pump drive system to cause dispensation of the bolus dosage.

20. The system of claim **19**, wherein the mobile device comprises a NFC device and the controller is adapted to receive via near field communication (NFC) from the NFC device, a signal indicative of a user's confirmation of acceptance of the bolus dosage according to the input received from the mobile device; and

wherein the controller is adapted to deliver the suggested bolus in response to receiving the signal.

21. The system of claim **19**, wherein the mobile device is a smartphone device adapted to prompt a user to confirm, via interaction with the smartphone device, the bolus dosage according to the input transmitted from the smartphone device.

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