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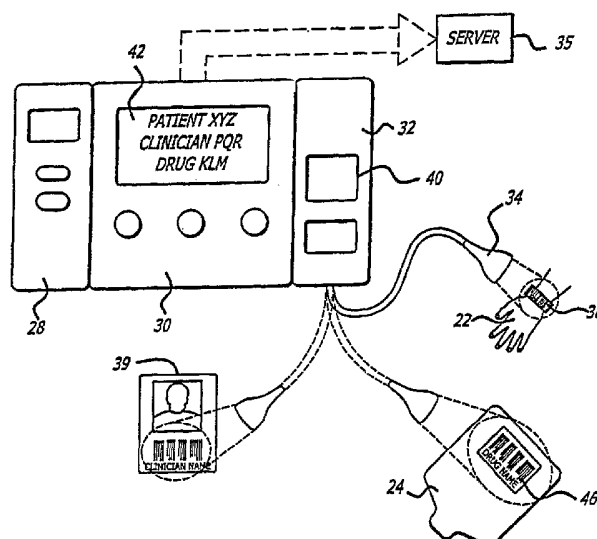
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(54) Title: MANAGEMENT OF PENDING MEDICATION ORDERS



(57) Abstract: Pending medication orders are presented on the controller of an infusion pump to which a patient has been identified. All pending medication orders are displayed on the screen of the controller and any may be selected by the clinician. Selecting a pending order at the controller that involves an infusion to the patient also results in automatic programming of the infusion pump in accordance with that order. Selection of an oral medication at the controller results, as does selection of any other order, in notification to the healthcare facility server that the order is being administered. Such notification resolves open controlled item transactions as well as provides information that may be relevant to a patient's EMAR. Selection of a pending order may occur manually or automatically through identification of a medication.

MANAGEMENT OF PENDING MEDICATION ORDERS

BACKGROUND OF THE INVENTION

The present invention relates generally to medication management systems and methods, and more particularly, to managing pending medication orders and controlled
5 medications.

Physicians and other medication personnel apply intravenous ("IV") infusion therapy to treat various medication complications in patients. IV infusion therapy typically involves infusing medication fluids, such as drugs or nutrients, from a fluid supply, such as a bag, bottle or other container, through the tube of a fluid administration set to a cannula
10 inserted into a patient's blood vessel. Other medications may be ordered by a physician for a patient, such as pills or liquids, to be taken orally by the patient. In some cases, a physician may order multiple medications for a single patient, and these are to be administered at particular times of a day or over a number of days resulting in a list of "pending medication orders" for the patient. In some cases, the administration of multiple
15 medications must occur sequentially and in other cases, there is an overlap of the administration of medications. In yet other cases, the administration of certain medications must occur at a certain time before or after the administration of another medication or medications.

In a typical facility, a physician enters an order for medication for a particular patient.
20 This order may be handled either as a simple prescription slip, or it may be entered into an automated system, such as a physician order entry ("POE") system. The prescription slip or the electronic prescription from the POE system is routed to the pharmacy, where the order is checked, then filled. For medication that is to be delivered by IV, the prescribed medication is prepared by a pharmacist and added to a bag, bottle, or other medication container (such as a
25 syringe) at a pharmacy. A pharmacist also typically identifies the prepared order, identifying the contents of the container and the patient for whom the container is intended with a written paper label that is attached to the container and in some cases by other means, such as including a bar code or magnetic device, or by use of a radio frequency ("RF") signal interactive device such as an RFID tag, as examples. The prepared medication is then delivered to a nurse's station for
30 subsequent administration to the patient.

For safety reasons and in order to achieve optimal results, the medical fluid is often administered in accurate amounts as prescribed by the doctor and in a controlled fashion by using an IV infusion pump. Infusion pumps operate by displacing the fluid located in a fluid administration set to force fluid from the fluid supply through the tube and into the patient. The infusion pump is programmed by an operator such as a nurse or other medical personnel or clinician, with operating parameters to achieve the administration of the drug as prescribed by the physician. Such operating, or pumping, parameters are drug and patient specific. That is, the pumping parameters are selected based on the particular drug prescribed and the specific patient for whom they are intended. It is the nurse's responsibility to match the prescribed drug with the correct patient and with the properly programmed pump at the correct time for administration of the medication.

Hospitals and other institutions continually strive to provide quality patient care. Medication errors, such as when a patient receives the wrong drug or receives the correct drug at the wrong time or in the wrong dosage, are significant problems for all health care facilities. In the administration of medication, focus is typically directed to the following five "rights" or factors: the right patient, the right drug, the right route, the right amount, and the right time. The nurse aims to ensure that these "rights" are accomplished. Systems and methods seeking to reduce medication errors should also take these five "rights" into consideration.

In some cases, a single patient may be prescribed multiple simultaneous infusions for different medications, sometimes four or more, which requires multiple infusion pumps that may all be programmed differently. Prior attempts have been made to assure that the right medication is administered to the right patient through the right pump. In one example, a bar code label identifying the medication and patient is applied to the bag at the pharmacy. After an operator such as a nurse manually programs the pump, a bar code scanner connected to the pump is used to read the bar code label on the bag to verify that it identifies the same medication as that programmed into the pump. In another example, U.S. Patent No. 5,078,683 to Sancoff et al. discloses a bar code label applied to the bag that is read with a bar code scanner to automatically program the pump, thus avoiding manual programming entirely. This feature of automatic programming or automatically populating the fields of the pumping parameters of the infusion pump can provide a significant benefit to busy clinicians, and can increase the accuracy of pump programming.

Advanced infusion pumps have revolutionized the way intravenous IV medications are delivered by providing dose limit protection, ensuring "right" dose. Still missing from these pumps in a non-networked environment is the ability to automatically select the "right" medication from the pump's drug library, ensure that the drug that is being
5 administered is for the patient that is currently connected to the pump, and that the caregiver administering the drug is authorized to do so.

In the environment of intensive care units, cardiac care units, operating rooms, or trauma centers, it is often necessary to infuse into the patient multiple medications simultaneously. In addition, some of the medications used in these environments are not
10 directly compatible with each other and therefore need to be infused into the patient at different points of the body. Recently, infusion pumps capable of infusing several medications at different rates into a patient have been developed. While some types of these pumps are designed to deliver the medications through a common cannula, others are designed with multiple pumps, or channels, that pump fluid into a patient through a
15 plurality of infusion lines. On such pump is the Medley medication safety system from ALARIS Products of Cardinal Health, San Diego, California, U.S.A., that provides this level of protection in a networked environment and a non-networked environment.

As the name implies, multi-channel infusion pumps have more than one pumping channel, and a separate infusion line or administration set is installed into each channel.
20 This arrangement allows each pump to be programmed to deliver the particular medication that flows through the infusion line or set installed in the channel such that each line may deliver medication at different rates or in different volumes. One problem that exists when infusing a patient with multiple infusion medications being delivered through different infusion lines is that it is necessary to ensure that each channel of the infusion pump is
25 properly programmed to deliver each medication. A distinct advantage exists in using a single controller to program multiple infusion pumps, or channels, to deliver various medications to the patient. The interface is the same for all channels and the controller is in the same location for all channels. Where four or more channels are present and all must be operated simultaneously, a substantial amount of programming can be involved.
30 A need exists for making such programming an easier task yet preserving safety in medication delivery.

Medication errors, that is, errors that occur in the ordering, dispensing, and administration of medications, regardless of whether those errors caused injury or not, are a significant consideration in the delivery of healthcare in the institutional setting. Additionally, adverse drug events ("ADE"), which are a subset of medication errors, defined as injuries involving a drug that require medical intervention, and representing some of the most serious medication errors, are responsible for a number of patient injuries and death. Healthcare facilities continually search for ways to reduce the occurrence of medication errors. Various systems and methods are being developed at present to reduce the frequency of occurrence and severity of preventable adverse drug events ("PADE") and other medication errors.

Most hospitals today have a pharmacy equipped with a computerized system for entering, preparing, and tracking prescriptions, managing drug inventory, checking for drug incompatibilities, and printing prescription orders and labels. Various solutions for increasing medication delivery safety have been proposed, such as systems that use bar codes to identify patients and medications, or systems allowing the bedside entry of patient data. While these systems have advanced the art significantly, even more comprehensive systems could prove to be of greater value.

Typically, medications are delivered to a nurse station in a drug cart or other carrier that allows a certain degree of security to prevent theft or other loss of medications. In one example, the drug cart or carrier is divided into a series of drawers or containers, each container holding the prescribed medication for a single patient. To access the medication, the nurse must enter the appropriate identification to unlock a drawer, door, or container. In other situations, inventories of commonly-used drugs may be placed in a secure cabinet located in an area at or close by a nurse station. This inventory may contain not only topical medications but oral, IM-, and IV-delivered medications as well. Nurse identification and a medication order number are typically required to gain access to the cabinet. The nurse station receives a listing of drugs to be delivered to patients at intervals throughout the day. A nurse or other clinician reads the list of medications to be delivered, and gathers those medications from the inventory at the nurse station. Once all of the medications have been gathered for the patients in the unit for which the nurse station is responsible, one or more nurses then take the medications to the individual patients and administer the dosages.

Such a system though may not be capable of thoroughly verifying that the appropriate regimen is being delivered to a patient in the case where IV drugs are being delivered. For example, a nurse may carry an IV bag to a particular patient area, hang the bag, program an infusion pump with appropriate treatment parameters, and begin infusion of the medication. The applicable hospital control system, such as the pharmacy information system, may not know that the patient has received the medication, and if the information is lost somewhere, the possibility exists of medicating the patient twice. Thus, there may be a break in the link of verification that the medication is being properly delivered to the patient if an event occurs resulting in a deviation from the desired treatment parameters.

Moreover, even where the right medication arrives at the right patient for administration, incorrect administration of the medication may occur where the medication is to be administered using an automated or semi-automated administration device, such as an infusion pump, if the automated device is programmed with incorrect medication administration parameters. For example, even where the medication order includes the correct infusion parameters, those parameters may be incorrectly entered into an infusion pump, causing the infusion pump to administer the medication in a manner that may not result in the prescribed treatment. The nurse may also start an infusion at the wrong time or forget to administer an infusion, resulting in incorrect treatment that may interfere with other scheduled medications prescribed by the physician.

One attempt at providing a system with built-in safeguards to prevent the incorrect entry of treatment parameters utilizes a customizable drug library which is capable of monitoring the parameter entry process and interacting with the clinician should an incorrect entry or an out-of-range entry be attempted. In such a case, an alert is communicated to the clinician that the parameter entered is either incorrect or out of an appropriate range for that medication as established by the institution where care is being provided. Such a system contributes to a large increase in patient safety. However, further increases in safety and data communication and availability are desired so that busy clinicians have needed data readily at hand.

Hence, those skilled in the art have recognized that a need exists to more accurately ensure that correct medications are provided to a patient. A further need exists to more accurately ensure that correct infusions are provided to a patient at the correct pumping

parameters. Further, those skilled in the art have recognized a need for providing more patient medication data to clinicians at the point of care of the patient. A still further need has been recognized for providing data concerning the administration of a medication. The present invention fulfills these needs and others.

5 SUMMARY OF THE INVENTION

Briefly and in general terms, the present invention is directed to displaying pending medication orders for a patient at a controller of an infusion pump once a patient has been identified by that controller. In another aspect, the invention is directed to presenting pending medication orders for a patient at an infusion controller at the point of care of the patient, and in another detailed aspect, the invention is directed to presenting all medication orders, infusion and otherwise, including oral medications, at an infusion controller at the point of care of the patient.

In further aspects, there is provided a system for managing pending medication orders pertaining to a patient located in a healthcare facility, the system comprising an infusion pump located at the patient, a controller located at the infusion pump and being in operational control over the infusion pump, the controller comprising a controller processor, a display located at the controller and being under the operational control of the controller, and an identification device configured to acquire patient identification data from the patient and provide that patient identification data to the controller wherein the controller processor is configured to: receive the patient identification data from the identification device, provide a patient-identification-received signal based on the patient identification data, receive pending medication orders pertaining to the identified patient, and display the received pending medication orders for the identified patient on the display.

In more detailed aspects, the identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller and the controller processor is configured to provide a patient-identification-received signal only after it has received the clinician identification data. The identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller, the controller includes a selection device configured to enable selection of a pending medication order

displayed on the display, and the controller processor is further configured to receive the clinician identification data and to enable the use of the selection device only after it has received the clinician identification data. The identification device is also configured to acquire clinician identification data from a clinician and provide that clinician

5 identification data to the controller and the controller processor is configured to receive the clinician identification data and to display pending medication orders for the identified patient only if the identified clinician is authorized to assist the identified patient. The identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller, and wherein the
10 controller processor is configured to receive the clinician identification data and to allow a clinician to select a pending order from the displayed pending medication orders only if the identified clinician is authorized to perform the selected pending order.

In further more detailed aspects, the controller processor is configured to provide a pending-order-executed signal to a second processor of the healthcare facility upon a
15 selection of a displayed pending order. The controller processor is configured to provide the pending-order-executed signal to the second processor of the healthcare facility upon manual selection of a displayed pending order. The identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller and the controller processor is configured to
20 automatically select a displayed pending order upon receipt of the medication identification data that corresponds to data of a displayed pending order.

In other aspects, the controller processor is configured to monitor the infusion pump and provide a pending-order-executed signal to a second processor of the healthcare facility upon determining the existence of infusion by the infusion pump in accordance
25 with a displayed pending order. The controller processor is configured to receive a manual indication that a medication has been administered to the patient in accordance with a selected pending medication order and provide a pending-order-executed signal to a second processor of the healthcare facility upon receiving the manual indication of dispensing.

30 Other aspects pertain to managing controlled items. Upon a selection of a displayed pending order comprising a controlled item, the controller processor provides a controlled-item-administration signal to a second processor of the healthcare facility. The

second processor is configured to note the controlled-item-administration signal to a log and thereby resolve a controlled-item-removed transaction. A dispensing processor of a medication dispensing site is configured to provide a controlled-item-removed signal to a second processor of the healthcare facility when a controlled item has been dispensed

5 wherein the second processor monitors time that elapses since provision of the controlled-item-removed signal and if the second processor does not receive a controlled-item-administration signal within a predetermined period of time, the second processor generates an alert signal. The dispensing processor is configured also to send an identification of a pending order that is associated with the controlled item that was

10 removed and identification of a patient for the pending order to the second processor, the second processor determines whether a patient-identification-received signal for the patient of the identified pending order by the dispensing processor has been received and if the patient identification has been received from a controller, the second processor communicates the alert to the controller that provided the patient-identification-received

15 signal. The controller processor is configured to provide the controlled-item-administration signal to the second processor upon manual selection of a displayed pending order. The identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller; and the controller processor is configured to provide the controlled-item-

20 administration signal to the second processor automatically upon receipt of the medication identification data from the identification device that matches a displayed pending order.

In yet other detailed aspects, the identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller, the medication identification data including a drug

25 identifier and drug administration information; and the controller processor compares the drug identifier and drug administration information to the pending medication orders and if a match to a pending order is determined, the controller processor enables selection of the matched pending order. The controller processor automatically programs the infusion pump with pumping parameters for the matched pending order when the matched order is

30 selected. The identification device is also configured to acquire medication identification data from a medication and provide that identification data to the controller, the medication identification data including a drug identifier and drug administration information, and the controller processor is further configured to access a drug library,

compare the medication identification data to data of the drug library and provide an alert if the medication identification data is not in conformance with the drug library. Upon selection of a pending medication order, the controller processor communicates to a second processor of the healthcare facility to obtain any updated information about the
5 selected pending medication order.

There is provided a method of providing pending medication orders comprising associating a controller that is located at an infusion pump and in operational control over the infusion pump with a patient by reading identification data from the patient, receiving pending medication orders for the identified patient, displaying received pending
10 medication orders for the identified patient on a display screen located at the controller, and selecting a displayed pending medication order from the controller, the selected pending medication order being selected from among the displayed pending medication orders. In further detail, the method further comprises reading medication identification data from a medication, comparing the read medication data to the displayed pending
15 orders, and selecting a pending order that matches the read medication data. The method further comprises programming the infusion pump upon matching the read medication data with a particular pending order from among the displayed pending medication orders.

In other aspects, there is provided a system for managing pending medication orders pertaining to a patient located in a healthcare facility, the system comprising an
20 infusion pump located at the patient, a controller located at the infusion pump and being in operational control over the infusion pump, the controller comprising a controller processor, a display located at the controller and being under the operational control of the controller, and an identification device configured to acquire patient identification data from the patient and provide that patient identification data to the controller and acquire
25 medication identification data from a medication and provide that medication identification data to the controller, wherein the controller processor is configured to: receive the patient identification data from the identification device, provide a patient-identification-received signal based on the patient identification data, receive pending medication orders pertaining to the identified patient, display the received pending
30 medication orders for the identified patient on the display, automatically select a displayed pending order upon receipt of the medication identification data that corresponds to data of

a displayed pending order, and automatically program the infusion pump with pumping parameters for the matched pending order when the matched order is selected.

These and other features and advantages of the present invention will become apparent from the following detailed description of the preferred embodiments which,
5 taken in conjunction with the accompanying drawings, illustrate by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a partial block diagram of a system in accordance with aspects of the invention in which an infusion device and associated controller are connected to a
10 healthcare facility server that communicates pending medication orders pertaining to a patient upon identification of the patient by the infusion pump or controller, and also shows the interaction of an automated dispensing machine with the server;

FIG. 2 is a diagram showing a means of identifying a patient, clinician, and medication through the use of an auto identification module connected to a controller
15 associated with the infusion pump of FIG. 1;

FIG. 3 is an exemplary display of pending medication orders pertaining to an identified patient presented on the display of an infusion pump or associated controller, both of which are located at the point of care of the patient;

FIG. 4 is a diagram showing a means of identifying a medication through the use of
20 an embedded scanner mounted in an auto identification module connected to a controller associated with the infusion pump of FIG. 1;

FIG. 5 is a block diagram showing the interaction of the controller with the display, a drug library, a patient identification device, a medication identification device, a clinician identification device, and a server, in which the server interacts with a medication order
25 entry device or devices, the patient's medical administration record ("MAR"), in this case an eMAR (electronic MAR), and an automated dispensing machine ("ADM"), and also showing the processors of the various devices;

FIG. 6 is a workflow diagram of a method implementing the patient identification and management of pending orders system and method described above, showing

administration of infusion and non-infusion medication and reporting of administration status to the server; and

FIG. 7 is a workflow diagram of a method implementing the patient identification and pending medication orders management system described above, showing closed-loop tracking of medications and medication orders.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in more detail to the drawings for purposes of illustration of embodiments of the invention, wherein like reference numerals designate corresponding or like elements among the several views, there is shown in FIG. 1 a partial block diagram of a system in accordance with certain aspects of the invention. An infusion pump system 20 is shown connected with a patient 22 to infuse medication fluid from an IV fluid container 24, such as a bag, to the patient through a fluid administration set 26. The pump system includes an infusion pump 28 located at the left side of a controller 30 and an auto identification module 32 or "auto ID module" located to the right side of the controller.

The identification module in this case includes a tethered 33 bar code reader 34.

The controller 30 is connected with a server 35, which may take the form of any server or servers in a health care facility. The box 35 identified as "server" may be a single server or it may comprise multiple servers or computers and memory for data storage. The data comprises patient identification data as well as pending medication orders for patients admitted to the health care facility. It may also store clinician identification data and other data. The "server" identified by numeral 35 may also include, for purposes of convenience of discussion and illustration, a server of the company that provides the infusion pump system 20 and establishes communication protocols between that infusion pump system and health care facility servers. The server 35 electronically receives medication orders from physicians from one or more sources 36, such as the pharmacy information system (PIS), laptop computers, physician order entry devices, personal digital assistants ("PDA"), and other devices. Medication orders may also be entered into the server by the pharmacy. The controller 30 may be in communication with the server 35 by any wired or wireless means and the server may be in communication with other devices by wired or wireless means.

As is well known, the pharmacy of the health care facility, or other pharmacy or other department, may print physical labels for the medications to be administered to patients. These labels may include various data such as patient name, medication name, concentration, and may include actual pumping parameters, such as a rate and a volume to be infused ("VTBI") as well as time for administration and other information. The label may also include a bar code label, either two dimensional or linear, or an RFID tag, or other machine readable data source. The labeled medications are transported to the location of the patient or near the patient for administration.

An automated dispensing machine ("ADM") 37 is also shown and typically includes medications for the patients in the vicinity. The ADM has a processor, termed a dispensing processor 50 (shown in FIG. 5), and may require clinician identification before permitting any medications to be withdrawn. The dispensing processor may permit only certain clinicians to remove certain items from the ADM. The ADM may also contain "controlled items" which, for the purposes herein, may be any item desired to be tracked by the healthcare facility in which the ADM is located. This may include narcotics but also may include items of much less sensitivity. When a controlled item is removed from the ADM, the dispensing processor of the ADM may send a controlled-item-removed signal to the server 35 that opens a controlled item transaction. The ADM may also provide the pending order to the server which will include a patient identification. The server may also begin monitoring the amount of time elapsed since the controlled-item-removed signal and if the elapsed time exceeds a predetermined time, send an alert signal. This alert signal may be provided to various locations as determined by the healthcare facility. Such locations may include the pharmacy and administrative offices if a narcotic is involved. Additionally in the case where a patient 22 has been identified to a controller 30, and the patient-identification-received signal provided to the server, the server may compare the patient identification from the controller with the patient associated with the controlled-item-removed signal and correlate the controller to the controlled item transaction. The server may then notify the controller of the alert.

Upon initial power up of the controller 30 in this embodiment, the controller prompts the clinician to associate the controller with a patient 22 through use of a patient identification number, or by other means. In the case of FIG. 2, a patient 22 has a wrist band 38 with a line bar code that indicates the patient identification number and/or name,

or other information specific to this patient. Using either an embedded bar code reader 40 or a tethered 33 bar code scanner 34 forming a part of an Auto ID module 32 as shown in FIG. 2, the clinician would scan the patient ID bracelet. The scanned patient ID would be sent from the Auto ID module 32 to the controller thereby informing the controller that it is now associated with a particular patient. The auto ID module may communicate by wired or wireless means with the controller. In one case, the controller includes a communications interface ("CI Board") containing a processor, programming, and a substantial memory. The CI Board is in contact with the auto ID module and upon receiving a patient identification, the CI Board then sends a message to the controller telling it that it is now associated with the scanned patient ID. In another embodiment, the functions of the CI Board are all performed by the controller processor 46 (shown in FIG. 5) and other components within the controller itself.

In another embodiment, the clinician would need to scan his/her identification 39 by the method described above to be able to receive even a display of pending medication orders for the patient. In order to do so, the clinician must have been authorized to assist this particular patient. If such authorization has been given, then the pending medication orders for the patient will be displayed on the display 42 at the controller. In another embodiment, the scanned clinician will not be able to select any pending order for the patient unless the clinician has been authorized to assist the identified patient for that particular medication order. For example, some clinicians may be authorized to administer oral medications but not administer infusions. If the clinician is authorized to administer infusions, then in one embodiment, the controller 30 would then make available the drug programming features to the clinician for programming the infusion pump 28.

As used herein, the term "medication" is meant to be understood in a broad sense as pertaining to medical care. "Medication" would include oral medications and infusions of medications, but is also meant to include physical therapy, taking vital signs, preparation for surgery, and other medical care. Also, "administer" is meant to be understood in a broad sense as providing medical care. "Administer" is meant to cover the dispensing of medications, such as oral medications, as well as performing infusions on a patient and other provisions of medical care. The illustrative controller 30 discussed herein and shown in the drawings as a separate unit may actually be a part of an infusion pump or other medical instrument, as may the display 42. The order of identifying individuals or

medications or performing steps is provided as embodiments. The identifications may be performed in different orders in certain healthcare facilities, the orders presented here are embodiments.

If authorized, the clinician may then scan a medication container 24 label 46 (FIG. 1) that contains patient ID, drug name, drug concentration, and drug dose. This information would then be passed to the controller where the controller 30 processor 46 would:

- 1) check to see if the scanned label contains the same patient ID that is associated with the controller to ensure "right" patient;
- 2) automatically select the drug library entry for the scanned medication to ensure "right" drug and concentration; and
- 3) automatically populate drug dose parameters in an associated infusion pump to administer the medication to the patient, ensuring "right" dose.

At this point error messages would be displayed to the clinician on the display 42 of the controller 30 if the patient ID in the controller and on the medication label do not match and if the medication scanned is not in the drug library profile that the controller is associated with. As used herein, medication "label" is meant to be understood in a broad sense. Medications may be in containers having labels, but medications may also be provided in individual form and may be scanned for identification.

If all the scanned parameters are valid, the programming parameters are automatically sent to the pump channel that the clinician selects; i.e., the pump channel is automatically programmed for infusion operation. The clinician must manually confirm that these parameters are correct before pumping may be started. In a networked environment, these parameters could be checked with an order entry system to verify that the right order is being administered to the right patient. In another embodiment, the clinician may manually program the pump with the pumping parameters contained in a pending medication order. In one embodiment, selecting a pending order on the display will result in the controller providing further detail of the pending order. Such further detail may contain pumping parameters that may be manually programmed into the pump.

A medication order is entered in the pharmacy and is sent via an electronic interface to a server capable of communication with the controller 30, such as the Pyxis®

Profiles Application or an ALARIS server. Such capabilities are provided by Pyxis Products and ALARIS Products respectively of Cardinal Health, San Diego, California. At the same time a bar coded IV label is generated in the pharmacy. The bar code contains a patient identification (Patient ID) and a pending order identification (Order ID).

- 5 Optional information on the bar code is Drug ID and concentration. Once a clinician identifies a patient 22 with an infusion pump 28, the Order ID and drug ID and concentration are sent to the infusion pump or associated controller 30.

The clinician powers on the controller 30, identifies herself/himself as required, and uses the auto ID module 32 to associate the controller with a patient 22, as shown and
10 discussed above. The controller notifies the server 35 that it has a Patient ID and the server then uploads the pending orders to the controller. The list of pending orders may appear on the display 42 of the controller as shown in FIG. 3. The clinician may select any of the orders by pressing a soft key 44 located adjacent the order listing. The clinician scans the bar code 46 on the IV container 24 as shown in FIG. 4, and can then manually
15 program the infusion. In this embodiment, the scanning was done with an embedded bar code reader 40 located in the front panel of the Auto ID module 32, which is connected to the controller 30. Once the infusion has been manually programmed and started, the infusion data along with Patient ID, Clinician ID, and Order ID are sent by wired means or wireless means back to the server 35, which passes this data through the hospital
20 information system ("HIS") 47 to the patient's eMAR 48, as shown in FIG. 5.

In another embodiment, the clinician need not manually select a pending medication order from the display 42 but may simply scan the medication 24 identification 46 into the controller 30. The controller will then correlate the information from the scanned medication to the list of pending medication orders and upon finding one that
25 corresponds, will select that pending order automatically.

There is also a dynamic update feature. When the clinician scans the patient ID 38 into the controller 30, the controller processor communicates the Patient ID to the server 35 processor. The server processor then communicates all pending medication orders for that identified patient to the controller. These communicated orders may have exactly the
30 same information in them that is on the bar code label 46 on the medication container 24 for the patient, or the order may have been updated since the bar code label was printed. This allows the physician to update the order to reflect changing patient needs even though

the barcode label has already been printed and placed on the medication. The barcode on the bag therefore serves primarily to identify the medication to be given, while the server-supplied information has priority over the barcode label as to how the medication is administered to the patient. Physician-initiated changes may also include canceling the order so that the medication is not ever given to the patient.

The management of pending medication orders invention permits the same data that was printed on the bar code label 46 of the medication container 24 to be transmitted to the controller 30 once it has been associated with a patient 22. When a pending medication order set with pending Order IDs, Patient ID, and Drug IDs have been sent to the controller using the management of pending medication orders invention, then when an IV container with that drug or order ID is scanned, the controller can correlate that to the pending order. This is a workflow benefit for nursing and makes updating the eMAR easier.

In a further feature, scanning the data label 46 on the medication container 24 to obtain the medication name may automatically program the infusion pump 28. If the scanned medication matches with a pending order already at the controller, the controller will automatically program the infusion pump for operation in accordance with the physician's order. The clinician need then only check that the programming is in place and is acceptable, check for any drug library limit-exceeded alerts and if none the clinician may press START on the infusion pump to begin the patient's infusion of the medication.

Regardless of how the infusion pump 28 is programmed, the controller 30 may also compare the programmed information to an internal or external drug library 44 having institution-determined safe delivery limits for authorized medications. If the programming is outside a limit, an alert or warning is provided to the clinician. Other action may also be taken. For further details on such drug libraries, see U.S. Patent Nos. 5,681,285 and 6,269,340 to Ford, incorporated herein by reference.

Referring to FIG. 6, a workflow diagram is presented and describes an embodiment of a method in accordance with aspects of the management of pending medication orders invention. A patient is identified 60 and the pending orders for that patient are communicated to the infusion pump or controller of that pump 62. The pending orders are displayed at the pump or controller for review by the clinician 64. The clinician may then

scan a medication label of a container and if the controller is able to automatically select a pending order based on that medication scan 66, a determination is made as to whether the medication is an infusion, oral, or other 68. If the controller is unable to automatically select a pending order based on a medication container scan, a pending order may be manually selected 70. If the medication is a non-infusion medication, it is administered 72 and a report is sent to the healthcare server 74.

If the medication is administered through an infusion, the controller may automatically program the pump for the infusion parameters 76. If this is not possible, the infusion pump must be manually programmed 78. Infusion now begins 80 by pressing the START button on the pump. A report is sent to the server 74.

In yet a further feature, labeled medications are transported to and stored in computer controlled storage cabinets, referred to herein as automated dispensing machines (ADMs) 37, in the vicinity of the patients for which they are to be administered (see FIG. 1). When the prescribed time comes for a medication to be administered, a clinician logs onto the ADM processor 50 (FIG. 5) and, if the clinician is recognized by the ADM as having the appropriate authority, the clinician is allowed to input the necessary information, such as a patient and medication identifier, in order to remove a selected medication for administration to a selected patient. At such time, the selected medication is designated by the server 35 as being checked out to the clinician. As shown in FIGS. 1 and 5, the ADM is in electronic communication with the server so that activity or transactions at the ADM, such as storage and removal of medication, can be reported to the server. For instance, when a medication is removed, the server obtains information as to the Drug ID of the removed medication, the identity of the clinician who removed it (Clinician ID), the time it was removed, and the Patient ID of the selected patient for whom it is prescribed.

Another feature in accordance with aspects of the invention is that the list of pending medication orders that are shown on the display 42 of the controller 30 also include oral and other types of non-infusion medications in addition to infusion medications. In this way, after a clinician has removed a non-infusion medication, such as an analgesic tablet, from the ADM 37 for administration to the patient associated 22 with the controller 30, the clinician may select a pending medication order to report that the non-infusion medication has been administered. This selection of the pending medication

order can be made manually from a selection device, such as softkey 44 on the controller display 42 immediately after administering the non-infusion medication to the patient. In so doing, a communication device of the controller, such as the controller communications interface (CI) board, transmits a signal representative of administration of the non-infusion medication to the server 35. At such time, the transaction of removing the non-infusion medication from the ADM is resolved by the server. If after a preselected period of time the server receives no such signal representative of administration, the server sends an alert or warning to a preselected individual or individuals, such as another clinician, a supervisor, or administrator, to resolve the transaction or investigate the delay in administration.

In other cases, an infusion or non-infusion medication 24 removed from the ADM 37 may have a bar code 46, radio frequency identification (RFID) tag, or other means of identification on it or associated with it. In these cases, the transaction associated with removal of the medication from the ADM is resolved upon an indication that the removed medication was administered to the right patient 22. The infusion pump system 20 can provide this indication of administration of the medication to the right patient to the server 35 in many ways, such as for example when the clinician (1) scans the bar code or RFID tag of the medication with a data reader 34, such as the Auto-ID module 32, (2) manually selects 44 a corresponding medication order on the list of displayed 42 pending medication orders on the controller 30, and (3) manually inputs the Drug ID of the medication into the user interface of the controller.

In a still further feature as discussed briefly above, the server 35 stores data regarding the movement and use of controlled items. This allows an institution to track the movement and use of controlled items, which may, for example, be performed to satisfy regulatory requirements or to facilitate internal workflow or auditing studies. Controlled items typically include certain narcotics and other so-called "controlled substances," but may also include any item an institution wishes to track. It is to be understood that a controlled item need not be a medication and may be a device, such as an empty syringe, for example. With this feature, the server 35 keeps a medication transaction log that may include the time, Clinician ID, Patient ID, Drug ID, and other information associated with the movement and use of a controlled item. With such information, institutions may, for example, ascertain whether removal of certain controlled items tend to have a greater than

average resolution time or tend to get lost, or whether certain clinicians have a tendency to lose or delay administration of particular controlled items.

Another feature is that the controller 30 keeps a Continuous Quality Improvement (CQI) log of activity on the infusion pump system 20. The log includes, but is not limited to, data involving errors and corrections made in programming the infusion pumps 28. As mentioned above, the controller processor 46 always compares the programmed information, whether obtained from scanning a label on a medication or obtained from manual input by a clinician, to an internal or external drug library 44 having institution-determined safe delivery limits for the medication. If the programming is outside a limit, an alert or warning is generated. Such alerts and warnings, the key-strokes or other actions taken by the clinician leading up to the alert or warning, and the key-strokes or other actions taken by the clinician in response to the alert or warning are stored in the CQI log of the controller. Such data may be used by the institution to support workflow study, auditing, training, and other efforts to improve the delivery of healthcare services.

Referring now to FIG. 7, a workflow diagram is presented and describes an embodiment of a method in accordance with aspects of the management of pending medications orders invention. A new medication order is generated 100 by a physician to have a selected medication administered to a selected patient. The medication order need not involve a drug medication, such as for example an order to provide a certain type of food or to take and report the vital signs of a patient. When the medication order involves a drug medication, the new medication order is communicated to a pharmacy, which enters 102 the new medication order into the server. At such time, the server updates 104 a list of pending medication orders for the selected patient to include the new medication order having an assigned Order ID. The pharmacy also instructs a technician to transport the selected medication, now associated with the Order ID, from the pharmacy and to store 106 it in an ADM 37 (FIG. 1) located in the general vicinity of the selected patient.

A clinician accesses a controller 30 of an infusion pump system 20 by scanning the clinician identification 39 from his or her identification device, such as a card or badge 37 (FIG. 2), and associates 108 the controller with the selected patient 22 by scanning the patient's identification device 38, such as the patient's bracelet (FIG. 2) for example. Thereafter, the controller provides a patient-identification received signal to the server 35, which responds by sending pending medication orders for the identified patient. At such

time, the controller display screen 42 (FIG. 3) of the infusion pump system displays 110 the list of pending medication orders for the selected patient. The displayed pending medication orders may be updated dynamically whenever another medication order is generated or an existing medication order is cancelled or modified for the selected patient
5 in accordance with certain aspects.

Upon seeing the new medication order among the pending medication orders on the controller display, the clinician obtains the selected medication from a medication dispensing site, such as a pharmacy or an automated dispensing machine ("ADM"). In cases where the selected medication is stored in an ADM, the clinician logs into the ADM
10 and removes 112 the selected medication from the ADM. At such time, the ADM communicates with the server 35, which updates 114 a medication tracking log to reflect that the selected medication was removed from the ADM, and may include other information as desired. As previously mentioned, the medication transaction log is useful in tracking movement and use of controlled items, such as narcotic medications that may
15 be regulated by government agencies.

Upon a positive indication 116 from the infusion pump system of the administration of the medication, the server updates 104 the medication transaction log to reflect that the selected medication was administered to the selected patient. When infusion of the selected medication is started 118, the status of administration is
20 dynamically reported by the infusion pump system controller to the server, ultimately resolving the removal transaction of the selected medication from the ADM. In cases when the selected medication is a non-infusion medication, resolution of its removal from the ADM occurs automatically when its bar code, RFID, or other machine readable tag is scanned 120 with the infusion pump system Auto-ID module 32 or when a medication
25 order is manually selected 122 at the infusion pump system 20 controller 30.

When no positive indication from the infusion pump system 20 is received by the server 35 after a predetermined period of time after the selected medication was removed from the ADM 37, the server may generate 124 an alert or warning in order to prompt the clinician or some other person to investigate the delay in administration. This may be
30 done in all cases where the medication or medical device is considered of significant importance to be tracked as a controlled item. The server updates 114 the medication transaction log to reflect resolution of the alert or warning, which may occur by returning

the medication to the ADM, reporting that the medication was wasted, or by other means. In this way, the management of pending medication orders of the present invention allows for efficient closed-loop tracking of medications to ensure that they are administered to the right patient at the right time and the right manner.

5 As previously mentioned, when a label 46 or tag on a medication or medication container 24 is scanned by the Auto-ID module 32, the controller 30 processor 46 can automatically correlate the medication to a particular pending medication order from among the pending medication orders obtained from the server 35. After this selection of a medication order is communicated to the server, the server records 126 that the selected
10 medication order has been performed and updates 104 the list of pending medication orders to prevent it from being inadvertently performed again. Thus, it will be appreciated that the management of pending medications order system and method of the present invention allows for efficient closed-loop tracking of medication orders, whether or not they involve medications, to ensure that they are performed properly.

15 While particular forms of the invention have been illustrated and described, it will also be apparent to those skilled in the art that various modifications can be made without departing from the scope of the invention. Accordingly, it is not intended that the invention be limited except by the appended claims.

WHAT IS CLAIMED IS:

1. A system for managing pending medication orders pertaining to a patient located in a healthcare facility, the system comprising:

an infusion pump located at the patient;

5 a controller located at the infusion pump and being in operational control over the infusion pump, the controller comprising a controller processor;

a display located at the controller and being under the operational control of the controller; and

10 an identification device configured to acquire patient identification data from the patient and provide that patient identification data to the controller;

wherein the controller processor is configured to:

receive the patient identification data from the identification device;

provide a patient-identification-received signal based on the patient identification data;

15 receive pending medication orders pertaining to the identified patient; and

display the received pending medication orders for the identified patient on the display.

2. The system of claim 1 wherein:

20 the identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller; and

the controller processor is configured to provide a patient-identification-received signal only after it has received the clinician identification data.

3. The system of claim 1 wherein:

25 the identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller;

the controller includes a selection device configured to enable selection of a pending medication order displayed on the display; and

30 the controller processor is further configured to receive the clinician identification data and to enable the use of the selection device only after it has received the clinician identification data.

4. The system of claim 1 wherein:

the identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller; and

the controller processor is configured to receive the clinician identification data and to display pending medication orders for the identified patient only if the identified

5 clinician is authorized to assist the identified patient.

5. The system of claim 1 wherein:

the identification device is also configured to acquire clinician identification data from a clinician and provide that clinician identification data to the controller; and

10 wherein the controller processor is configured to receive the clinician identification data and to allow a clinician to select a pending order from the displayed pending medication orders only if the identified clinician is authorized to perform the selected pending order.

6. The system of claim 1 wherein the controller processor is configured to provide a pending-order-executed signal to a second processor of the healthcare facility

15 upon a selection of a displayed pending order.

7. The system of claim 6 wherein the controller processor is configured to provide the pending-order-executed signal to the second processor of the healthcare facility upon manual selection of a displayed pending order.

8. The system of claim 6 wherein:

20 the identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller; and

the controller processor is configured to automatically select a displayed pending order upon receipt of the medication identification data that corresponds to data of a displayed pending order.

25 9. The system of claim 1 wherein the controller processor is configured to: monitor the infusion pump; and

provide a pending-order-executed signal to a second processor of the healthcare facility upon determining the existence of infusion by the infusion pump in accordance with a displayed pending order.

30 10. The system of claim 1 wherein the controller processor is configured to:

receive a manual indication that a medication has been administered to the patient in accordance with a selected pending medication order; and

provide a pending-order-executed signal to a second processor of the healthcare facility upon receiving the manual indication of dispensing.

5 11. The system of claim 1 wherein upon a selection of a displayed pending order comprising a controlled item, the controller processor provides a controlled-item-administration signal to a second processor of the healthcare facility.

10 12. The system of claim 11 wherein the second processor is configured to note the controlled-item-administration signal to a log and thereby resolve a controlled-item-removed transaction.

15 13. The system of claim 1 further comprising a dispensing processor of a medication dispensing site, the dispensing site processor configured to provide a controlled-item-removed signal to a second processor of the healthcare facility when a controlled item has been dispensed;
wherein the second processor monitors time that elapses since provision of the controlled-item-removed signal and if the second processor does not receive a controlled-item-administration signal within a predetermined period of time, the second processor generates an alert signal.

20 14. The system of claim 13 wherein:
the dispensing processor is configured also to send an identification of a pending order that is associated with the controlled item that was removed and identification of a patient for the pending order to the second processor;
the second processor determines whether a patient-identification-received signal for the patient of the identified pending order by the dispensing processor has been
25 received; and
if the patient identification has been received from a controller, the second processor communicates the alert to the controller that provided the patient-identification-received signal.

30 15. The system of claim 11 wherein the controller processor is configured to provide the controlled-item-administration signal to the second processor upon manual selection of a displayed pending order.

16. The system of claim 11 wherein:

the identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller; and

the controller processor is configured to provide the controlled-item-administration signal to the second processor automatically upon receipt of the medication identification data from the identification device that matches a displayed pending order.

17. The system of claim 1 wherein:

the identification device is also configured to acquire medication identification data from a medication and provide that medication identification data to the controller, the medication identification data including a drug identifier and drug administration information; and

the controller processor compares the drug identifier and drug administration information to the pending medication orders and if a match to a pending order is determined, the controller processor enables selection of the matched pending order.

18. The system of claim 17 wherein the controller processor automatically programs the infusion pump with pumping parameters for the matched pending order when the matched order is selected.

19. The system of claim 1 wherein:

the identification device is also configured to acquire medication identification data from a medication and provide that identification data to the controller, the medication identification data including a drug identifier and drug administration information; and

the controller processor is further configured to access a drug library, compare the medication identification data to data of the drug library and provide an alert if the medication identification data is not in conformance with the drug library.

20. The system of claim 1 wherein upon selection of a pending medication order, the controller processor communicates to a second processor of the healthcare facility to obtain any updated information about the selected pending medication order.

21. A method of providing pending medication orders comprising:

associating a controller that is located at an infusion pump and in operational control over the infusion pump with a patient by reading identification data from the patient;

receiving pending medication orders for the identified patient;
displaying received pending medication orders for the identified patient on a
display screen located at the controller; and
selecting a displayed pending medication order from the controller, the selected
5 pending medication order being selected from among the displayed pending medication
orders.

22. The method of claim 21 further comprising:
reading medication identification data from a medication;
comparing the read medication data to the displayed pending orders; and
10 selecting a pending order that matches the read medication data.

23. The method of claim 22 further comprising programming the infusion
pump upon matching the read medication data with a particular pending order from among
the displayed pending medication orders.

24. A system for managing pending medication orders pertaining to a patient
15 located in a healthcare facility, the system comprising:
an infusion pump located at the patient;
a controller located at the infusion pump and being in operational control over the
infusion pump, the controller comprising a controller processor;
a display located at the controller and being under the operational control of the
20 controller; and
an identification device configured to acquire patient identification data from the
patient and provide that patient identification data to the controller and acquire
medication identification data from a medication and provide that medication
identification data to the controller;

25 wherein the controller processor is configured to:
receive the patient identification data from the identification device;
provide a patient-identification-received signal based on the patient
identification data;
receive pending medication orders pertaining to the identified patient;
30 display the received pending medication orders for the identified patient on
the display.

automatically select a displayed pending order upon receipt of the medication identification data that corresponds to data of a displayed pending order; and

5 automatically program the infusion pump with pumping parameters for the matched pending order when the matched order is selected.

25. The system of claim 24 wherein upon selection of a displayed pending order comprising a controlled item, the controller processor provides a controlled-item-administration signal to a second processor of the healthcare facility.

10 26. The system of claim 25 further comprising a dispensing processor of a medication dispensing site, the dispensing site processor configured to provide a controlled-item-removed signal to a second processor of the healthcare facility when a controlled item has been dispensed;

15 wherein the second processor monitors time that elapses since provision of the controlled-item-removed signal and if the second processor does not receive a controlled-item-administration signal within a predetermined period of time, the second processor generates an alert signal.

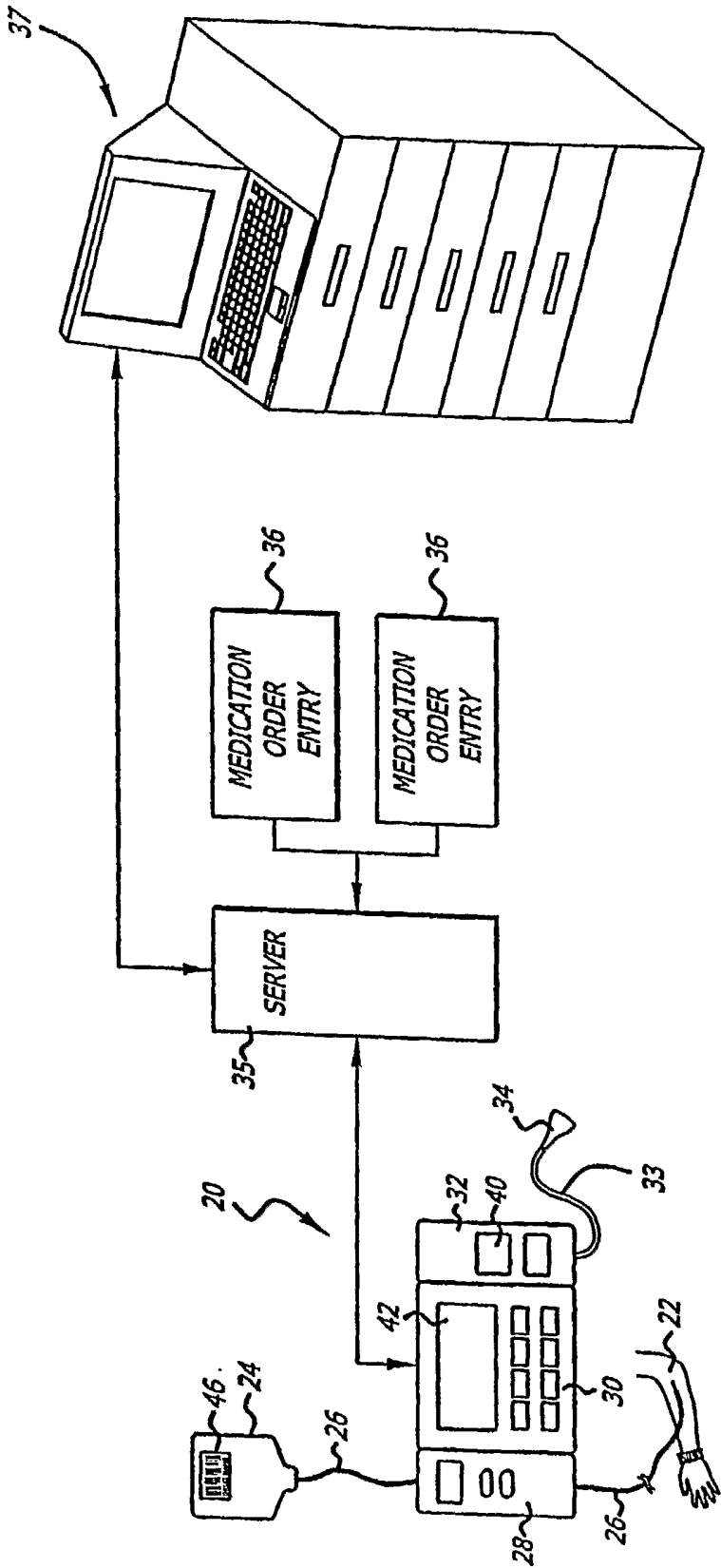
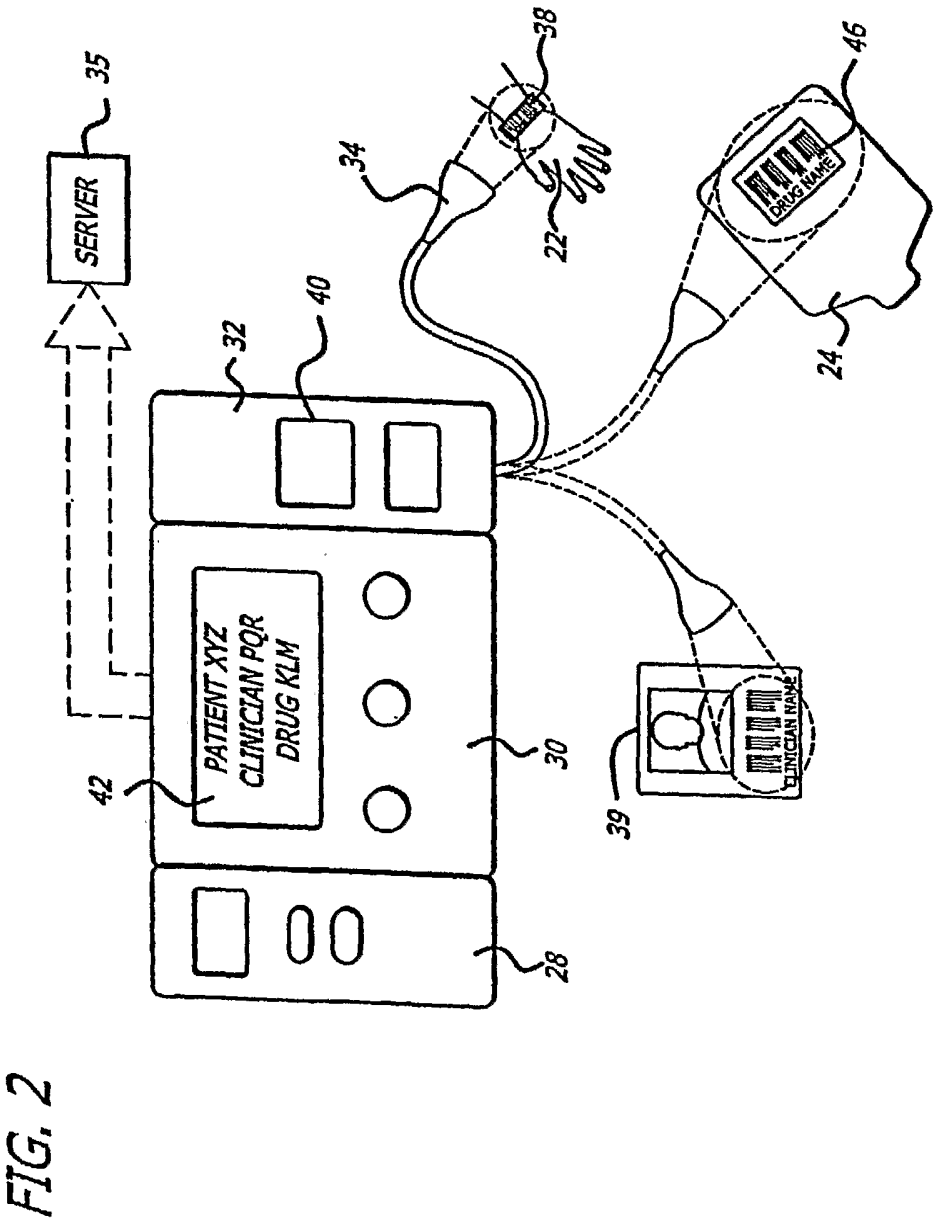


FIG. 1



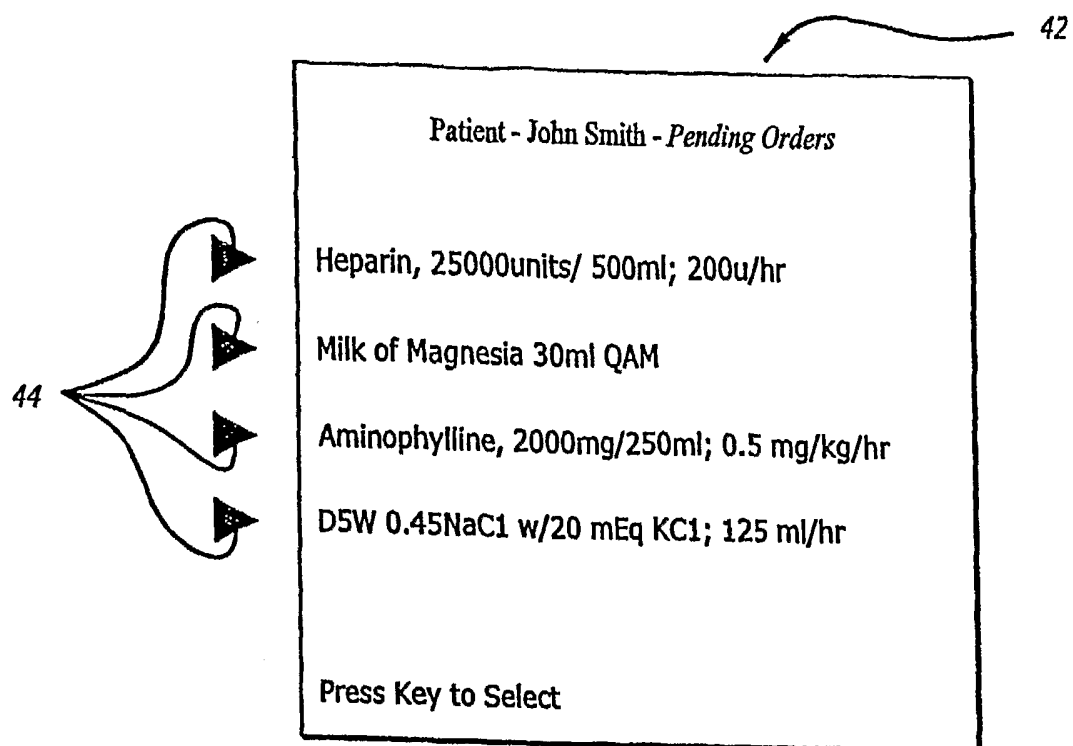


FIG. 3

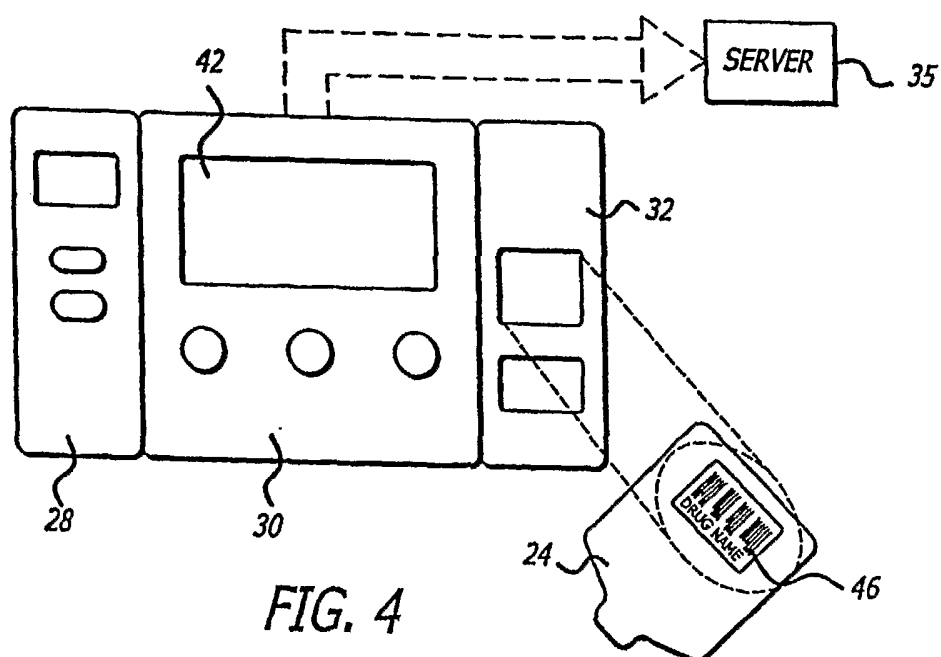


FIG. 4

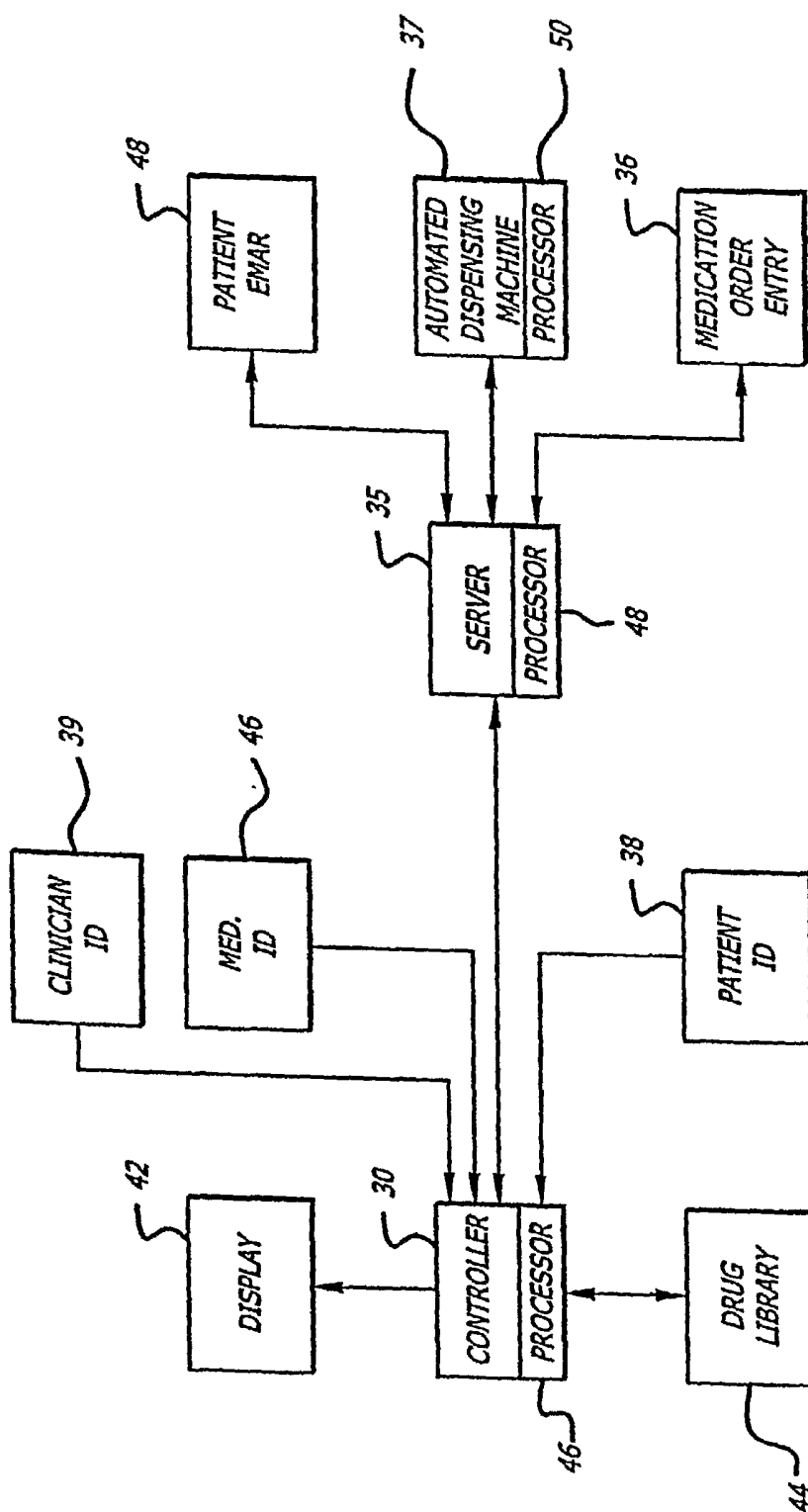
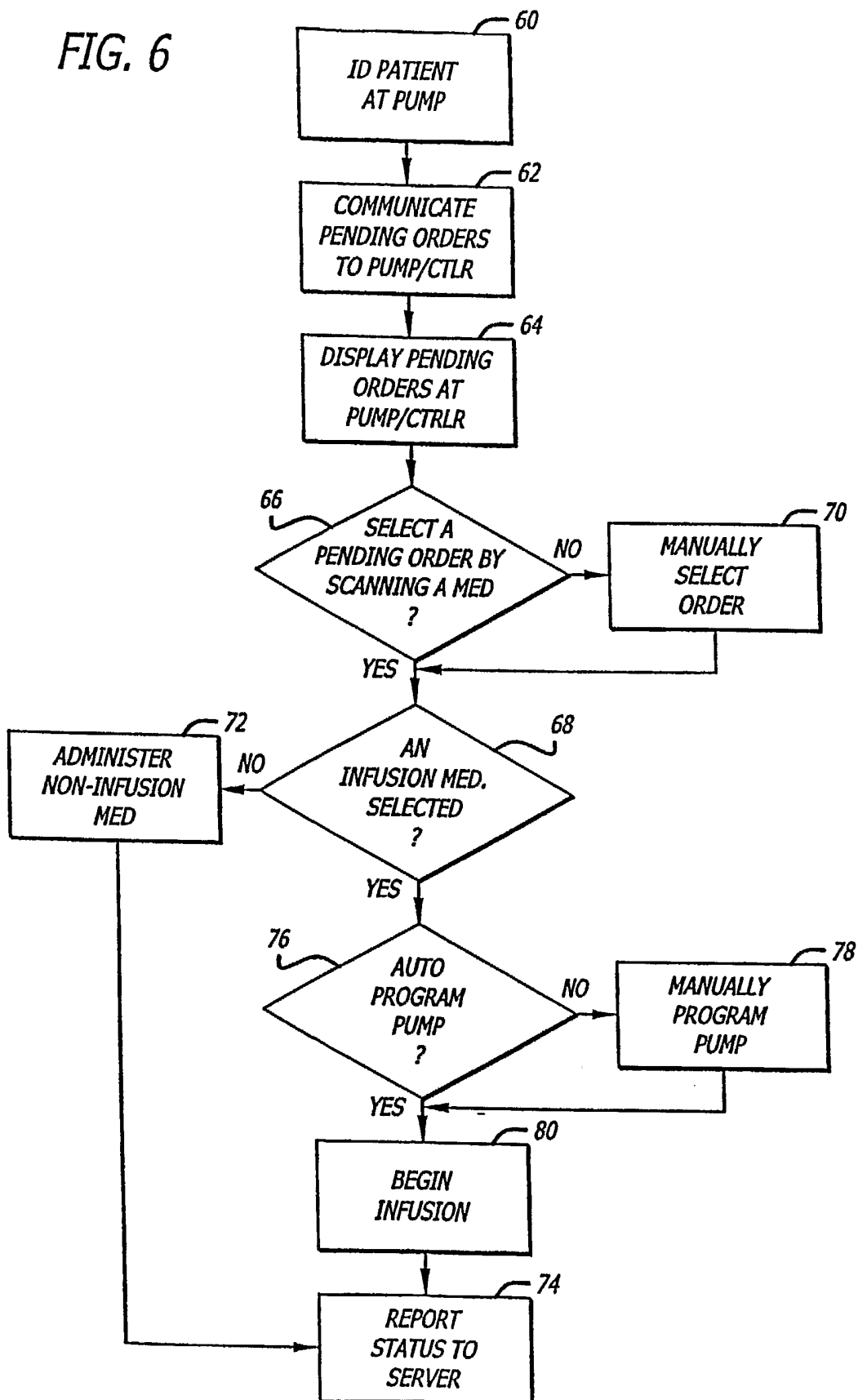
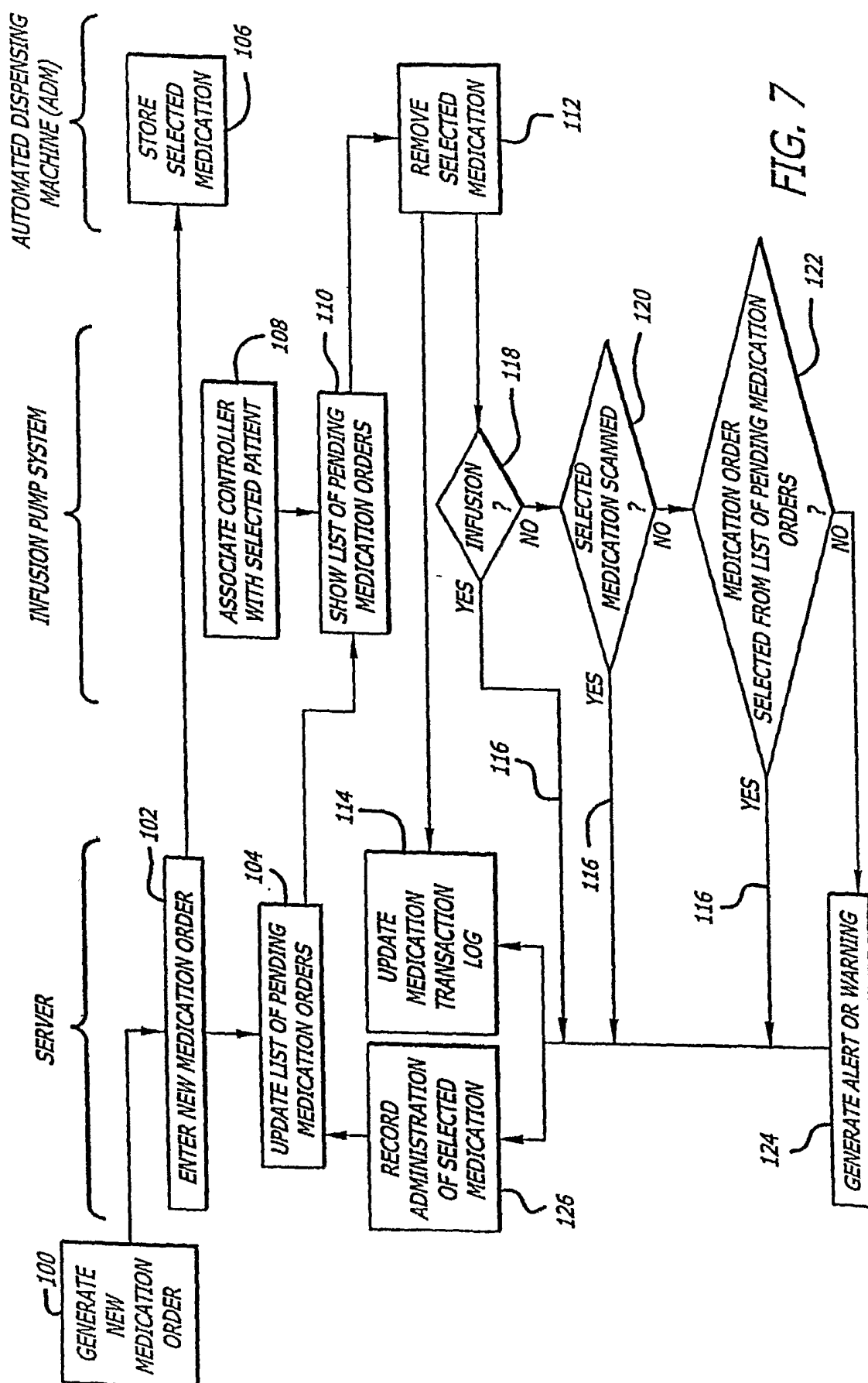


FIG. 5

FIG. 6





INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/004864

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/168 A61M5/142

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/038392 A1 (DE LA HUERGA CARLOS) 28 March 2002 (2002-03-28) the whole document -----	1-26
X	WO 03/092769 A (BAXTER INTERNATIONAL INC) 13 November 2003 (2003-11-13) the whole document -----	1-26
X	US 6 671 563 B1 (ENGELSON JOSEPH J ET AL) 30 December 2003 (2003-12-30) the whole document -----	1-26
X	US 2003/135388 A1 (MARTUCCI JAMES ET AL) 17 July 2003 (2003-07-17) the whole document -----	1-26
X	US 2003/139701 A1 (WHITE GALE ET AL) 24 July 2003 (2003-07-24) the whole document -----	1-26

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search

14 June 2006

Date of mailing of the international search report

22/06/2006

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/004864

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