INFUSION LINE MANAGEMENT SYSTEM

FIELD OF THE INVENTION

This invention relates to a system for identifying and managing patient infusion system configurations, including medication containers, tubing sets, access ports, pump channels, and catheters.

BACKGROUND

Errors in administration of medication through a patient infusion system can result from many causes, including misconnections. Accordingly, to reduce the potential for such errors, professional guidelines and/or standard operating procedures obligate clinicians, such as nurses, to perform "line management," also known as line tracing, numerous times throughout their working shifts. Line management involves verifying that each medication, typically contained in a bag, bottle, or syringe, is routed through tubing to the correct catheter and the tubing is associated with the correct pump channel (if an infusion pump is used). The activity further includes verifying that it is safe to join two or more tubing segments containing different medications and/or flowing at different rates. By way of example, a nurse may perform line management for each patient when starting a shift, when receiving a patient from another facility, another area of the hospital, or another clinician, and just prior to administration of an intravenous medication. Repeated performance of the detailed line management procedure imposes a time burden on the clinicians, and is prone to errors, particularly as the complexity of a patient's overall infusion tubing system increases. That is, multiple tubing sets, medications, junctions, access ports, pump channels, and catheters both increase the amount of time required to perform line management and introduce additional opportunities for error.

While the medication container typically arrives from the pharmacy with a simple label already applied to it, clinicians often manually label infusion setups at various locations throughout the tubing system to facilitate line management. Generally,

the labeling is crude, using materials on hand such as medical tape wrapped around the tubing and labeled with identifying information such as the medication name. This labeling is repeated at several points throughout the system. For example, labels may be placed at one or more of the spike end and the catheter connection end of the tubing set, at each access port and junction, on the roller clamp and slide clamp, on the catheter, and on the pump channel itself. If the medication being delivered is changed but the tubing system is reused, the labels must be removed and replaced with new labels bearing the new medication's name.

Accordingly, there is a need to streamline the line management process, both to save clinician time and to reduce the possibility of errors. Additionally, there is a need for a more complete and professional label system that is cost effective.

SUMMARY

An infusion line management system addresses these needs. The system allows for a streamlined clinician workflow that helps the clinician map patient infusions. Further, the labels produced using the system are relatively low cost, professional, uniform, and relatively easy to read.

In a first aspect, an infusion line management system includes a label generating device that receives prescription information for one or more patient prescriptions. The received prescription information is used to generate, for each of the one or more prescriptions, a label including a master label and one or more related sub-labels related to the corresponding prescription. Each generated master label includes at least information related to the prescription and an indicator identifying a particular portion of a patient infusion system to which the prescription should be connected. Similarly, each of the one or more related sub-labels includes the indicator. The sub-labels are individually removable from the master label and affixable to locations throughout the patient infusion system.

In another aspect, a non-transitory computer readable medium is configured for storing instructions that, when executed by a processor, cause a computer to perform a line management method. The method includes receiving prescription information from a hospital information system, selecting an indicator, and associating the selected indicator with the received prescription information. The method further includes creating a label creation request for printing a master label and one or more sub-labels. The master label has at least the received prescription information and the

associated indicator, and the one or more sub-labels each include at least the associated indicator.

In yet another aspect, an infusion line management system includes a hospital computer system storing prescription information related to one or more prescriptions associated with a patient. A label generating device receives the prescription information from the hospital computer system, and generates, for each of the one or more prescriptions, a label including a master label and one or more sub-labels related to the corresponding prescription. Each master label includes at least the prescription information and a unique indicator, and each of the sub-labels includes the unique indicator. The one or more sub-labels are individually removable from the master label and affixable to locations throughout the patient infusion system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic diagram showing the present infusion line management system;

FIG 2A shows a top plan view of a multi-part label of the infusion line management system of FIG. 1;

FIG. 2B shows a bottom plan view of a multi-part label of the infusion line management system of FIG. 1; and

FIGs. 3A and 3B show an example screenshot of a virtual infusion map using the infusion line management system of FIG. 1

DETAILED DESCRIPTION

An infusion tube line management system is generally designated 10. As shown in FIG. 1, the system 10 preferably includes a computerized physician/prescriber order entry (cPOE) system 12, a multi-part label 14, and a label generating device 16 used to generate the label. While the description refers to a cPOE system 12, those of skill in the art will recognize that any other computerized system capable of producing required information for printing labels described herein may be used in place of the cPOE system.

The multi-part label 14 is preferably generated as a single entity at the time that a prescription medication is prepared for a patient, and is applied to the medication container (e.g., bag, bottle, syringe, etc.), preferably in a single step. Information transferred to the label 14 is preferably derived from the cPOE system 12.

The cPOE system 12 allows for electronic entry of medical practitioner instructions for the treatment of patients. Typically, hospitals have an existing cPOE system 12 in place, and the line management system 10 preferably interfaces with the existing cPOE system and other hospital information systems such that the line management system receives data from the cPOE system via wired or wireless communications.

The label generating device 16 is preferably located in a hospital or clinic pharmacy for use when prescriptions are filled. As shown in FIG. 2, the label generating device 16 is preferably a computerized device, having at least a memory 18, a processor 20, one or more input devices 22, a network communication interface 24, a display 26, an output device 28, and a power source. The memory 18 is preferably a non-transitory computer-readable recording medium, such as a read only memory (ROM), random access memory (RAM), hard disk, non-volatile flash memory or other electronically erasable programmable read-only memories (EEPROMs), optical or magneto-optical, or other computer-readable storage media. Instructions for operation of the label-generating device 16 are preferably stored on the memory 18.

The device 16 also includes a processor 20, such as a microprocessor or other central processing unit capable of executing instructions stored in the memory 18. The display 26 is a device such as a liquid crystal display, cathode ray tube, plasma display, organic light emitting diode (OLED) display, or any other device capable of outputting data from the memory and processor in a way that is easily discernible by a user. An output device 28, such as a printer, is used to output the multi-part labels 14, preferably at the time a prescription is filled. Alternatively, the labels 14 can be output when the prescription is entered into the cPOE system 12, or when the prescription is delivered to the patient. Additionally, the output device 28 is preferably capable of electronically outputting data to be stored on a nonvolatile memory such as an RFID tag embedded within the label 14.

The network communication interface 24 allows the label-generating device 16 to connect to the cPOE system 12 and/or the hospital information system via a local area network (LAN), wide area network (WAN), and/or the Internet. The network connection interface 24 may be a wired Ethernet connection using, for example, the IEEE 802.3 standard, or a wireless connection using standards such as IEEE 802.11 a/b/g/n/ac, or any newly developed standards that supersede these. The network connection interface 24 may also be used to connect to a cellular data network such as LTE, WiMAX, UMTS,

CDMA, HSPA, HSPA+, GPRS, and the like. Still further, the network connection interface 24 may include a Wireless Personal Area Network interface such as a Bluetooth, wireless USB, or other connection as defined in the IEEE 802.15 standards.

Each multi-part label 14 preferably includes a master label 30 containing information suitable for the medication container and one or more associated sub-labels 32 removably attached to the master label. Turning now to FIGs. 2A and 2B, at least the master label 30 preferably includes a front surface 34 for displaying prescription information 35 related to the medication, as received from the cPOE system 12, and a rear surface 36 coated in an adhesive 38 such as a pressure-sensitive adhesive.

The information 35 contained on the front surface 34 of the master label 30 may include prescription information represented as human-readable information indicating, for example: medication name, prescribed dosage, patient identifying information, and the like, as well as machine-readable information, such as optically readable data including one or more of a barcode, a QR code, and the like. Alternatively, the master label 30 optionally includes a storage device 40 (shown hidden), such as a radio frequency identification (RFID) tag for electronically storing and transmitting machine readable information.. The RFID tag can be affixed to the front surface 34 of the label 14, or embedded within the label.

Additionally, the information 35 contained on the front surface of the master label 30 includes an indicator 41 having a minimal number of human-readable characters (for example, a single alphabet character) used to associate the label and corresponding medication with the infusion system. The indicator 41 preferably also includes other identifying indicia, such as a unique color, pattern, and/or shape. An example of an indicator would therefore be the letter “A”, printed in red, on a star-shaped field, and with a cross-hatch pattern. Maintaining the indicator 41 across each of the associated sub-labels reinforces a clinician’s ability to quickly and accurately recognize the labels, and thus recognize that certain items in an infusion tubing system are related, tracing a desired line.

Each sub-label 32 preferably includes all or a subset of the information contained on the associated master label. Preferably, each of the sub-labels includes at least the indicator 41 as described above (i.e., unique minimal human-readable characters, color, shape, and/or pattern). Each of the sub-labels 32 is preferably individually separable from the master label 30 and attachable to an element of the infusion system (e.g., the tubing connecting a medication container to a catheter, a pump channel

operating on the tubing, etc.). This process of removing sub-labels 32 from the master label 30 on the medication container and attaching them to various elements within the infusion system is performed by the clinician as the medication is first administered to the patient.

Preferably the sub-labels 32 include the indicator 41, without medication-specific information. This advantageously allows the sub-labels 32 and tubing to be re-used even if the medication being delivered is changed. Accordingly, the label management system 10 is preferably optimized to track indicators currently assigned to each medication for a given patient, and reassigns an indicator from a discontinued medication to a replacement medication when it is appropriate to use the same infusion setup to administer the replacement medication. The clinician will know that a medication bearing a reassigned indicator is to be connected to the infusion system at the spike bearing the same indicator. For example, a new medication container bearing the indicator "B" should be connected to the spike that was previously labeled "B." Additionally, the clinician will be able to easily reference which medication is associated with a particular indicator at any point in time by reading the master label, which contains both the medication name and its associated indicator. Thus, the number of times that a clinician is required to re-label a given tubing set is reduced.

Of course, an associated pump channel flow rate may require adjustment when a medication is replaced. This may be set manually by referring to a flow rate printed on the master label on the medication container, or automatically by using a scanner (e.g., RFID reader, barcode scanner, etc.) to read the machine-readable portion of the master label 30 of the replacement medication if using a pump with this automatic programming capability.

Referring now to FIGs. 3A and 3B, the present line management system 10 is preferably used in conjunction with a patient information software system including a display in the form of an infusion map 42, as shown in FIGs. 3A and 3B. When used in this way, the labeling system 10 allows for easy correspondence between the "virtual" infusion map 42 of the patient information software and the actual infusion system at the patient's bedside. This in turn allows a clinician to look at the infusion map 42 displayed by the software and quickly locate the corresponding physical item, such as an access port, in the actual infusion tubing system. Moreover, the combination of the patient information software and line management system 10 helps to ensure that the entire infusion system is configured in a safe and effective manner.

As shown in the infusion map display 42, an infusion system 44 includes at least one or more medication containers 46, one or more tubing sets 48 associated with each of the medication containers, and an optional infusion pump 50 configured for administering the medication contained in the one or more medication containers as is well known in the art.

Tubing sets 48 used in infusion tubing systems include a number of access ports, typically between zero and three. Preferably, the tubing set manufacturer will include a prominent number near each access port, starting with the number "1" for the first access port at the spike end of the set, then "2" at the next access port, then "3" and so on. When combined with the clinician-applied sub-labels 32, each access port in the entire infusion setup can be uniquely identified (for example A1, A2, A3, B1, C1, C2, etc. as shown in FIG. 1). This allows the system 10 to unambiguously specify both the tubing set 48 and the particular access port to which a medication should be connected.

Preferably, the multi-part labels 14 are printed at the pharmacy and attached to the medication container before delivery to the patient's bedside. Alternatively, the multi-part labels 14 could be generated on demand at the point of care. The label generating device 16 may take many forms, including a laptop or desktop computer, a client computer integrated with a hospital information system to allow for access at multiple locations (e.g. pharmacy, nursing station, emergency department, diagnostic laboratory, and physician offices), or a portable device such as a laptop computer, tablet, smartphone, personal digital assistant, computer on wheels, workstation on wheels, or a hand-held label maker. Additionally, the computerized device may be integrated into bedside equipment such as smart infusion pumps and/or patient monitors. These alternative devices preferably also communicate with the cPOE via wired or wireless communications methods as discussed above. Alternatively, the label-generating device can be programmed by reading information from the master label on the medication container. Alternatively, the label-generating device could be manually programmed by the clinician at the time of use.

As an alternative to generating physical labels, the system could "write" directly onto the various elements of interest, such as medication containers, tubing sets, etc. For example, the element could receive and retain ink or dye to produce human-readable information on the element. Other methods of information transfer such as electrical, magnetic, thermal, optical, etc. are also contemplated. Examples of such an information transfer method include an erasable programmable read-only memory

(EPROM) technology, a radio frequency identification tag, or other non-volatile computer-readable storage device.

While a particular embodiment of the present infusion line management system has been described herein, it will be appreciated by those skilled in the art that changes and modifications may be made thereto without departing from the invention in its broader aspects and as set forth in the following claims.

CLAIMS

1. An infusion line management system comprising:

a label generating device receiving prescription information for one or more patient prescriptions, the received information being used to generate, for each of the one or more prescriptions, a label including a master label and one or more sub-labels related to the corresponding prescription;

each said master label includes at least information related to the prescription and an indicator identifying a particular portion of a patient infusion system to which the prescription should be connected; and

said one or more sub-labels each include the indicator, said one or more sub-labels being individually removable from said master label and affixable to locations throughout said patient infusion system.

2. The infusion line management system of claim 1, wherein said patient infusion system includes:

a medication container containing the prescribed medication;

one or more tubing sections; and

an infusion pump,

and wherein said master label is affixable to said medication container.

3. The infusion line management system of claim 2, wherein said one or more sub-labels includes a plurality of sub-labels affixable to each of said one or more tubing sections and said infusion pump.

4. The infusion line management system of claim 1, said label generating device including:

a network communication interface configured for receiving the prescription information;

an output device configured for printing the prescription information and the indicator on said master label and the indicator on each of said one or more sub-labels; and

a processor configured for controlling said network communication interface and said printer.

5. The infusion line management system of claim 4, wherein said output device is further capable of writing data to a radio frequency identification tag embedded in said master label, and

wherein the information includes machine-readable information stored in said radio frequency identification tag.

6. The infusion line management system of claim 1, wherein the information includes both human-readable information and machine-readable information.

7. The infusion line management system of claim 6, wherein the machine-readable information is information represented as an optically readable element.

8. The infusion line management system of claim 1, wherein said master label includes a front surface for displaying the information and the indicator and a rear surface coated in an adhesive and configured for adhesion to a medication container, and wherein each of said one or more sub-labels includes a front surface for displaying at least the indicator and a rear surface coated in an adhesive configured for adhesion to said patient infusion system.

9. The infusion line management system of claim 1, further comprising a patient information software system, said patient information software system storing an infusion map indicating medications being administered to each patient.

10. The infusion line management system of claim 1, wherein said label generating device is in electrical communication with a hospital computer system, said label generating device receiving the prescription information from said hospital computer system.

11. A non-transitory computer readable medium storing instructions that, when executed by a processor, cause a computer to perform steps comprising:

receiving prescription information from a hospital information system;

selecting an indicator and associating the selected indicator with the received prescription information; and

creating a label creation request to print a master label and one or more sub-labels, the master label including at least the received prescription information and the associated indicator, and the sub-labels including at least the associated indicator.

12. The non-transitory computer readable medium of claim 11, wherein the received prescription information is printed on the master label as human readable information and as optically machine-readable information.

13. The non-transitory computer readable medium of claim 11, wherein the master label includes a radio frequency identification tag embedded therein, and wherein the label creation request further includes an information storage request to store the received prescription information to the radiofrequency identification tag.

14. The non-transitory computer readable medium of claim 11, the process further comprising storing a patient infusion map based on the received prescription information and the associated indicator.

15. An infusion line management system comprising:

a hospital computer system storing prescription information related to one or more prescriptions associated with a patient;

a label generating device receiving the prescription information from said hospital computer system, said label generating device generating, for each of the one or more prescriptions, a label including a master label and one or more sub-labels related to the corresponding prescription;

each said master label includes at least the prescription information and a unique indicator; and

each of said one or more sub-labels includes the indicator, said one or more sub-labels being individually removable from said main label and affixable to locations throughout said patient infusion system.

16. The infusion line management system of claim 15, wherein the prescription information includes both human-readable information and machine-readable information.

17. The infusion line management system of claim 16, wherein the machine-readable information includes optical machine-readable data.

18. The infusion line management system of claim 16, wherein the machine-readable information includes electrical machine-readable data.

19. The infusion line management system of claim 18, wherein said master label includes a storage device embedded therein, and wherein the electrical machine-readable data is stored on said storage device.

20. The infusion line management system of claim 15, said label generating device including:

a network communication interface configured for receiving the prescription information;

a printer configured for printing the prescription information and the indicator on said master label and the indicator on each of said sub-labels; and

a processor configured for controlling said network communication interface and said printer.