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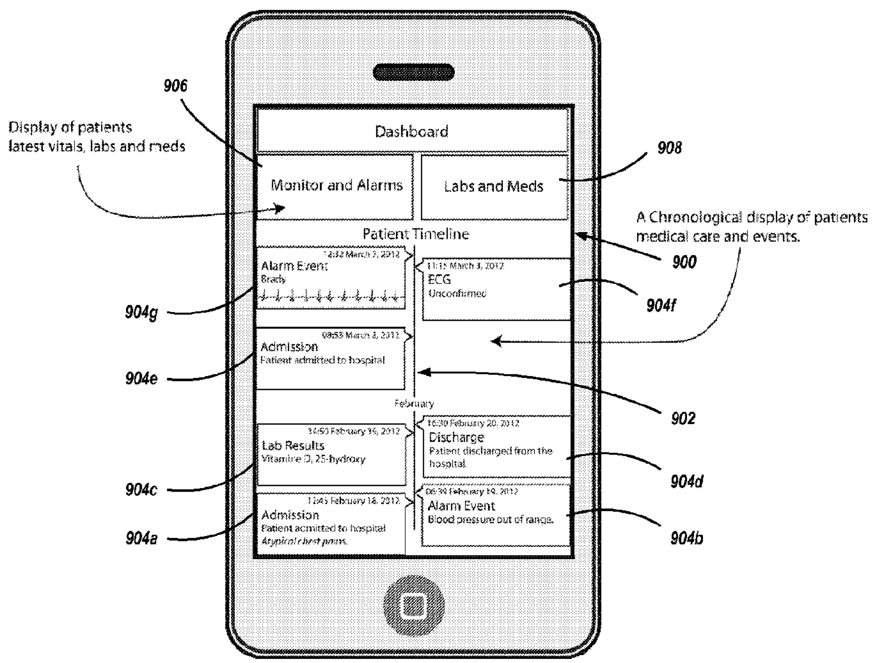

(57) Abrégé/Abstract:
Methods, systems, and apparatus, including computer programs encoded on a computer storage medium, for receiving user input, the user input indicating a user command to display a timeline screen, in response to the user input, processing patient-specific data to determine one or more medical events to be graphically depicted, the one or more medical events being specific to a patient, and displaying the timeline screen on the mobile device, the timeline screen displaying a timeline associated with the patient and comprising at least a portion of the one or more medical events, each medical event comprising summary information, the one or more medical events being displayed in chronological order.

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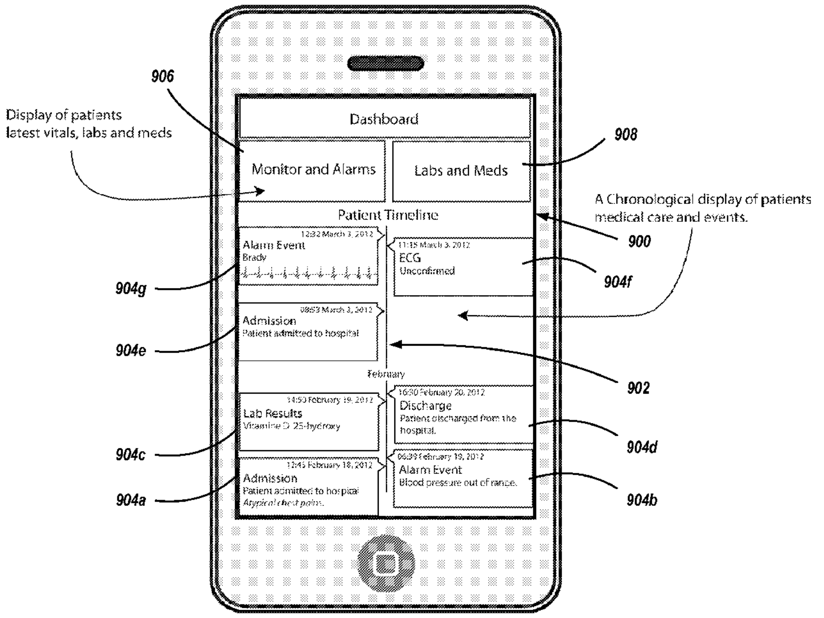

FIG. 9

(57) **Abstract**: Methods, systems, and apparatus, including computer programs encoded on a computer storage medium, for receiving user input, the user input indicating a user command to display a timeline screen, in response to the user input, processing patient-specific data to determine one or more medical events to be graphically depicted, the one or more medical events being specific to a patient, and displaying the timeline screen on the mobile device, the timeline screen displaying a timeline associated with the patient and comprising at least a portion of the one or more medical events, each medical event comprising summary information, the one or more medical events being displayed in chronological order.

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SYSTEMS AND METHODS FOR DISPLAYING PATIENT DATA

BACKGROUND

[0001] Implementations of the present disclosure are directed to displaying patient data and/or information on mobile devices.

[0002] While physicians and other health care providers currently utilize a large number of products and systems that benefit from advances in wireless communication technology, there are still significant limitations to the information that can be transmitted, received, and displayed over these devices in a practical and efficient manner. There are many limitations that are intrinsic to mobile devices, especially those constraints related to speed, performance, memory, and display size. In addition, because of the critical nature of medical data, it is important that the technology work reliably and efficiently over potentially low speed, low bandwidth, and sometimes intermittent wireless connections.

SUMMARY

[0003] Implementations of the present disclosure include methods for providing a user of a mobile device access to patient information and patient physiological data. In some examples, methods include actions of receiving user input, the user input indicating a user command to display a timeline screen, in response to the user input, processing patient-specific data to determine one or more medical events to be graphically depicted, the one or more medical events being specific to a patient, and displaying the timeline screen on the mobile device, the timeline screen displaying a timeline associated with the patient and comprising at least a portion of the one or more medical events, each medical event comprising summary information, the one or more medical events being displayed in chronological order. Other implementations of this aspect include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

[0004] These and other implementations can each optionally include one or more of the following features: each medical event corresponds to an event category of a plurality

of event categories; actions further include receiving patient data and/or patient information from an electronic medical record (EMR) associated with the patient, the summary information including at least a portion of the patient data and/or patient information; actions further include determining the chronological order based on timestamp information associated with each of the one or more events; actions further include receiving user input associated with a medical event, and in response to the user input, displaying detailed medical event information; displaying detailed medical event information includes displaying an event screen in place of the timeline screen; actions further include receiving user input, and in response to the user input, scrolling the timeline in the timeline screen to display another portion of the one or more medical events; actions further include receiving user input, and in response to the user input, zooming the timeline in the timeline screen to display another portion of the one or more medical events; at least one medical event of the one or more medical event includes an icon, the icon graphically depicting an event category associated with the at least one medical event; the icon includes a generic icon that is provided for all medical events of the same event category; the icon includes an event-specific icon that is specific to a sub-category associated with the at least on medical event; actions further include receiving user input specific to a medical event, and in response to the user input, manipulating summary information provided in the medical event; manipulating summary information provided in the medical event, includes scrolling the summary information provided in the medical event; the summary information provided in the medical event includes a waveform, and manipulating includes scrolling the waveform; the summary information provided in the medical event includes a plurality of thumbnail images, and manipulating includes scrolling between images of the plurality of thumbnail images; and actions further include receiving user input, the user input indicating user selection of a category icon, and in response to the user input, filtering the timeline to include a sub-set of the one or more medical events, medical events in the sub-set corresponding to a category associated with the category icon.

[0005] Implementations of the present disclosure further include methods for providing a user of a mobile device access to patient information and patient physiological data. In some examples, methods include actions of receiving user input, the user input indicating a user command to display a waveform strip screen, in response to the user input, processing patient-specific data to provide waveform data, and displaying the waveform strip screen on the mobile device, the waveform strip screen displaying one or more waveform strips, each waveform strip of the one or more waveform strips being based on the waveform data and graphically depicting a physical waveform strip. Other implementations of this aspect include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

[0006] These and other implementations can each optionally include one or more of the following features: a waveform strip of the one or more waveform strips includes a real-time waveform strip; the real-time waveform strip is updated in response to patient data provided from a remote monitoring device; the real-time waveform strip is animated to scroll absent user input based on updates to waveform data used to provide the real-time waveform strip; a waveform strip of the one or more waveform strips includes a historical waveform strip; actions further include receiving user input to the historical waveform strip, and in response to the user input, animating the waveform strip to scroll to display portions of a waveform that were absent from the waveform strip before scrolling; the historical waveform strip includes a strip stack; scrolling of the historical waveform strip induces animation of waveform strip segments to be unfolded from the strip stack; scrolling of the historical waveform strip induces animation of waveform strip segments to be folded into the strip stack; each waveform strip provides a graphical representation of strip paper, the strip paper including one or more scales; each scale is associated with at least one unit of measure; the waveform strip screen further displays at least one waveform view that depicts one or more waveforms respectively corresponding to waveforms of the one or more waveform strips; the at least one waveform view includes a scrubber bar that provides a reference to associate waveforms of the one or more waveform strips to the one or more waveforms of the at least one waveform view and actions further include receiving user input, the user input indicating movement of the scrubber bar, and in response to the user input, scrolling at least one waveform strip relative to movement of the scrubber bar.

[0007] Implementations of the present disclosure provide methods for providing a user of a mobile device access to patient information and patient physiological data. In some examples, methods include actions of processing patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip, and displaying the at least one graphical representation as a stacked waveform strip, the stacked waveform strip including: a first strip segment, the first strip segment being associated with a first time period, a second strip segment, the second strip segment being associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, and a third strip segment, the third strip segment being associated with a third time period earlier than the second time period and being displayed beneath the second strip segment. Other implementations of this aspect include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

[0008] These and other implementations can each optionally include one or more of the following features: actions further include receiving, the patient data, the patient data reflective of one or more physiological characteristics of a patient; actions further include receiving user input, the user input indicating a zoom command, and in response, providing a graphical representation comprising a zoomed stacked waveform strip; the zoomed waveform strip includes a greater number of strip segments than the stacked waveform strip; the zoomed waveform strip includes a lower number of strip segments than the stacked waveform strip; the zoom command includes a command to zoom out; and the zoom command comprises a command to zoom in.

[0009] Implementations of the present disclosure provide methods for providing a user of a mobile device access to patient information and patient physiological data. In some examples, methods include actions of processing patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations including a waveform strip, displaying a first graphical representation of the patient data in a first window of a display, the first graphical representation including historical patient data, and displaying a second graphical representation of the patient data in a second window of a display, the second graphical representation comprising real-time patient data. Other implementations of this aspect include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

[0010] These and other implementations can each optionally include one or more of the following features: actions further include receiving user input, and in response to the user input, scrolling the first graphical representation of the patient data in the first window; and actions further include receiving the patient data, the patient data reflective of one or more physiological characteristics of a patient.

[0011] Implementations of the present disclosure provide methods for providing a user of a mobile device access to patient information and patient physiological data. In some examples, methods include actions of processing patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations including a waveform strip, displaying a first graphical representation of the patient data in a first window of a display, the first graphical representation including a strip segment of the waveform strip, and displaying a second graphical representation of the patient data in a second window of a display, the second graphical representation including the waveform strip and an indicator, the indicator indicating, within the waveform strip, the strip segment displayed in the first window. Other implementations of this aspect include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

[0012] These and other implementations can each optionally include one or more of the following features: actions further include receiving user input, and in response to the user input, moving the indicator relative to a position along the waveform strip within the second window, and updating the first graphical representation in the first window based on the position; the first graphical representation is a magnified portion of the second graphical representation; and actions further include receiving the patient data, the patient data reflective of one or more physiological characteristics of a patient.

[0013] Other aspects of the present disclosure provide systems including one or more processors, and a computer-readable medium coupled to the one or more processors having instructions stored thereon which, when executed by the one or more processors, cause the one or more processors to perform one or more of the methods provided herein.

[0013a] According to one aspect of the present invention, there is provided a computer-implemented method for providing a user of a mobile device access to patient information and patient physiological data, the method being executed using one or more processors and comprising: processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising: a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period; a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment; a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

[0013b] According to another aspect of the present invention, there is provided a computer-readable storage device coupled to one or more processors and having instructions stored thereon which, when executed by the one or more processors, cause the one or more

processors to perform operations comprising: processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising:
a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period; a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment; a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

[0013c] According to still another aspect of the present invention, there is provided a system, comprising: one or more processors; and a computer-readable storage medium in communication with the one or more processors and having instructions stored thereon which, when executed by the one or more processors, cause the one or more processors to perform operations comprising: processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising: a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period; a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment; a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

[0014] It is appreciated that methods in accordance with the present disclosure can include any combination of the aspects and features described herein. That is to say that methods in accordance with the present disclosure are not limited to the combinations of aspects and features specifically described herein, but also include any combination of the aspects and features provided.

[0015] The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

[0016] FIG. 1 is a schematic illustration of an example system architecture in accordance with implementations of the present disclosure.

[0017] FIG. 2 is a schematic illustration of another example system architecture in accordance with implementations of the present disclosure.

[0018] FIG. 3 is a. functional block diagram of an example system in accordance with implementations of the present disclosure.

[0019] FIG. 4 is a more detailed view of the functional block diagram of FIG. 3.

[0020] FIG. 5 depicts an example platform for providing integrated and unified views of patient data and patient information.

[0021] FIG. 6 depicts example components and sub-components that can be included in core components of FIG. 5.

[0022] FIGs. 7-13 depict example graphical user interfaces (GUIs) for providing integrated and unified views of patient data and patient information in accordance with implementations of the present disclosure.

[0023] FIG. 14 is a flowchart illustrating an example process that can be executed in accordance with implementations of the present disclosure.

[0024] FIGs. 15 and 16 depict example graphical user interfaces (GUIs) for providing integrated and unified views of patient data and patient information in accordance with implementations of the present disclosure.

[0025] FIG. 17 is a flowchart illustrating an example process that can be executed in accordance with implementations of the present disclosure.

[0026] Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

[0027] Implementations of the present disclosure are generally directed to an enterprise scalable, data- and vendor-agnostic mobility architecture to securely deliver patient data and information from medical devices, electronic medical records (EMRs) and patient monitors to healthcare providers anywhere across a healthcare continuum. More particularly, implementations of the present disclosure provide integrated and unified views of patient data and patient information on mobile devices (e.g., smartphones, tablets) from a plurality of data sources across the healthcare continuum. As discussed in further detail herein, implementations of the present disclosure enable timely and collaborative clinical decision-making, and enable healthcare systems to better track quality metrics, empower a mobile workforce, expand networks, and achieve clinical transformation.

[0028] Example systems and methods that can be included in implementations of the present disclosure are provided in U.S. Provisional Application Serial No. 61/771,591, filed March 1, 2013.

[0029] Referring now to FIG. 1, an example system architecture 100 is illustrated, and includes a mobile device 102, connectivity interface(s) 104, a network 106, a first facility system 108, and a second facility system 110. As discussed in further detail herein, data is transferred from each of the first and second facility systems 108, 110 through the network 106 and connectivity interface(s) 104 for presentation, or display on the mobile device 102. Further, data can be transferred from the mobile device 102 through the connectivity interface(s) 104 and the network 106 to each of the first and second facility systems 108, 110. Although a single mobile device 102 is illustrated, it is contemplated that one or more mobile devices 102 can communicate with each of the first and second facility systems 108, 110 through the network 106 and the connectivity interface(s) 104. Similarly, although two facility systems are illustrated, implementations of the present disclosure can include one or more facility systems.

[0030] The mobile device 102 can include any number of example devices. Such example devices include, but are not limited to, a mobile phone, a smartphone, a tablet computing device, a personal digital assistant (PDA), a laptop personal computer (PC), a desktop PC, and/or appropriate combinations thereof. In the depicted example, the mobile device 102 includes a display 122, a processor 124, memory 126, an input interface 128, and a communication interface 130. The processor 124 can process instructions for execution of implementations of the present disclosure. The instructions can include, but are not limited to, instructions stored in the memory 126 to display graphical information on the display 122. Example displays include, but are not limited to, a thin-film-transistor (TFT) liquid crystal display (LCD), or an organic light emitting diode (OLED) display. The memory 126 stores information within the mobile device 102. In some implementations, the memory 126 can include a volatile memory unit or units, and/or a non-volatile memory unit or units. In other implementations, removable memory can be provided, and can include, but is not limited to, a memory card. Example memory cards can include, but are not limited to, a secure digital (SD) memory card, a mini-SD memory card, a USB stick, and the like.

[0031] In some examples, the input interface 128 can include a keyboard, a touchscreen, a mouse, a trackball, a microphone, a touchpad, and/or appropriate combinations thereof. In some implementations, an audio codec (not shown) can be provided, which receives audible input from a user or other source through a microphone, and converts the audible input to usable digital information. The audio codec can generate audible sound, such as through a speaker that is provided with the mobile device 102. Example sounds can include sound from voice telephone calls, recorded sound (e.g., voice messages, music files, etc.), and/or sound generated by applications operating on the mobile device 102.

[0032] The mobile device 102 may communicate wirelessly through the communication interface(s) 104, which can include digital signal processing circuitry. The communication interface(s) 104 may provide communications under various modes or protocols including, but not limited to, GSM voice calls, SMS, EMS or MMS messaging, CDMA, TDMA, PDC, WCDMA, CDMA2000, and/or GPRS. Such communication may occur, for example, through a radio-frequency transceiver (not shown). Further, the mobile device can be capable of short-range communication using features including, but not limited to, Bluetooth and/or WiFi transceivers (not shown).

[0033] The mobile device 102 communicates with the network 106 through the connectivity interface(s) 104. In some examples, the connectivity interface(s) 104 can include a satellite receiver, cellular network, a Bluetooth system, a Wi-Fi system (e.g., 802.x), a cable modem, a DSL/dial-up interface, a private branch exchange (PBX) system, and/or appropriate combinations thereof. Each of these connectivity interfaces 104 enables data to be transmitted to/from the network 106. In some examples, the network 106 can be provided as a local area network (LAN), a wide area network (WAN), a wireless LAN (WLAN), a metropolitan area network (MAN), a personal area network (PAN), the Internet, and/or combinations thereof.

[0034] In the example systems of FIGs. 1 and 2, the first facility system 108 includes a plurality of facilities 140, and the second facility system 110 includes a facility 140. It is contemplated that each facility system 108, 110 can include one or more facilities, and is not limited to the example arrangement described herein. In the case of multiple facilities, the facilities can be remotely located from one another, and/or can be located at a common location, or site (e.g., separate departments in a common (the same) building). Each facility system 108, 110 can be provided as a medical care system, for example, which medical care system can include one or more hospitals, hospital systems, clinics, physician offices, and the like.

[0035] In some examples, each facility 140 includes an associated information system 142, computer interface(s) 144, and patient monitoring device(s) 146. Example information systems can include, but are not limited to, a clinical information system (CIS), an EMR system, an electronic health record (EHR) system, and/or a hospital information system (HIS). Each information system 142 can be provided as a server, and supports the acquisition, storage, modification, and distribution of clinical information, such as patient data, throughout the facility 140 and/or facility system 108, 110. In some examples, each information system 142 can communicate with one or more ancillary information systems (not shown) that can include, but are not limited to, a pharmacy management system, a laboratory management system, and/or a radiology management system. Although the example system architecture 100 includes an information system 142 located at each facility 140, it is contemplated that the facilities 140 can communicate with a common information system 142 that is remotely located from either facility 140, or that is located at one of the facilities 140 within the facility system 108, 110.

[0036] In some examples, the computer interface 144 can communicate with the information system 142 to enable access to information that is stored within, and managed by the information system 142. In some examples, the computer interface 144 can include a personal computer (PC) (e.g., desktop, laptop, or tablet). Although a single computer interface 144 is illustrated in the example architectures described herein, it is contemplated that one or more computer interfaces 144 can communicate with the information system 142. Communication between each computer interface 144 and the information system 142 can be achieved via a direct connection, or remotely through a network (not shown) that can include, but is not limited to, a LAN, a WAN, a WLAN, and/or the Internet.

[0037] In some examples, each patient monitoring device 146 monitors physiological characteristics of a particular patient 150, and generates data signals based thereon. As discussed in further detail herein, implementations of the present disclosure provide patient monitoring devices that include a computing device, such as a tablet computing device. The data signals are communicated to the information system 142, which collects patient data based thereon, and stores the data to a patient record that is associated with the particular patient. An example patient record can include an electronic medical record (EMR). Although a single patient monitoring device 146 is illustrated per each patient 150, it is contemplated that multiple patient monitoring devices 146 can monitor a particular patient 150. The patient monitoring device(s) 146 can communicate with the information system 142 via a direct connection, or remotely through a network (not shown) that can include, for example, a LAN, a WAN, a WLAN, and/or the Internet.

[0038] In some examples, the patient data is made available for display on the computer device 144. A healthcare provider (e.g., a nurse and/or physician) can augment the patient data by inputting patient information that is also stored to the information system 144. More specifically, the healthcare provider can input patient information corresponding to a particular patient 150, which patient information can be stored to the patient record (e.g., EMR). As one example, a nurse can input nursing notes, which nursing notes can be stored to the patient record in the information system. Example patient information can include any non-physiological information corresponding to a patient (e.g., name, age, date-of-birth (DOB), gender).

[0039] As discussed above, each information system 142 stores patient data that can be collected from the patient monitoring devices 146, as well as additional patient information, that can include information that is input by a healthcare provider. The information system 144 communicates the patient data and/or the additional patient data to a data management system (DMS) 160. The DMS 160 can be provided as a server, or a virtual server, that runs server software components, and can include data storage including, for example, a database and/or flat files. In the example system architecture 100 of FIG. 1, each facility system 108, 110 includes a corresponding DMS 160. In such an arrangement, each information system 142 communicates patient data, and/or additional patient data to the DMS 160. Furthermore, and as discussed in further detail below, the DMS 160 can communicate ancillary information to the information system 142. Communication between the DMS 160 and the information system(s) 142 can be achieved via a direct connection, or remotely through a network (not shown) that can include, for example, a LAN, a WAN, a WLAN, and/or the Internet.

[0040] In some examples, a DMS 160 corresponding to a particular facility system can be remotely located from any of the facilities 140 of the facility system 108, 110, or can be located at a particular facility 140 of the facility system 108, 110. In the example system architecture 100 of FIG. 1, the DMS 160 is remotely located from either facility 140 within each of the facility systems 108, 110. It is contemplated, however, that the DMS 160 can be located at one of the facilities 140, and remote from the other facility 140.

[0041] In the example system architecture 100' of FIG. 2, a DMS 160' is provided that is common to (the same for) the facility systems 108, 110. For example, the DMS 160' can be described as being common to various facility systems 108, 110, and is not associated with a particular facility system 108, 110. For example, the DMS 160' can be hosted by a third-party vendor (e.g., a cloud service provider). In some examples, each information system 42 communicates with the DMS 160' via a direct connection, or remotely through a network (not shown) that can include, but is not limited to, a LAN, a WAN, a WLAN, and/or the Internet. In the example arrangement of FIG. 2, the DMS 160' communicates with each of the information systems 142 through the network 106. The information systems 142 communicate patient data and/or patient information to the DMS 160', and the DMS 160' can communicate ancillary information to the information system 142, as discussed in further detail below.

[0042] In the example system architecture 100 of FIG. 1, the facility 140, or facility system 108, 110 installs the DMS 160 as a local DMS, and the DMS 160 sits at the local site with other servers that can include, for example, the information system 142. In some implementations, the DMS 160 can be sectioned off, or separated from a logical network perspective, but still physically exists with the other servers that belong to the respective facility 140. In some examples, server components are installed on the DMS 160, which components can include, for example, a database component, a database synchronization component, a web services component, and/or a structured query language (SQL) component. An information system interface can also be installed on the DMS 160, and functions as the interface to the information system 142. As one example, the information system interface can include OBLink, provided by GE Healthcare. In some implementations, the DMS 160 can be arranged in a multiple server configuration, in which one server only hosts web service related components and is logically segregated, and another server has the remaining necessary server components installed.

[0043] The example system architecture 100' of FIG. 2, provides for the remote location of data collection at the DMS 160'. In such implementations, the DMS 160' can be provided at a third-party site, remote from any of the facilities 140, or facility systems 108, 110. The third-party functions as a DMS host, and the necessary server components are installed on the remotely hosted DMS 160'. In some implementations, a business-to-business (B2B) virtual private network (VPN) can be created between the remotely hosted DMS 160' and the network of the facility 140 or facility system 108, 110. In this manner, the facility 140 and/or facility system 108, 110 forgoes the purchase and/or maintenance of another physical server, or DMS 160. Further, the up-time and the status of availability of the DMS 160’ are easier to manage on the part of a dedicated third-party. The DMS’ access to the network can be attended to by the third-party, as opposed to burdening the facility 140, or the facility systems 108, 110. Further, the third-party can implement virtual server technologies to leverage multiple DMS installations on a single physical server. In such implementations, a plurality of virtual servers are logically partitioned in a single physical server, and each virtual server has the capability of running its own operating system and server components, and can be independently booted.

[0044] In accordance with implementations of the present disclosure, the DMS 160, 160’ synchronizes and transfers data between the mobile device 102, or multiple mobile devices 102, and the information system 142, or multiple information systems 142. More specifically, the DMS 160, 160’ processes and prepares the patient data and/or patient information for transfer to and presentation on the mobile device 102, or multiple mobile devices 102, from the information system 142, and/or other systems, as discussed in further detail herein. The DMS 160, 160’ also processes and prepares ancillary information for transfer to and storage in the information system 142 from the mobile device 102, or multiple mobile devices 102 for potential presentation at a corresponding computer device 144. Example DMSs can include, but are not limited to, the AirStrip Server provided by AirStrip Technologies, LLC, which AirStrip Server includes AirStrip Server Components installed therein.

[0045] Referring now to FIGs. 3 and 4, example module structure, or system 300 that can be implemented to provide features of the present disclosure will be described in detail. In some examples, the example system 300 enables patient data and patient information to be communicated to/from, and to be exchanged between mobile devices and data sources across healthcare continua. In some examples, each module can be provided as one or more computer-executable programs that are executed using one or more computing devices (e.g., computing devices provided as part of a DMS, computing devices located at one or more facilities of a facility system).

[0046] FIG. 3 illustrates an overview of the example system 300. In the depicted example, the module structure includes modules located at a DMS 301, a first facility system 302 and a second facility system 304. In some examples, the first facility system

302 and the second facility 304 can be included in at least a portion of a healthcare continuum, discussed in further detail herein. The facility system 302 includes a patient record module 303 (e.g., EMR module) that accesses one or more patient records managed and stored by the facility system 302. The facility system 304 includes a patient record module 305 (e.g., EMR module) that accesses one or more patient records managed and stored by the facility system 304.

[0047] In the depicted example, and as discussed in further detail herein, patient data and/or information can be provided for integrated and unified display on the mobile device 102 through the network 106 and the DMS 301 from across healthcare continua (e.g., the facility systems 302, 304). In some examples, patient data and/or information can be provided for display on a mobile device 102', 102" through the network 106 from a facility system (e.g., the facility system 302, 304). In some examples, the mobile devices 102, 102', 102" are the same device. That is, for example, a mobile device can receive patient data and/or information from across a healthcare continuum, and/or from individual facility systems.

[0048] In some implementations, the DMS 301 includes a web module 310, a host module 312, a data cache module 314 and an adapter module 316, web module 320, a host module 322, a data cache module 324, a collector module 326. In general, modules of the DMS 301 enable the DMS 301 to retrieve and combine data from multiple facility systems (e.g., the facility systems 302, 304) across healthcare continua. In some examples, the web module 310 provides a first-level network facing interface to the DMS infrastructure. In some examples, and in response to a request from a mobile device (e.g., the mobile device 102), the web module 310 performs request validation and user authentication and routes the request to the host module 312. In some examples, the web module 310 includes one or more sub-modules. Example sub-modules include a request validation sub-module, which validates received requests, a user authentication module, which authenticates an identity of the user and/or mobile device from which a request is received, and a request routing sub-module, which routes requests after validation and authentication.

[0049] In some implementations, the host module 312 orchestrates request processing. In some examples, the host module 312 includes one or more sub-modules.

Example sub-modules include a request parsing sub-module that parses received requests, a pipeline assembly sub-module, a pipeline processing sub-module, an operation execution sub-module, a data access sub-module, a results formatting sub-module, an access control sub-module, an encryption sub-module, a data conditioning sub-module, and a logging sub-module. In some examples, the host module 312 parsers a received request (e.g., using the request parsing sub-module) to determine, for example, what type of device issued the request, which application executing on the device issued the request, and/or patient data/information (or other data such as analytical data, discussed below) is needed to fulfill the request. In some examples, and based on the parsed information, the host module 312 builds a pipeline (e.g., using the pipeline assembly sub-module). In some examples, a pipeline can be provided as a list of tasks that need to be executed to fulfill the request. Example tasks can include retrieving particular patient data/information, processing retrieved patient data to generate additional data and/or data visualizations (e.g., analytical data, trend graphs, discussed below), encrypting/decrypting retrieved data, performing access control to retrieve data, generating logs of tasks.

[0050] In some implementations, the host module 312 coordinates data retrieval with the data cache module 314 (e.g., using the data access sub-module). The retrieved data is provided back to the host module 312. In some examples, the host module 312 processes the retrieved data (e.g., using the operation execution sub-module, the results formatting sub-module and/or the data conditioning sub-module). In some examples, the retrieved data is processed to generate additional data (e.g., data used for data visualizations). In some examples, the retrieved data and/or the additional data are conditioned to provide efficient transfer back to the requesting mobile device. In some examples, conditioning can include converting data based on transmission protocol, formatting data for optimal display on the particular device, and/or packaging data to send to the requesting device.

[0051] In some implementations, the data cache module 314 enables access to and optional storage of detailed patient data/information used by other components of the system 300. In some examples, the data cache module 314 includes one or more sub-modules and/or data stores. An example sub-module can include a cache services sub-module. In some examples, the data cache module 314 can operate in a pass-through mode (real-time mode) and a reposed mode. In some examples, patient data/information required to satisfy a given request can be directly accessed from a source system (e.g., the facility system 302, 304) in real-time. In such examples, the data cache module 314 operates in a pass-through mode, retrieving the patient data/information from multiple data sources and passing the patient data/information onward for responding to the request. In some examples, an application program interface (API), or other programmatic mechanism can be used to retrieve the patient data/information. In some examples, in the pass-through mode, patient data/information is not stored in a persistent data store accessed by the data cache module 314. In some implementations, it might be desired to improve retrieval performance. Consequently, the data cache module 314 can store data identifiers and/or pointers in a persistent data store. When in the pass-through mode, the data cache module 314 uses the adapter module 316 to perform the actual retrieval of patient data/information from one or more facility systems.

[0052] In some examples, the patient data/information that is required to satisfy a request cannot be directly accessed from the facility systems (e.g., the facility systems 302, 304). In such examples, the data cache module 314 operates in the reposed mode. In some examples, in the reposed mode, the data cache module 314 stores a detailed copy of the patient data/information in the persistent data store. That is, for example, stored patient data/information is stored at the DMS-level, but had been retrieved from remote data sources (e.g., data sources located at the facility systems 302, 304). In some examples, when a request is made for patient data/information in the reposed mode, the patient data/information is retrieved directly from the persistent data store (e.g., by the cache services sub-module).

[0053] In some implementations, the adapter module 316 enables the retrieval of patient data/information from across healthcare continua. Consequently, the adapter module 316 can be referred to as a federated adapter module. In some examples, in response to receiving a request from the mobile device 102 for patient data/information from multiple data sources (e.g., the facility systems 302, 304), the data cache module 314 utilizes the adapter module 316 to retrieve the requested patient data/information from the multiple data sources. In some examples, the adapter module 316 communicates with local host modules (discussed in further detail below) of the respective facility systems.

[0054] In some implementations, the request processing operation of the DMS 301 is stateless. More particularly, the modules of the DMS 301 handle each received request as a distinct unit and, once a request is handled, stores no state information associated with a completed request. In other words, after the DMS 301 has processed a request, the DMS 301 (e.g., modules within the DMS 302 that handled the request) "forget" that the request even occurred. In this manner, subsequently received requests are not influenced by (e.g., handled based on) previously processed requests.

[0055] In some examples, operation of the DMS 301 is stateless, but the DMS 301 can still provide a log of requests handled (e.g., using the logging sub-module). For example, a request log can be accessed during an audit of the system 300.

[0056] In some implementations, each facility system 302, 304 includes one or more local web modules 320, 330, one or more local host modules 322, 332, one or more local data cache modules 324, 334, and one or more vocabulary service modules 328, 338. In the depicted example, the facility system 302 includes one or more collector modules 326, and the facility system 304 includes one or more patient record (EMR) adapter modules 336.

[0057] In some examples, each of the web modules 320, 330 provides functionality as similarly discussed above with respect to the web module 310. More particularly, the web modules 320, 330 operate at a local level (e.g., local to the respective facility systems 302, 304), each performing request validation and user authentication, and routing requests to the respective local host modules 322, 332. For example, the web modules 320, 330 can receive requests from the respective mobile devices 102', 102", can validate the requests and authenticate the respective users/mobile devices, and route the requests accordingly. In some examples, each web module 320, 330 includes one or more sub-modules. Example sub-modules include a request validation sub-module, which validates received requests, a user authentication module, which authenticates an identity of the user and/or mobile device from which a request is received, and a request routing sub-module, which routes requests after validation and authentication.

[0058] In some examples, each of the local host modules 322, 332 provides functionality as similarly discussed above with respect to the host module 312. More particularly, the local host modules 322, 332 operate at a local level (e.g., local to the respective facility systems 302, 304), each orchestrating request processing. In some examples, the local host modules 322, 332 orchestrate request processing for requests received from the mobile device 102 through the DMS 301, and/or from the respective mobile devices 102', 102" through the respective local web modules 320, 330. In some examples, each local host module 322, 332 includes one or more sub-modules. Example sub-modules include a request parsing sub-module that parses received requests, a pipeline assembly sub-module, a pipeline processing sub-module, an operation execution sub-module, a data access sub-module, an access control sub-module and an encryption sub-module.

[0059] In some examples, each of the local data cache modules 324, 334 provides functionality as similarly discussed above with respect to the data cache module 314. More particularly, the local data cache modules 324, 334 operate at a local level (e.g., local to the respective facility systems 302, 304), each enabling access to and optional storage of detailed patient data/information used by other components of the system 300. In some examples, the each data cache module 324, 334 can operate in a pass-through mode and a reposed mode, as discussed above with respect to the data cache module 314. In the pass-through mode, the local data cache modules 324, 334 retrieve the patient data/information from one or more local data sources and passed the patient data/information onward for responding to the request. In some examples, it might be desired to improve retrieval performance. Consequently, the local data cache modules 324, 334 can store data identifiers and/or pointers in a persistent data store. When in the pass-through mode, the local data cache modules 324, 334 use the collector module 326 and the patient record adapter module 336, respectively, to perform the actual retrieval of patient data/information from local data source(s) (e.g., the patient record module 303 and the patient record module 305, respectively). In some examples, when in the pass-through mode, the local data cache modules 324, 334 can write data back to the respective patient record modules 303, 305.

[0060] In some examples, the patient data/information that is required to satisfy a request (e.g., from the mobile device 102', 102") cannot be directly accessed from the local data sources (e.g., the patient record modules 303, 305). In such examples, each local data cache module 324, 334 can operate in the reposed mode. In some examples, in the reposed mode, the local data cache module 324, 334 stores a detailed copy of the patient data/information in the persistent data store. That is, for example, stored patient data/information is stored at the local level, having been previously received from local data source(s) (e.g., the patient record modules 303, 305). In some examples, when a request is made for patient data/information in the reposed mode, the patient data/information is retrieved directly from the persistent data store (e.g., by the cache services sub-module).

[0061] In some implementations, the collector module 326 and the adapter module 336 are specific to the type of patient record module 303, 305, respectively. In the example of FIG. 3, the patient record module 303 can be accessed based on a particular messaging protocol. An example messaging protocol can include the Health Level 7 (HL7) messaging protocol. In some examples, patient data/information provided based on such messaging protocols is reposed by the data cache module 324. Consequently, requests for such data can be fulfilled based on operation of the data cache module 314 and/or the local data cache module 324 in the reposed mode, as discussed above. In some examples, changes to patient records in the patient record module 303 can trigger updating of reposed patient data/information by the data cache modules 314, 324. For example, the collector module 326 can automatically receive a message from the patient record module 303 in response to a change/updated, triggering updating/changing of reposed patient data/information.

[0062] In the example of FIG. 3, the patient record module 305 supports programmatic interface (e.g., API) access. In some examples, patient data/information provided through programmatic interfaces is passed-through the data cache module 314 and/or the data cache module 334. Consequently, requests for such data can be fulfilled based on operation of the data cache module 314 and/or the local data cache module 334 in the pass-through mode, as discussed above. In this manner, such patient data/information is not persisted by the data cache module 314, 334.

[0063] Although the example of FIG. 3 depicts facility systems 302, 304 having different types of patient record modules 303, 305, it is appreciated that facility systems can include any appropriate combination of types of patient record modules and any number of patient record modules (e.g., patient record modules 303, 305), and respective adapter modules (e.g., modules 326, 336). Further, although the example of FIG. 3 depicts two facility systems, implementations of the present disclosure are applicable in instances include any number of facility systems.

[0064] In some implementations, the vocabulary services modules 328, 338 perform translation between the vendor-specific vocabularies and a standard vocabulary. In this manner, patient data/information retrieved through the modules 303, 305 use standard vocabulary to be provided back to the mobile device 102 in a unified manner. For example, the patient record modules 303, 305 can each be provided by a respective third-party (e.g., a vendor) and can record data/information based on a vocabulary that is specific to the particular vendor. Consequently, data sources provided from different third-parties can refer to the same data/information or type of data/information using different terminology. In some examples, each vocabulary service module 328, 338 is specific to a respective patient record module 303, 305.

[0065] FIG. 4 is a more detailed view of the functional block diagram of FIG. 3, depicting additional components of the example system 300. In the depicted example, the DMS 301 further includes a patient list import module 400, a patient membership portal module 402, a patient matching service module 404, a provider management (mgmt) module 406, a patient information data store 408, and a directory information data store 410. In some examples, the patient information data store 408 stores patient demographic information 420, a data pointer cache 422, a patient-to-provider index 424 and a patient-to-facility index 426. In some examples, the directory information data store 410 stores a facility directory 430, a provider directory 432, and provider-to-facility index 434.

[0066] In some implementations, the patient list import module 400 enables initial and ongoing import of patient lists and patient demographic information for patients. In some examples, the patient list import module 400 provides an interface to receive a patient list, e.g., provided in a computer-readable document, and processes the patient list to populate the patient information data store 408 (e.g., the demographic information 420). In some examples, the patient membership portal module 402 provides an interface that enables users (e.g., an administrator) to establish relationships between patient data/information stored across healthcare continua and particular patients. In some examples, healthcare providers, facilities and/or facility systems across healthcare continua can be included in a healthcare organization (e.g., an accountable care organization (ACO)). In some examples, the patient membership portal module 402 enables a user to define relationships between multiple patient records (e.g., based on respective medical record numbers (MRNs)) to the healthcare organization. In some examples, relationship information defined through the patient membership portal module 402 can be stored in the patient information data store 408.

[0067] In some implementations, the patient matching service module 404 can be accessed by the host module 312 and the patient membership portal module 402. In some examples, the patient matching service module 404 can be accessed by an application executed on a mobile device (e.g., the mobile device 102) through the host module 312. In some examples, the patient matching service module 404 processes patient data and/or patient information to identify potential patient matches between disparate data sources (e.g., multiple, different EMRs across the healthcare continuum). In some examples, patient information associated with confirmed matches (e.g., confirmed by an administrator through the patient membership portal module 402, confirmed by a healthcare provider using a mobile device through the host module 312) can be stored in the patient information data store 408. In some examples, a patient matching user interface (UI) is provided (e.g., displayed on a mobile device) and can be used by a healthcare provider to search for patients and establish, record and/or confirm relationships between patient records in different systems that are related to a single patient.

[0068] In some examples, the demographics information 420 includes information that can be used to identify any patient that has been established in the system. In some examples, the demographics information 420 can be used to search for patients, discussed in further detail herein. Example demographics information can include name, age and/or gender. In some examples, the data pointer cache 422 stores identifiers associated with detailed patient data. In some examples, the identifiers point to particular data stores, in which to be retrieved patient data/information is stored. In this manner, retrieval performance (e.g., speed) can be improved. In some examples, the patient-to-provider index 424 maps particular patients to one or more healthcare providers, and/or particular healthcare providers to one or more patients. For example, a patient can be treated by a plurality of healthcare providers (e.g., members of a patient care team, discussed below). As another example, a healthcare provider can treat a plurality of patients. In some examples, the patient-to-facility index 426 maps particular patients to one or more facilities and/or facility systems. In some examples, a patient can be mapped to particular facilities based on respective MRNs of the patient at the respective facilities. For example, a healthcare continuum for a particular patient can include a hospital and a clinic. In this example, the patient-to-facility index can map the patient to the MRN of the hospital and the MRN of the clinic.

[0069] In some implementations, the provider management portal module 406 provides an interface (e.g., web portal) to enable members of a healthcare organization (e.g., ACO) to update healthcare provider directory information and/or healthcare provider-to-facility relationships. For example, a physician can be associated with one or more facility systems of the healthcare organization and credentials (e.g., for log on and/or authentication) can be provided to enable the physician to access patient data/information provided from the one or more facility systems.

[0070] In some examples, the facility directory 430 provides a directory of the facilities interfaced to by the system (e.g., the DMS 301). In some examples, the facility directory 430 also provides configuration parameters to enable communication (messaging) between the system and computing devices associated with the respective facilities. In some examples, the provider directory 432 includes a directory of healthcare providers (e.g., nurses, physicians, specialists, and the like) that are able to access patient data/information through the system (e.g., the DMS 301). In some examples, the provider-to-facility index 434 maps each healthcare provider (e.g., in the provider directory) to one or more facilities. For example, a healthcare provider can treat patients at multiple facilities. In some examples, the provider-to-facility index 434 securely stores credentials of healthcare providers for facilities that the healthcare provider is mapped to.

For example, a healthcare provider can have first credentials for accessing patient data/information at a first facility, and can have second credentials for accessing patient data/information at a second facility. In some examples, the provider-to-facility index 434 supports single sign-on functionality discussed in further detail herein.

[0071] An example data flow will be discussed to illustrate implementations of the present disclosure. It is appreciated that implementations of the present disclosure are equally applicable to other data flows. The example data flow can be initiated in response to a request received from a mobile device (e.g., the mobile device 102). In some examples, the request includes a user identifier, a device identifier, a patient identifier, patient data identifiers, patient information identifiers and additional data identifiers. In some examples, the user identifier can be used to determine the particular user that has issued the request, and the device identifier can be used to determine the particular device that transmitted the request. In some examples, the patient identifier identifies the particular patient that is the subject of the request, the patient data identifiers identify the particular patient data that has been requested, the patient information identifiers identify the particular patient information that has been requested, and the additional data identifiers identify additional data that has been requested. For example, the patient data identifiers can indicate that patient vital data has been requested, and the additional data identifiers can indicate that vitals alarm data and vital data trend visualizations have also been requested.

[0072] In the example data flow, the web module 310 receives the request and processes the request to validate the request and to authenticate the user, who submitted the request (e.g., based on the user identifier and/or the device identifier). Upon validation and authentication, the web module 310 provides the request to the host module 312. The host module 312 processes the request, as discussed above. In some examples, it can be determined that patient data/information required to fulfill the request can be provided from the data cache module 314 (e.g., reposed mode). In such examples, the patient data/information is provided to the host module 312 from the data cache module 314. In some examples, it can be determined that that patient data/information required to fulfill the request is to be retrieved from one or more data sources across a healthcare continuum of the patient (e.g., federated mode).

[0073] In some examples, if patient data/information required to fulfill the request is to be retrieved from one or more data sources across the healthcare continuum (e.g. federated mode), request information (e.g., assembled by the host module 312, as discussed above) is provided to the adapter module 316 by data cache module 314. In some examples, the adapter module 316 accesses information stored in the directory store 410 to request data from one or more facility systems (e.g., the facility system 304). For example, the adapter module 316 can be aware of which facility systems to retrieve patient data/information from (e.g., based on the patient-to-facility index 426) and can access the provider-to-facility index 434 to retrieve user credentials for the particular provider (e.g., user that issued the request). In this manner, the adapter module 316 can provide appropriate user credentials to respective facility systems for patient data/information retrieval.

[0074] In some examples, the adapter module 316 sends requests to identified facility systems, each request identifying patient data/information and providing appropriate user credentials. In some examples, respective host modules (e.g., the host module 332) of the facility systems receive the requests from the adapter module 316, and can process the requests as similarly discussed above with reference to the host module 312. The respective host modules fulfill the requests and provide the requested patient data/information back to the adapter module 316. In some examples, the adapter module 316 provides the retrieved patient data/information to the host module 312, which completes processing of the request, as discussed above, and provides a response to the mobile device that issued the request.

[0075] As discussed at the outset, the present disclosure provides a healthcare provider, or user of the mobile device 102, with secure, remote access to patient data and/or patient information. Example patient data can include physiological data. In some examples, physiological data can be obtained from patient monitoring device(s). In some examples, physiological data can be obtained by a local healthcare provider (e.g., a nurse, or physician measuring blood pressure, temperature, heart rate). In some examples, physiological data can be recorded in one or more patient records (e.g., EMRs). In the example case of a maternity patient, patient data can include delivery progress information such as cervical exam status, membrane status, gravida, para, epidural status, and/or whether the patient is attempting a vaginal birth after cesarean (VBAC). In some examples, the term patient information refers to information corresponding to a particular patient that is, for example, input into the information system 142 by the local healthcare provider. Example patient information can include the patient's name, the name of the doctor(s) assigned to the patient, the nurse(s) assigned to the patient, a facility identification, a patient bed identification, a summary of patient data, and/or chart annotations. The term patient information can also refer to patient information provided from one or more patient records (e.g., EMRs).

[0076] The patient data and/or patient information provided to the remotely located user can be provided as real-time data, and/or as historical data and information. The patient data and/or patient information is communicated between the mobile device 102 and the DMS 160, 160' using a secure connection that is established over the network 106. A secure log-in, or sign-on process is provided, which is preferably compliant with the provisions of the Health Insurance Portability and Accountability Act (HIPAA). The secure sign-on authenticates the identity of the user of the mobile device 102 based on a unique user ID and password combination. Both the user ID and the password must be correct in order to establish the secure communication between the mobile device 102 and the DMS 160, 160'.

[0077] In some examples, a census, or patient list is provided, which captures a variety of the information and/or data described herein that is associated with each of one or more monitored patients 150. Strip charting is also provided, in which patient data and/or information can be presented to the user in graphical form. In the example case of a maternity patient, a fetal strip and maternal contraction information can be provided for a particular patient 150. More specifically, the particular patient 150 is selected from the patient list, and the patient information and/or data is subsequently presented. The presented information and/or data can include a fetal strip and maternal contraction waveform, the patient name, the hospital name, the patient room and/or bed number, and the date and time. The strip charting can provide a real-time view of the patient data, as well as a historical view of the patient data. More specifically, the waveform display can be updated in real-time, such that the user of the mobile device 102 observes the patient data as it occurs and/or is recorded. The user can scroll through the waveform display, to view historical patient data, as described in further detail below.

[0078] Several navigation features can be provided that enable the user to manipulate a view of the waveform display. In some implementations, the user can zoom in/out of the displayed image. In this manner, the user can view very specific waveform information, and/or other waveform micro-characteristics by zooming in, for example, and/or can view patterns or other waveform macro-characteristics by zooming out, for example. In some implementations, the user can scroll forward or backward through the waveform display. In this manner, the user can view historical patient data.

[0079] A patient data display can also be provided. In some implementations, the patient data display can overlay the strip charting described herein. In other implementation, the patient data display can be provided as an overlay, and/or as a separate display. The patient data display can include, but is not limited to, the patient's name, age, fetal gestation, gravida, parity, cervical exam information, and physician name.

[0080] Implementations of the present disclosure can be realized on any one of a number of operating systems, or platforms 302 associated with the particular mobile device 102. Example platforms include, but are not limited to, RIM Blackberry, Apple iOS and/or OS X, MS Pocket PC, Win Mobile (Pocket PC, Smartphone), Win Mobile (standard, professional) and/or any other appropriate platforms (e.g., Google Android, and Hewlett-Packard WebOS, Microsoft Windows, Unix, Linux).

[0081] As discussed in detail herein, implementations of the present disclosure are directed to systems and methods of providing integrated and unified views of patient data and patient information from disparate data sources and/or products. More particularly, implementations of the present disclosure provide integrated and unified views of patient data and patient information retrieved from across a healthcare continuum. In some examples, the healthcare continuum can include a plurality of disparate clinical data sources. In some examples, a clinical data source can correspond to one or more categories of healthcare services. Example categories can include emergency medical services (EMS), outpatient services, inpatient services, ambulatory services, post-acute services, home services and stand-alone services. Example EMS can include emergency departments (e.g., emergency room (ER) of a hospital), urgent care facilities and transport (e.g., ambulance). Example outpatient services and/or inpatient services can include hospitals and/or critical access hospitals (CAHs). Example ambulatory services can include clinics, physicians groups/offices, surgery centers and pre-acute care. Example post-acute services can include skilled nursing facilities, long-term care hospitals, rehabilitation centers and home healthcare. Example stand-alone services can include imaging centers (e.g., MIR), oncology centers, laboratories, virtual call centers and retail clinics.

[0082] FIG. 5 depicts an example platform 500 for providing integrated and unified views of patient data and patient information. The example platform 500 includes one or more product applications 502 and core components 504. The example platform enables the transfer of patient data/information to/from one or more data sources 506 for display on a mobile device (e.g., the mobile device 102). In some examples, the example platform 500 is provided as one or more computer-executable programs that are executed using one or more computing devices (e.g., the DMS 160, 160'). Example data sources 506 can include one or more medical devices (e.g., bedside monitors), one or more EMRs, health information exchange (HIE) data 512, image data 514 (e.g., x-ray data), and sensor data 516.

[0083] In some implementations, the example platform 500 can include a mobile application platform 520. An example mobile application platform 520 can include the mobile application platform disclosed in U.S. App. No. 13/716,974, filed December 17, 2012, and which claims the benefit of U.S. Prov. App. No. 61/579,954, filed December 23, 2011.

[0084] In some examples, the mobile application platform 520 separates native graphical user interface (GUI) and operating system components from the application logic. In this manner, the mobile application platform 520 translates and interprets application logic into the native languages of each operating system of mobile devices to/from which patient data/information is to be transferred, and embraces the unique properties, features, function, and usability of each operating system. In some implementations, the mobile application platform 520 embodies a template-based approach, where one or more templates are provided, each template corresponding to a view of patient data/information that is to be presented on a mobile device. In some examples, and as discussed in further detail herein, default templates can be provided, which provide default views of patient data/information. In some examples, custom templates can be provided, and can include templates customized by a user of a mobile device.

[0085] In some examples, the mobile application platform 520 processes patient data/information based on a template that defines a view to be displayed on the mobile device. In some examples, the mobile application platform 520 generates instructions for rendering graphics based on the patient data/information and the template, and provides instructions to the mobile device, the mobile device executing the instructions to provide the template-based view of the patient data/patient (e.g., rendering the patient data/information in a view displayed on the mobile device).

[0086] In some examples, the product applications 502 can include medical software applications that enable mobility in healthcare. For example, products can enable patient information and patient data (e.g., waveforms and other critical data from EMRs, bedside monitors and devices, pharmacy, lab, and other clinical information systems) to be securely and natively accessed by healthcare provides on mobile devices. Example products can include an obstetrics (OB) product (e.g., AirStrip OB provided by AirStrip Technologies, LLC), a cardiologiy product (e.g., AirStrip CARDIO provided by AirStrip Technologies, LLC), a patient monitoring product (e.g., AirStrip PATIENT MONITORING provided by AirStrip Technologies, LLC), and an EMR extension product (e.g., AirStrip EMR EXTENDER provided by AirStrip Technologies, LLC).

[0087] FIG. 6 depicts example components and sub-components that can be included in the core components 504 of FIG. 5. In some examples, each component and/or sub-component can be provided as one or more computer-executable programs that can be executed using one or more computing devices (e.g., computing devices of the DMS 160, 160' of FIGs. 1 and 2). In some examples, the core components provide secure data access and data transport, single sign-on and profile/context management, interoperability (data adapters and interfaces), intelligent message routing, master patient indices (e.g., EMPI) and care collaboration.

[0088] In the depicted example, the core components 504 include a security component 600, a care coordination and collaboration interfaces component 602, a data and workflow integration component 604, a data source adapters component 606 and a services component 608. In the depicted example, the security component 600 includes a single sign-on sub-component 610 and a user context/profiles sub-component 612. In the depicted example, the care coordination and collaboration interfaces component 602 includes a voice sub-component 614, a video sub-component 616 and a messaging sub-component 618. In the depicted example, the data and workflow integration component 604 includes a patient index (or indices) component 620 and an intelligent routing sub-component 622. In some examples, the data source adapters component 606 can include adapter services sub-components 624 (e.g., the adapter services module 324 of FIG. 3). In the depicted example, the services component 608 includes a reporting and analytics sub-component 626, a clinical transformation sub-component 628 and an implementation and support sub-component 630.

[0089] In some examples, the single sign-on sub-component 610 supports single sign-on functionality, discussed herein. In some examples, a user can be authenticated once (e.g., by providing log-in credentials to an application executed on a mobile device) and can be provided access to data across a plurality of data sources, without being authenticated for each data source individually. In some examples, the user context/profiles sub-component 612 supports user-specific customizations based on a context of the user and/or a profile of the user, as discussed in further detail herein. Example contexts can include the user being an attending physician at one hospital and a part-time physician at another hospital. In some examples, one or more profiles can be associated with the user, each profile reflecting one or more customizations associated with the particular user. For example, the user can customize a default view that can be displayed on a mobile device, to provide a customized view. Consequently, after the user is authenticated, one or more user-defined (user-customized) views can be provided to the mobile device.

[0090] In some examples, the care coordination and collaboration interfaces component 602 supports collaboration between members of a patient care team. For example, a patient care team can include a physician, a consultant, a specialist, an intensivist and a nurse. In some examples, the voice sub-component 614 provides voice-based collaboration between care team members (e.g., teleconferencing). In some examples, the video sub-component 616 provides video-based collaboration between care team members (e.g., video conferencing). In some examples, the messaging sub-component 618 provides messaging-based collaboration between care team members (e.g., SMS/MMS text messaging). In some examples, the care coordination and collaboration component 602 provides security in remote collaboration between care team members (e.g., secure teleconferencing, secure video conferencing and/or secure messaging).

[0091] In some examples, the data and workflow integration component 604 integrates data from a plurality of data sources and routes data for display on mobile devices. In some examples, the patient index (or indices) component 620 provides one or more indices for mapping users to facilities and/or patients. In some examples, one or more indices can be provided to associate a user (e.g., a physician) with a facility or multiple facilities (e.g., hospitals), to associate a patient with a facility or multiple facilities, and/or to associate a user with one or more patients. In some examples, an index can be based on an ACO. In some examples, the ACO includes one or more healthcare providers across a healthcare continuum and can provide cross-access to patient data/information. In some examples, the intelligent routing sub-component 622 provides intelligent routing functionality, discussed above.

[0092] In some examples, the data source adapters component 606 provides adapter functionality. In the depicted example, the services component 608 includes a reporting and analytics sub-component 626, a clinical transformation sub-component 628 and an implementation and support sub-component 630.

[0093] As discussed in further detail herein, patient data and patient information can be provided from one or more disparate patient data sources (e.g., examples depicted in FIG. 5). In some examples, a patient can be associated with one or more healthcare services across the healthcare continuum. Consequently, and for each patient, patient data and patient information can be distributed across the healthcare continuum. For example, a patient can be taken to a hospital by EMS (e.g., ambulance), can be treated in an emergency department of the hospital (e.g., ER), can stay in the hospital on an inpatient basis, can frequent a rehabilitation center (e.g., physical therapy), can be undergoing home healthcare (e.g., home nursing care), and patient samples can be sent to a laboratory for analysis (e.g., blood analysis provided by an external laboratory). In this example, treatment of the particular patient touches multiple facilities across the healthcare continuum, and each facility can generate its own patient data, patient information and patient records (EMRs).

[0094] In general, an EMR can be described as a digital medical record provided as an electronic document that can be processed (e.g., read from / written to) by one or more computer programs executed by one or more computing devices. Further, each entity or organization (e.g., clinic, hospital, physician, rehabilitation center, laboratory) that treats a patient can include its own, stand-alone information system that provides an EMR that is specific to the information system. Consequently, multiple, disparate EMRs can be provided for a single patient across the healthcare continuum. Within the context of the example above, a first EMR can be provided for the patient by an ambulance service that transported the patient to the hospital, a second EMR can be provided for the patient by the hospital, a third EMR can be provided for the patient by the rehabilitation center and a fourth EMR can be provided for the patient by a nursing company that is providing home nursing care to the patient. In some examples, and as noted above, EMRs can be generated from disparate information systems. Consequently, format and syntax of one EMR can be different from the format and syntax of another EMR.

[0095] In some examples, historical patient data and information can be provided for viewing by a healthcare provider, as well as providing real-time patient data for viewing to the healthcare provider. Extending the example above, the patient can be re-admitted to the hospital on an inpatient basis and can be connected to one or more patient monitoring devices that generate patient physiological data based on patient physiological activity. In accordance with implementations of the present disclosure, and as discussed in further detail herein, patient data and information from one or more of the first EMR, the second EMR, the third EMR and the fourth EMR, as well as real-time patient data can be provided for display to a healthcare provider (e.g., a physician attending to the patient) on a mobile device in an integrated and unified manner. For example, real-time and/or historical patient physiological data can be provided for display by multiple products (e.g., a cardiology product and a patient monitoring product). Implementations of the present disclosure enable integration and unification of the patient physiological data across the products.

[0096] In accordance with implementations of the present disclosure, patient data can be displayed to a user of a computing device. In some implementations, the user provides log-in credentials to an application that is executed on the mobile device. For example, the application can open and can provide a log-in screen for the user to provide credentials. In some examples, the credentials can include a personal identification number (PIN). If the PIN is not authenticated (e.g., the user-input PIN is not the same as a pre-stored PIN), an error is displayed. If the PIN is authenticated (e.g., the user-input PIN is the same as a pre-stored PIN), a sites screen or a base screen can be displayed. In some examples, authentication can be provided based on a personal identifier (e.g., the PIN) and another identifier. In some examples, another identifier can include an identifier that is unique to a mobile device that the user is using. For example, the PIN and a unique device identifier can be provided for authentication.

[0097] FIG. 7 depicts an example sites screen 700. In some implementations, the sites screen 700 provides a GUI including one or more site icons that can be selected (e.g., clicked on) by the user. In some examples, a site can include a specific facility (e.g., hospital clinic), a system of facilities (e.g., a hospital system including one or more hospitals, one or more clinics, and/or one or more laboratories, and the like). In some examples, an index (e.g., a user-facility index) can be accessed based on an identifier associated with the user, to determine the one or more site icons that are to be displayed to the user. In some examples, in response to the PIN being authenticated, an identifier associated with the user can be provided to the DMS 160', for example, by the mobile device 102 (see FIGs. 1 and 2). In some examples, the DMS 160' stores an index (e.g., a user-facility index) that is accessed based on the identifier. In some examples, the index maps the identifier associated with the user to one or more facilities that the user is associated with. In response, the DMS 160' provides instructions to the mobile device 102 to display the sites screen 700 including the one or more site icons 702, 704, 706, 708, 710, 712, 714, 716, each site icon being a graphical representation of a facility of facilities that the user is associated with.

[0098] In some implementations, and as noted above, the user can be associated with more than one site (e.g., 702, 704, 706, 708, 710, 712, 714, 716). In some implementations, the user is affiliated with a single site, which is included in a network that includes a plurality of inter-communicating sites associated therewith. In some examples, a site can include a medical center, a dispensary, a hospital, an infirmary, a surgery center, an ambulatory setting, a nursing home, a rest home, a sanatorium, a sanitarium, or any other appropriate healthcare facility. In some implementations, the site screen 700 can provide a summary of each site and/or specific sites, with which the user is associated. In some examples, a site summary can include a plurality of selectable icons (e.g. a site access icon, a site information icon, a patient information icon, etc.). In some implementations, each site summary can include attributes (e.g. patient counts).

[0099] User input can be provided to the site screen 700, the user input indicating a selection of a site icon of the one or more site icons. In some examples, user input can include touching of a touchscreen display with a digit (e.g., finger), a stylus, and/or other pointing device, as well as with a digital cursor and/or a keypad.

[00100] In some implementations, a base screen can be displayed. In accordance with implementations of the present disclosure, and as discussed in further detail herein, the base screen can include a menu. In some examples, the menu provides a GUI, through which the user can request display of patient data/information. In some examples, the menu is a user-specific menu. In some examples, the menu is specific to one or more user contexts. In some examples, the menu is specific to a site selected by the user. In some examples, the base screen is displayed in response to the PIN being authenticated. In some examples, the base screen is displayed in response to user input to the sites screen.

[00101] In accordance with implementations of the present disclosure, the menu is provided as a slide-out menu that is animated in response to user selection of an icon. In some examples, the menu can be animated such that the menu appears to slide-out from an edge of the base screen (e.g., left-side edge). In some examples, the menu is animated such that the menu appears to slide-in to the edge of the base screen in response to user selection of an icon from the menu.

[00102] In accordance with implementations of the present disclosure, the menu can include icon groups. In some examples, the icon groups can be provided as default icon groups. For example, a default icon group can be displayed in the menu, the default icon group being agnostic to the particular user (e.g., displayed for any user). In some examples, the icon groups can include user-customized icon groups. For example, the menu can include a user-customized icon group that is specific to (e.g., that was defined by) the user. In some examples, the icon groups can include user-specific and/or site-specific icon groups. For example, an icon group can include a workflow icon group that is specific to the role of the user (e.g., an attending physician) at a specific facility.

[00103] FIGs. 8 illustrates an example screen-shot of a base screen 800 that includes a menu 802. The example base screen 800 of FIG. 8 is user-specific and site-specific. For example, the base screen 800 can be displayed in response to user selection of a site icon (e.g., the site icon 704 of FIG. 7). Consequently, a site identifier 816 can be provided to indicate the site, to which the menu 802 is specific. In some examples, a request for the base screen is provided to the DMS 160' in response to user selection of an icon from the sites screen 700. In some examples, the request indicates the site that was selected. In some examples, a user-facility index can be accessed to determine a configuration of a menu to be displayed in the base screen. For example, and for a given site (facility), the user can have an associated profile, user-defined patient groups, context-specific workflows and/or facility-specific workflows. Consequently, the DMS 160' can provide instructions for displaying a user-specific, site-specific base screen, such as the example base screen 800 of FIG. 8. More particularly, the instructions can include instructions for displaying a user-specific, site-specific menu 802 for the base screen 800.

[00104] In the depicted example, the menu 802 provides icons for initiating respective displays of patient data/information. In the menu 802, the icons are displayed in icon groups, or menu groups 804a, 804b. It is appreciated that more or fewer icon groups can be displayed. In the example of FIG. 8, the icon group 804a can be provided as a default icon group. For example, the icon group 804a includes icons “My Patients” 806, “Recently Viewed” 808, and “Find Patients” 810. In some examples, the icons 806, 808, 810 are default icons. That is, for example, the icons 806, 808, 810 are not specific to the user and/or the facility (e.g., the icons 806, 808, 810 are displayed regardless of the particular user and/or the particular facility). In some examples, the icon group 804a can be customized by the user. For example, the user can define a patient group (e.g., “My

Cardio Patients," "My OB Patients") and can associate one or more patients with the group. Consequently, an icon that is representative of a user-defined group can be displayed in the icon group 804a.

[00105] In the example of FIG. 8, the icon group 804b can be provided as a user-specific and facility-specific icon group. For examples, the icon group 804b can be representative of a workflow (e.g., "Cardio") associated with the user at the particular facility (e.g., as indicated by the identifier 816). Consequently, the icon group 804a can include icons that are relevant to the particular workflow. In the depicted example, the icon group 804b includes an "In Basket" icon 812 and an "EMS" icon 814. In some examples, a workflow can include one or more tasks to be performed by the user as part of the user's role at a particular facility.

[00106] In some implementations, a request can be provided to the DMS 160' in response to user selection of an icon from the menu 802. In the example of FIG. 8, the user can select the "My Patients" icon 806. In response, a request can be provided to the DMS 160', the request indicating a request for a list of all patients that the user is associated with. The DMS 160' can provide a response that includes instructions to display a list of all patients associated with the user and can include patient data/information for display. In some examples, and in response to the user selection of the "My Patients" icon 806, the menu 802 is animated to slide-in to the edge of the screen.

[00107] FIG. 9 depicts an example patient data dashboard 900. In some implementations, the dashboard can provide a timeline 902 of patient data and/or patient information associated with a particular patient. In some examples, the timeline 902 provides an interactive, chronological ordering of medical events associated with the particular patient. More particularly, the timeline 902 can include graphical representations of one or more medical events provided in chronological order. In the depicted example, example events include hospital admission (event 904a, 904e), hospital discharge (event 904d), alarms (events 904b, 904g), lab results (event 904e), ECG testing (event 904f), and/or any other appropriate event. In some examples, each graphical representation of an event provides summary information associated with the event (e.g., date/time of the event, type of event, notes describing the event.

[00108] In some examples, event data can be retrieved from one or more information systems. In some examples, event data can be retrieved from one or more EMR systems, ECG management systems, perinatal systems, and/or any appropriate clinical information system. The event data can be processed to provide the respective graphical representations of the events.

[00109] In some implementations, the graphical representations of the events are interactive. For example, a user can tap-on a graphical representation of a particular event and, in response, detailed information of the event can be retrieved and can be displayed. In this manner, the user can have quick access to detailed patient information with the timeline 902 providing overall context for the detailed patient information.

[00110] In some implementations, the timeline is scrollable forward or backward in time to provide a complete picture of events provided in the EMR. In some examples, a user swiping motion on the touchscreen display can induce scrolling of the timeline to reveal previously un-displayed events and to hide previously displayed events.

[00111] In some implementations, the dashboard 900 includes quick access to other patient information. In the depicted example, the dashboard 900 includes icons 906, 908, the icon 906 being associated with a patient monitor and alarms and the icon 908 being associated with patient laboratory work and medications. In some examples, and in response to the user tapping on the icon 906, patient data can be displayed (e.g., patient vital display). In some examples, and in response to the user tapping on the icon 908, laboratory and medication information can be displayed.

[00112] FIGs. 10A-10D illustrate more detailed timeline views in accordance with implementations of the present disclosure. More specifically, FIGs. 10A-10D provide example screenshots of a "Timeline" screen 1000 that can be displayed in response to user selection of a "Timeline" icon 1002 in a patient summary screen (not shown). In this example, the screen 1000 is user-specific and patient-specific. In some examples, the screen 1000 can be site-specific (e.g., specific to General Hospital). In some examples, the screen 1000 can be site-agnostic.

[00113] The screen 1000 includes a display region 1004 and a menu 1006. The menu 1006 provides icons for applying filters to a timeline 1007 displayed in the display region 1004. In the depicted example, the menu 1006 includes a "Summary" icon 1008, a

"Vitals" icon 1010, a "Labs" icon 1012, a "Medications" icon 1014, an "Imaging" icon 1016, a "Documents" icon 1018, and an "ECGs" icon 1020. In the depicted example, the icon 1008 is selected.

[00114] The timeline 1007 provides an interactive, chronological ordering of medical events associated with the particular patient. More particularly, the timeline 1007 includes graphical representations of one or more medical events provided in chronological order. In the depicted example, each medical event corresponds to an event category. Example event categories include patient vitals, laboratory results, medications, imaging, documents and ECGs. In some examples, the example categories respectively correspond to the icons 1010, 1012, 1014, 1016, 1018, 1020.

[00115] In the example of FIGs. 10A and 10B, the timeline 1007 includes graphical representations corresponding to an imaging event 1030, medication events 1032a, 1032b, 1032c, 1032d, ECG events 1034a, 1034b, an activation event 1036, a procedure event 1038, orders events 1040a, 1040b, note events 1042a, 1042b, alarm events 1044a, 1044b, a consultation event 1046, and a vitals event 1048. In the example of FIGs. 10A and 10B, the screen 1000 of FIG. 10A depicts a first portion of the timeline 1007, and the screen 1000 of FIG. 10B depicts a second portion of the timeline 1007, the first portion being earlier in time than the second portion. In some examples, user input can be provided to the touchscreen display to induce scrolling (e.g., left-right scrolling) of the timeline. For example, a user swiping gesture from right-to-left in the screen 1000 can result in scrolling of the screen from displaying the first portion (FIG. 10A) to displaying the second portion (FIG. 10B).

[00116] In the example of FIGs. 10A and 10B, the screen 1000 depicts approximately a 12-hour period from edge-to-edge (e.g., left edge to right edge). In some examples, a marker can be provided to delineate time periods. For example, FIG. 10B depicts a date marker 1050 indicating that events occurring to the left of the date marker 1050 occurred on or before the indicated date (e.g., 07/19/2012), and that events occurring to the left of the date marker 1050 occurred after the indicated date.

[00117] In some implementations, the extent of a time period displayed in the screen 1000 at a given moment can be adjusted. In some examples, the user can zoom in, to provide a more detailed timeline view (e.g., a shorter time period). In some examples, the user can zoom out to provide a less detailed timeline view (e.g., a longer time period). For example, and as noted above, the screen 1000 of FIGs. 10A and 10B depicts approximately a 12-hour period. The user can provide user input to zoom in, such that the screen depicts a shorter time period (e.g., 6 hours, 1 hour). The user can provide user input to zoom out, such that the screen depicts a longer time period (e.g., 24 hours, 1 week, 1 month, 6 months, 1 year, 2 years). In some examples, information and/or graphics provided in the graphical representations and/or the size of graphical representations can be adjusted based on the time period being displayed and/or the number of graphical representations being displayed. In this manner, crowding of the screen (which can make review of the timeline difficult) can be inhibited.

[00118] In accordance with implementations of the present disclosure, each graphical representation can include summary patient data/information, as well as event-specific information. For example, each medication event 1032a, 1032b, 1032c, 1032d includes a time and date (e.g., a timestamp) associated with the respective medication event, and includes a brief description of the respective medication event. As another example, each alarm event 1044a, 1044b includes a time and date (e.g., a timestamp) associated with the respective alarm event, and includes a graphical (e.g., waveform) and textual patient data that is specific to the respective alarm event. As another example, each ECG event 1034a, 1034b includes a time and date (e.g., a timestamp) associated with the respective ECG event, and includes one or more graphical (e.g., waveform) and textual patient data that are specific to the respective ECG event. As another example, the image event 1030 includes a time and date (e.g., a timestamp) associated with the image event, and includes graphical (e.g., thumbnail images) and textual patient data that is specific to the respective imaging event. For example, thumbnail images can be provided that correspond to the actual images (e.g., x-rays, MRIs, CT scans) associated with the respective event.

[00119] In some implementations, graphical representations can include a generic icon representative of an event category associated with a medical event. In this manner, the user is able to readily discern event categories between events on the timeline. For example, each medication event 1032a, 1032b, 1032c, 1032d includes an icon depicting a generic prescription bottle. As another example, each orders event 1040a, 1040b includes an icon depicting a generic clipboard. In some examples, icons provided in a graphical representation can be specific to a sub-category of an event. In some examples, a consultation (e.g., between physicians treating a patient) can occur in-person, by teleconference, or video-conference). Consequently, a graphical representation corresponding to a consultation event can include an icon that is specific to the manner in which the underlying consultation was conducted. For example, the consultation event 1046 includes a camera icon visually indicating that the underlying consultation was conducted by video-conference. In some examples, a telephone icon can visually indicate that an underlying consultation was conducted by teleconference, and a caricature icon (e.g., depicting one or more persons) can visually indicate that the underlying consultation was conducted in-person. In some examples, medication can be provided to a patient in various manners. For example, medication can be administered orally (e.g., pills, liquid), or intravenously (e.g., an injection (shot), continuous IV infusion). Consequently, a graphical representation corresponding to a medication event can include an icon that is specific to the manner in which the underlying medication was administered.

[00120] In some implementations, and as discussed above, graphical representations can provide actual patient data/information. For example, each alarm event 1044a, 1044b depicts actual waveforms and textual values. In some examples, graphical representations can depict actual patient data/information in caricaturized form. For example, each note event 1042a, 1042b can include a caricaturized depiction of actual notes. In some examples, notes such as physician notes and/or nursing notes can be digitally entered (e.g., into an EMR). In some examples, the caricaturized depiction includes the text of the actual notes, but the text is displayed in a font that is representative of handwriting, as depicted in FIGs. 10A and 10B). In some examples, the caricaturized depiction can also include the “handwritten” notes displayed on a notepad, as depicted in FIGs. 10A and 10B. In this manner, the actual text is provided, but in caricaturized form, such that the user is quickly able to discern note events from other displayed events in the timeline.

[00121] In accordance with implementations of the present disclosure, graphical representations of events are user-selectable to induce display of a corresponding screen associated with a respective event. In some examples, a user can select an event from the timeline (e.g., tap on the event), and a screen can be displayed corresponding to the event. For example, user input (e.g., tap on) to the imaging event 1030 can be received, and in response, an imaging screen can be displayed (e.g., replacing the screen 1000) that provides further detail of the event, and/or larger images associated with the event. As another example, user input (e.g., tap on) to the alarm event 1044a can be received, and in response, an alarms screen can be displayed (e.g., replacing the screen 1000) that provides further detail of the event, and/or larger waveform(s) associated with the event.

[00122] In some implementations, graphical representations provided in the timeline 1007 are interactive. More specifically, user input can be provided to a graphical representation of an event and the event can be modified in response to the user input. For example, user input can be provided to the note event 1042a and can indicate a user command to scroll. In response to the user input, the notes displayed in the note event 1042a can be scrolled (e.g., upward-downward, left-right) to reveal additional notes not originally displayed. In this manner, the user can read the extent of the notes without having to navigate away from the screen 1000 (e.g., to a notes screen). As another example, user input can be provided to the alarm event 1044a and can indicate a user command to scroll. In response to the user input, the waveform displayed within the alarm event 1044a can be scrolled (e.g., upward-downward, left-right) to reveal additional waveform data not originally displayed. In this manner, the user can review the extent of the waveform without having to navigate away from the screen 1000 (e.g., to a waveform screen).

[00123] In the example of FIGs. 10A and 10B, the timeline 1007 is an unfiltered timeline and includes all events associated with the user, regardless of event category. For example, and in response to selection of the summary icon 1008, and the timeline icon 1002, an unfiltered timeline associated with the respective patient is displayed (e.g., the timeline 1007).

[00124] In some implementations, the timeline 1007 can be filtered to display specific event categories. In some examples, the timeline 1007 can be filtered based on the icons 1010, 1012, 1014, 1016, 1018, 1020 to provide respective filtered timelines. For example, FIGs. 10C and 10D depict filtered timelines 1007', 1007'', respectively. More particularly, the timeline 1007' of FIG. 10C is displayed in response to user selection of the icon 1012 and includes graphical representations corresponding to laboratory result events for the particular patient. The timeline 1007" of FIG. 10D is displayed in response to user selection of the icon 1014 and includes graphical representations corresponding to medication events for the particular patient.

[00125] FIG. 11 depicts an example stacked waveform viewer 1100. In the depicted example, the stacked waveform viewer 1100 depicts a single physiological waveform and associated medical information. The stacked waveform viewer 1100 eases the visualization by illustrating the variation of physiological waveforms over time.

[00126] In some implementations, a continuous waveform is divided into waveform segments and each waveform segment is depicted in a respective segment sub-viewer 1102a-1102g. In some examples, the top-most segment sub-viewer 1102a is associated with the most-recent waveform segment. For example, the right edge of the waveform segment displayed in the segment sub-viewer 1102a can be associated with a current time (t_{NOW}), representing the most-recently received (or measured) physiological data. The left edge of the waveform segment displayed in the segment sub-viewer 1102a corresponds to an older acquisition of the physiological data, and is continued at the right edge of the segment sub-viewer 1102b displayed one level lower in the stack. Consequently, the physiological waveform displayed in the lowest segment sub-viewer 1102g represents the oldest acquired data, ending at an initial point in time (t_{INIT}) (e.g., when patient data collection started).

[00127] In some implementations, a user can interact with a device displaying the stacked waveform viewer 1100 (e.g., the remote device 102) to zoom in, to increase the amplitude of the displayed waveform. In some implementations, zooming can affect (e.g., reduce, increase) the number of stacked waveform segments that are displayed. For example, the example stacked waveform viewer 1100 includes seven segments. In some examples, zooming in on the example stacked waveform viewer 1100 can result in less than seven segments being displayed. In some examples, zooming out of the example stacked waveform viewer 1100 can result in more than seven segments being displayed. In some examples, zooming in on the example stacked waveform viewer 1100 can result in more than seven segments being displayed. In some examples, zooming out of the example stacked waveform viewer 1100 can result in less than seven segments being displayed.

[00128] In general, the stacked waveform view can help healthcare providers quickly view, identify, mark or delete any type of medical event. In some implementations, the stacked waveform view can enable a user to add or delete call-outs and identifiers along the waveforms to highlight specific events that have occurred in the past. For example, an event can be an irregularity that is called out and is associated with the waveform. In some implementations the patient monitoring device 146 and/or the remote device 102 can identify whether a physiological parameter is outside the normal range and automatically trigger an alarm and set a corresponding marker in the stacked waveform view.

[00129] In some implementations, the stacked waveform view can help a consumer or a family member to monitor the physiological progression of a patient. For example, the stacked waveform view can be used in nursing home care and/or home healthcare.

[00130] FIG. 12 depicts an example split-screen waveform viewer 1200. In some implementations, the split-screen waveform viewer 1200 includes a first window 1202 and a second window 1204. In the depicted example, the first window 1202 displays a portion of one or more patient data waveforms and provides a historical view. For example, a user can scroll through the waveform(s) within the first window 1202. In some examples, the user can scroll through the waveform(s) between the initial time (t_{INIT}) and the current time (t_{NOW}). In the depicted example, the second window 1204 displays a portion of the one or more patient data waveforms and provides a real-time view as patient data is collected and is represented in the waveform(s). In some examples, the second window 1204 displays the waveform(s) from the current time (t_{NOW}) and an intermediate time (t_{INTER}), where t_{INTER} is more recent than t_{INIT}.

[00131] FIG. 13 depicts another example split-screen waveform viewer 1300. In some implementations, the split-screen waveform viewer 1300 includes a first window 1302 and a second window 1304. In the depicted example, the first window 1302 displays a portion of a patient data waveform and provides a magnified view of a complete waveform. In the depicted example, the second window 1304 displays the complete waveform and provides a real-time view as patient data is collected and is represented in the waveform. In some examples, the second window 1304 includes a scrubber bar 1306 that indicates the portion of the complete waveform that is displayed in the first window 1302. In some examples, user input can be provided to move the scrubber bar 1306 back and forth across the complete waveform. In response to movement of the scrubber bar 1306, the portion of the waveform displayed in the first window 1302 is updated to reflect the portion of the complete waveform within the scrubber bar 1306.

[00132] FIG. 14 depicts an example process 1400 that can be executed in accordance with implementations of the present disclosure. In some examples, the example process 1400 can be provided in one or more computer-executable programs that can be executed using one or more computing devices (e.g., the mobile device 102 and/or the DMS 160, 160').

[00133] A command to display a timeline screen is received (1402). In some examples, user input is provided to a mobile device, the user input indicating a user command to display a timeline screen. Patient data and/or patient information are retrieved (1404) and one or more medical events are determined (1406). In some examples, in response to the user input, patient data/information associated with a particular patient is retrieved, and information regarding medical events is determined. In some examples, retrieved patient-specific data and/or medical event information are processed to determine the one or more medical events to be displayed. Instructions are provided for displaying the timeline screen (1408). The timeline screen is displayed on the mobile device. For example, the mobile device processes the instructions to display the timeline screen. In some examples, the timeline screen displays a timeline include including the one or more medical events, each medical event providing summary patient data/information associated with an underlying event.

[00134] It is determined whether a particular medical event has been selected (1410). In some examples, user input to the timeline screen can be determined, the user input indicating selection of a particular medical event from the timeline. If it is determined that a particular medical event has been selected, detailed event information and/or underlying patient data/information can be retrieved, and instructions are provided for displaying an event-specific screen (1412).

[00135] If it is determined that a particular patient has not been selected, it is determined whether a new screen is to be displayed (1414). For example, the user can choose to navigate to a different screen from the timeline screen. If it is determined that a new screen is to be displayed, the new screen is displayed (1416). If it is determined that a new screen is not to be displayed, the example process 1400 loops back.

[00136] FIG. 15 depicts an example historical strip segment viewer 1500 in accordance with implementations of the present disclosure. The strip segment viewer 1500 can be displayed on a device (e.g., the remote device 102) and can enable a user of the device to flip-through graphical representations of a waveform strip segment at different points in time to provide a graphical representation of changes to the particular strip segment over time. In the depicted example, the example waveform segment corresponds to fetal monitoring. As noted above, implementations of the present disclosure are applicable to any type of physiological data, including but not limited to, maternal/fetal heart rate, blood pressure, respiratory, vital signs, electrocardiogram, oximetry, anesthesia waveforms, and/or any other appropriate physiological data.

[00137] In accordance with the present disclosure, a waveform strip can be split into segments and strip segments can be displayed in multiple layers. Example layers can include a primary layer 1502, future secondary layers 1502a, 1502b, 1502c, 1502d and past secondary layers 1502e, 1502f, 1502g, 1502h. The primary layer 1502 depicts a strip segment associated with a particular time interval (t_i). The future secondary layers 1502a, 1502b, 1502c, 1502d depict strip segments associated with respective time intervals (t_{i+1}, t_{i+2}, t_{i+3}, t_{i+4}) that occur later in time than the time interval (t_i). The past secondary layers 1502e, 1502f, 1502g, 1502h depict strip segments associated with respective time intervals (t_{i-1}, t_{i-2}, t_{i-3}, t_{i-4}) that occur earlier in time than the time interval (t_i).

[00138] In some implementations, the layers can be scrolled forward or backward in time to provide an animation-like flip through of the strip segments. For example, the layers can be scrolled forward in time, such that the primary layer 1502 becomes the past secondary layer 1502e, the future secondary layer 1502a becomes the primary layer 1502, the future secondary layer 1502b becomes the future secondary layer 1502a, and so on. As another example, the layers can be scrolled backward in time, such that the primary layer 1502 becomes the future secondary layer 1502a, the future secondary layer 1502a becomes the future secondary layer 1502b, the past secondary layer 1502e becomes the primary layer 1502, and so on.

[00139] In some implementations, scrolling of the layers can be provided in response to user input. In some examples, scrolling of the layers can be provided in response to a user swiping action on the touchscreen. For example, a user can swipe the touchscreen in a left-to-right direction to induce scrolling of the layers backward in time. As another example, a user can swipe the touchscreen in a right-to-left direction to induce scrolling of the layers forward in time.

[00140] In some implementations, animations can be provided and can include a forward animation and a reverse animation. In some examples, the animation can be provided as a slideshow of the strip segments. In some examples, a forward animation can begin with a depiction of the strip segment associated with an initial time period (t_0) (e.g., the time at which collection of patient data began) in the primary layer. The forward animation can progress with successive depictions of the strip segments scrolling forward in time until the strip segment associated with a final time period (t_{END}) (e.g., the time at which collection of patient data ended) is depicted in the primary layer. In some examples, a reverse animation can begin with a depiction of the strip segment associated with the final time period (t_{END}) in the primary layer. The reverse animation can progress with successive depictions of the strip segments scrolling backward in time until the strip segment associated with the initial time period (t_0) is depicted in the primary layer.

[00141] In some examples, historical strip segment viewer mimics the "real" paper strip review, which is standardly used by some healthcare providers, such as in obstetrics interventions. The historical strip segment viewer provides an animated view of the paper strip in digital format, enabling the healthcare provider to historically review the physiological waveforms divided into segments covering equitemporal intervals.

[00142] In some implementations, the currently viewed physiological waveform segment is centered and it is fully displayed (i.e., in the primary layer), while the waveform segments, which are further in the past or closer to the present, are only partially displayed (i.e., in the secondary layers).

[00143] FIG. 16 illustrates a “Strip viewer” screen 1600 in accordance with implementations of the present disclosure. More specifically, FIG. 16 provides an example screenshot of the screen 1600 that can be displayed in response to user selection of one or more icons. In this example, the screen 1600 is user-specific and patient-specific.

[00144] The screen 1600 includes a display region 1604 and a menu 1606. The menu 1606 provides icons for displaying respective patient data/information in the display region 1004. In the depicted example, the menu 1606 includes a “Summary” icon 1608, a “Vitals” icon 1610, a “Labs” icon 1612, a “Medications” icon 1614, an “Imaging” icon 1616, a “Documents” icon 1618, and an “ECGs” icon 1620. In the depicted example, the icon 1610 is selected. In some examples, in response to user selection of the icon 1610 and a “Monitors” icon 1622, the display region 1604 displays one or more waveforms and one or more strips, as discussed in further detail herein.

[00145] In the example of FIG. 16, example waveforms correspond to fetal monitoring and include fetal heart rate waveforms, and maternal contraction waveforms. As noted above, implementations of the present disclosure are applicable to any type of physiological data, including but not limited to, maternal contractions/fetal heart rate, blood pressure, respiratory, vital signs, electrocardiogram, oximetry, anesthesia waveforms, and/or any other appropriate physiological data.

[00146] In the depicted example, a first strip view 1630, a second strip view 1632 and a waveform view 1634. The first strip view 1630 depicts a realistic graphical representation of a strip 1640, and the second strip view depicts a realistic graphical representation of a strip 1642. In some examples, the strip 1640 and the strip 1642 represent different segments of the same underlying strip. Each strip 1640, 1642 depicts waveforms 1644, 1646. In the example context, the waveform 1644 corresponds to a fetal heart rate (e.g., based on data collected from a fetal heart rate monitor), and the waveform 1646 corresponds to maternal contractions (e.g., based on data collected from a contraction monitor). In the depicted example, the strips 1640, 1642 provide displayed graph scales. In the example context, scales include beats-per-minute (BPM) for the waveform 1644, and pressure (e.g., kPa, mmHg) for the waveform 1646. In some examples, the strips 1640, 1642 can include one or more timestamps 1648 indicating an approximate time, at which patient data was recorded by a remote monitoring device.

[00147] In the depicted examples, the strip 1640 includes a bowed portion 1650 toward the right edge of the screen 1600. The bowed portion 1650 provides the appearance of an actual strip as it would feed out of a physical monitoring device (e.g., be rolled from a strip roll provided in the monitoring device). In some examples, the strip 1640 can be provided as a real-time strip, such that the strip 1640 is animated to move from right-to-left across the screen 1600 in real-time, as patient physiological data is provided from a remote monitoring device. In such an example, the right-most edge of the strip 1640 (e.g., in the bowed portion 1650) provides depicts the most recently received patient data, while the left-most edge of the strip depicts patient data received earlier in time.

[00148] In the depicted example, the strip 1642 includes a strip stack portion 1652 that depicts a stack of strip segments 1654. That is, for example, the strip stack portion 1652 provides a realistic depiction of an actual strip that includes folded segments stacked together. Accordingly, the remainder of the strip 1642 (e.g., to the right of the strip stack portion 1652) provides a realistic depiction of an actual strip as it is unfolded from a strip stack. In some examples, the strip 1642 can be provided as a historical strip, such that the strip 1642 is animated to move from left-to-right or right-to-left across the screen 1600 in response to user input. More particularly, a user can provide a scrolling gesture to the screen 1600 associated with the strip 1642 (e.g., contact the screen over the strip 1642 and provide a swipe gesture). In response to the scrolling gesture, the strip can be animated to display portions of the waveforms 1644, 1646 earlier in time or later in time. In some examples, animated folding and un-folding of strip segments 1654 to or from the strip stack portion 1652 can be provided. For example, in response to user input indicating scrolling of the strip 1642 from left-to-right, the strip 1642 can be animated such that strip segments 1654 unfold from the strip stack portion 1652. As another example, in response to user input indicating scrolling of the strip 1642 from right-to-left, the strip 1642 can be animated such that strip segments 1654 fold into the strip stack portion 1652.

[00149] In view of the foregoing, and in the example context, the strips 1640, 1642 individually and collectively provide a realistic depiction of a physical fetal monitoring strip that a healthcare provider would review as it was fed from a patient monitoring device.

[00150] In the example of FIG. 16, the waveform view 1634 depicts waveforms 1660, 1062 that respectively correspond to the waveforms 1644, 1646 of the strips 1640, 1642. In some examples, the waveform viewer 1634 provides an overall view of waveform data. In some examples, the waveforms 1660, 1662 can representative of the extent of the collected patient data, or a portion of the collected patient data. In the depicted example, the waveform viewer includes a scrubber bar 1664 and associated interface element 1666. In some examples, the scrubber bar 1664 can provide a reference to associate the waveforms 1644, 1646 to the waveforms 1660, 1662. In some examples, the user can interact with the interface element 1666 to move the scrubber bar 1664 along the waveforms 1660, 1662. For example, the user can touch the touchscreen over the interface element 1666 and can provide a swiping gesture (e.g., left-to-right, right-to-left). In response to the swiping gesture, the scrubber bar 1664 and the interface element 1666 are moved linearly along the waveforms 1660, 1662. In some examples, and in response to movement of the scrubber bar 1664 and the interface element 1666, one or both of the strips 1640, 1642 correspondingly scroll (e.g., scrolling with animation), as discussed above.

[00151] FIG. 17 depicts an example process 1700 that can be executed in accordance with implementations of the present disclosure. In some examples, the example process 1700 can be provided in one or more computer-executable programs that can be executed using one or more computing devices (e.g., the mobile device 102 and/or the DMS 160, 160').

[00152] A command to display a waveform strip screen is received (1702). In some examples, user input is provided to a mobile device, the user input indicating a user command to display a waveform strip screen. Patient data and/or patient information are retrieved (1704). In some examples, in response to the user input, patient data/information associated with a particular patient is retrieved, and information regarding one or more waveforms is determined. In some examples, retrieved patient-specific data and/or waveform information are processed to determine one or more waveforms that are to be displayed. Instructions are provided for displaying the waveform strip screen (1708). The waveform strip screen is displayed on the mobile device. For example, the mobile device processes the instructions to display the waveform strip screen. In some examples, the waveform strip screen provides a realistic depiction of a physical waveform strip that a healthcare provider would review as it was fed from a patient monitoring device.

[00153] It is determined whether scrolling has been selected (1710). In some examples, user input to the waveform strip screen can be determined, the user input indicating scrolling of one or more waveform(s). If it is determined that scrolling has been selected, instructions are provided for animating the waveform strip(s) displayed in the waveform strip screen (1712), and the example process 1700 loops back.

[00154] If it is determined that scrolling has not been selected, it is determined whether a new screen is to be displayed (1714). For example, the user can choose to navigate to a different screen from the timeline screen. If it is determined that a new screen is to be displayed, the new screen is displayed (1716). If it is determined that a new screen is not to be displayed, the example process 1700 loops back.

[00155] Implementations of the present disclosure can be provided using digital electronic circuitry, or in computer hardware, firmware, software, or in combinations thereof. In some examples, implementations can be provided one or more computer program products, e.g., a computer program tangibly embodied in a machine-readable storage device, for execution by, or to control the operation of, data processing apparatus, and/or a programmable processor, a computer, or multiple computers. A computer program can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for use in a computing environment. A computer program can be deployed to be executed on one computer or on multiple computers at one site or distributed across multiple sites and interconnected by a communication network. Such a computer program can include modules and/or code segments for executing one or more of the features, aspects and/or implementations provided herein.

[00156] Operations in accordance with implementations of the present disclosure can be performed by one or more programmable processors executing a computer program product to perform functions by operating on input data and generating output. By way of example, a computer program product can include modules and/or code segments corresponding to each of the method steps, aspects and/or features provided herein. Method steps can also be performed by, and apparatus of the present disclosure can be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application-specific integrated circuit).

[00157] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. Elements of a computer can include a processor for executing instructions and one or more memory devices for storing instructions and data. Generally, a computer can also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. Information carriers suitable for embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in special purpose logic circuitry.

[00158] The present disclosure can be implemented in a system including, but not limited to the example systems described herein, which include a back-end component, e.g., as a data server, or that includes a middleware component, e.g., an application server, or that includes a front-end component, e.g., a client device, such as the mobile device 102, having a graphical user interface or a Web browser through which a user can interact with an implementation of the invention, or any combination of such back-end, middleware, or front-end components. The components of the system can be interconnected by any form or medium of digital data communication, e.g., a communication network.

[00159] A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. For example, steps of the present disclosure can be performed in a different order and still achieve desirable results. Accordingly, other implementations are within the scope of the following claims.

CLAIMS:

1. A computer-implemented method for providing a user of a mobile device access to patient information and patient physiological data, the method being executed using one or more processors and comprising:

processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and

displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising:

a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period;

a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment;

a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and

receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

2. The method of claim 1, further comprising receiving patient data and/or patient information from an electronic medical record (EMR) associated with the patient, the summary information comprising at least a portion of the patient data and/or patient information.

3. The method of claim 1, further comprising:

receiving user input associated with a medical event; and

in response to the user input, displaying detailed medical event information.

4. The method of claim 3, wherein displaying detailed medical event information comprises displaying an event screen in place of the stacked waveform strip.

5. The method of claim 1, further comprising:

receiving user input specific to a medical event; and

in response to the user input, manipulating summary information provided in the medical event.

6. The method of claim 5, wherein manipulating summary information provided in the medical event, comprises scrolling the manipulating summary information provided in the medical event.

7. The method of claim 5, wherein the summary information provided in the medical event comprises a waveform, and manipulating comprises scrolling the waveform.

8. The method of claim 5, wherein the summary information provided in the medical event comprises a plurality of thumbnail images, and manipulating comprises scrolling between images of the plurality of thumbnail images.

9. The method of claim 1, further comprising:

receiving user input, the user input indicating user selection of a category icon; and

in response to the user input, filtering the stacked waveform strip to comprise a sub-set of the one or more medical events, medical events in the sub-set corresponding to a category associated with the category icon.

10. A computer-readable storage device coupled to one or more processors and having instructions stored thereon which, when executed by the one or more processors, cause the one or more processors to perform operations comprising:

processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising:

a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period;

a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment;

a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and

receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

11. A system, comprising:

one or more processors; and

a computer-readable storage medium in communication with the one or more processors and having instructions stored thereon which, when executed by the one or more processors, cause the one or more processors to perform operations comprising:

processing, by the one or more processors, patient data to generate one or more graphical representations of the patient data, at least one graphical representation of the one or more graphical representations comprising a waveform strip; and

displaying the at least one graphical representation as a stacked waveform strip depicting a single physiological waveform, the stacked waveform strip comprising:

a first strip segment, the first strip segment comprising a first portion of the single physiological waveform that is updated in real-time and is associated with a first time period;

a second strip segment, the second strip segment comprising a second portion of the single physiological waveform that is updated in real-time and is associated with a second time period earlier than the first time period and being displayed beneath the first strip segment, such that a right edge of the second strip segment corresponds to a left edge of the first strip segment;

a third strip segment, the third strip segment comprising a third portion of the single physiological waveform that is updated in real-time and is associated with a third time period earlier than the second time period and being displayed beneath the second strip segment, such that a right edge of the third strip segment corresponds to a left edge of the second strip segment; and receiving, by the one or more processors, user input, the user input indicating a zoom command, and in response to the user input, providing a graphical representation comprising a zoomed stacked waveform strip, the zoomed waveform strip comprising a different number of strip segments than the stacked waveform strip such that a second zoomed strip segment of the zoomed waveform strip is associated with a second zoomed time period earlier than a first zoomed time period and is displayed beneath a first zoomed strip segment, such that a right edge of the second zoomed strip segment corresponds to a left edge of the first zoomed strip segment.

12. The method of claim 1, wherein the real-time waveform strip is animated to scroll absent user input based on updates to waveform data used to provide the real-time waveform strip.

13. The method of claim 1, wherein a waveform strip of the one or more waveform strips comprises a historical waveform strip.

14. The method of claim 13, further comprising:

receiving user input to the historical waveform strip; and

in response to the user input, animating the waveform strip to scroll to display portions of a waveform that were absent from the waveform strip before scrolling.

15. The method of claims 13, wherein the historical waveform strip comprises a strip stack.

16. The method of claim 15, wherein scrolling of the historical waveform strip induces animation of waveform strip segments to be unfolded from the strip stack.

17. The method of claim 15, wherein scrolling of the historical waveform strip induces animation of waveform strip segments to be folded into the strip stack.

18. The method of claim 1, wherein each waveform strip provides a graphical representation of strip paper, the strip paper comprising one or more scales.

19. The method of claim 18 wherein each scale is associated with at least one unit of measure.

20. The method of claim 1, wherein the waveform strip screen further displays at least one waveform view that depicts one or more waveforms respectively corresponding to waveforms of the one or more waveform strips.

21. The method of claim 20, wherein the at least one waveform view includes a scrubber bar that provides a reference to associate waveforms of the one or more waveform strips to the one or more waveforms of the at least one waveform view.

22. The method of claim 21, further comprising:

receiving user input, the user input indicating movement of the scrubber bar; and in response to the user input, scrolling at least one waveform strip relative to movement of the scrubber bar.

23. The method of claim 1, further comprising receiving, by the one or more processors, the patient data, the patient data reflective of one or more physiological characteristics of a patient.

24. The method of claim 1, further comprising receiving user input, the user input indicating a zoom command, and in response, providing a graphical representation comprising a zoomed stacked waveform strip.

25. The method of claim 24, wherein the zoomed waveform strip comprises a greater number of strip segments than the stacked waveform strip.

26. The method of claim 24, wherein the zoomed waveform strip comprises a lower number of strip segments than the stacked waveform strip.

27. The method of claim 24, wherein the zoom command comprises a command to zoom out.

28. The method of claim 24, wherein the zoom command comprises a command to zoom in.

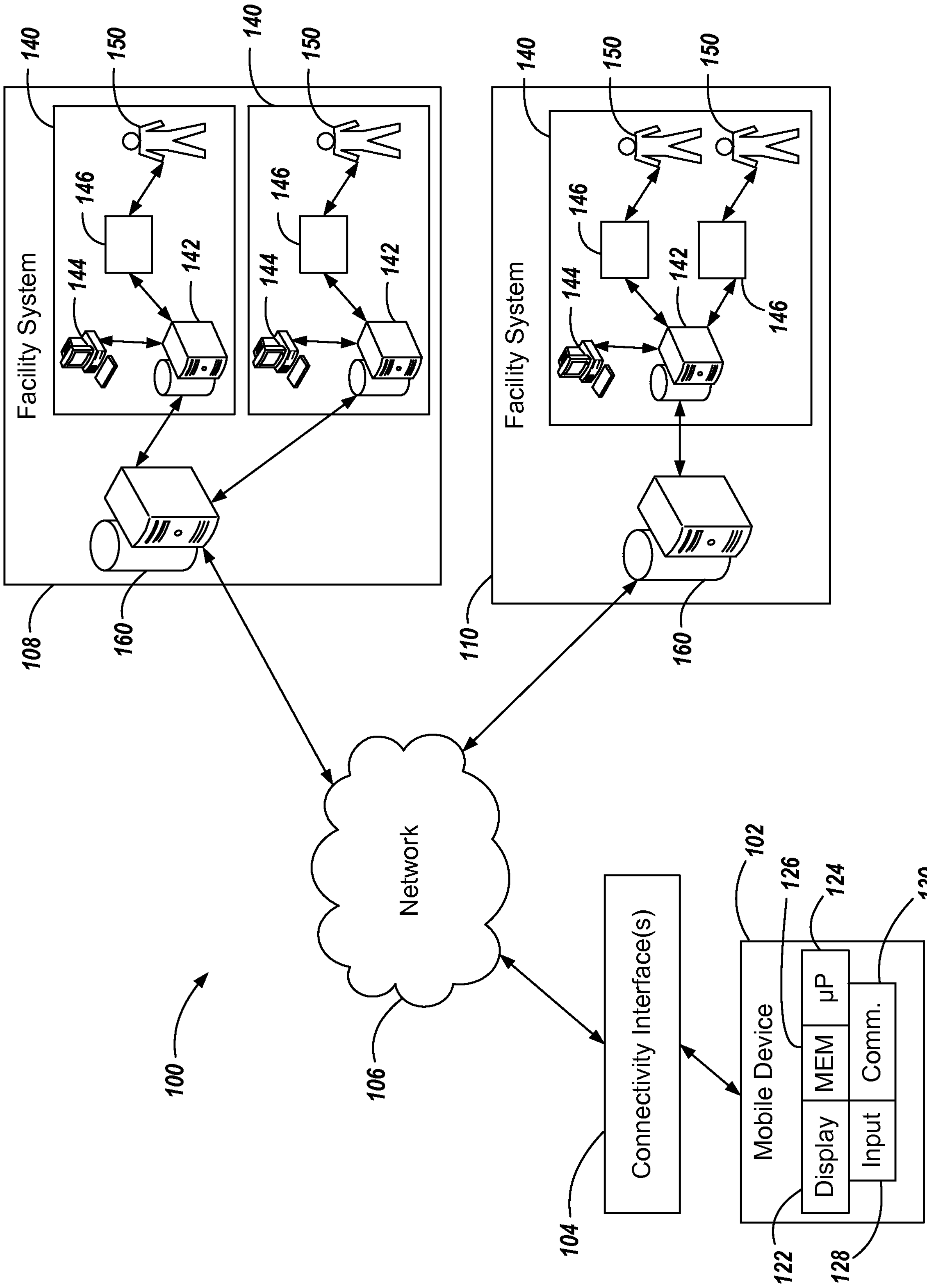

Facility System
140
150
146
144
142
140
150
146
144
142
108
160
Facility System
140
150
150
146
144
142
146
110
160
Network
106
100
Connectivity Interface(s)
104
Mobile Device
102
126
124
130
Display
MEM
µP
Input
Comm.
122
128

FIG. 1

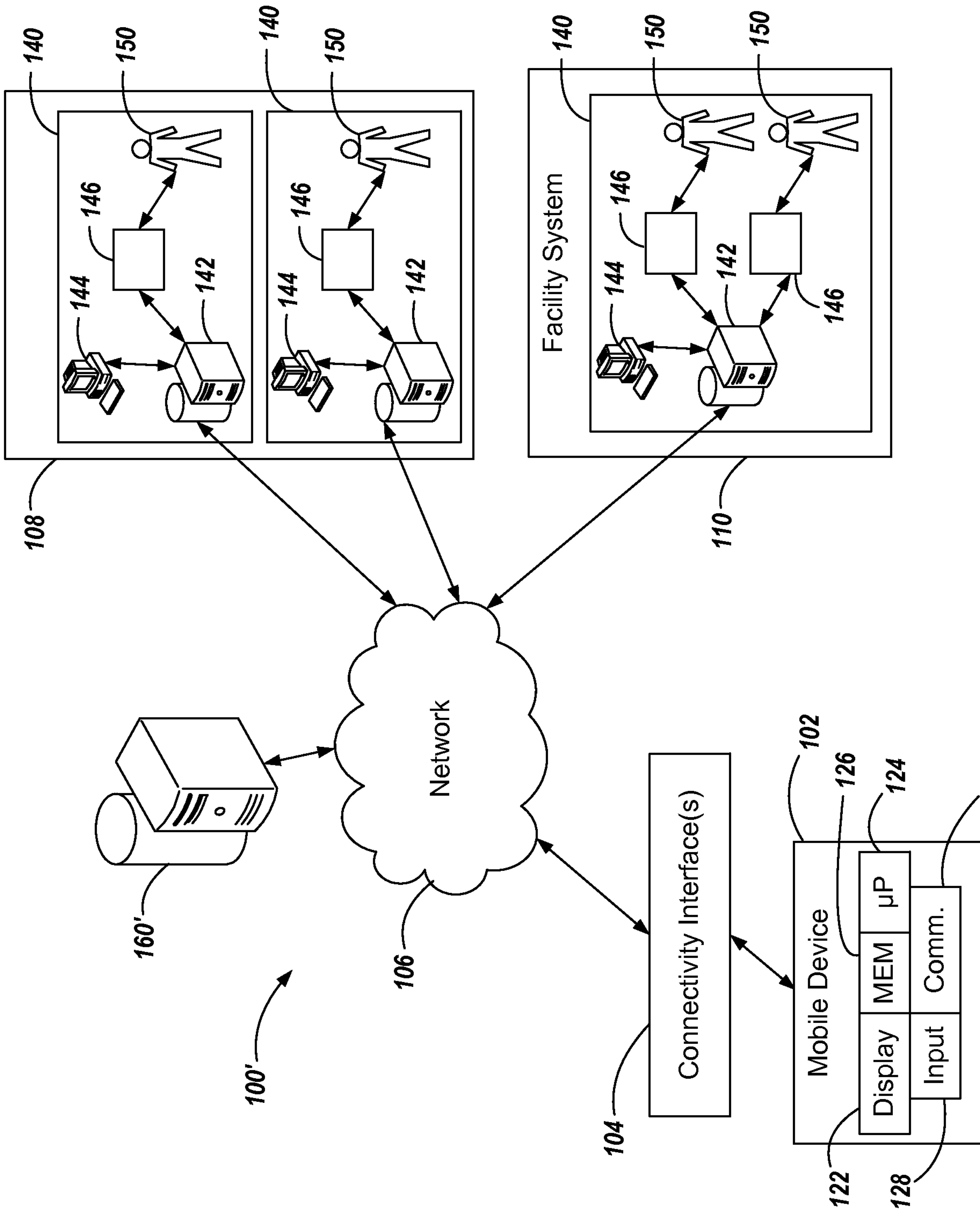
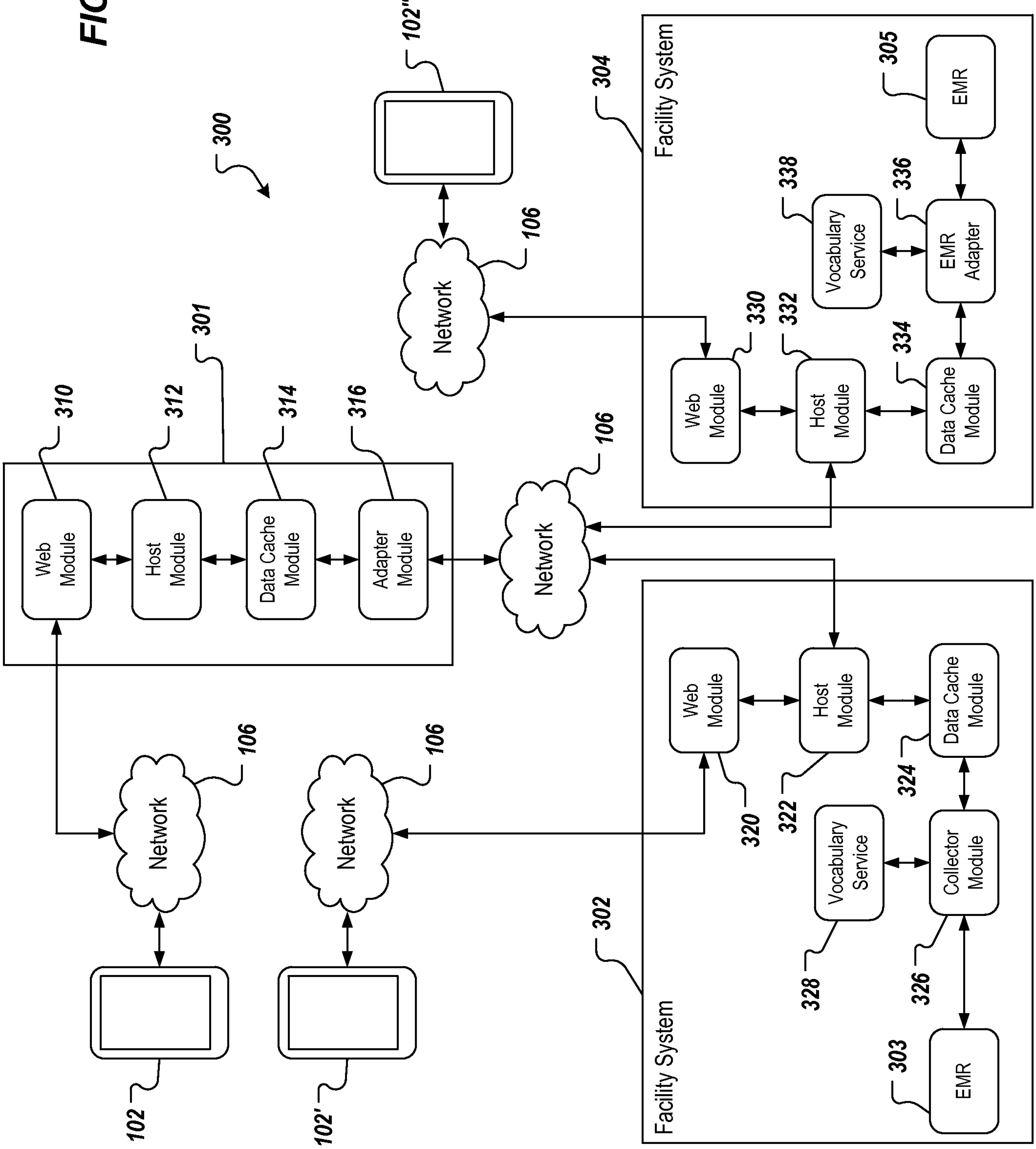

100'
160'
Network
106
108
140
150
146
144
142
110
Facility System
Connectivity Interface(s)
104
Mobile Device
102
Display
MEM
µP
Input
Comm.
122
126
124
128
130

FIG. 2

FIG. 3


300
301
Web Module
Host Module
Data Cache Module
Adapter Module
310
312
314
316
Network
106
102
102'
102"
Facility System
302
Web Module
Host Module
Data Cache Module
Collector Module
Vocabulary Service
EMR
320
322
324
326
328
303
Facility System
304
Web Module
Host Module
Data Cache Module
EMR Adapter
Vocabulary Service
EMR
330
332
334
336
338
305

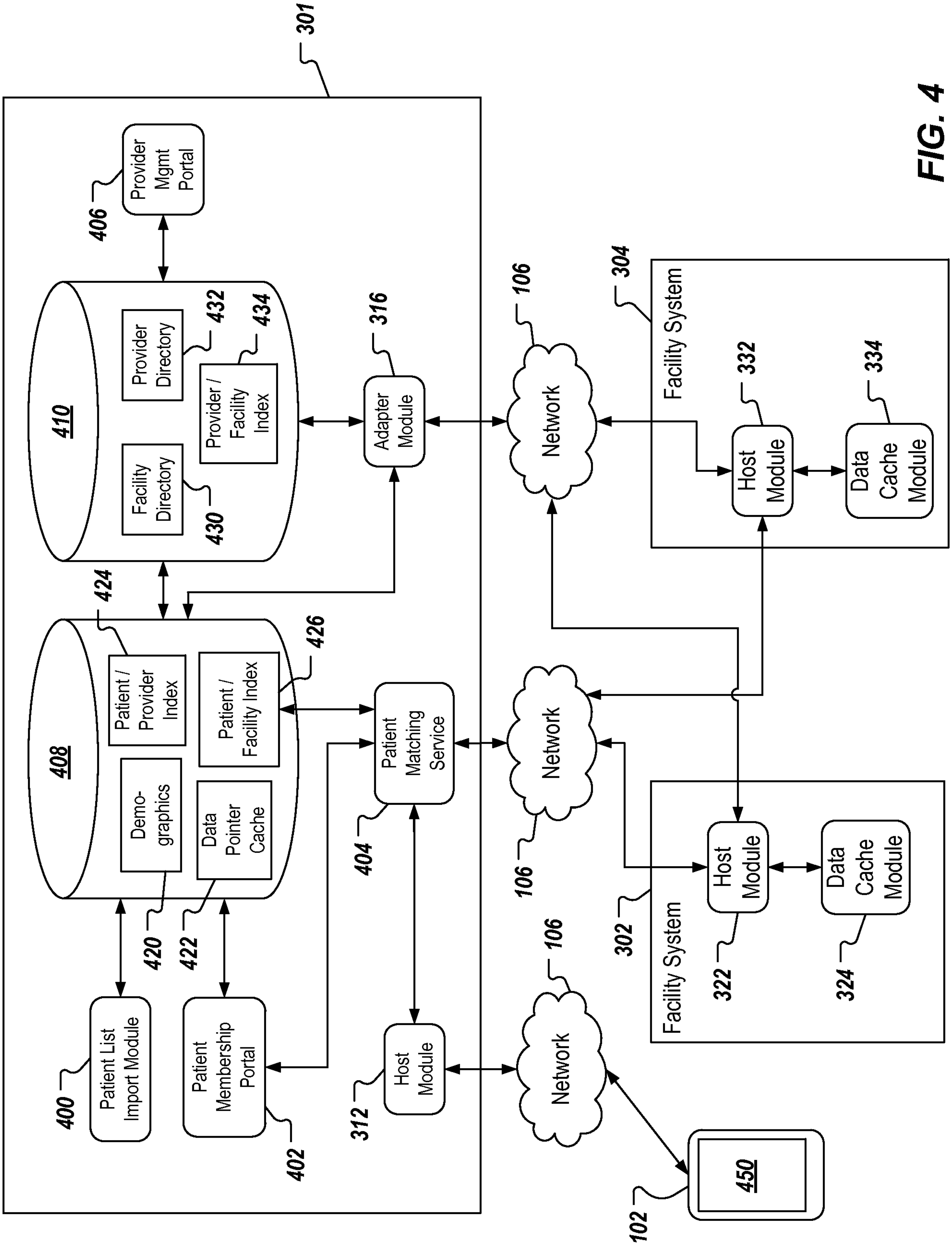

301
Provider Mgmt Portal
406
410
Provider Directory
432
Provider / Facility Index
434
Facility Directory
430
316
Adapter Module
106
Network
304
Facility System
332
Host Module
334
Data Cache Module
424
408
Patient / Provider Index
Patient / Facility Index
426
Demo-graphics
Data Pointer Cache
420
422
Patient Matching Service
404
106
Network
302
Facility System
Host Module
322
Data Cache Module
324
Patient List Import Module
400
Patient Membership Portal
402
Host Module
312
106
Network
450
102

FIG. 4

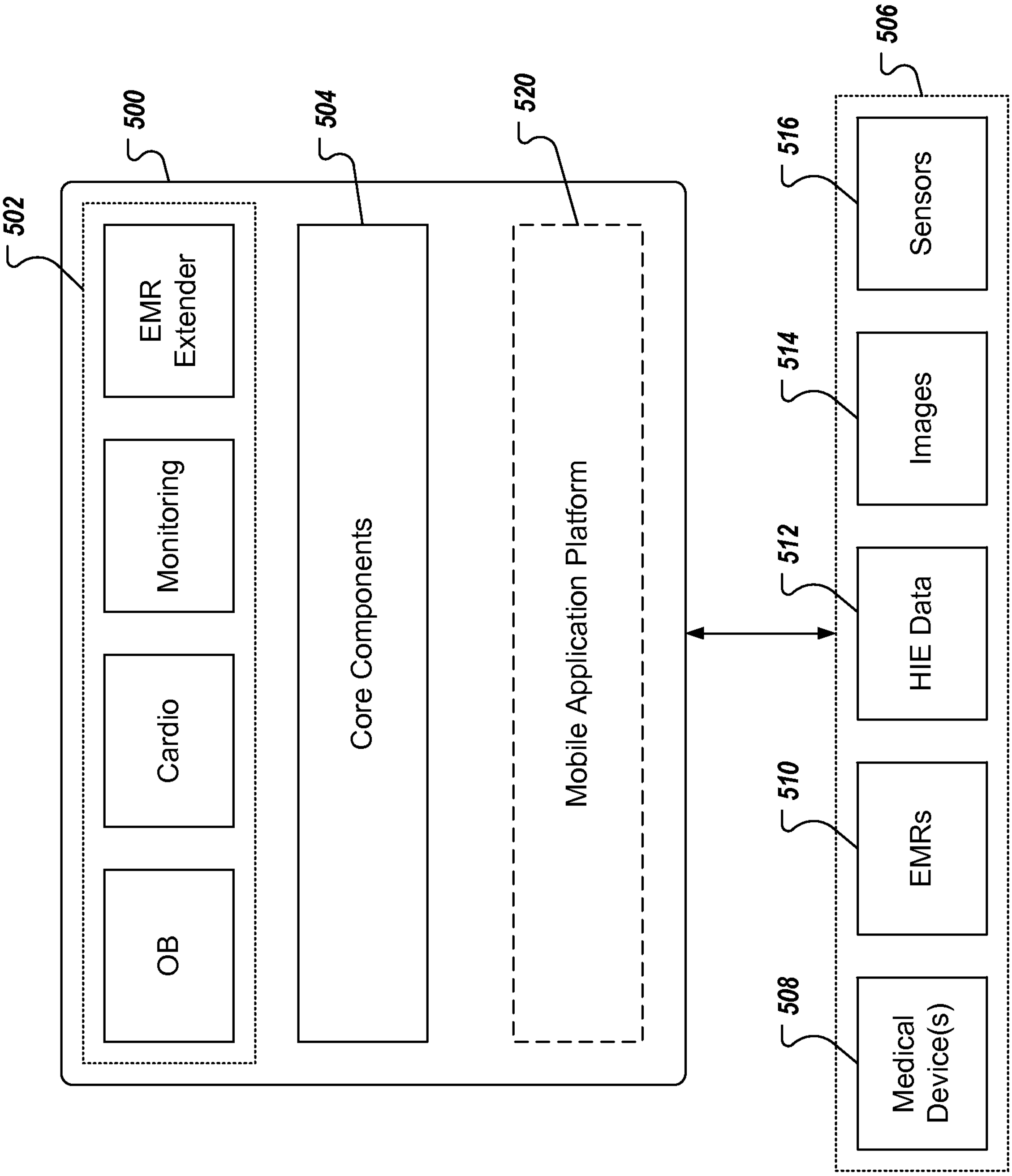

500
502
EMR Extender
Monitoring
Cardio
OB
504
Core Components
520
Mobile Application Platform
506
516
Sensors
514
Images
512
HIE Data
510
EMRs
508
Medical Device(s)

FIG. 5

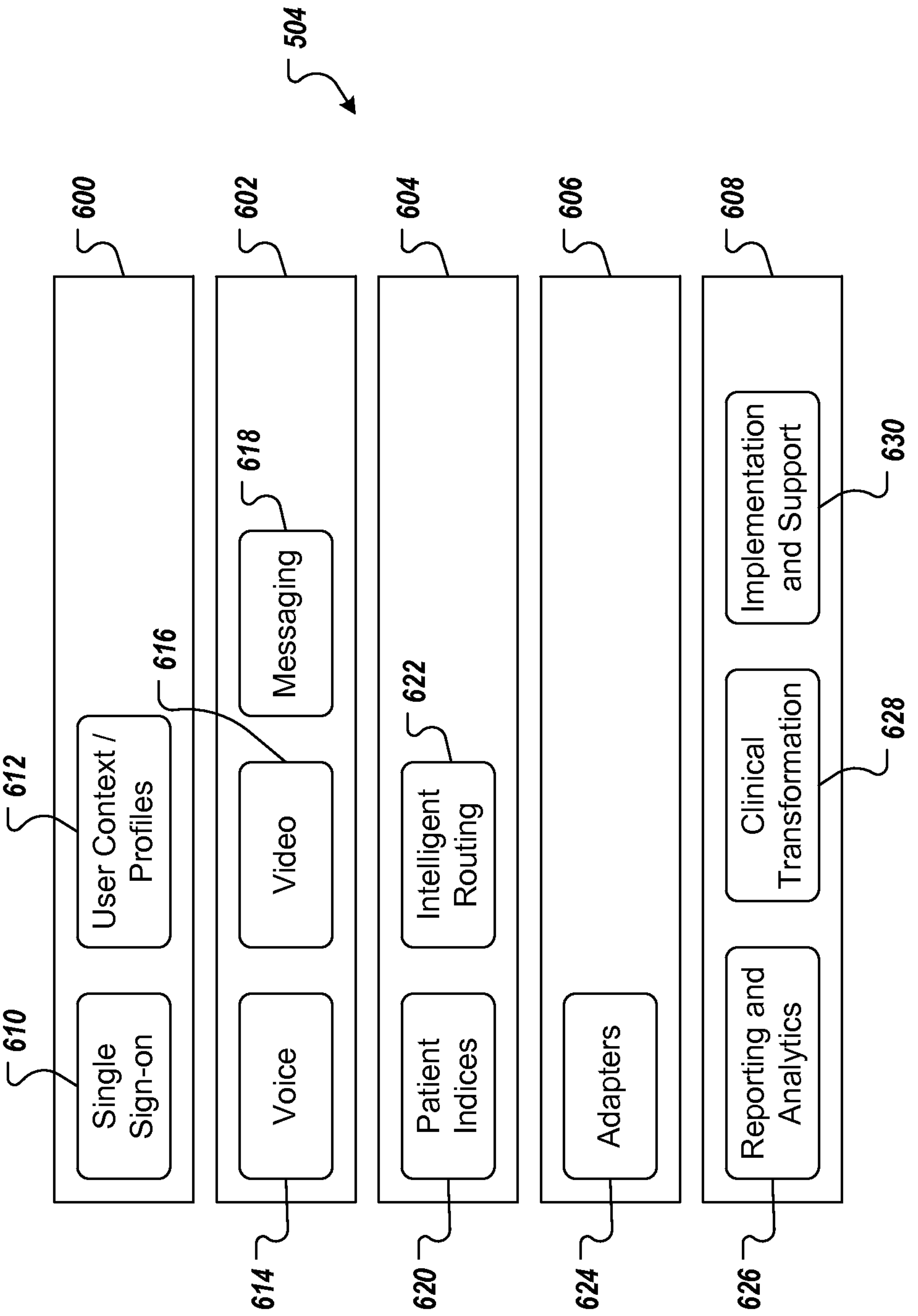

504
600
602
604
606
608
610
612
614
616
618
620
622
624
626
628
630
Single Sign-on
User Context / Profiles
Voice
Video
Messaging
Patient Indices
Intelligent Routing
Adapters
Reporting and Analytics
Clinical Transformation
Implementation and Support

FIG. 6

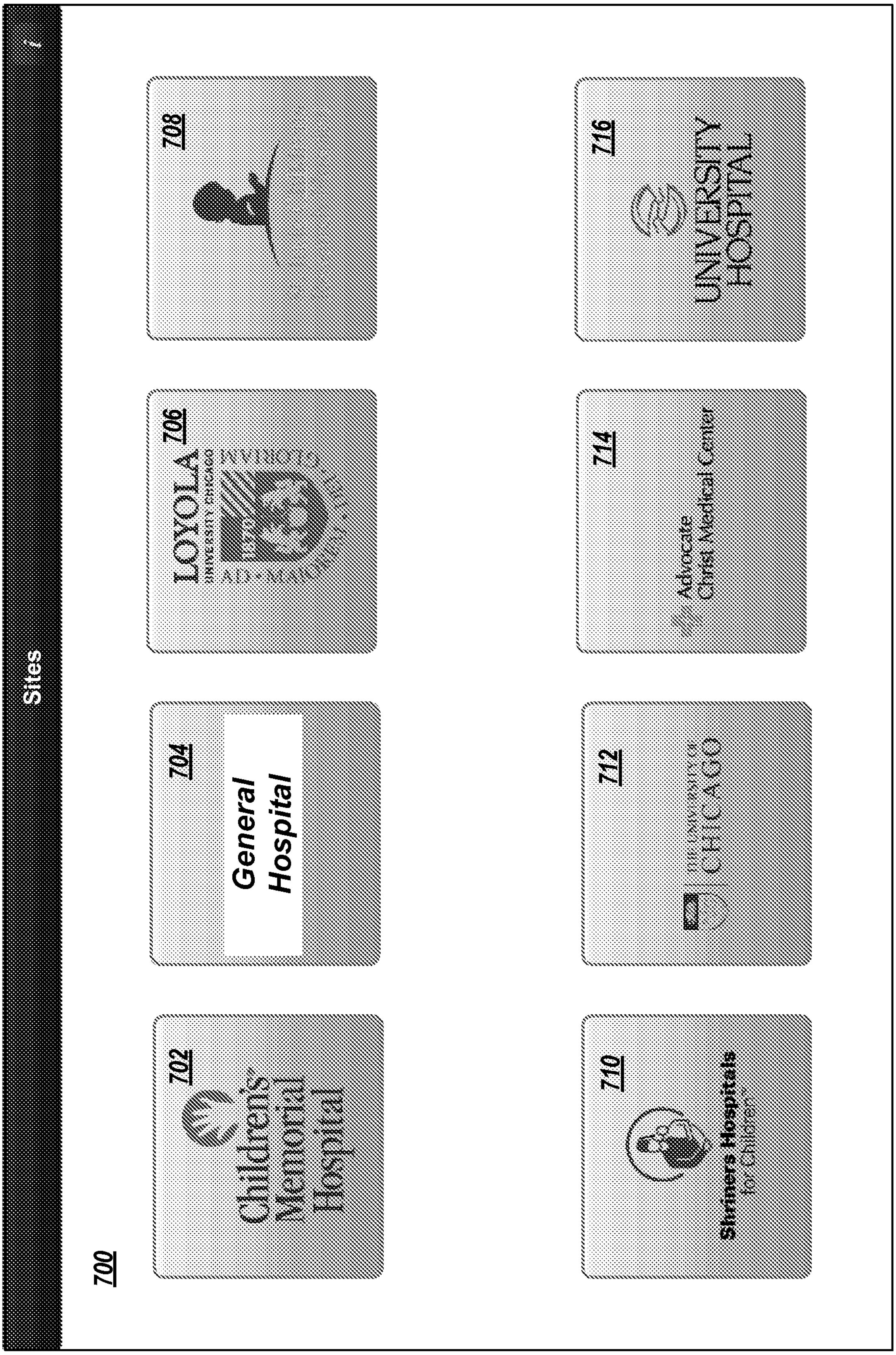

Sites
700
702
Children's Memorial Hospital
704
General Hospital
706
LOYOLA UNIVERSITY CHICAGO
708
710
Shriners Hospitals for Children
712
THE UNIVERSITY OF CHICAGO
714
Advocate Christ Medical Center
716
UNIVERSITY HOSPITAL

FIG. 7

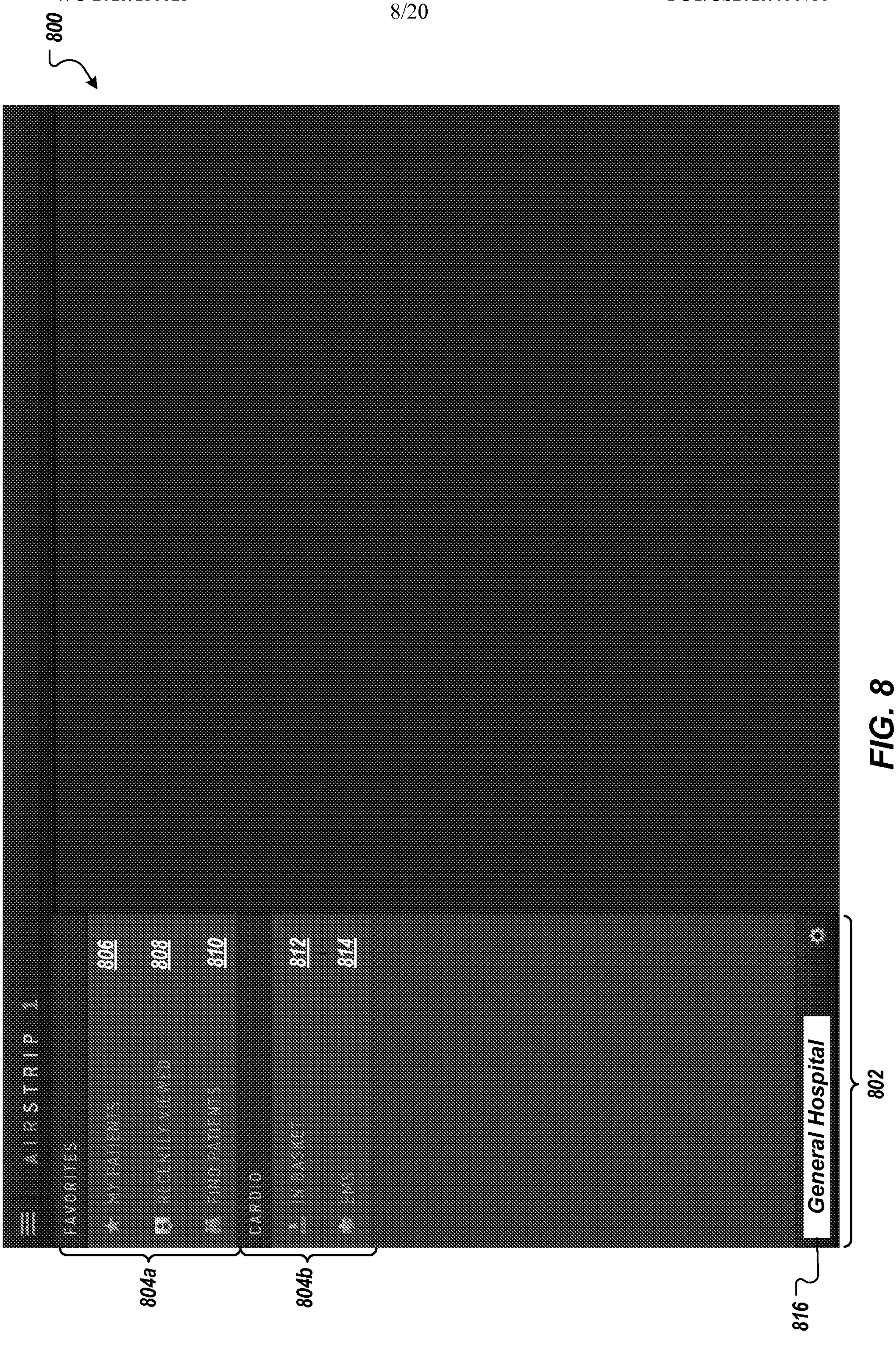

800
AIRSTRIP 1
FAVORITES
MY PATIENTS
RECENTLY VIEWED
FIND PATIENTS
CARDIO
806
808
810
812
814
General Hospital
804a
804b
816
802

FIG. 8

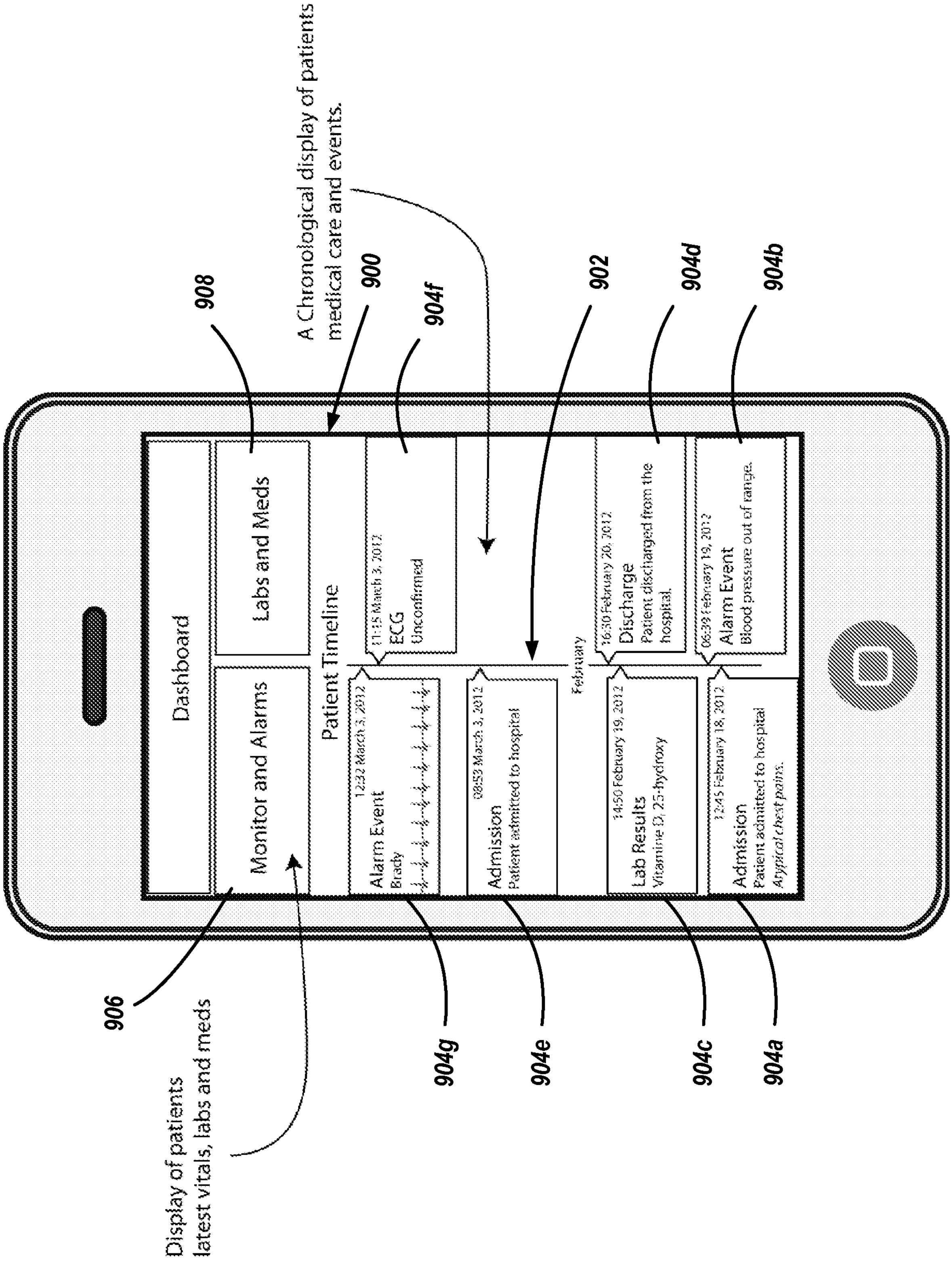

A Chronological display of patients medical care and events.
Display of patients latest vitals, labs and meds
Dashboard
Monitor and Alarms
Labs and Meds
Patient Timeline
12:32 March 3, 2012
Alarm Event
Brady
11:15 March 3, 2012
ECG
Unconfirmed
08:53 March 3, 2012
Admission
Patient admitted to hospital
February
14:50 February 19, 2012
Lab Results
Vitamine D, 25-hydroxy
16:30 February 20, 2012
Discharge
Patient discharged from the hospital.
12:45 February 18, 2012
Admission
Patient admitted to hospital
Atypical chest pains.
06:39 February 19, 2012
Alarm Event
Blood pressure out of range.
900
902
904a
904b
904c
904d
904e
904f
904g
906
908

FIG. 9

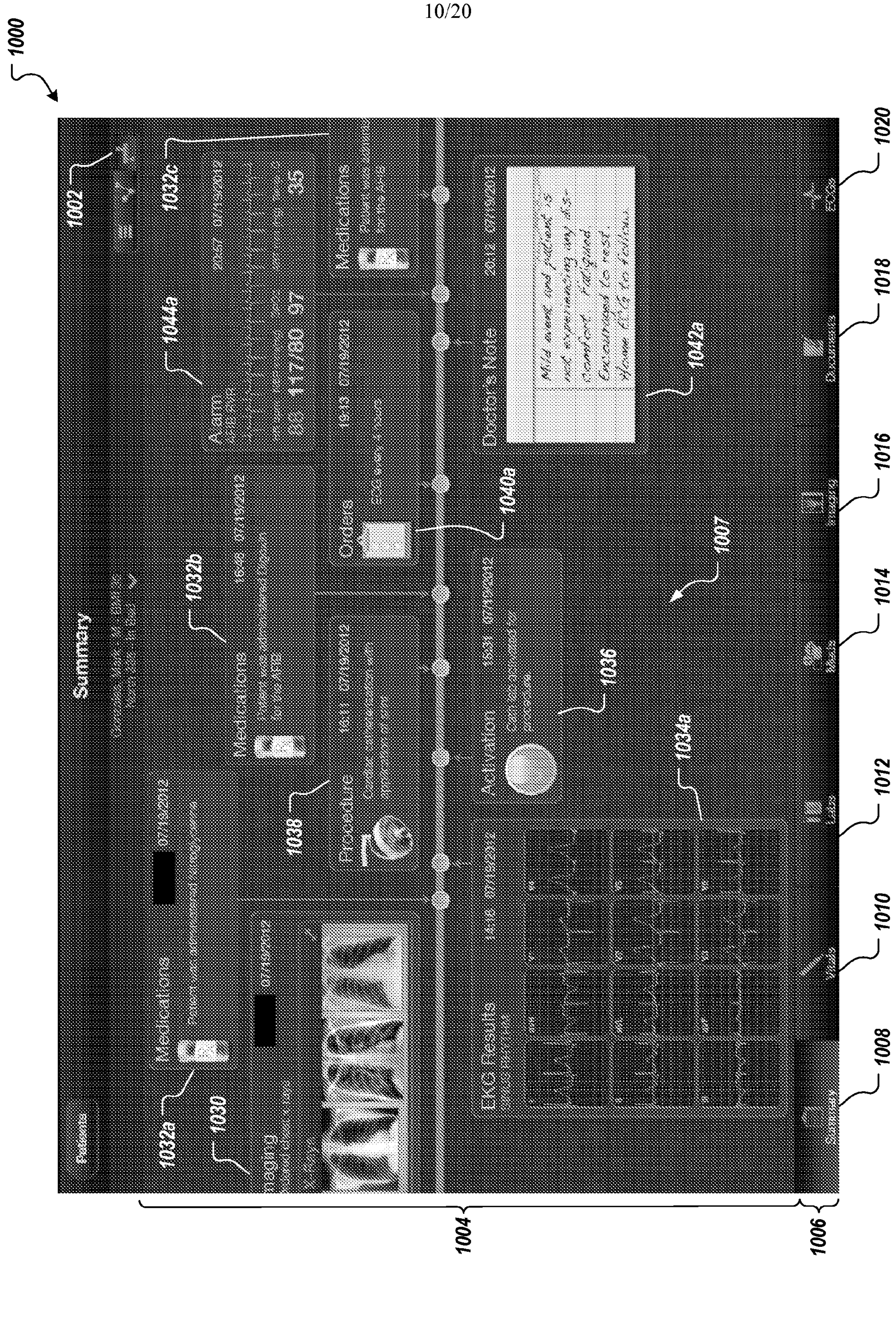

1000
1002
1004
1006
1007
1008
1010
1012
1014
1016
1018
1020
1030
1032a
1032b
1032c
1034a
1036
1038
1040a
1042a
1044a
Summary
Patients
Medications
Procedure
Activation
Orders
Alarm
Doctor's Note
EKG Results

FIG. 10A

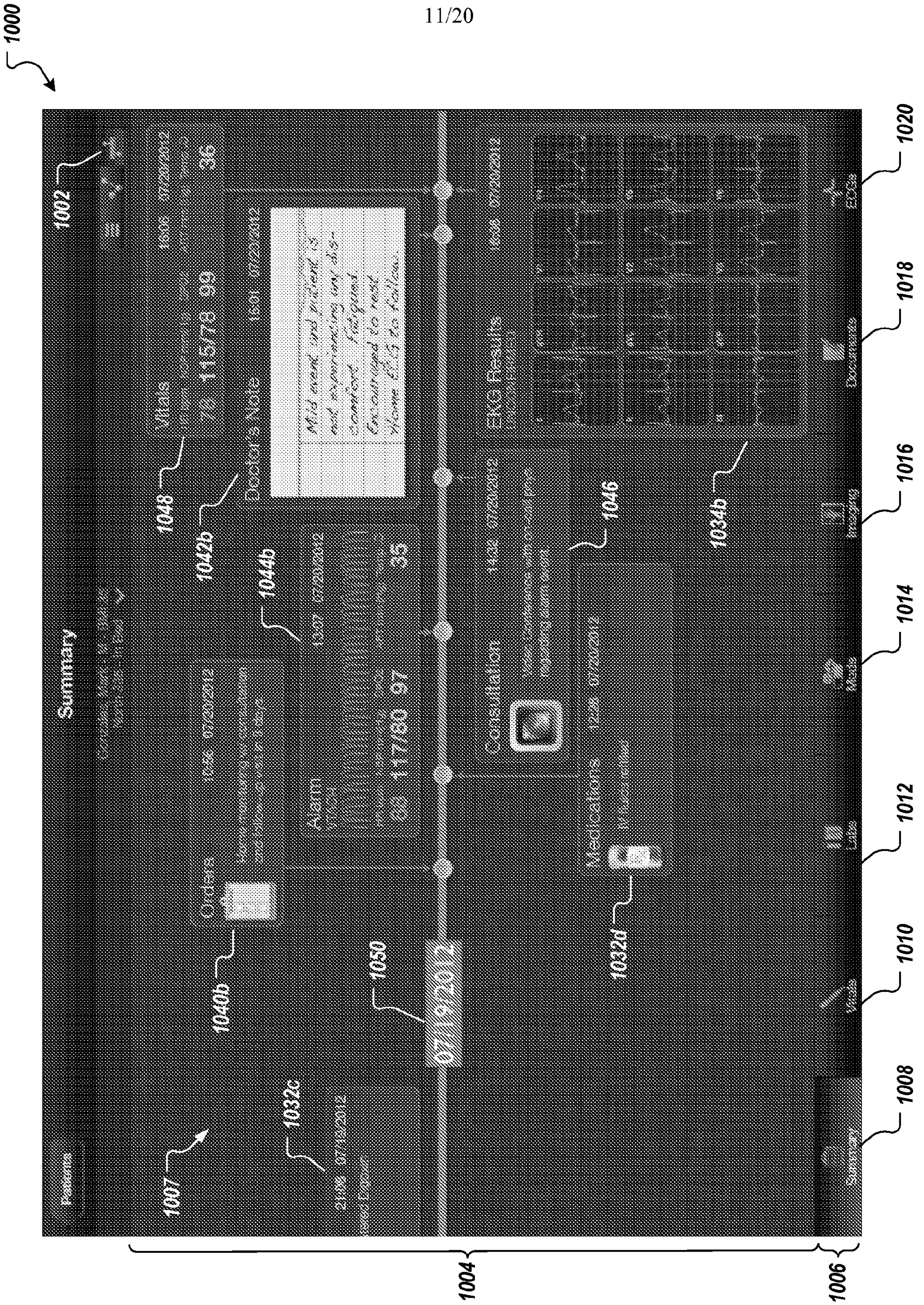

1000
1002
1004
1006
1007
1008
1010
1012
1014
1016
1018
1020
1032c
1032d
1034b
1040b
1042b
1044b
1046
1048
1050
Patients
Summary
Vitals
Doctor's Note
Orders
Alarm
Consultation
Medications
EKG Results
07/19/2012
Mild event and patient is not experiencing any discomfort. Fatigued. Encouraged to rest. Home EKG to follow.
115/78
99
117/80
97
36
35
Summary
Vitals
Labs
Meds
Imaging
Documents
EKGs

FIG. 10B

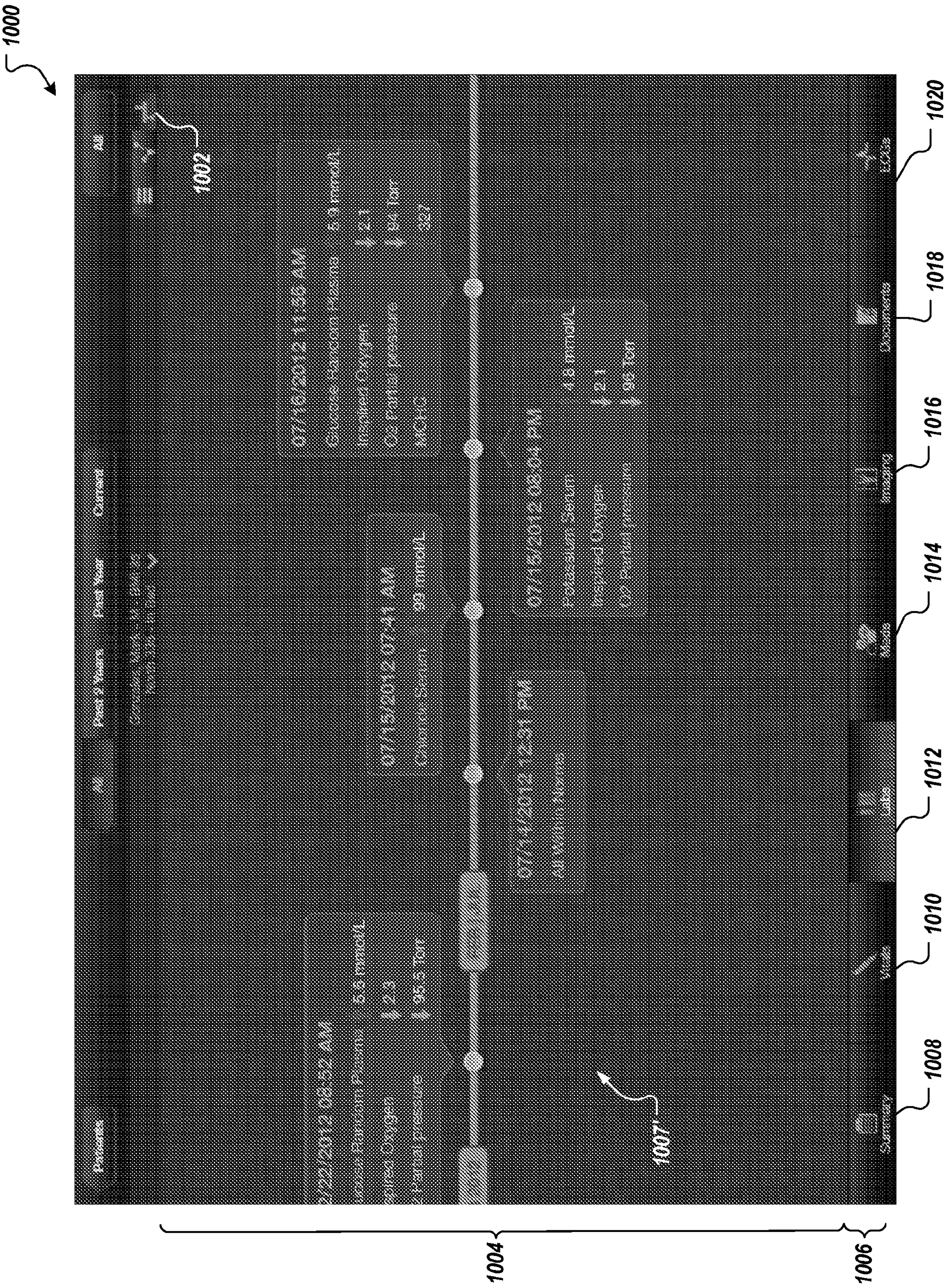

1000
1002
1004
1006
1007
1008
1010
1012
1014
1016
1018
1020
Patients
Current
07/16/2012 11:36 AM
07/15/2012 07:41 AM
07/15/2012 08:04 PM
07/14/2012 12:31 PM
5.6 mmol/L
5.3 mmol/L
4.8 mmol/L
99 mmol/L
94 Torr
96 Torr
95.5 Torr
Summary
Documents

FIG. 10C

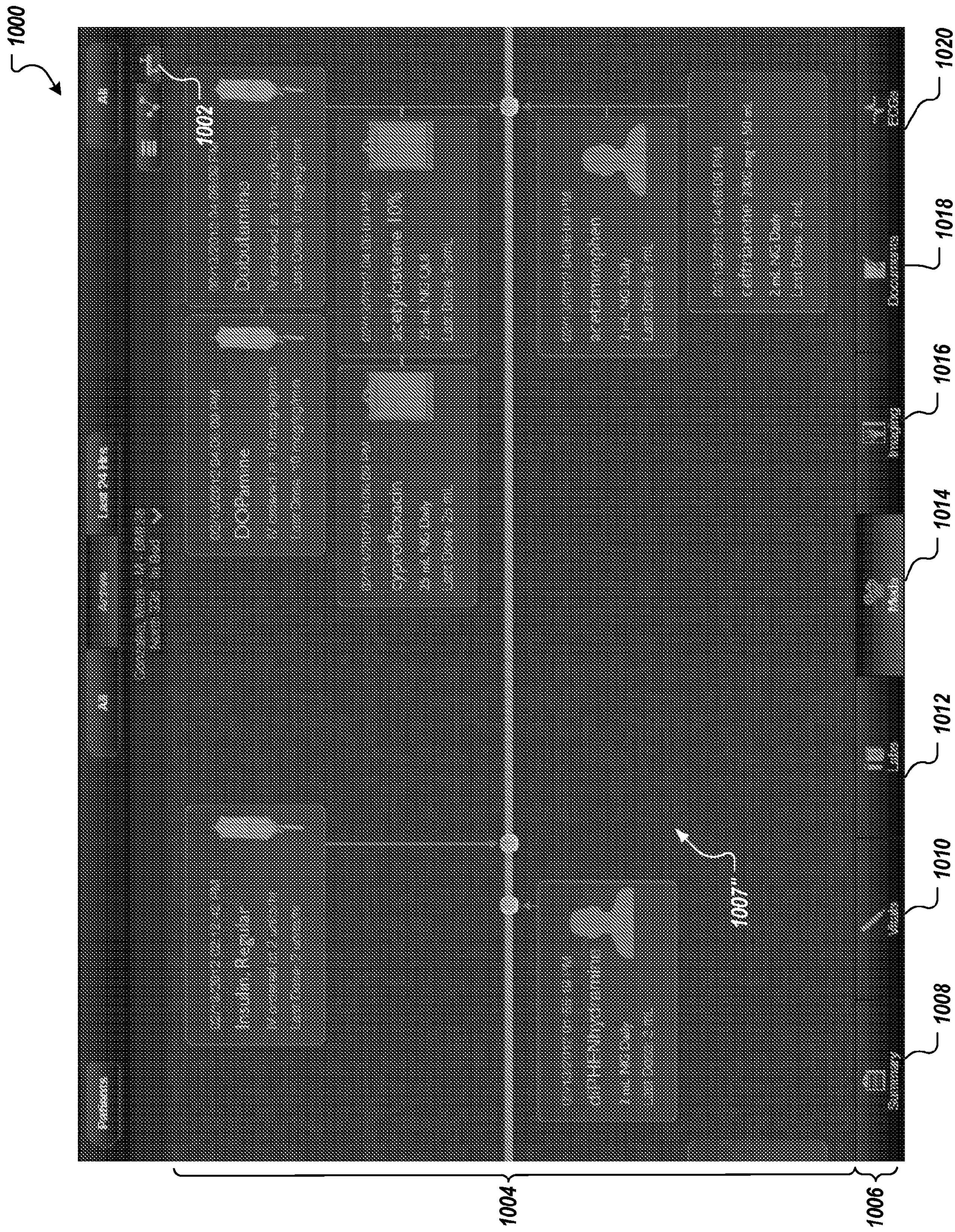


FIG. 10D

Stacked Waveform View

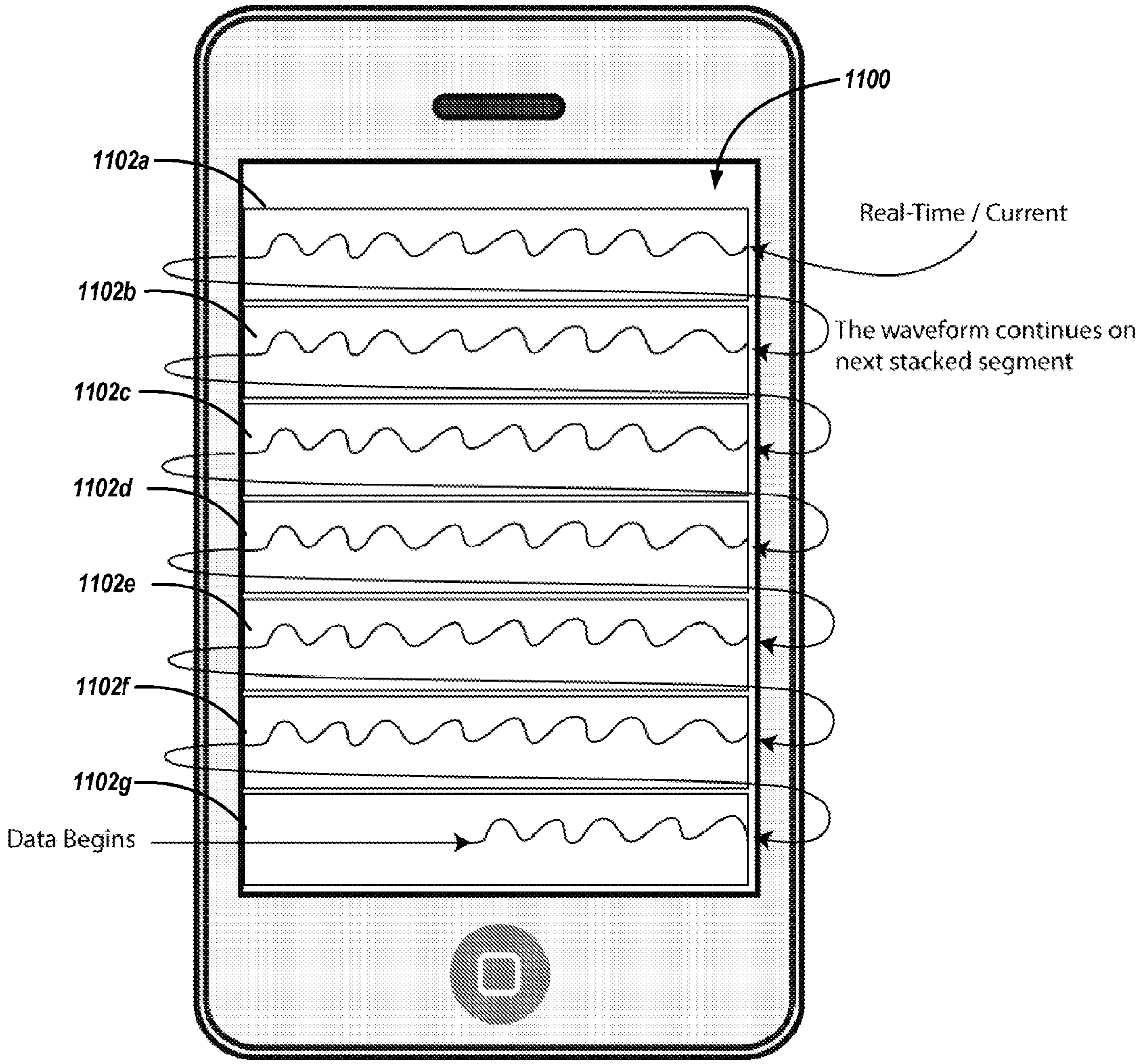


FIG. 11

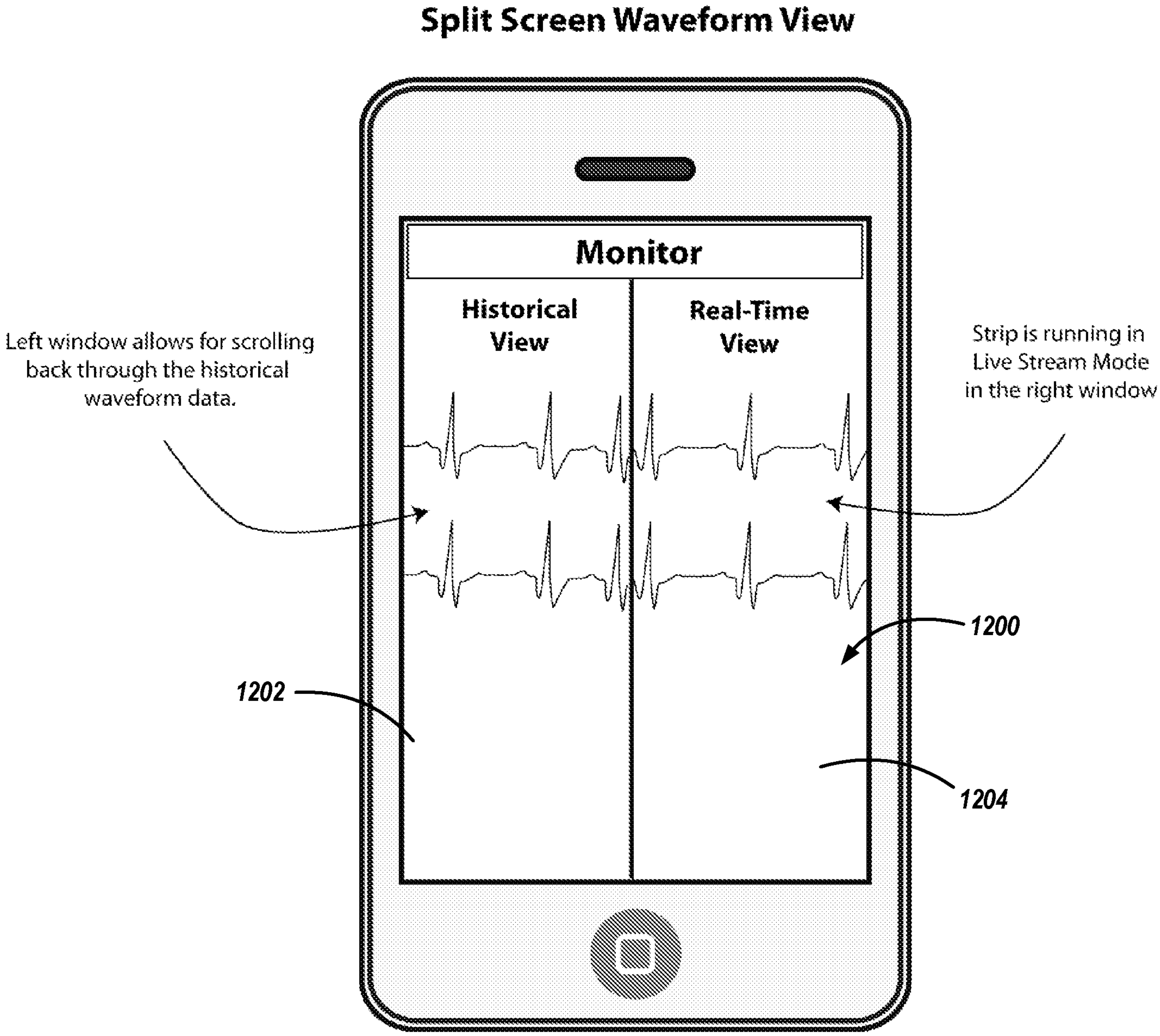

Split Screen Waveform View
Monitor
Historical View
Real-Time View
Left window allows for scrolling back through the historical waveform data.
Strip is running in Live Stream Mode in the right window
1200
1202
1204

FIG. 12

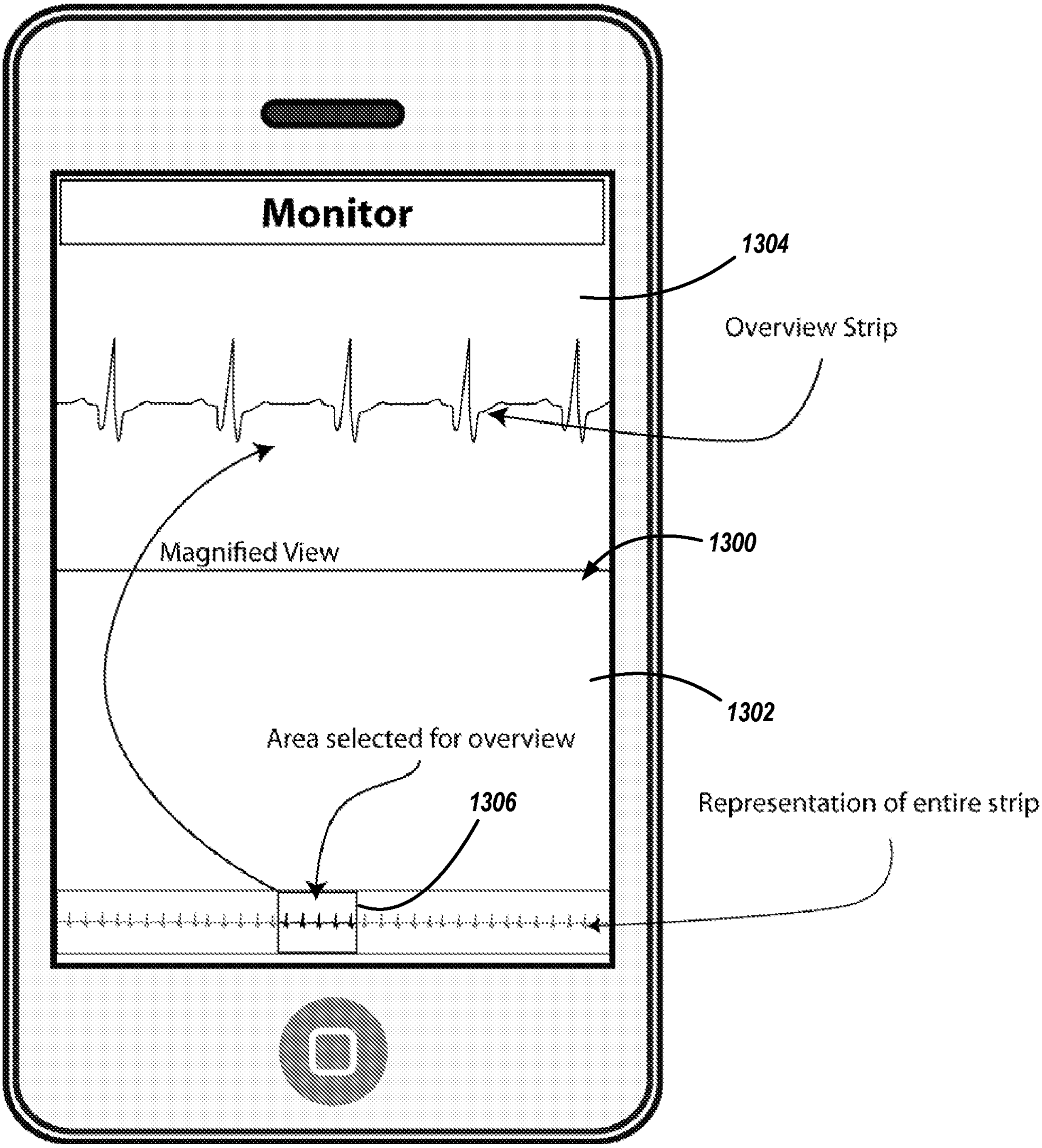

Monitor
1304
Overview Strip
Magnified View
1300
1302
Area selected for overview
1306
Representation of entire strip

FIG. 13

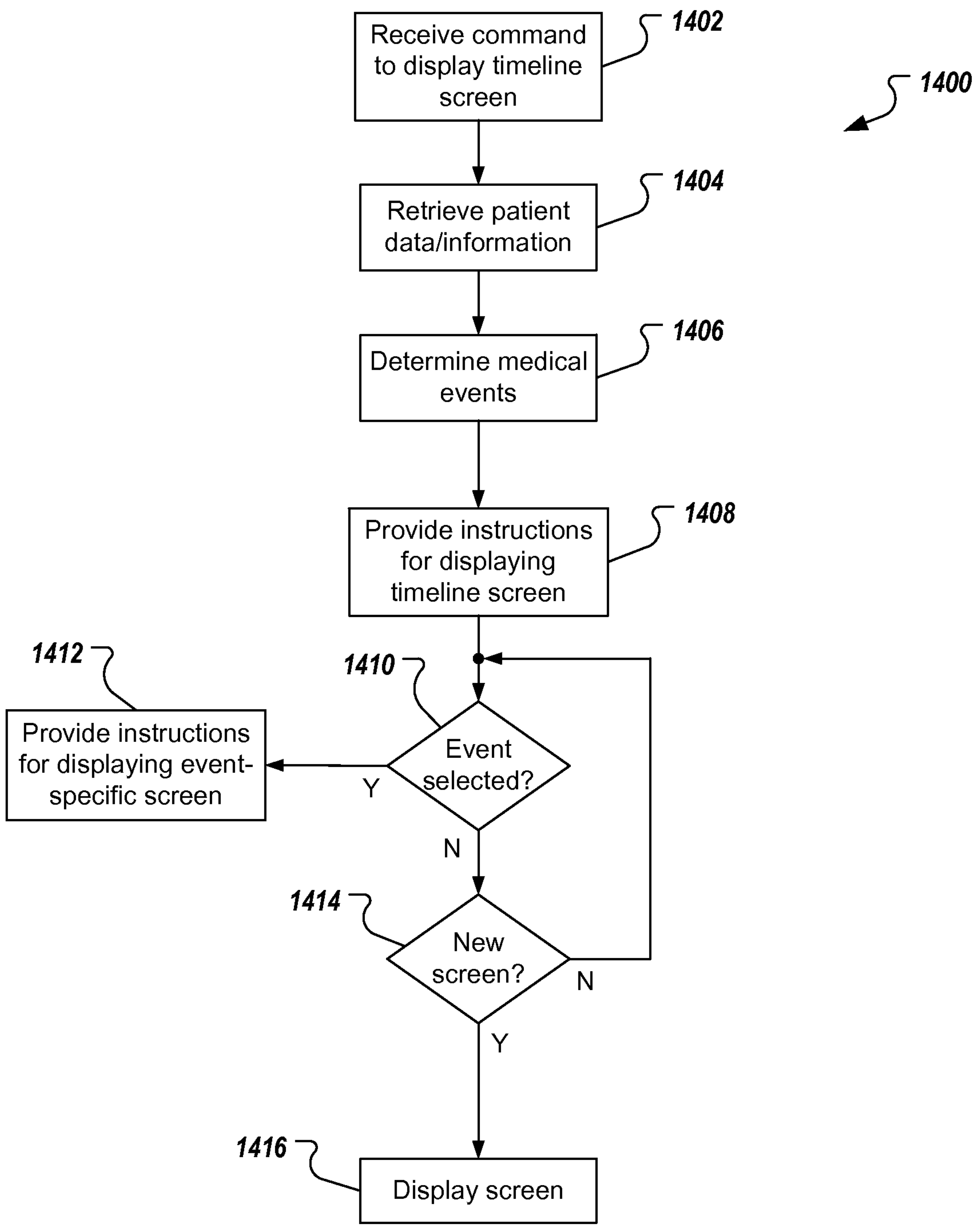

1400
Receive command to display timeline screen
1402
Retrieve patient data/information
1404
Determine medical events
1406
Provide instructions for displaying timeline screen
1408
1410
Event selected?
Y
N
1412
Provide instructions for displaying event-specific screen
1414
New screen?
N
Y
1416
Display screen

FIG. 14

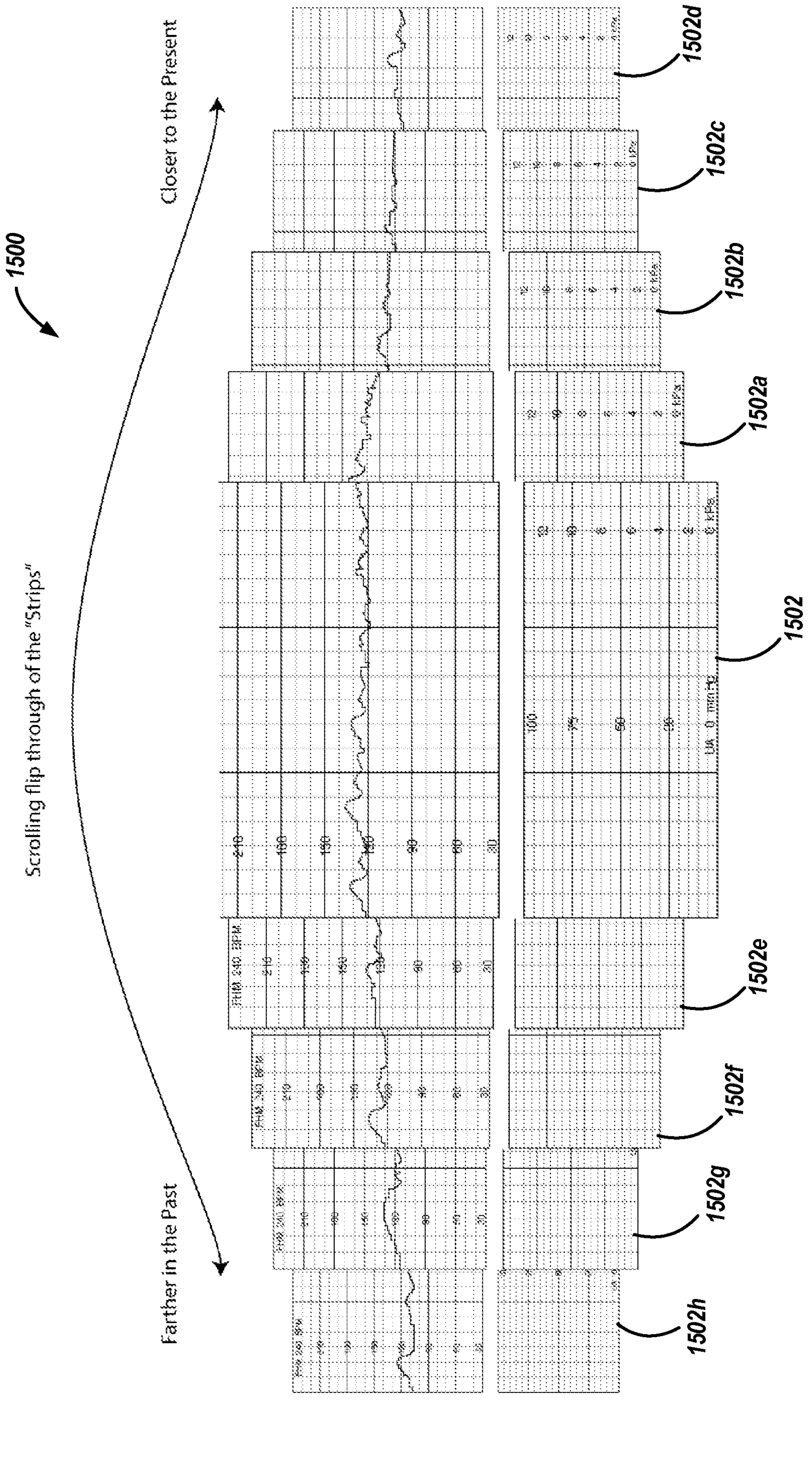

1500
Closer to the Present
Scrolling flip through of the "Strips"
Farther in the Past
1502
1502a
1502b
1502c
1502d
1502e
1502f
1502g
1502h
FHR 240 BPM
210
180
150
120
90
60
30
UA 0 mmHg
100
75
50
25
12
10
8
6
4
2
0 kPa

FIG. 15

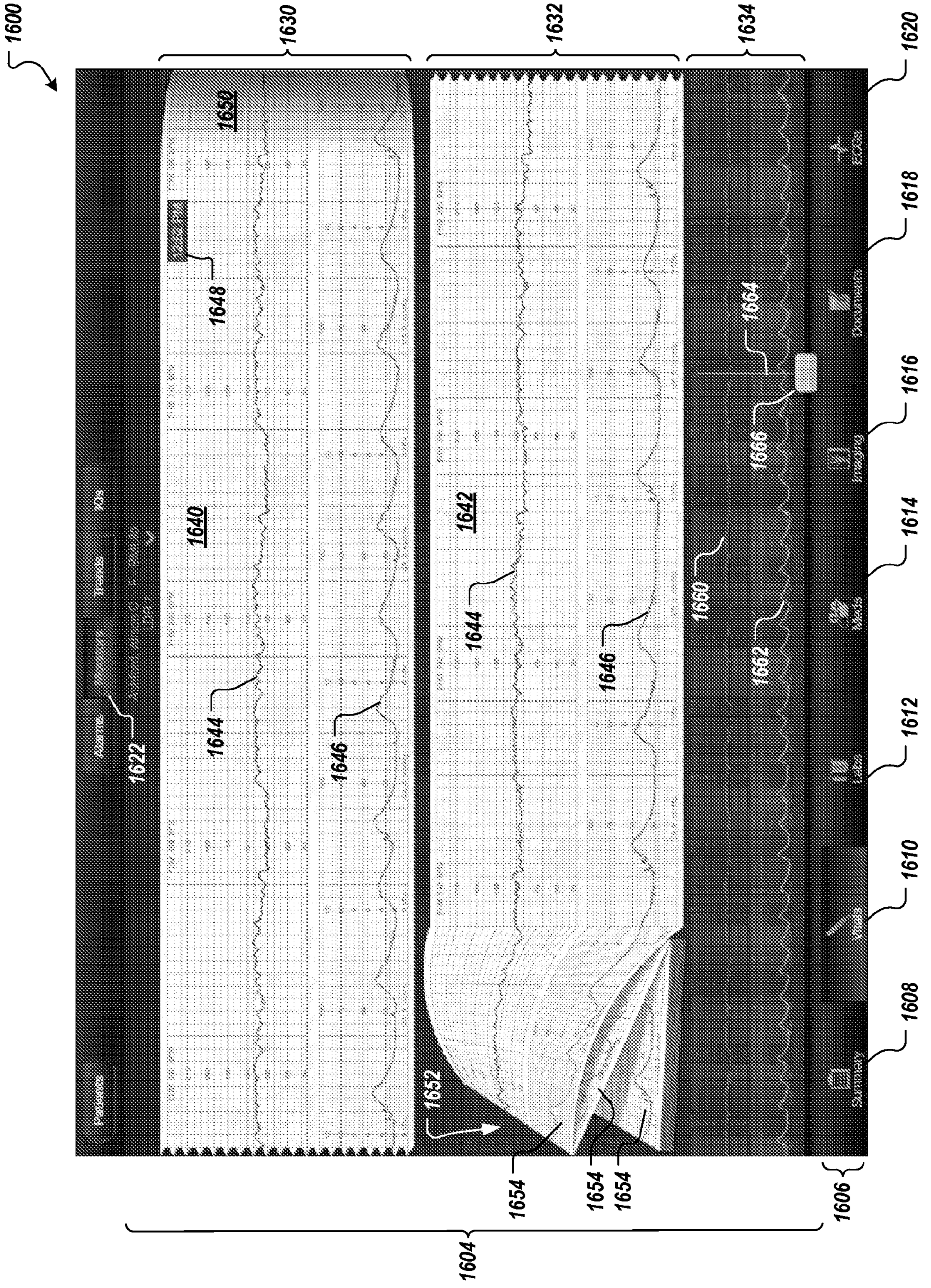

1600
1630
1632
1634
1620
1650
1648
1618
1664
1616
1666
1640
1642
1614
1660
1644
1644
1662
1646
1646
1622
1612
1610
1652
1608
1654
1654
1654
1606
1604

FIG. 16

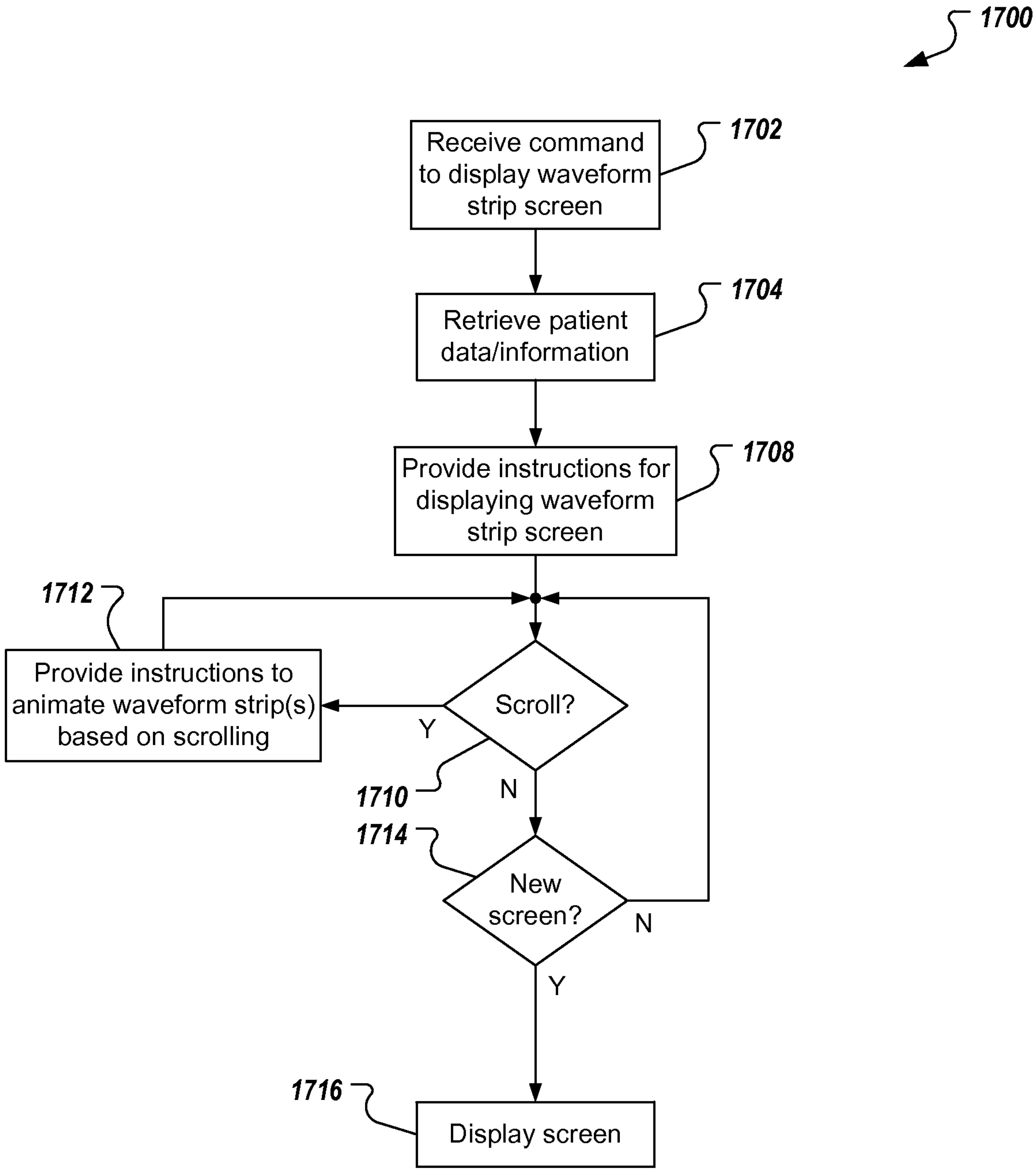
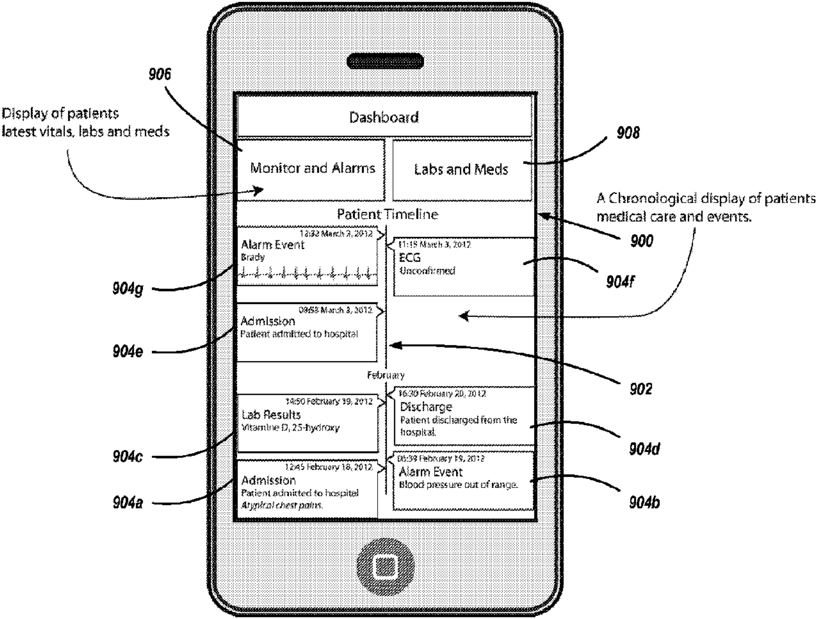

1700
Receive command to display waveform strip screen
1702
Retrieve patient data/information
1704
Provide instructions for displaying waveform strip screen
1708
1712
Provide instructions to animate waveform strip(s) based on scrolling
Scroll?
Y
1710
N
1714
New screen?
N
Y
1716
Display screen

FIG. 17


906
Display of patients
latest vitals, labs and meds
Dashboard
Monitor and Alarms
Labs and Meds
908
A Chronological display of patients
medical care and events.
Patient Timeline
900
12:32 March 3, 2012
Alarm Event
Brady
11:15 March 3, 2012
ECG
Unconfirmed
904f
904g
09:53 March 3, 2012
Admission
Patient admitted to hospital
904e
902
February
16:30 February 20, 2012
Discharge
Patient discharged from the hospital.
14:50 February 19, 2012
Lab Results
Vitamine D, 25-hydroxy
904d
904c
06:39 February 19, 2012
Alarm Event
Blood pressure out of range.
12:45 February 18, 2012
Admission
Patient admitted to hospital
Atypical chest pains.
904a
904b