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(54) **ADVANCED PATIENT MANAGEMENT SYSTEM INCLUDING INTERROGATOR/TRANSCEIVER UNIT**

(75) Inventors: **Scott Thomas Mazar**, Inver Grove Heights, MN (US); **Yatheendhar D. Manicka**, Woodbury, MN (US)

(73) Assignee: **Cardiac Pacemakers, Inc.**, St. Paul, MN (US)

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(52) **U.S. Cl.** **607/60**
(58) **Field of Search** 607/60, 31; 600/300; 709/224

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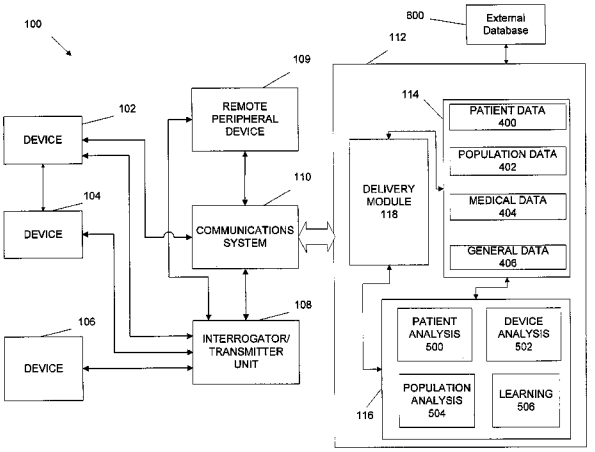
(74) *Attorney, Agent, or Firm*—Merchant & Gould P.C.

(57) **ABSTRACT**

An advanced patient management system including at least one device that is implanted in a patient, the device being configured to measure physiological attributes of the patient and provide therapy to the patient. The advanced patient management system may also include an interrogator/transceiver unit in communication with the device and a network, the unit being positioned relative to the device to facility communication between the repeater and the device. The advanced patient management system also includes a host, in communication with the device through the network, to store data from the device and to provide a predictive diagnosis of an oncoming event. The interrogator/transceiver unit may include programmable or updateable with software from a computer system or remote host.

9 Claims, 6 Drawing Sheets



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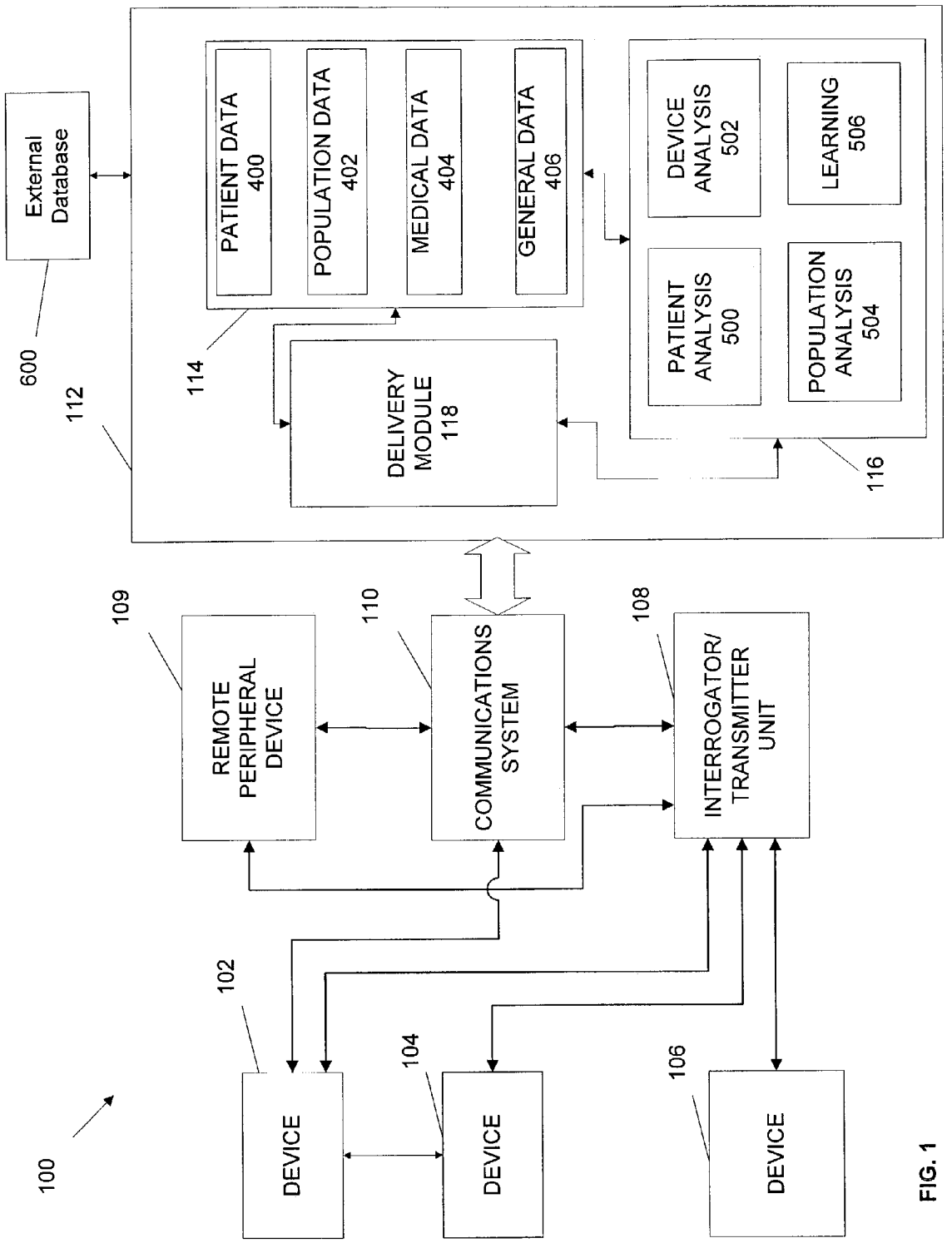
100
DEVICE
102
DEVICE
104
DEVICE
106
REMOTE PERIPHERAL DEVICE
109
COMMUNICATIONS SYSTEM
110
INTERROGATOR/ TRANSMITTER UNIT
108
112
114
PATIENT DATA 400
POPULATION DATA 402
MEDICAL DATA 404
GENERAL DATA 406
DELIVERY MODULE 118
PATIENT ANALYSIS 500
DEVICE ANALYSIS 502
POPULATION ANALYSIS 504
LEARNING 506
116
External Database
600

FIG. 1

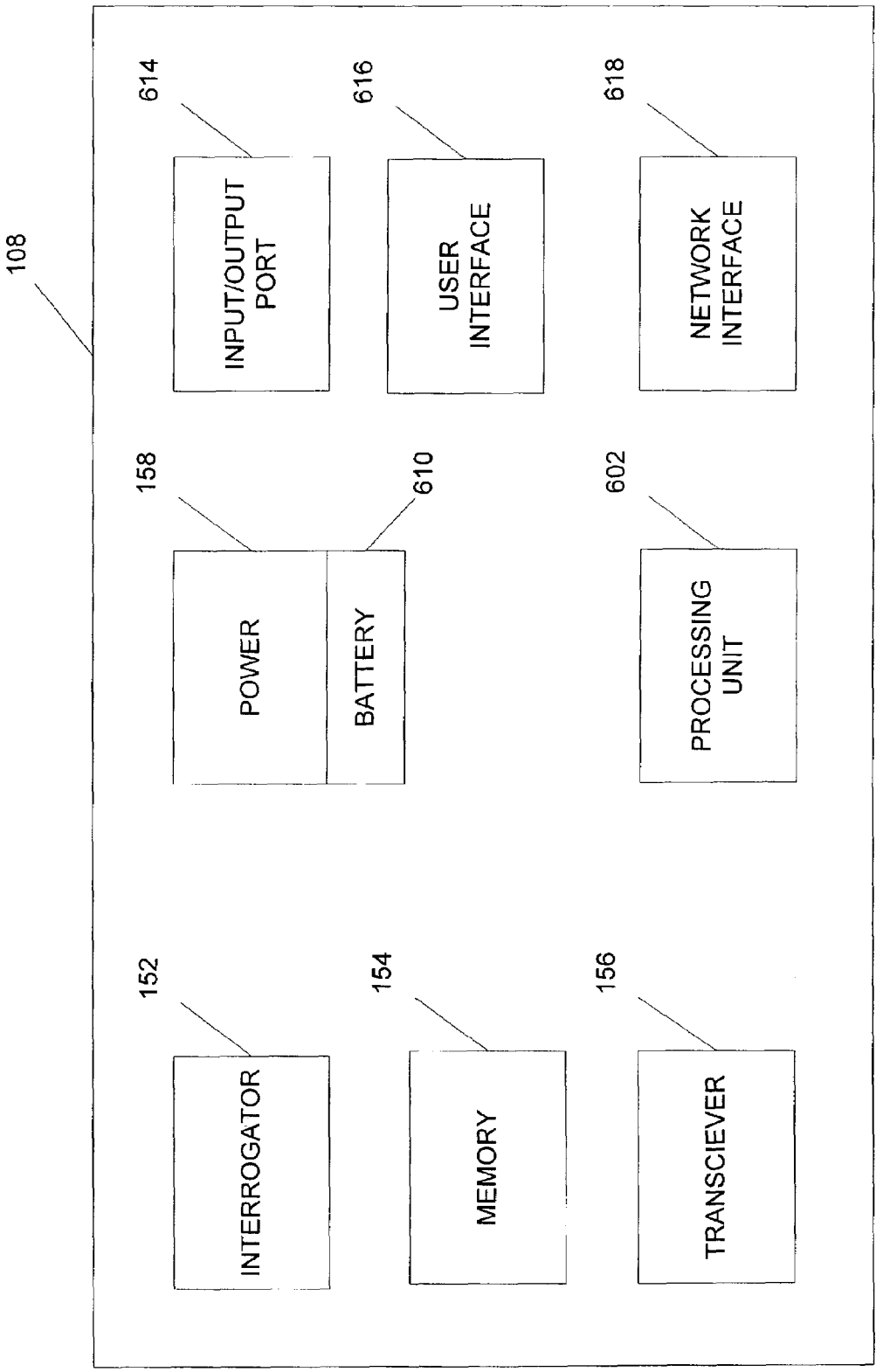
108
614
INPUT/OUTPUT PORT
616
USER INTERFACE
618
NETWORK INTERFACE
158
POWER
610
BATTERY
602
PROCESSING UNIT
152
INTERROGATOR
154
MEMORY
156
TRANSCIEVER

FIG. 2

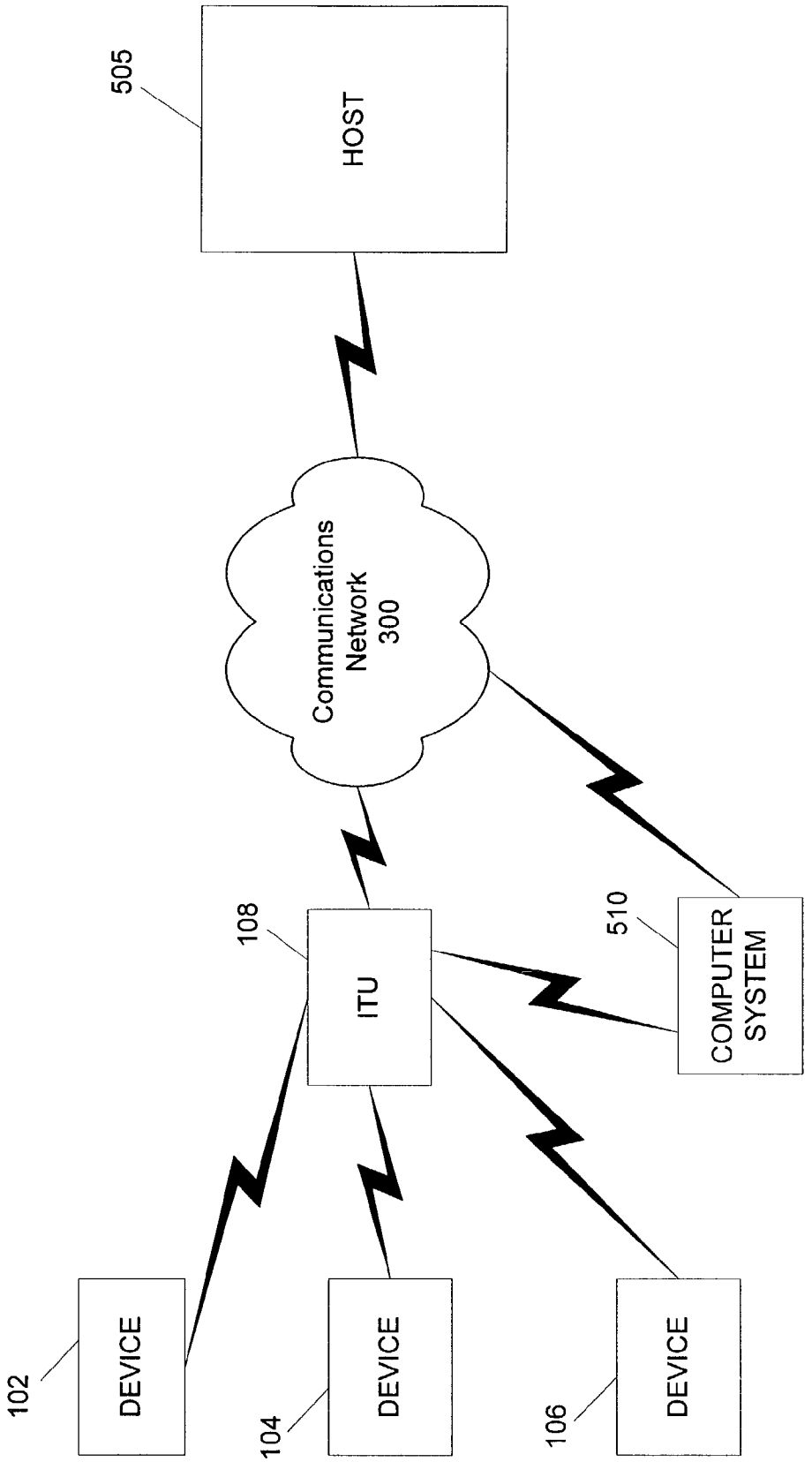
505
HOST
Communications Network 300
108
ITU
510
COMPUTER SYSTEM
102
DEVICE
104
DEVICE
106
DEVICE

FIG. 3

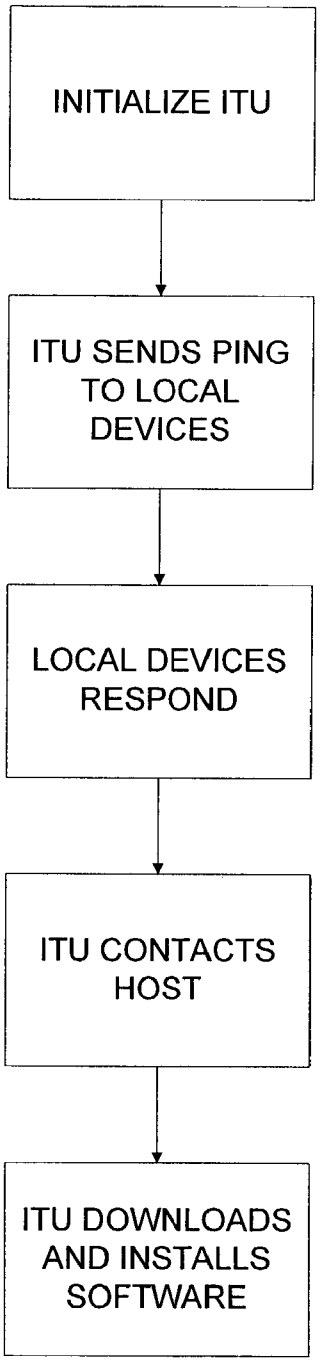
INITIALIZE ITU
ITU SENDS PING TO LOCAL DEVICES
LOCAL DEVICES RESPOND
ITU CONTACTS HOST
ITU DOWNLOADS AND INSTALLS SOFTWARE

FIG. 4

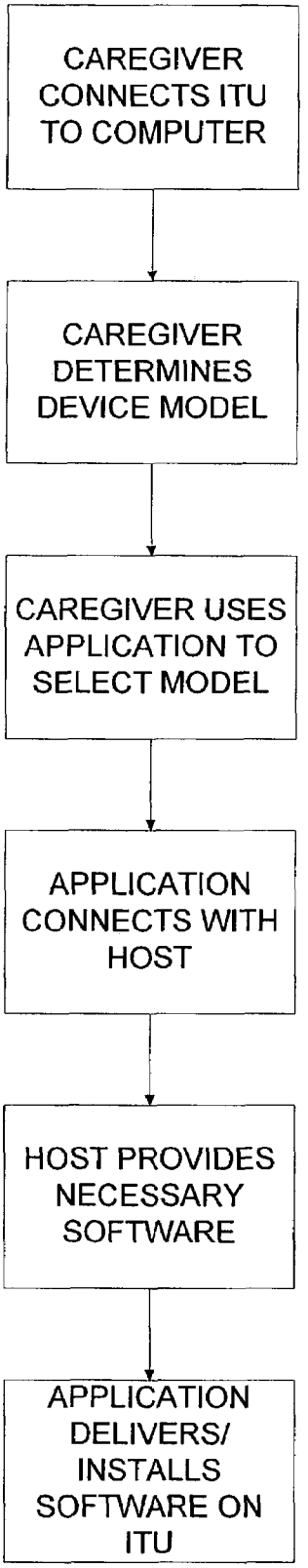
CAREGIVER CONNECTS ITU TO COMPUTER
CAREGIVER DETERMINES DEVICE MODEL
CAREGIVER USES APPLICATION TO SELECT MODEL
APPLICATION CONNECTS WITH HOST
HOST PROVIDES NECESSARY SOFTWARE
APPLICATION DELIVERS/ INSTALLS SOFTWARE ON ITU

FIG. 5

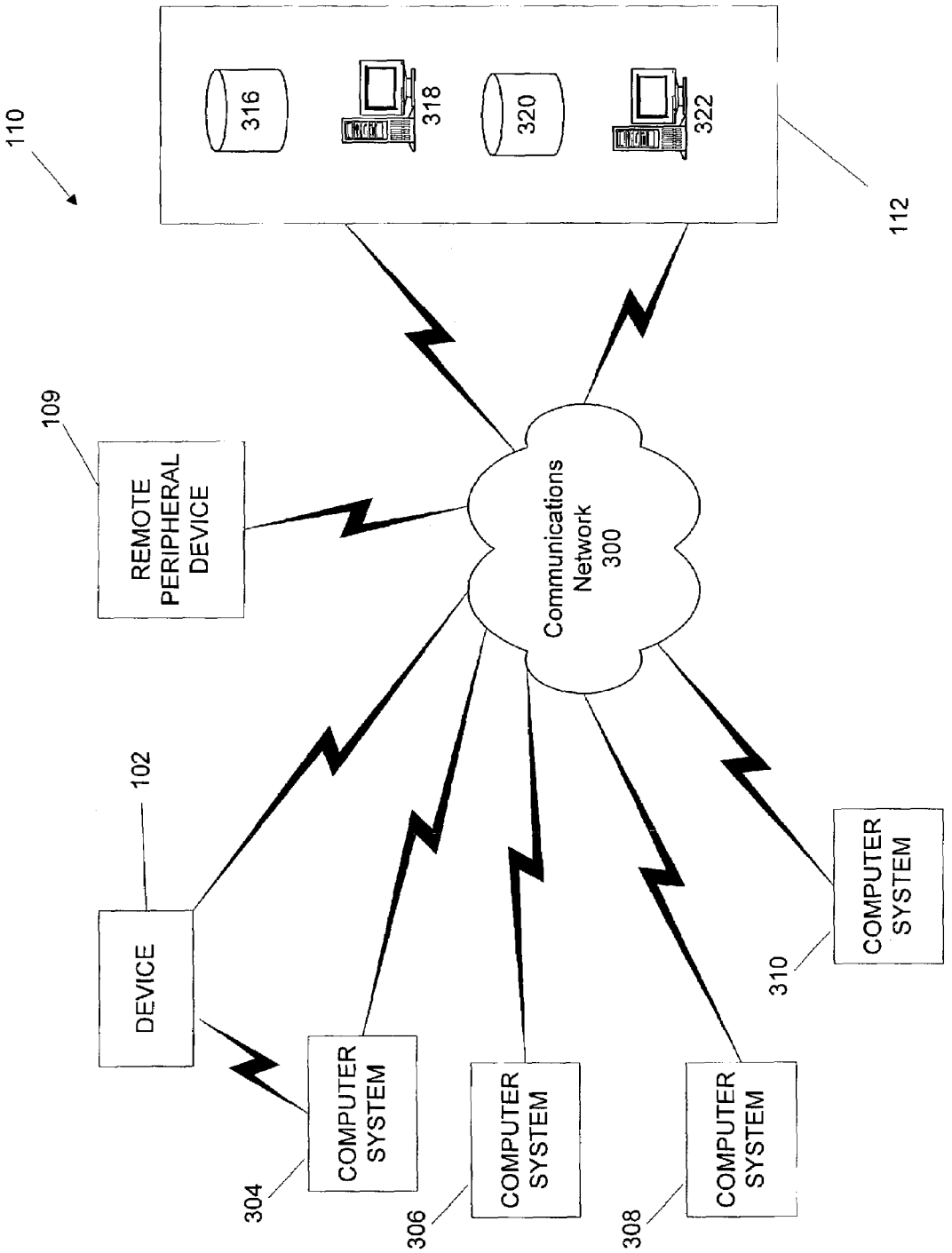
110
316
318
320
322
112
109
REMOTE PERIPHERAL DEVICE
Communications Network 300
102
DEVICE
COMPUTER SYSTEM
304
COMPUTER SYSTEM
306
COMPUTER SYSTEM
308
COMPUTER SYSTEM
310

FIG. 6

ADVANCED PATIENT MANAGEMENT SYSTEM INCLUDING INTERROGATOR/TRANSCEIVER UNIT

TECHNICAL FIELD

The present disclosure relates generally to advanced patient management systems. More particularly, the present disclosure relates to advanced patient management systems including an interrogator/transceiver unit to collect, analyze, and forward data from one or more patients.

BACKGROUND

Management of patients with chronic disease consumes a significant proportion of the total health care expenditure in the United States. Many of these diseases are widely prevalent and have significant annual incidences as well. Heart failure prevalence alone is estimated at over 5.5 million patients in 2000 with incidence rates of over half a million additional patients annually, resulting in a total health care burden in excess of $20 billion. Heart failure, like many other chronic diseases such as asthma, COPD, chronic pain, and epilepsy, is event driven, where acute de-compensations result in hospitalization. In addition to causing considerable physical and emotional trauma to the patient and family, event driven hospitalizations consume a majority of the total health care expenditure allocated to the treatment of heart failure.

Hospitalization and treatment for an acute de-compensation typically occurs after the de-compensation event has happened. However, most heart failure patients exhibit prior non-traumatic symptoms, such as steady weight gain, in the weeks or days prior to the de-compensation. If the caregiver is aware of these symptoms, it is possible to intervene before the event, at substantially less cost to the patient and the health care system. Intervention is usually in the form of a re-titration of the patient's drug cocktail, reinforcement of the patient's compliance with the prescribed drug regimen, or acute changes to the patient's diet and exercise. Such intervention is usually effective in preventing the de-compensation episode and thus avoiding hospitalization.

Patients with chronic heart disease can receive implantable cardiac devices such as pacemakers, implantable cardioverter defibrillators (ICDs), and heart failure cardiac resynchronization therapy (CRT) devices. Currently, the electrophysiologist that implants pacemakers and ICDs requires their patients to make clinic visits periodically, usually once every three or four months, in order to verify if their implanted device is working correctly and programmed optimally. Device follow-ups are usually performed by the nurse-staff assisted by the sales representative from the device manufacturers. Device follow-ups are labor intensive and typically require patients to make multiple clinic visits.

The data the caregiver does receive regarding a patient requires the caregiver to analyze the data and provide predictive and post-event diagnosis based on the data. However, as the amount of data collected regarding a particular patient increases, it becomes more difficult for a caregiver to assimilate and provide a meaningful analysis of all of the data. In addition, it is difficult for a caregiver to identify trends and other information from particular patients and leverage this knowledge for the treatment of larger populations.

It would therefore be desirable to develop an automated system to collect data regarding the physiological condition of a patient, as well as collect data from implanted devices, and to automate the process of analyzing the data.

SUMMARY

The present disclosure relates generally to advanced patient management systems. More particularly, the present disclosure relates to advanced patient management systems including an interrogator/transceiver unit to collect, analyze, and forward data from one or more patients.

According to one aspect, the invention relates to an interrogator/transceiver unit in an advanced patient management system, the unit being configured to communicate with at least one device associated with a patient, and a host. The unit includes a processor module to process software instructions, an interface with a remote host, and a memory module, wherein the memory module includes, at startup, baseline software to allow the unit to ping the device and, upon a response from the device, the unit is configured to connect through the interface to the remote host to download software into the memory module that is specific to the device.

According to another aspect, the invention relates to a system for configuring an interrogator/transceiver unit for use in an advanced patient management system, the unit being configured to communicate with at least one device associated with a patient, and a host. The system includes an interrogator/transceiver unit, the unit including a processor to process software instructions, an interface, and a memory module, wherein the unit is blank at initialization, and a computer system coupled to the unit through the interface, wherein the computer system allows a user to select one or more of a plurality of device models and, upon selection, installs software associated with the selected device model on the unit.

According to yet another aspect, the invention relates to a method of transmitting data from a device associated with a patient to a remote host as part of an advanced patient management system, the method including: providing an interrogator/transceiver unit being configured to communicate with the device; initializing the unit; sending a ping from the unit to the device; and responding with identification information from the device to the unit.

According to another embodiment, the invention relates to a method of transmitting data from a device associated with a patient to a remote host as part of an advanced patient management system, the method including: providing a blank interrogator/transceiver unit; providing a computer system to allow selection from a list of a plurality of device models; selecting the device from the list of the plurality of device models; and installing software on the unit to allow the unit to communicate with the device.

The above summary is not intended to describe each disclosed embodiment or every implementation of the present invention. The figures and the detailed description which follow more particularly exemplify these embodiments.

DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. **1** illustrates an example advanced patient management system made in accordance with the present invention;

FIG. **2** illustrates an example interrogator/transceiver unit made in accordance with the present invention;

FIG. **3** illustrates an example system for updating software on an interrogator/transceiver unit;

FIG. **4** illustrates an example automatic method for initially updating software on an interrogator/transceiver unit;

FIG. **5** illustrates an example manual method for initially updating software on an interrogator/transceiver unit; and

FIG. **6** illustrates an example communication system made in accordance with the present invention.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

DETAILED DESCRIPTION

The present system and methods are described with respect to an advanced patient management system configured to collect patient-specific information, store and collate the information, and generate actionable recommendations to enable the predictive management of patients. The advanced patient management system is also configured to leverage a remote communications infrastructure to provide automatic device follow-ups to collect data, coordinate therapy, and to determine if remote devices are functioning properly. The term "patient" is used herein to mean any individual from whom information is collected. The term "caregiver" is used herein to mean any provider of services, such as health care providers including, but not limited to, nurses, doctors, and other health care provider staff.

FIG. **1** illustrates an example advanced patient management system **100** made in accordance with the present invention. Advanced patient management system **100** generally includes the following components: one or more devices **102**, **104**, and **106**, one or more interrogator/transceiver units **108**, a communication system **110**, one or more remote peripheral devices **109**, and a host **112**.

Each component of the advanced patient management system **100** can communicate using the communication system **110**. Some components may also communicate directly with one another. For example, devices **102** and **104** may be configured to communicate directly with one another. The various components of the example advanced patient management system **100** illustrated herein are described below.

I. Implanted/External Devices

Devices **102**, **104**, and **106** can be implantable devices or external devices that may provide one or more of the following functions with respect to a patient: (1) sensing, (2) data analysis, and (3) therapy. For example, in one embodiment, devices **102**, **104**, and **106** are either implanted or external devices used to measure a variety of physiological, subjective, and environmental conditions of a patient using electrical, mechanical, and/or chemical means. The devices **102**, **104**, and **106** can be configured to automatically gather data or can require manual intervention by the patient. The devices **102**, **104**, and **106** can be configured to store data related to the physiological and/or subjective measurements and/or transmit the data to the communication system **110** using a variety of methods, described in detail below. Although three devices **102**, **104**, and **106** are illustrated in the example embodiment shown, more or fewer devices may be used for a given patient.

The devices **102**, **104**, and **106** can be configured to analyze the measured data and act upon the analyzed data. For example, the devices **102**, **104**, and **106** are configured to modify therapy or provide alarm indications based on the analysis of the data.

In one embodiment, devices **102**, **104**, and **106** also provide therapy. Therapy can be provided automatically or in response to an external communication. Devices **102**, **104**, and **106** are programmable in that the characteristics of their sensing, therapy (e.g., duration and interval), or communication can be altered by communication between the devices **102**, **104**, and **106** and other components of the advanced patient management system **100**. Devices **102**, **104**, and **106** can also perform self-checks or be interrogated by the communication system **110** to verify that the devices are functioning properly. Examples of different embodiments of the devices **102**, **104**, and **106** are provided below.

Devices implanted within the body have the ability to sense and communicate as well as to provide therapy. Implantable devices can provide direct measurement of characteristics of the body, including, without limitation, electrical cardiac activity (e.g., a pacemaker, cardiac resynchronization management device, defibrillator, etc.), physical motion, temperature, heart rate, activity, blood pressure, breathing patterns, ejection fractions, blood viscosity, blood chemistry, blood glucose levels, and other patient-specific clinical physiological parameters, while minimizing the need for patient compliance. Derived measurements can also be determined from the implantable device sensors (e.g., a sleep sensor, functional capacity indicator, autonomic tone indicator, sleep quality indicator, cough indicator, anxiety indicator, and cardiovascular wellness indicator for calculating a quality of life indicator quantifying a patient's overall health and well-being).

Devices **102**, **104**, and **106** can also be external devices, or devices that are not implanted in the human body, that are used to measure physiological data (e.g., a thermometer, sphygmomanometer, or external devices used to measure blood characteristics, body weight, physical strength, mental acuity, diet, heart characteristics, and relative geographic position). Devices **102**, **104**, and **106** can also be environmental sensors used to measure environmental conditions (e.g., temperature, air quality, humidity, carbon monoxide level, oxygen level, barometric pressure, light intensity, and sound).

One or more of the devices **102**, **104**, and **106** (for example, device **106**) may be external devices that measure subjective or perceptive data from the patient related to a patient's feelings, perceptions, and/or opinions, as opposed to objective physiological data. In one example embodiment, the subjective device presents the patient with a relatively small number of responses to each question posed to the patient. The responses available to the patient may include three faces representing feelings of happiness, nominalness, and sadness. Averaged over time, a trend of a patient's well being will emerge with a finer resolution than the quanta of the three responses.

The advanced patient management system **100** may also include one or more remote peripheral devices **109** (e.g., cellular telephones, pagers, PDA devices, facsimiles, remote computers, printers, video and/or audio devices) that use wired or wireless technologies to communicate with the communication system **110** and/or the host **112**.

II. Interrogator/Transceiver Unit

Referring now to FIG. **2**, the example advanced patient management system **100** includes one or more interrogator/transceiver units ("ITUs"), such as example ITU **108**. The example ITU **108** includes an interrogator module **152** for sending and receiving data from a device, such as devices **102**, **104**, and **106**, a memory module **154** for storing data, and a transceiver module **156** for sending and receiving data to and from other components of the APM system **100**. The transceiver module may operate as an interrogator of the devices **102**, **104** and **106** as well. The example ITU **108** also includes a power module **158** that provides power. Further included in the ITU **108** are a processor **602**, memory **606**, a battery **610**, an input/output port **614**, a user interface **616**, and a network interface **618**.

The processor **602** is a typical processor for processing instructions provided in software code.

The user interface **616** allows the patient or others to communicate with the ITU **108**. For example, the user interface includes one or more input devices, such as a mouse, keyboard, touch screen, microphone, etc., and one or more output devices, such as a liquid crystal display (LCD) or light emitting diode (LED), CRT screen, speaker, lights, vibrating motor, etc. The user interface **616** may be used to collect subjective data from the patient (see section I of the present application), or to provide information or alerts to the patient (see section IV of the present application).

The input/output port **614** is a typical communication port that allows the ITU **108** to connect to external devices. For example, the input/output port **614** may be a parallel, serial, or universal serial bus (USB) port to allow the ITU **108** to be connected to a computer. Other types of ports as generally known in the art may also be used.

The network interface **618** allows the ITU **108** to be connected to a network. For example, the ITU **108** may be connected to a LAN in the patient's home or directly connected to the communication system **110**.

The battery **610** is part of the power module **158**. The battery **610** may be rechargeable or non-rechargeable. If the battery **610** is rechargeable, the battery can be charged by using a standard battery charger, or may be charged by placing the ITU **108** in a cradle configured to accept it. In an alternative embodiment, the battery may be removed and the power module **158** can be directly connected to a standard AC power source.

The memory **154** may include any typical form of memory, such as RAM, ROM, etc. for storing data, software applications, and other electronic information. Other types of memory can also be used, such as removable memory including flash memory, microdrives, etc.

The ITU **108** performs one or more of the following functions: (1) data storage; (2) data analysis; (3) data forwarding; (4) patient interaction; (5) patient feedback; and (6) data communications. For example, the ITU **108** facilitates communications between the devices **102**, **104**, and **106** and the communication system **110**. The ITU **108** can, periodically or in realtime, interrogate and download into memory clinically relevant patient data from the devices **102**, **104**, and/or **106**. This data includes, in the cardiac sensor context, for example, P and R-wave measurements, pacing, shocking events, lead impedances, pacing thresholds, battery voltage, capacitor charge times, ATR episodes with electrograms, tachycardia episodes with electrograms, histogram information, and any other clinical information necessary to ensure patient health and proper device function. The data is sent to the ITU **108** by the devices **102**, **104**, and **106** in real-time or periodically uploaded from buffers in the devices.

The ITU **108** can be customizable and include a variety of software packages to enhance usability and compatibility. The software may control the ability of the ITU **108** to communicate with each device, as well as control the functionality of the ITU **108** itself. For example, the software allows the ITU **108** to communicate with the various devices (e.g., devices **102**, **104**, and **106**), download data from the devices, and update configurations of the devices.

It may be advantageous to provide this functionality in software because different implanted and external devices, such as devices **102**, **104**, and **106**, may each function and communicate differently. For example, different models of implanted pacemakers communicate with interrogators differently, and the ITU **108** must be able to communicate with each model to allow the ITU **108** to interrogate the pacemakers and successfully download desired information. It may be impractical, due to cost and size, to include memory sufficient to store the software necessary to communicate with every model of every device.

In one embodiment shown in FIG. **3**, the ITU **108** is customizable through the download of software updates from a host download source system **505**. (In some embodiments, the host download source system **505** may be the same system as the host **112**.) When initially taken out of the box, the ITU **108** is "blank" or includes only "baseline software." The term "blank" is used to indicate that the ITU **108** can perform initial functions such as booting up, but does not include software to allow the ITU **108** to communicate with a device. The term "baseline software" is used to indicate that the ITU includes software necessary to allow the ITU **108** to boot up and to perform generic functions such as communicating with a device at a high level. These generic functions may include the ability to send messages (e.g., ping) to devices in local proximity to the ITU to enable the ITU to determine what is in the environment surrounding the ITU, and as well as the ability to communicate with a hosting system (through, for example, the communication network **300**). However, the ITU **108** with baseline software does not necessarily include software to communicate functionally with specific models of implanted or external devices.

The software necessary to allow the ITU **108** to communicate with different devices is maintained on the host download source system **505**, and the software must be downloaded and installed on the ITU **108** to allow the ITU **108** to functionally communicate with the desired device or devices.

There are several methods by which the ITU **108** can download the software necessary to functionally communicate with one or more given devices. In one example method illustrated in FIG. **4**, the ITU **108** includes baseline software to allow it to "ping" devices in local range of the ITU **108**. A ping is a request from the ITU **108** to any devices within range to respond with identification information, such as model number, serial number, and other identifying information. Any devices in range of the ping from the ITU **108** will respond by sending back to the ITU information related to the type of device. Based on this information, the ITU **108** establishes communication with the host **505** and downloads/installs the software necessary to allow the ITU **108** to functionally communicate with the device or devices. This is an automated method for identifying and installing the needed software, and this method may be performed at initial startup of the ITU **108**, as well as after a reset of the ITU **108** as desired.

In another example method illustrated in FIG. **6**, the ITU **108** is blank and is programmed by the caregiver or patient

prior to use by the patient. For example, if the patient has three devices **102**, **104**, and **106** that are to be monitored, the caregiver uses a computer system **510** (see FIG. **3**) that is networked to the host **505** (through, for example, communication network **300**) to identify and download the software required for the ITU **108** to communicate with the devices **102**, **104**, and **106**. The computer system **510** includes one or more applications to assist the caregiver in the selection of the proper software for download and installation. For example, the application on the computer system **510** may include a list of all models of a given device, and the caregiver can select the correct model and configure the desired software as needed. Once the model is selected, the application establishes a connection with the host **505** and downloads the correct software to the computer system **510**. The computer system **510** and the ITU **108** are connected so that the software is then uploaded and installed on the ITU **108**.

In an alternative embodiment, the software for communicating with various devices resides on the computer system **510** or a removable storage medium such as a compact disk. Therefore, once the caregiver or patient selects the appropriate device model, the software can be installed without requiring the computer system **510** to connect to the host **505**.

In addition, using either the automated or manual method, the ITU **108** can be reprogrammed multiple times as desired. For example, if the ITU **108** is initially programmed to communicate with a first device, and subsequently the first device is removed and a second device is added, the ITU **108** can, automatically or manually, be reprogrammed to communicate with the second device.

At the same time that the software is downloaded by either method illustrated in FIGS. **4** and **5**, it is also possible to provide patient information to the host to allow data sent by the ITU **108** to the host to be properly matched with the patient (see section IV of the present application). For example, in the automated method of FIG. **4**, the device provides additional information related to the patient in response to the ping, and the ITU **108** forwards this information to the host. In the manual method of FIG. **5**, the caregiver or patient provides patient information at the time that the desired software is selected and downloaded from the host.

In another embodiment, the ITU **108** periodically establishes a connection with the host **505** to check if any software updates have been released. If a new version of the software is available, the ITU **108** downloads and installs the updated version.

III. Communication System

Communication system **110** provides for communications between and among the various components of the advanced patient management system **100**, such as the devices **102**, **104**, and **106**, host **112**, and remote peripheral device **109**. FIG. **6** illustrates one embodiment for the communication system **110** made in accordance with the present invention. The communication system **110** includes a plurality of computer systems **304**, **306**, **308**, and **310**, as well as device **102**, host **112**, and remote peripheral device **109**, connected to one another by the communications network **300**. The communications network **300** may be, for example, a local area network (LAN), wide area network (WAN), or the Internet. Communications among the various components, as described more fully below, may be implemented using wired or wireless technologies.

In the example embodiment illustrated, the host **112** includes server computers **318** and **322** that communicate with computers **304**, **306**, **308**, and **310** using a variety of communications protocols, described more fully below. The server computers **318** and **322** store information in databases **316**.and **320**. This information may also be stored in a distributed manner across one or more additional servers.

A variety of communication methods and protocols may be used to facilitate communication between devices **102**, **104**, and **106**, ITU **108**, communication system **110**, host **112**, and remote peripheral device **109**. For example, wired and wireless communications methods may be used. Wired communication methods may include, for example and without limitation, traditional copper-line communications such as DSL, broadband technologies such as ISDN and cable modems, and fiber-optics, while wireless communications may include cellular, satellite, radio frequency (RF), Infrared, etc.

For any given communication method, a multitude of standard and/or proprietary communication protocols may be used. For example and without limitation, protocols such as radio frequency pulse coding, spread spectrum, direct sequence, time-hopping, frequency hopping, SMTP, FTP, and TCP/IP may be used. Other proprietary methods and protocols may also be used. Further, a combination of two or more of the communication methods and protocols may also be used.

The various communications between the components of the advanced patient management system **100** may be made secure using several different techniques. For example, encryption and/or tunneling techniques may be used to protect data transmissions. Alternatively, a priority data exchange format and interface that are kept confidential may also be used. Authentication can be implemented using, for example, digital signatures based on a known key structure (e.g., PGP or RSA). Other physical security and authentication measures may also be used, such as security cards and biometric security apparatuses (e.g., retina scans, iris scans, fingerprint scans, veinprint scans, voice, facial geometry recognition, etc.). Conventional security methods such as firewalls may be used to protect information residing on one or more of the storage media of the advanced patient management system **100**. Encryption, authentication and verification techniques may also be used to detect and correct data transmission errors.

Communications among the various components of the advanced patient management system **100** may be enhanced using compression techniques to allow large amounts of data to be transmitted efficiently. For example, the devices **102**, **104**, and **106** or the ITU **108** may compress the recorded information prior to transmitting the information to the ITU **108** or directly to the communication system **110**.

The communication methods and protocols described above can facilitate periodic and/or real-time delivery of data.

IV. Host

The example host **505** (see FIG. **3**) is configured to receive a request for software from the ITU **108** or computer system **510** and to upload the software to the ITU **108** or computer system **510**. Specifically, the host **505** may comprise one or more databases to house software necessary to communicate with a plurality of different devices. Upon receiving a request for software from the ITU **108**, the host **505** queries one or more databases and identifies the correct software for the selected device model or models. This software is made available for the ITU **108** or computer

system **510** to download. The host **505** may also perform other functions, such as to automatically push software updates down to the ITU **108** as needed.

The host **505** may be a part of the example host **112** (see FIG. **1**). The host **112** includes a database module **114**, an analysis module **116**, and a delivery module **118**. Host **112** preferably includes enough processing power to analyze and process large amounts of data collected from each patient, as well as to process statistics and perform analysis for large populations. For example, the host **112** may include a mainframe computer or multi-processor workstation. The host **112** may also include one or more personal computer systems containing sufficient computing power and memory. The host **112** may include storage medium (e.g., hard disks, optical data storage devices, etc.) sufficient to store the massive amount of high-resolution data that is collected from the patients and analyzed.

The host **112** may also include identification and contact information (e.g., IP addresses, telephone numbers, or a product serial number) for the various devices communicating with it, such as ITU **108** and peripheral device **109**. For example, each ITU **108** is assigned a hard-coded or static identifier (e.g., IP address, telephone number, etc.), which allows the host **112** to identify which patient's information the host **112** is receiving at a given instant. Alternatively, each device **102**, **104**, and **106** may be assigned a unique identification number, or a unique patient identification number may be transmitted with each transmission of patient data.

When a device is first activated, several methods may be used to associate data received by the advanced patient management system **100** with a given patient. For example, each device may include a unique identification number and a registration form that is filled out by the patient, caregiver, or field representative. The registration form can be used to collect the necessary information to associate collected data with the patient. Alternatively, the user can logon to a web site to allow for the registration information to be collected. In another embodiment, a barcode is included on each device that is scanned prior to or in conjunction deployment of the device to provide the information necessary to associate the recorded data with the given patient.

Referring again to FIG. **1**, the example database module **114** includes a patient database **400**, a population database **402**, a medical database **404**, and a general database **406**, all of which are described further below. The patient database **400** includes patient specific data, including data acquired by the devices **102**, **104**, and **106**, as well as a patient's medical records and historical information. The population database **402** includes non-patient specific data, such as data relating to other patients and population trends. The example medical database **404** includes clinical data relating to the treatment of diseases, such as historical trend data for multiple patients in the form of a record of progression of their disease(s) along with markers of key events. The general database **406** includes non-medical data of interest to the patient, such as information relating to news, finances, shopping, technology, entertainment, and/or sports.

In another embodiment, information is also provided from an external source, such as external database **600**. For example, the external database **600** includes external medical records maintained by a third party, such as drug prescription records maintained by a pharmacy, providing information regarding the type of drugs that have been prescribed for a patient.

The example analysis module **116** includes a patient analysis module **500**, device analysis module **502**, population analysis module **504**, and learning module **506**. Patient analysis module **500** may utilize information collected by the advanced patient management system **100**, as well as information for other relevant sources, to analyze data related to a patient and provide timely and predictive assessments of the patient's well-being. Device analysis module **502** analyzes data from the devices **102**, **104**, and **106** and ITU **108** to predict and determine device issues or failures. Population analysis module **504** uses the data collected in the database module **114** to manage the health of a population. Learning module **506** analyzes the data provided from the various information sources, including the data collected by the advanced patient system **100** and external information sources, and may be implemented via a neural network (or equivalent) system to perform, for example, probabilistic calculations.

Delivery module **118** coordinates the delivery of feedback based on the analysis performed by the host **112**. For example, based on the data collected from the devices and analyzed by the host **112**, the delivery module **118** can deliver information to the caregiver or to the patient using, for example, a display provided on the ITU **108**.

One or more headings have been provided above to assist in describing the various embodiments disclosed herein. The use of headings, and the resulting division of the description by the headings, should not be construed as limiting in any way. The subject matter described under one heading can be combined with subject matter described under one or more of the other headings without limitation and as desired.

The systems and methods of the present disclosure can be implemented using a system as shown in the various figures disclosed herein including various devices and/or programmers, including implantable or external devices. Accordingly, the methods of the present disclosure can be implemented: (1) as a sequence of computer implemented steps running on the system; and (2) as interconnected modules within the system. The implementation is a matter of choice dependent on the performance requirements of the system implementing the method of the present disclosure and the components selected by or utilized by the users of the method. Accordingly, the logical operations making up the embodiments of the method of the present disclosure described herein can be referred to variously as operations, steps, or modules. It will be recognized by one of ordinary skill in the art that the operations, steps, and modules may be implemented in software, in firmware, in special purpose digital logic, analog circuits, and any combination thereof without deviating from the spirit and scope of the present invention as recited within the claims attached hereto.

The present invention should not be considered limited to the particular examples described above, but rather should be understood to cover all aspects of the invention as fairly set out in the attached claims. Various modifications, equivalent processes, as well as numerous structures to which the present invention may be applicable will be readily apparent to those of skill in the art to which the present invention is directed upon review of the instant specification.

What is claimed is:

1. An interrogator/transceiver unit in an advanced patient management system, the unit being configured to communicate with at least one device associated with a patient, and a host, the unit comprising:

a processor module to process software instructions;

an interface with a remote host; and

a memory module, wherein the memory module includes, at startup, baseline software to allow the unit to ping the device and, upon a response from the device, the unit

is configured to connect through the interface to the remote host to download software into the memory module that is specific to the device;

wherein, upon reset of the unit, the unit automatically pings the device and downloads software from the remote host.

2. The unit of claim **1**, further comprising user interface means for communicating with a patient.

3. The unit of claim **1**, wherein the device is implanted.

4. The unit of claim **1**, wherein the unit automatically communicates with the remote host to download the software.

5. The unit of claim **1**, wherein the unit periodically communicates with the remote host to download updated software.

6. A method of transmitting data from a device associated with a patient to a remote host as part of an advanced patient management system, the method comprising:

providing an interrogator/transceiver unit being configured to communicate with the device;

initializing the unit;

sending a ping from the unit to the device;

responding with identification information from the device to the unit;

establishing communication between the unit and the remote host;

downloading software from the remote host associated with the device to the unit;

installing the software on the unit;

resetting the unit;

sending a second ping from the unit to a second device;

responding with identification information from the second device to the unit;

establishing communication between the unit and the remote host;

downloading software associated with the second device to the unit; and

installing the software on the unit.

7. The method of claim **6**, wherein, prior to initialization of the unit, the unit includes only baseline software.

8. The method of claim **6**, wherein the device and the second device are identical.

9. The method of claim **6**, wherein the device is implanted.

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