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(71) Applicant: HEALTH HERO NETWORK, INC. [US/US]; Suite 111, 2570 West El Camino Real, Moutain View, CA 94040 (US).

(72) Inventor: BROWN, Stephen, J.; 3324 Woodside Road, Woodside, CA 94062 (US).

(74) Agent: ALBOSZTA, Marek; 426 Lowell Avenue, Palo Alto, CA 94301 (US).

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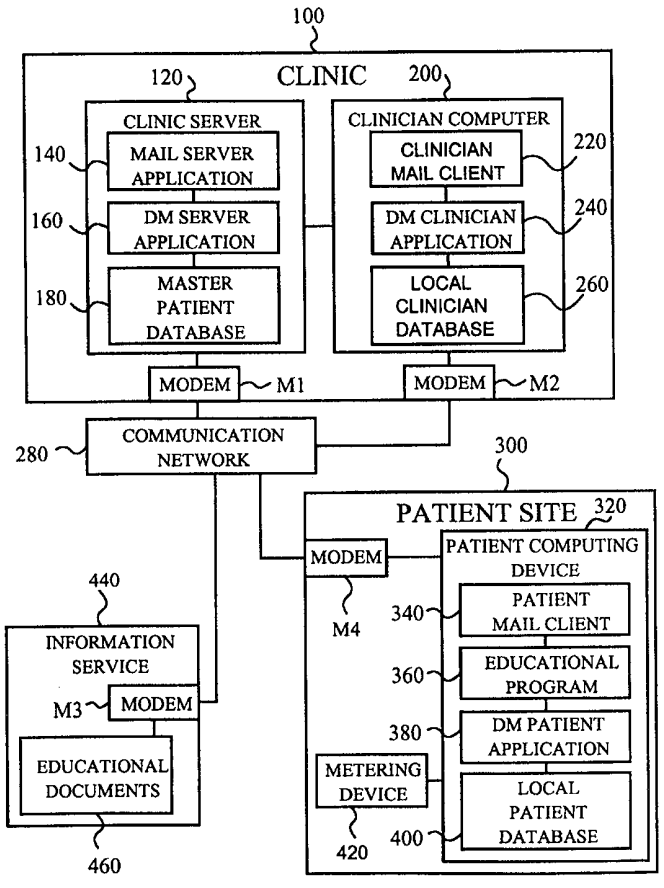
(54) Title: HEALTH MANAGEMENT PROCESS CONTROL SYSTEM

(57) Abstract

A system and method for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition. A patient computing device (320) collects data relating to the patient's health condition and transmits the data to a clinician computer (200) via a communication network (280). The data is analyzed in the clinician computer to determine an educational need of the patient for treating the health condition. An educational program corresponding to the patient's educational need is selected and a pointer to the educational program is embedded in an electronic message to the patient. The educational program (360) is started on the patient computing device by selecting the embedded pointer in the electronic message. As the patient works with the educational program, new data relating to the patient's health condition is collected in the patient computing device and transmitted to the clinician computer for analysis. With this continuous feedback loop between the patient and clinician, the clinician is able to monitor the patient's progress and effectively train the patient to comply with the treatment plan.



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HEALTH MANAGEMENT PROCESS CONTROL SYSTEM

BACKGROUND -- FIELD OF THE INVENTION

The present invention relates to the field of health management, and in particular to a system and method for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition.

BACKGROUND -- DESCRIPTION OF PRIOR ART

In recent years, an increasing number of healthcare providers have initiated outpatient or home healthcare programs for their patients. The potential benefits of these home healthcare programs are particularly good for chronically ill patients, such as those suffering from asthma or diabetes, who must treat their diseases on a daily basis. However, the success of these home healthcare programs is currently limited by the ability of healthcare providers to assess, monitor and train patients to comply with treatment plans for their health conditions.

Many systems have been developed for remotely monitoring a patient's compliance with a prescribed medication plan. For example, U.S. Patent 5,390,238 issued to Kirk et al. on February 14, 1995 discloses a home healthcare and communication support system. The system includes a health support unit located in the patient's home for monitoring and supporting a patient. The health support unit is networked to a remote monitoring terminal for continuous remote monitoring of the patient. The health support unit includes a medication controller for measuring the patient's medicine compliance and a communications module for communicating with an operator at the monitoring terminal. The health support is further networked to the patient's healthcare provider to allow the healthcare provider access to the patient's medicine compliance data.

A similar system for monitoring a patient's medicine compliance is described in U.S. Patent 5,016,172 issued to Dessertine on May 14, 1991. The system includes an automatic medicine compliance monitoring device for measuring the patient's actual medicine consumption. The monitoring device is connected to a patient computing device for recording the patient's medicine consumption. The patient computing device is further connected to a remote monitoring terminal for displaying the patient's medicine compliance to a healthcare provider. The system optionally includes a second monitoring device for monitoring a physical condition of the patient, such as heart rate, blood pressure, blood glucose, or respiration.

Although the systems described by Kirk and Dessertine allow remote monitoring of a patient's health condition and medicine compliance, they have no mechanism for ensuring patient compliance with a treatment plan. Further, these systems are not directed at providing the patient guidelines for treating a health condition. They are simply designed to monitor the patient from a remote location.

Numerous systems have also been developed for prompting a patient take prescribed doses of medication in addition to remotely monitoring the patient's health condition. For example, U.S. Patent 5,501,231 issued to Kaish on March 26, 1996 describes a patient-operated, hand-held system for testing and recording peak flow rates of an asthma patient. The system includes a peak flow meter for measuring the patient's peak flow rates and an alarm for prompting the patient to take a prescribed dose of medication. In using the system, the patient records his or her peak flow rates over a predetermined period of time, typically fifteen days to six months, before returning the system to a doctor for recovery of the peak flow data. At this time, the doctor may optionally reprogram the system with new alarm times and prescribed medicine doses.

Although the system described by Kaish has the advantage of prompting a patient to take medication, it lacks any mechanism for training the patient to actually comply with the prompts. The

system is limited to issuing preprogrammed medicine instructions to the patient without teaching the patient why or how to follow the instructions. Further, the system cannot identify any problems the patient is experiencing in following a treatment plan for his or her health condition or teach the patient how to solve the problems. As a result, the patient may not be able to comply with the prescribed treatment plan, severely limiting the effectiveness of this home healthcare system. Additionally, the system described by Kaish does not permit continuous feedback between the doctor and patient for ongoing adjustment of the treatment plan.

Another system for remotely monitoring a patient and for prompting a patient to take a prescribed dose of medication is disclosed in U.S, Patent 4,731,726 issued to Allen on March 15, 1988. Allen describes a diabetes management system having a blood glucose meter for measuring a patient's blood glucose levels and for sending the blood glucose measurements to a physician. The system further includes a user interface for entering in the system data relating to the patient's medication usage, exercise routine, and dietary intake. Based on the entered data, the system calculates a recommended insulin dose for the patient using a physician prescribed algorithm stored in its memory.

Allen's system suffers from the same disadvantage as Kaish's system in failing to train the patient to comply with the prescribed treatment plan. The system is limited to issuing dosage instructions based on a preprogrammed algorithm without identifying any problems the patient is experiencing with the diabetes program or teaching the patient how to solve the problems. Consequently, the effectiveness of this diabetes management system is also limited.

A similar system for home management of diabetes is disclosed in U.S. Patent 5,109,974 issued to Beckers on May 28, 1991. The system includes a physician computer for developing a diabetes therapy program and a patient recorder having an interface for exchanging data with the physician computer. The recorder has a blood glucose test strip for measuring the patient's blood glucose

levels and a user interface for entering in the recorder data relating to the patient's insulin usage, exercise routines, and dietary intake. Using the patient data and therapy guidelines downloaded from the physician computer, the recorder calculates and displays to the patient a recommended insulin dosage, exercise plan, and diet. The recorder also receives from the physician computer new therapy guidelines developed from the patient's recorded data.

Although the diabetes management program disclosed by Beckers has the advantage of adjusting a patient's recommended therapy program based on remote monitoring of the patient, it also has the same disadvantage as the previous systems in failing to teach the patient how to follow the prescribed treatment plan. Becker's system has no mechanism for identifying problems the patient is experiencing with the diabetes program or for teaching the patient how to solve the problems. As a result, Becker's system is also ineffective for training the patient to comply with the diabetes treatment plan.

OBJECTS AND ADVANTAGES OF THE INVENTION

In view of the above, it is an object of the present invention to provide a system and method for remotely monitoring a patient and for effectively training the patient to comply with a treatment plan for a health condition. It is another object of the invention to provide a method for teaching a patient to solve a specific problem the patient is experiencing with a treatment plan. A further object of the invention is to provide a system that allows continuous feedback between a clinician and patient for ongoing adjustment of a treatment plan.

The invention provides a new and useful system for healthcare monitoring and patient training based on a small microprocessor-based unit or a personal computer which is networked with the clinician's resources and requisite databases.

These and other objects and advantages will become more apparent after consideration of the ensuing description and the accompanying drawings.

SUMMARY OF THE INVENTION

The invention presents a system and method for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition. The system includes a patient computing device, such as a personal computer or network terminal, for collecting data relating to the health condition. In the preferred embodiment, the data includes measurements of a physical characteristic of the health condition, such as blood glucose measurements for a diabetic patient or peak flow measurements for an asthmatic patient. Also in the preferred embodiment, the data includes measurements of a psychological characteristic of the health condition, such as the patient's knowledge, comprehension, or attitude in treating the health condition.

The system further includes a clinician computer having a data analysis program for analyzing the data to determine an educational need of the patient. The clinician computer also has a message program, such as an electronic mail program, for composing an electronic message to the patient. The electronic message contains a pointer to an educational program corresponding to the patient's educational need. The pointer is a prompt embedded in the message. When the patient selects the pointer the latter loads and executes the educational program instructions linked to the message. A communication network connects the patient computing device and the clinician computer and transmits the data and the electronic message therebetween.

A preferred method of using the system includes the steps of entering data relating to the patient's health condition into the patient computing device and transmitting the data from the patient computing device to the clinician computer via the communication network. The method further includes the steps of analyzing the data received in the clinician computer to determine an educational need of the patient and selecting an educational program corresponding to the educational need. A pointer to the selected educational program is then embedded in an electronic message to the patient. The electronic message is transmitted

through the communication network from the clinician computer to the patient computing device.

The educational program is started on the patient computing device when the patient selects the embedded pointer in the electronic message. As the patient works with the educational program, new data relating to the patient's health condition is collected in the patient computing device and transmitted to the clinician computer for analysis. With this continuos feedback loop between the patient and clinician, the clinician is able to monitor the patient's progress and effectively train the patient to comply with the treatment plan.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a block diagram that illustrates a healthcare monitoring system arranged in accordance with the invention.

FIG. 1B is a schematic block diagram illustrating an alternative healthcare monitoring system arranged in accordance with the invention.

FIG. 2 diagrammatically illustrates monitoring systems constructed in accordance with the invention connected in signal communication with a remotely located computing facility which includes provision for making the data supplied by the monitoring system of the invention available to a designated healthcare professional and/or for providing data and instructions to the system user.

FIG. 3 is a schematic block diagram of the main components of a health management process control system according to the invention.

FIG. 4 is a schematic block diagram illustrating the entering of patient data into a patient computing device according to the method of the invention.

FIGS. 5-6 are sample logbook entry screens appearing on the patient computing device of FIG. 4.

FIGS. 7-8 are sample medication entry screens appearing on the patient computing device of FIG. 4.

FIG. 9 is a schematic block diagram illustrating the transmitting of an electronic message in response to an analysis of the patient data of FIG. 4 according to the method of the invention.

FIGS. 10-11 are sample data views appearing on the screen of a clinician computer and on the screen of the patient computing device of FIG. 4.

FIGS. 12-14 are sample electronic messages sent from a doctor to a patient according to the method of the invention.

FIG. 15 is a flow chart illustrating steps included in the method of the invention.

DESCRIPTION

FIG. 1A depicts a self-care health monitoring system arranged in accordance with the invention. In the arrangement shown in FIG. 1A, a data management unit **10** is electrically interconnected with a computing device such as a computer or a handheld microprocessor-based unit **12** via a cable **14**. In the depicted arrangement, data management unit **10** also is electrically interconnected with a blood glucose monitor **16** of the type capable of sensing blood glucose level and producing an electrical signal representative thereof.

Although FIG. 1A illustrates blood glucose monitor **16** as being connected to data management unit **10** by a cable **18**, it may be preferable to construct blood glucose monitor **16** as a plug-in unit that is placed in a recess or other suitable opening or slot in data management unit **10**.

Also shown in FIG. 1A are two additional monitoring devices **20** and **22**, which are electrically connected for serial data communication with data management unit **10** via cables **24** and **26**, respectively. Monitoring units **20** and **22** of FIG. 1A represent devices other than blood glucose monitor **16** that can be used to configure the invention for self-care health monitoring applications other than (or in addition to) diabetes care. For example, as is indicated in FIG. 1A, the monitoring device **20** can

be a peak-flow meter that provides a digital signal representative of the airflow that results when a person suffering from asthma or another chronic respiratory affliction expels a breath of air through the meter. As is indicated by monitor **22** various other devices can be provided for monitoring conditions such as blood pressure, pulse, and body temperature to thereby realize systems for self-care monitoring and control of conditions such as hypertension, certain heart conditions and various other afflictions and physical conditions. Upon understanding the hereinafter discussed aspects and features of the invention it will be recognized that the invention is easily implemented for these and other types of healthcare monitoring.

As is shown in FIG. 1A, handheld microprocessor unit **12** includes a display screen **28** and a plurality of switches or keys (**30**, **32**, **34**, **36**, and **38**), which are mounted on a housing **40**. Located in the interior of housing **40**, but not shown in FIG. 1A, are a microprocessor, memory circuits, and circuitry that interfaces switches **30**, **32**, **34**, **36** and **38** with the microprocessor.

Stored in the memory of program microprocessor unit **12** is a set of program instructions that establishes a data protocol that allows microprocessor unit **12** to perform digital data signal processing and generate desired data or graphics for display on display unit **28** when a program cartridge **42** is inserted in a slot or other receptacle in housing **40**. That is, program cartridge **42** includes read-only memory units (or other memory means such as battery-powered random access memory) which store program instructions and data that adapt handheld microprocessor **12** for operation in a blood glucose monitoring system. More specifically, when the instructions and data of program cartridge **42** are combined with program instructions and data included in the internal memory circuits of microprocessor unit **12**, microprocessor unit **12** is programmed for processing and displaying blood glucose information in the manner described below and additional monitors **22** to provide health monitoring for asthma and various other previously mentioned chronic conditions. In each case, the plurality of switches or keys **30**, **32**, **34**, **36**, and **38** are selectively operated

to provide signals that result in pictorial and/or alphanumeric information being displayed by display unit **42**.

Various devices are known that meet the above-set forth description of microprocessor unit **12**. For example, compact devices are available in which the plurality of keys allows alphanumeric entry and internal memory is provided for storing information such as names, addresses, phone numbers, and an appointment calendar. Small program cartridges or cards can be inserted in these devices to program the device for various purposes such as the playing of games. More recently, less compact products that have more extensive computational capability and are generally called "palm top computers" have been introduced into the marketplace. These devices also can include provision for programming the device by means of an insertable program card or cartridge. Alternatively, the program can be loaded into their memory from a network or via a modem connection. A person of average skill in the art will appreciate that there exist other suitable methods for loading programs into suitable computer devices.

Another advantage of realizing handheld microprocessor unit **12** in the form of a compact video game system is the relatively simple, yet versatile arrangement of switches that is provided by such a device. For example, a compact video game system includes a control pad **30** that allows an object displayed on display unit **42** to be moved in a selected direction (i.e., up-down or left-right). As also is indicated in FIG. 1A, compact video game systems typically provide two pair of distinctly-shaped push button switches. A pair of spaced-apart circular push button switches (**36** and **38**) and a pair of elongate switches (**32** and **34**) are provided. The functions performed by the two pairs of switches is dependent upon the program instructions contained in each program cartridge **42**.

Yet another advantage of utilizing a compact video game system for handheld microprocessor-based unit **12** of FIG. 1A is the widespread popularity and low cost of such units. In this regard, manufacture and sale of a data management unit **10**, blood glucose

monitor **16** and program cartridge **42** that operate in conjunction with a compact microprocessor-based video allows the self-care health monitoring system of FIG. 1A to be manufactured and sold at a lower cost than could be realized in an arrangement in which handheld unit **12** is designed and manufactured solely for use in the system.

An even further advantage of using a compact video game system for handheld microprocessor **12** is that such video game systems include means for easily establishing the electrical interconnection provided by cable **14**. In particular, such compact video game systems include a connector **40** mounted to the game unit housing and a cable that can be connected between the connectors of two video game units to allow interactive operation of the two interconnected units (i.e., to allow contemporaneous game play by two players or competition between players as they individually play identical but separate games). The cable supplied with handheld microprocessor unit **12** can be used as cable **14** to establish serial data communication between the handheld microprocessor unit **12** (compact video game system) and data management unit **10**.

Depending upon the operational mode selected by the user, data is supplied to data management unit **10** by blood glucose monitor **16**, by additional monitors (**20** and **22** in FIG. 1A) or any interconnected computers or data processing facility (such as the hereinafter described user's computer **48** and clearinghouse **54**). During such operation, mode switches **30**, **32**, **34**, **36** and **38** are selectively activated so that signals are selectively coupled to microprocessor unit **12** and processed in accordance with program instructions stored in program cartridge **42**. The signal processing performed by microprocessor unit **12** results in the display of alphanumeric, symbolic, or graphic information on the video game display **28**, which allow the user to control system operation and obtain desired test results and other information.

Although the above-discussed advantages apply to use of the invention by all age groups, employing a compact video game system in the practice of the invention is of special significance in

monitoring a child's blood glucose or other health parameters. Children and young adults are familiar with compact video game systems. Thus, children will accept a health monitoring system incorporating a compact video game system more readily than a traditional system, even an embodiment of the invention that uses a different type of handheld microprocessor unit. Moreover, an embodiment of the invention that functions in conjunction with a compact video game system can be arranged to motivate children to monitor themselves more closely than they might otherwise by incorporating game-like features and/or animation in system instruction and test result displays. Similarly, the program instructions can be included in program cartridges **41**, **42** and **43** (or additional cartridges) that allow children to select game-like displays that help educate the child about his or her condition and the need for monitoring.

With continued reference to FIG. 1A, data management unit **10** includes a data port **44** that allows communication between data management unit **10** and a personal computer **48** (or other programmable data processor). Data port **44** is, for example, an RS-232 connection that allows serial data communication between data management unit **10** and personal computer **48**. In the practice of the invention, personal computer **48** can be used to supplement data management unit **10** by, for example, performing more complex analyses of blood glucose and other data that has been supplied to and stored in the memory circuits of data management unit **10**. With respect to embodiments of the invention configured for use by a child, personal computer **48** can be used by a parent or guardian to review and analyze the child's progress and to produce printed records for subsequent review by a healthcare professional.

Alternatively, personal computer **48** can be used to supply data to data management unit **10** that is not conveniently supplied by using handheld microprocessor switches **30**, **32**, **34**, **36** and **38** as an operator interface to the system of FIG. 1A. For example, some embodiments of the invention may employ a substantial amount of alphanumeric information that must be entered by the system user. Although it is possible to enter such data by using switches **30**, **32**, **34**, **36** and **38** in conjunction with menus and

selection screens displayed on display screen **28** of FIG. 1A, it may be more advantageous to use a device such as personal computer **48** for entry of such data. However, if personal computer **48** is used in this manner, some trade-off of system features may be required because data management unit **10** must be temporarily interconnected with personal computer **48** during these operations. That is, some loss of system mobility might result because a suitably programmed personal computer would be needed at each location at which data entry or analysis is to occur. Of course, it will be recognized by a person of average skill in the art that in certain embodiments personal computer **48** can absorb the entire functionality of unit **12** and data management unit **10**. A system based on computer **48** only may be more successful with adult patients or when the data to be displayed is very complicated and requires the entire computer screen.

As is indicated in FIG. 1A, data management unit **10** of the currently preferred embodiments of the invention also includes a modem that allows data communication between data management unit **10** and an information service, computing facility or clearinghouse **54** via a conventional telephone line **50** in and a modem **52** that interconnects clearinghouse **54** via telephone line **50**.

Clearinghouse **54** facilitates communication between a user of the system and his or her healthcare professional and can provide additional services such as updating system software or downloading specific programs to the user. In fact, in one embodiment clearing house **54** is the computer used by the clinician. As is indicated by facsimile machine **55** of FIG. 1A, a primary function of clearinghouse **54** is providing the healthcare professional with standardized reports **56**, which indicate both the current condition and condition trends of the system user. Although a single facsimile machine **55** is shown in FIG. 1A, it will be recognized that numerous healthcare professionals (and hence facsimile machine **55**) can be connected in signal communication with a clearinghouse **54**. In this situation each healthcare professional may have his or her own clinician computer

linked to clearinghouse **54** according to methods well known in the art.

Regardless of whether a compact video game system, another type of commercially available handheld microprocessor-based unit, or a specially designed unit is used, the system of FIG. 1A provides a self-care blood glucose monitoring system in which program cartridge **42**: (a) adapts handheld microprocessor unit **12** for displaying instructions for performing the blood glucose test sequence and associated calibration and test procedures; (b) adapts handheld microprocessor unit **12** for displaying (graphically or alphanumerically) statistical data such as blood glucose test results taken during a specific period of time (e.g., a day, week, etc.); (c) adapts handheld microprocessor unit **12** for supplying control signals and signals representative of food intake or other useful information to data management unit **10**; (d) adapts handheld microprocessor unit **12** for simultaneous graphical display of blood glucose levels with information such as food intake; and, (e) adapts handheld microprocessor unit **12** for displaying information or instructions from a healthcare professional that are coupled to data management unit **10** from a clearinghouse **54**. In the event that computer **48** absorbs all of the functions of unit **12** and data management unit **10**, cartridge **42** or appropriate software is communicated directly to computer **48** instead. Computer **48** then performs all of the above functions. The manner in which the arrangement of FIG. 1A implements the above-mentioned functions and others can be better understood with reference to FIG. 2 discussed further below.

Alternatively, the functionality of handheld unit **12**, computer **48**, data management unit **10** and modem **52** can be replaced by a single integrated device. Such an embodiment is shown in Fig. 1B, by a schematic block diagram of an integrated device **1**. Device **1** includes a microprocessor **2** and a memory **3** connected to microprocessor **2**. Memory **3** is preferably a non-volatile memory, such as a serial EEPROM. Memory **3** stores programs or script programs received from clearing house **54**, measurements received from monitoring devices **16**, **20** or **22**, and the patient's responses. Microprocessor **2** also includes built-in read only

memory (ROM) which stores firmware for controlling the operation of apparatus **1**. The firmware includes a script interpreter used by microprocessor **2** to execute the script programs. The script interpreter interprets script commands which are executed by microprocessor **2**. Specific techniques for interpreting and executing script commands in this manner are well known in the art.

Microprocessor **2** is preferably connected to memory **3** using a standard two-wire I^2C interface. Microprocessor **2** is also connected to user input buttons **4**, LED **5**, a clock **6**, and a display driver **7**. Clock **6** indicates the current date and time to microprocessor **2**. For clarity of illustration, clock **6** is shown as a separate component, but is preferably built into microprocessor **2**. Display driver **7** operates under the control of microprocessor **2** to display information on display **8**. Microprocessor **2** is preferably a PIC 16C65 processor which includes a universal asynchronous receiver transmitter (UART) **9**. UART **9** is for communicating with modem **52** and a device interface **11**. A CMOS switch **13** under the control of microprocessor **2** alternately connects modem **52** and interface **11** to UART **9**.

Modem **52** is connected to a telephone jack **15** through modem jack **17**. Modem **52** is for exchanging data with clearing house **54** through telephone line or any other suitable communication network **50**. The data includes programs, e.g., script programs which are received from the server as well as responses to queries, device measurements, any required script identification codes, and the patient's unique identification code which modem **52** transmits to the clearing house. Modem **52** is preferably a complete 28.8 K modem commercially available from Cermetek, although any suitable modem may be used.

Device interface **11** is connected to device jacks **19A**, **19B**, and **19C**. Device interface **11** is for interfacing with monitoring devices **16**, **20**, **22** which can include blood glucose meters, respiratory flow meters, blood pressure cuffs, weight scales, pulse rate monitors or any other suitable patient monitoring devices. Device interface **11** operates under the control of

microprocessor **2** to collect measurements from the monitoring devices and to output the measurements to microprocessor **2** for storage in memory **3**. In the preferred embodiment, interface **11** is a standard RS232 interface. In alternative embodiments, apparatus **1** may include multiple device interfaces to accommodate monitoring devices which have different connection standards.

As shown in FIG. 2, clearinghouse **54** receives data from a plurality of self-care microprocessor-based healthcare systems of the type shown in either FIG. 1A or FIG. 1B, with the individual self-care health monitoring systems being indicated in FIG. 2 by reference numeral **58**. Preferably, the data supplied to clearinghouse **54** by each individual self-care health monitoring system **58** consists of "raw data," i.e., test results and related data that was stored in memory circuits of data management unit **10**, without further processing by data management unit **10**. For example, with respect to the arrangement shown in FIG. 1A or FIG. 1B, blood glucose test results and associated data such as food intake information, medication dosage and other such conditions are transmitted to clearinghouse **54** and stored with a digitally encoded signal that identifies both the source of the information (i.e., the system user or patient) and those having access to the stored information (i.e., the system user's doctor or other healthcare professional).

As shall be recognized upon understanding the manner in which it operates, clearinghouse **54** can be considered to be a central server for the various system users **58** and each healthcare professional **60**. Thus, clearinghouse **54** includes conventionally arranged and interconnected digital processing equipment, i.e., digital signal processor **57** which receives digitally encoded information from user **58** or healthcare professional **60**; processes the information as required; stores the information (processed or unprocessed) in memory if necessary; and transmits the information to an intended recipient (i.e., user **58** or healthcare professional **60**).

In FIG. 2, rectangular outline **60** represents one of numerous remotely located healthcare professionals who can utilize

clearinghouse **54** and the arrangement described relative to FIG. 1A or FIG. 1B in monitoring and controlling patient healthcare programs. Shown within outline **60** is a computer **62** (e.g., personal computer), which is coupled to clearinghouse **54** by means of a modem (not shown in FIG. 2) and a telephone line **64**. Also shown in FIG. 2 is the previously mentioned facsimile machine **55**, which is coupled to clearinghouse **54** by means of a second telephone line **68**. Using the interface unit of computer **62** (e.g., a keyboard or pointing device such as a mouse), the healthcare professional can establish data communication between computer **62** and clearinghouse **54** via telephone line **64**. Once data communication is established between computer **62** and clearinghouse **54**, patient information can be obtained from clearinghouse **54** in a manner similar to the manner in which subscribers to various database services access and obtain information.

In particular, the healthcare professional can transmit an authorization code to clearinghouse **54** that identifies the healthcare professional as an authorized user of the clearinghouse and, in addition, can transmit a signal representing the patient for which healthcare information is being sought. As is the case with conventional database services and other arrangements, the identifying data is keyed into computer **62** by means of a conventional keyboard (not shown in FIG. 2) in response to prompts that are generated at clearinghouse **54** for display by the display unit of computer **62** (not shown in FIG. 2).

Depending upon the hardware and software arrangement of clearinghouse **54** and selections made by the healthcare professional via computer **62**, patient information can be provided to the healthcare professional in different ways. For example, computer **62** can be operated to access data in the form that it is stored in the memory circuits of clearinghouse **54** (i.e., raw data that has not been processed or altered by the computational or data processing arrangements of clearinghouse **54**). Such data can be processed, analyzed, printed and/or displayed by computer **62** using commercially available or custom software. On the other hand, various types of analyses may be performed by

clearinghouse **54** with the results of the analyses being transmitted to the remotely located healthcare professional **60**. For example, clearinghouse **54** can process and analyze data in a manner identical to the processing and analysis provided by the self-care monitoring system of FIG. 1A or FIG. 1B. With respect to such processing and any other analysis and processing provided by clearinghouse **54**, results expressed in alphanumeric format can be sent to computer **62** via telephone line **64** and the modem associated with computer **62**, with conventional techniques being used for displaying and/or printing the alphanumeric material for subsequent reference.

The arrangement of FIG. 2 also allows the healthcare professional to send messages and/or instructions to each patient via computer **62**, telephone line **64**, and clearinghouse **54**. In particular, clearinghouse **54** can be programmed to generate a menu that is displayed by computer **62** and allows the healthcare professional to select a mode of operation in which information is to be sent to clearinghouse **54** for subsequent transmission to a user of the system described relative to FIG. 1A or FIG. 1B. This same menu (or related submenus) can be used by the healthcare professional to select one or more modes of operation of the above-described type in which either unmodified patient data or the results of data that has been analyzed by clearinghouse **54** is provided to the healthcare provider via computer **62** and/or facsimile machine **55**.

Operation of the arrangement of FIG. 2 to provide the user of the invention with messages or instructions such as changes in medication or other aspects of the healthcare program, e.g., instructional programs, is similar to the operation that allows the healthcare professional to access data sent by a patient, i.e., transmitted to clearinghouse **54** by a data management unit **10** of FIG. 1A or FIG. 1B. The process differs in that the healthcare professional enters the desired message or instruction via the keyboard or other interface unit of computer **62**. Once the data is entered and transmitted to clearinghouse **54**, it is stored for subsequent transmission to the user for whom the information or instruction is intended.

With respect to transmitting stored messages or instructions to a user of the invention, at least two techniques are available. The first technique is based upon the manner in which operational modes are selected in the practice of the invention. Specifically, in the currently preferred embodiments of the invention, program instructions that are stored in data management unit **10** and program cartridge **42** cause the system of FIG. 1A or FIG. 1B to generate menu screens which are displayed by display unit **28** of microprocessor unit **12**. The menu screens allow the system user to select the basic mode in which the system is to operate and, in addition, allow the user to select operational subcategories within the selected mode of operation. Various techniques are known to those skilled in the art for displaying and selecting menu items. For example, in the practice of this invention, one or more main menus can be generated and displayed which allow the system user to select operational modes that may include: (a) a monitor mode (e.g., monitoring of blood glucose level); (b) a display mode (e.g., displaying previously obtained blood glucose test results or other relevant information); (c) an input mode (e.g., a mode for entering data such as providing information that relates to the healthcare regimen, medication dosage, food intake, etc.); and, (d) a communications mode (for establishing a communication link between data management unit **10** and personal computer **48** of FIG. 1A or FIG. 1B; or between data management unit **10** and a remote computing facility such as clearinghouse **54** of FIG. 2).

In embodiments of the invention that employ a compact video game system for handheld microprocessor unit **12**, the selection of menu screens and the selection of menu screen items preferably is accomplished in substantially the same manner as menu screens and menu items are selected during the playing of a video game. For example, the program instructions stored in data management unit **10** and program cartridge **42** of the arrangement of FIG. 1A or FIG. 1B can be established so that a predetermined one of the compact video game switches (e.g., switch **32**) allows the system user to select a desired main menu in the event that multiple main menus are employed. When the desired main menu is displayed,

operation by the user of control pad **30** allows a cursor or other indicator that is displayed on the menu to be positioned adjacent to or over the menu item to be selected. Activation of a switch (e.g., switch **36** of the depicted handheld microprocessor unit **12**) causes the handheld microprocessor unit **12** and/or data management unit **10** to initiate the selected operational mode or, if selection of operational submodes is required, causes handheld microprocessor unit **12** to display a submenu.

In view of the above-described manner in which menus and submenus are selected and displayed, it can be recognized that the arrangement of FIG. 1A or FIG. 1B can be configured and arranged to display a menu or submenu item that allows the user to obtain and display messages or instructions that have been provided by a healthcare professional and stored in clearinghouse **54**. For example, a submenu that is generated upon selection of the previously mentioned communications mode can include submenu items that allow the user to select various communication modes, including a mode in which serial data communication is established between data management unit **10** and clearinghouse **54** and data management unit **10** transmits a message status request to clearinghouse **54**. When this technique is used, the data processing system of clearinghouse **54** is programmed to search the clearinghouse memory to determine whether a message exists for the user making the request. Any messages stored in memory for that user are then transmitted to the user and processed for display on display unit **28** of handheld microprocessor unit **12**. Of course, the message may include an entire program, e.g., an instructional video. If no messages exist, clearinghouse **54** transmits a signal that causes display unit **28** to indicate "no messages." In this arrangement, clearinghouse **54** preferably is programmed to store a signal indicating that a stored message has been transmitted to the intended recipient (user). Storing such a signal allows the healthcare professional to determine that messages sent to clearinghouse **54** for forwarding to a patient have been transmitted to that patient.

In addition, the program instructions stored in data management unit **10** preferably allow the system user to designate whether

received messages and instructions are to be stored in the memory of data management unit **10** for subsequent retrieval or review. In addition, in some instances it may be desirable to program clearinghouse **54** and data management unit **10** so that the healthcare professional can designate (i.e., flag) information such as changes in medication that will be prominently displayed to the user (e.g., accompanied by a blinking indicator) and stored in the memory of data management unit **10** regardless of whether the system user designates the information for storage.

A second technique that can be used for forwarding messages or instructions to a user does not require the system user to select a menu item requesting transmission by clearinghouse **54** of messages that have been stored for forwarding to that user. In particular, clearinghouse **54** can be programmed to operate in a manner that either automatically transmits stored messages for that user when the user operates the system of FIG. 1A or FIG. 1B to send information to the clearinghouse or programmed to operate in a manner that informs the user that messages are available and allows the user to access the messages when he or she chooses to do so.

Practicing the invention in an environment in which the healthcare professional uses personal computer in some or all of the above-discussed ways can be very advantageous. On the other hand, the invention also provides healthcare professionals timely information about system users without the need for a computer (**62** in FIG. 2) or any equipment other than a conventional facsimile machine **55** in FIGS. 1 and 2. Specifically, information provided to clearinghouse **54** by a system user **58** can be sent to a healthcare professional **60** via telephone line **68** and facsimile machine **55**, with the information being formatted as a standardized graphic or textual report **56**. Formatting a standardized report **56** (i.e., analyzing and processing data supplied by blood glucose monitor **16** or other system monitor or sensor) can be effected either by data management unit **10** or within the clearinghouse facility **54**.

A preferred embodiment of the invention is focused on sending the patient an educational program corresponding to an educational need as assessed by the system of the invention. The adaptation of the system of FIGS. 1 and 2 for this purpose is shown in detail in FIGS. 3 - 15.

FIG. 3 shows the main components of a health management system for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition. A healthcare clinic **100** has a clinic server computer **120** that includes a mail server application **140** for managing electronic mail services for clinic **100**. Clinic server **120** also includes a master patient database **180** for storing data relating to each patient managed by clinic **100**. Clinic server **120** further includes a data management server application **160** for managing and performing database operations taking place on master patient database **180**. Clinic server **120** is coupled to a modem **M1** for connecting server **120** to a communication network **280**.

A clinician computer **200** is networked to clinic server **120**. Clinician computer **200** has a clinician mail client application **220** for composing, sending, and receiving electronic mail messages. Clinician computer **200** further includes a local clinician database **260** for storing patient data downloaded from clinic server **120**. Clinician computer **200** also has a clinician data management application **240** for managing patient data stored in local clinician database **260**. Clinician computer **200** is coupled to a modem **M2** for connecting clinician computer **200** to communication network **280**.

A patient computing device **320** for collecting patient data relating to the patient's health condition is located at a patient site **300**, typically the patient's home. In the preferred embodiment, patient computing device **320** is a personal computer having a display monitor. However, in alternative embodiments, patient computing device **320** may be any information processing and display unit, such as a network terminal, a television set with a set-top cable converter box, a personal digital assistant, or a video educational program system as described above.

Patient computing device **320** includes a patient mail client **340** for sending and receiving electronic mail messages. Patient computing device **320** further includes a local patient database **400** for storing the patient data and a data management application **380** for managing the patient data stored in database **400**. Patient computing device **320** is coupled to a modem **M4** for connecting patient computing device **320** to communication network **280**.

A metering device **420** is connected to patient computing device **320**. Device **420** is for measuring a physical characteristic of the patient's health condition, such as blood glucose levels for a diabetic patient or peak flow rates for an asthmatic patient, and for uploading the measurements to computer **320**. Specific techniques for connecting a metering device to a patient computing device for remote monitoring of a patient are well known in the art.

An on-line information service **440** having educational documents **460** is connected to communication network **280** through a modem **M4**. In the preferred embodiment, on-line information service **440** is a world wide web service having educational documents **460** located on a world wide web site, such as the American Diabetes Association's web site or the American Lung Association's web site. Of course, there are many other on-line services such as Compuserve, America On-Line, and other electronically accessible database servers that may be used as a source of educational documents in alternative embodiments.

An educational video educational program **360** for training the patient to comply with a treatment plan for his or her health condition is installed on patient computing device **320**. In the preferred embodiment, educational video educational program **360** is a *Health Hero* ® video educational program, such as *Packy & Marlon* ®, commercially available from Health Hero Network, Inc. of Mountain View, California. Educational video educational program **360** is preferably a role-playing educational program that permits a patient to simulate treating his or her health condition. Educational program **360** is further capable of scoring patient

responses to the role-playing program to determine the patient's knowledge, comprehension, and attitude in complying with the treatment plan for his or her health condition.

For example, in the educational video educational program *Packy & Marlon* ®, one or two players manage the diabetes of two educational program characters and attempt to progress to higher educational program levels through successful management of the diabetes. Diabetes management steps in the educational program include selecting appropriate foods, taking insulin doses, measuring blood glucose levels, and answering questions about diabetes. Educational program responses are recorded in several categories to indicate the player's knowledge, comprehension, and attitude in managing diabetes. A player's attitude may also be determined by recording whether the player played alone or with a friend, indicating if the player is adjusting socially to his or her health condition.

FIG. 4 is a schematic block diagram illustrating the entering of patient data relating to the patient's health condition into local patient database **400**. The patient data includes educational program response information **500** derived by scoring patient responses to educational video educational program **360**. Educational program response information **500** includes a knowledge score **530A** for indicating the patient's understanding of the treatment plan. Educational program response information **500** also includes a comprehension score **530B** for indicating a cognitive ability of the patient to understand an educational program designed to teach compliance with the treatment plan. Educational program response information **500** further includes an attitude score **530C** for indicating the patient's attitude toward complying with the treatment plan. The patient data further includes device measurements **540** received from metering device **420** and logbook records **520** of the patient's treatment plan. Logbook records **520** are entered into database **400** using a logbook program **480** included in patient data management application **380**.

FIG. 5 shows a sample logbook entry screen **560** of logbook program **480** as it appears on patient computing device **320**. Screen **560**

illustrates a typical logbook entry for a diabetic patient. Screen **560** includes a date field **580** and a time field **600** for selecting a specific blood glucose reading **620** from device measurements **540**. Screen **560** further includes four radio buttons **640**. Each radio button **640** is designed to display a list of events in a list box **660**. List box **660** contains a selected event **680** that has been chosen by the patient as the appropriate event corresponding to blood glucose reading **620**. Screen **560** also has a notes field **710** for free form entry of other information relating to the patient's treatment plan.

Screen **560** also includes an add medication button **720** for displaying an add medication screen **800**, as shown in FIG. 7. Screen **800** includes a list box **810** listing diabetes medications. List box **810** contains a selected medication **820** that has been chosen by the patient. Screen **800** also includes a dosage field **840** for recording a medicine dosage. An OK button **860** and a CANCEL button **880** are for confirming and canceling, respectively, the information entered in screen **800**.

Referring again to FIG. 5, a medication field **700** shows the information entered in add medication screen **800**. An OK button **740** and a CANCEL button **760** are for confirming and canceling, respectively, the logbook information entered in screen **560**. FIG. 6 illustrates a sample logbook entry screen **780** for an asthmatic patient. FIG. 8 shows a sample add medication screen **900** for the asthmatic patient. The design and use of such a logbook program for entering logbook records **520** into database **400** are well known in the art.

Referring to FIG. 9, clinician data management application **240** includes a clinician data view program **920** for analyzing patient data to determine an educational need of the patient in learning to comply with his or her treatment program. Data view program **920** is capable of displaying a selected subset of device measurements **540** and logbook records **520** in graphical form.

FIG. 10 shows a data view **980** produced by data view program **920** on the screen of clinician computer **200**. Data view **980** is a sample

data view of a diabetic patient's data. Data view **980** includes a selected subset **101** of device measurements **540** and logbook records **520** corresponding to one day in the patient's treatment plan indicated by a date field **103**. Data view **980** further includes a graph **102** of selected subset **101**. A set of control buttons **104** allow the clinician to scroll through different days or weeks of the patient's data to quickly view selected subsets from different days. FIG. 11 shows a sample data view **106** for an asthmatic patient's data. Specific techniques for creating a data view program to display data in this manner are well known in the art.

Referring again to FIG. 9, patient data management application **380** includes a patient data view program **960** having the same functionality as clinician data view program **920**. Thus, patient data view program **960** is also capable of displaying data views **980** and **106** on patient computing device **320**. Application **380** further includes a document view program **970** for displaying an educational document retrieved from on-line information service **440**, as will be explained in the operation section below.

Clinician mail client **220** is of the type that allows a user to compose an electronic mail message containing an embedded pointer to a selected program installed on patient computing device **320**. Mail client **220** further allows the pointer to be represented in the message as an icon. The pointer may optionally include specific data and instructions to be executed by the selected program or point to an address that has a set of instructions to be executed by the program. Patient mail client **340** is of the type that allows a user to start the selected program on patient computing device **320** by selecting the icon in the electronic mail message. A suitable electronic mail program for performing these functions is Microsoft Exchange™ commercially available from Microsoft Corporation of Redmond, Washington. The programming of an electronic mail application to perform these functions is well known in the art.

FIG. 12 illustrates a sample electronic mail message **940** in detail. Message **940** contains an icon **110** that includes an embedded pointer to patient data view program **960**. Icon **110**

further includes patient data from a specific date and instructions for program **960** to display the patient data in graphical form. An alternative electronic mail message **112** is illustrated in FIG. 13. Message **112** contains an icon **114** that includes an embedded pointer to educational video educational program **360**. Icon **114** further includes instructions for video educational program **360** to execute educational program level two. A third electronic mail message **121** is illustrated in FIG. 14. Message **121** contains an icon **122** that includes an embedded pointer to document view program **970**. Icon **122** further includes an educational document retrieved from on-line information service **440** and instructions for program **970** to display the educational document.

The operation of the preferred embodiment is illustrated in FIG. 15. FIG. 15 is a flow chart showing a preferred method of using the health management system for remotely monitoring a patient and for training the patient to comply with a treatment plan for his or her health condition. In step **202**, the patient is tested with metering device **420** to produce device measurements **540**. Typically, the test is self-administered by the patient. Next, measurements **540** are uploaded to patient computing device **320**, step **204**, and stored in local patient database **400**.

Once device measurements **540** are stored in database **400**, the patient enters logbook records **520** into database **400** using logbook program **480**, step **206**. Additionally, the patient plays educational video educational program **360**, entering educational program responses into patient computing device **320**. As the patient plays video educational program **360**, the patient's educational program responses are scored to produce knowledge score **530A**, comprehension score **530B**, and attitude score **530C**. Knowledge score **530A**, comprehension score **530B**, and attitude score **530C** are stored as educational program response information **500** in database **400**, step **208**.

Next, educational program response information **500**, logbook records **520**, and device measurements **540** are transmitted through

communication network **280** to clinic server **120** and stored in master patient database **180**, step **210**. In a typical implementation, clinic **100** manages the healthcare of hundreds of patients and the data for each patient is stored in master patient database **180**. A clinician at clinician computer **200** downloads patient data of a particular patient for whom he or she is responsible from master patient database **180** to local clinician database **260**, step **212**.

The downloaded patient data is analyzed in clinician computer **200** using clinician data view program **920**, step **214**. As shown in FIG. 10, data view program **980** displays on clinician computer **200** graph **102** of selected subset of data **101**. The clinician also analyzes knowledge score **530A**, comprehension score **530B**, and attitude score **530C** to assess the patient's psychological state. Based on analysis of the patient data, the clinician determines an educational need of the patient for learning to comply with a treatment program, step **216**. A first example of such an educational need is illustrated in FIG. 12. As indicated in electronic mail message **940**, the clinician has determined that the patient needs to learn the health consequences of failing to eat balanced meals in a diabetes treatment plan.

A second example of an educational need is illustrated in FIG. 13. As indicated in electronic mail message **112**, the clinician has determined that the patient needs to learn the importance of taking medication. A third example of an educational need is illustrated in FIG. 14. As indicated in electronic mail message **121**, the clinician has determined that the patient needs to learn how to treat diabetes while traveling. Of course, these are just a few examples of possible educational needs of the patient. The clinician may identify many other educational needs, such as the patient's need to learn coping skills, communication skills, and other social adjustment factors.

Once the clinician has determined the patient's educational need, he or she selects an educational program corresponding to the educational need, step **218**, and embeds in an electronic message a pointer or a prompt to the educational program, step **221**. The

program will execute when the patient selects the pointer or reponds to the prompt. In the preferred embodiment, the educational program is selected to be either patient data view program **960**, educational video educational program **360**, or document view program **970** depending on the educational need determined by the clinician.

FIG. 12 shows an example of the clinician selecting data view program **960** as the educational program. The clinician embeds a pointer to program **960** in icon **110**. The clinician further loads icon **110** with patient data from a specific day and instructions for program **960** to display the patient data in graphical form. FIG. 13 shows an example of the clinician selecting a educational program level of educational video educational program **360** as the educational program. The clinician embeds a pointer to the selected educational program level of video educational program **360** that has an educational content corresponding to the patient's educational need. FIG. 14 shows an example of the clinician selecting document view program **970** as the educational program. The clinician embeds a pointer to program **970** in icon **122**. The clinician further loads icon **122** with an educational document retrieved from information service **440**.

Next, the electronic message containing the embedded pointer is transmitted from clinician computer **200** to patient computing device **320** through mail server **140** and communication network **280**, step **222**. The selected educational program is then started on the patient computing device by selecting the embedded pointer in the electronic mail message, step **224**, typically by clicking the icon in which the pointer is embedded with a mouse or pointing device.

As the patient works with the educational program, he or she continues the feedback loop with the clinician, step **226**, by returning to step **202** and repeating the method described. With this continuous feedback loop between the patient and clinician, the clinician is able to monitor the patient's progress and effectively train the patient to comply with the treatment plan.

SUMMARY, RAMIFICATIONS, AND SCOPE

Although the above description contains many specificities, these should not be construed as limitations on the scope of the invention but merely as illustrations of the presently preferred embodiment. Many other embodiments of the invention are possible. For example, in one alternative embodiment, the clinic server is eliminated from the system so that the clinician computer exchanges information directly with the patient computing device. The clinic server is presently preferred for performing resource intensive operations, such as storing large amounts of patient data, but the clinic server is not necessary to enable the system and method of the invention. In embodiments that include the clinic, server, the clinic server need not be physically located at the clinic. The server may be located off-site and networked to the clinician computer.

Additionally, the preferred embodiment describes the use of modems for connecting the various computers in the health management system to the communication network. However, it is obvious that many other types of connections may be employed, such as ethernet connections. Specific techniques for networking computers are well known in the art.

Further, the logbook entry screens illustrated are exemplary of just one possible embodiment of the invention. In alternative embodiments, the logbook entry screens and logbook records include fields for entering and storing other health-related parameters, such as the patient's dietary intake and exercise routines. Similarly, the data views illustrated are exemplary of just one possible embodiment. Many other data views are possible, such as weekly views of the patient's data, trend graphs of the patient's data, and calendar views of the patient's logbook records.

Although the preferred embodiment describes a system and method for training patients having diabetes or asthma, the invention is not limited to patient's with these diseases. The system and method of the invention are equally effective for training patients to comply with treatment plans for other health conditions, such as cardiovascular diseases, high blood pressure,

mental health conditions, addictions, or diet and exercise problems.

Therefore, the scope of the invention should be determined, not by examples given, but by the appended claims and their legal equivalents.

CLAIMS

I claim:

1. A method for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition, the method comprising the following steps:

a) entering in a patient computing device data relating to the health condition;

b) transmitting the data from the patient computing device to a clinician computer via a communication network;

c) analyzing the data received in the clinician computer to determine an educational need of the patient;

d) selecting in the clinician computer an educational program corresponding to the educational need;

e) transmitting an electronic message from the clinician computer to the patient computing device, wherein the electronic message contains an embedded pointer to the selected educational program; and

f) starting the educational program on the patient computing device by selecting the embedded pointer in the electronic message.

2. The method of claim 1, wherein the educational program comprises an educational video program.

3. The method of claim 1, wherein the educational program comprises questions.

4. The method of claim 3, wherein patient answers to the questions are sent to the clinician computer to create and update a patient database.

5. The method of claim 1, wherein the educational program comprises a patient data view program for displaying a selected subset of the data in graphical form.

6. The method of claim 1, wherein the educational program comprises a document view program for displaying an educational document.

7. The method of claim 6, wherein the educational document is retrieved from an on-line information service connected to the communication network.

8. The method of claim 1, wherein the embedded pointer to the educational program comprises an icon.

9. The method of claim 1, wherein the data comprises measurements of a physical characteristic of the health condition and wherein the entering step comprises:

a) testing the patient with a metering device to produce the measurements; and

b) uploading the measurements from the metering device to the patient computing device.

10. The method of claim 1, wherein the data comprises records of the treatment plan and wherein the records are entered in the patient computing device using a logbook program installed on the patient computing device.

11. The method of claim 1, wherein the data comprises information derived from patient responses to an educational video program played on the patient computing device and wherein the patient responses are entered by the patient while playing the educational video program.

12. The method of claim 11, wherein the information derived from the patient responses comprises a comprehension score for indicating a cognitive ability of the patient to understand the educational video program.

13. The method of claim 11, wherein the information derived from the patient responses comprises a knowledge score for indicating the patient's understanding of the treatment plan.

14. The method of claim 11, wherein the information derived from the patient responses comprises an attitude score for indicating the patient's attitude toward complying with the treatment plan.

15. The method of claim 1, wherein the data is analyzed by a clinician using a clinician data view program on the clinician computer.

16. A system for remotely monitoring a patient and for training the patient to comply with a treatment plan for a health condition, the system comprising:

a) a patient computing device for collecting data relating to the health condition;

b) a clinician computer having an analysis means for analyzing the data to determine an educational need of the patient, the clinician computer further having a message means for composing an electronic message containing an embedded pointer to an educational program that corresponds to the educational need; and

c) a communication network for connecting the patient computing device to the clinician computer and for transmitting the data and the electronic message therebetween;

wherein the patient computing device further has a means for starting the educational program when the patient selects the embedded pointer in the electronic message.

17. The system of claim 16, wherein the educational program comprises an educational video program played on the patient computing device.

18. The system of claim 16, wherein the educational program comprises a patient data view program for displaying a selected subset of the data in graphical form.

19. The system of claim 16, wherein the educational program comprises a document view program for displaying an educational document.

20. The system of claim 16, wherein the analysis means comprises a clinician data view program for displaying a selected subset of the data in graphical form.

21. The system of claim 16, wherein the embedded pointer to the educational program comprises an icon.

22. A method for remote patient monitoring and remote patient training using a computer system, the computer system comprising a clinician computer, a patient computing device having an educational program loaded thereon, and a communication network connecting the clinician computer to the patient computing device, the method comprising the following steps:

a) entering in the patient computing device data relating to a health condition of a patient;

b) transmitting the data from the patient computing device to the clinician computer via the communication network;

c) analyzing the data received in the clinician computer to determine an educational need of the patient;

d) selecting a segment of the educational program having an educational content corresponding to the educational need;

e) transmitting an electronic message from the clinician computer to the patient computing device, wherein the electronic message contains an embedded pointer to the selected segment; and

f) starting the educational program on the patient computing device at the selected segment by selecting the embedded pointer in the electronic message.

23. The method of claim 22, wherein the data comprises measurements of a physical characteristic of the health condition and wherein the entering step comprises:

a) testing the patient with a metering device to produce the measurements; and

b) uploading the measurements from the metering device to the patient computing device.

24. The method of claim 22, wherein the data comprises records of a treatment plan for the health condition and wherein the records are entered into the patient computing device using a logbook program installed on the patient computing device.

25. The method of claim 22, wherein the data comprises information derived from patient responses to the educational video program and wherein the patient responses are entered in the patient computing device by the patient while playing the educational video program.

26. The method of claim 25, wherein the information derived from the patient responses comprises a comprehension score for indicating a cognitive ability of the patient to understand the educational video program.

27. The method of claim 25, wherein the information derived from the patient responses comprises a knowledge score for indicating the patient's understanding of the treatment plan.

28. The method of claim 25, wherein the information derived from patient responses comprises an attitude score for indicating the patient's attitude toward complying with the treatment plan.

29. The method of claim 22, wherein the embedded pointer to the selected segment comprises an icon.

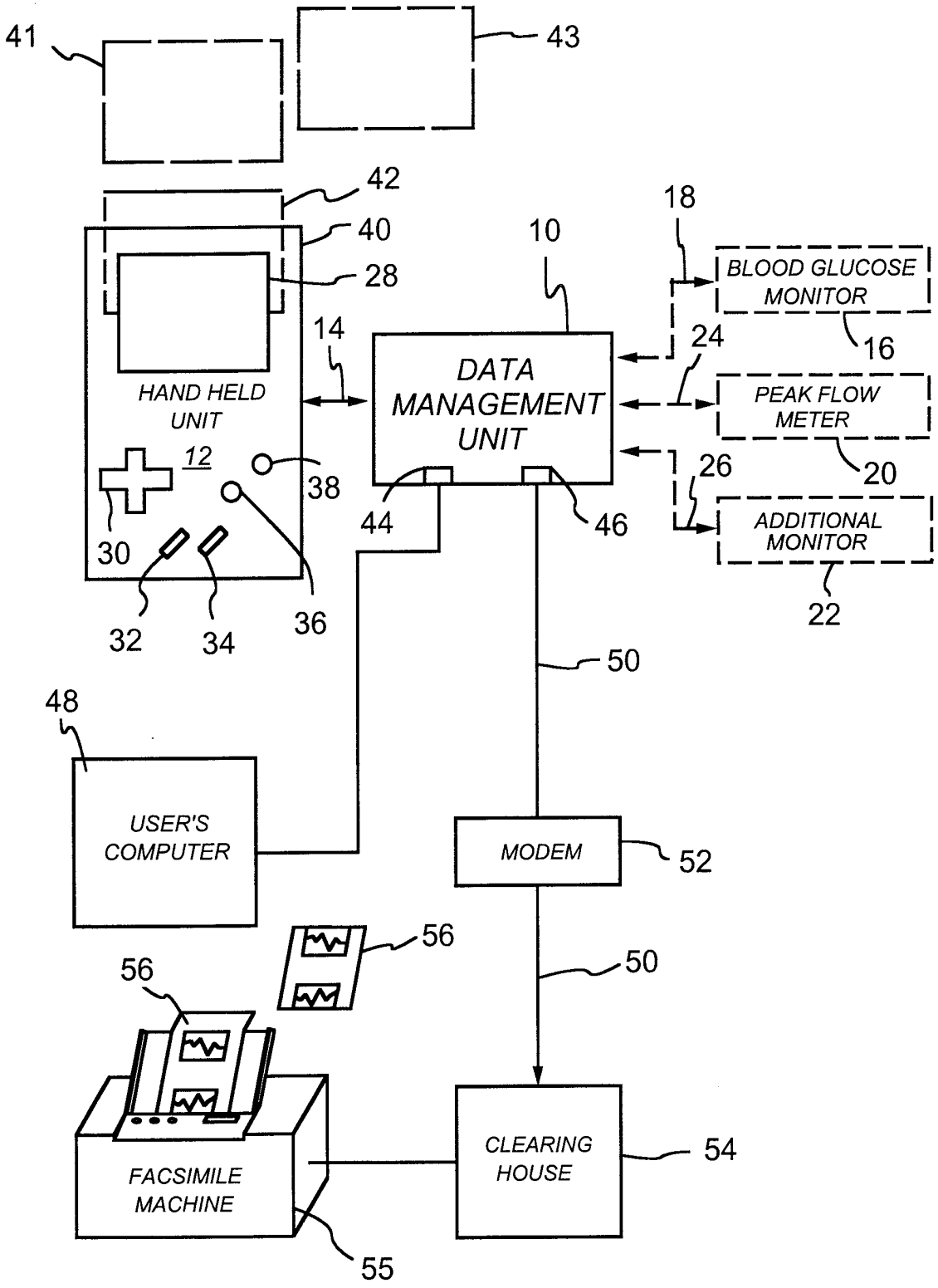
41
43
42
40
28
HAND HELD UNIT
12
30
32
34
36
38
10
14
DATA MANAGEMENT UNIT
44
46
18
BLOOD GLUCOSE MONITOR
16
24
PEAK FLOW METER
20
26
ADDITIONAL MONITOR
22
50
48
USER'S COMPUTER
MODEM
52
56
56
50
FACSIMILE MACHINE
55
CLEARING HOUSE
54

FIG. 1A

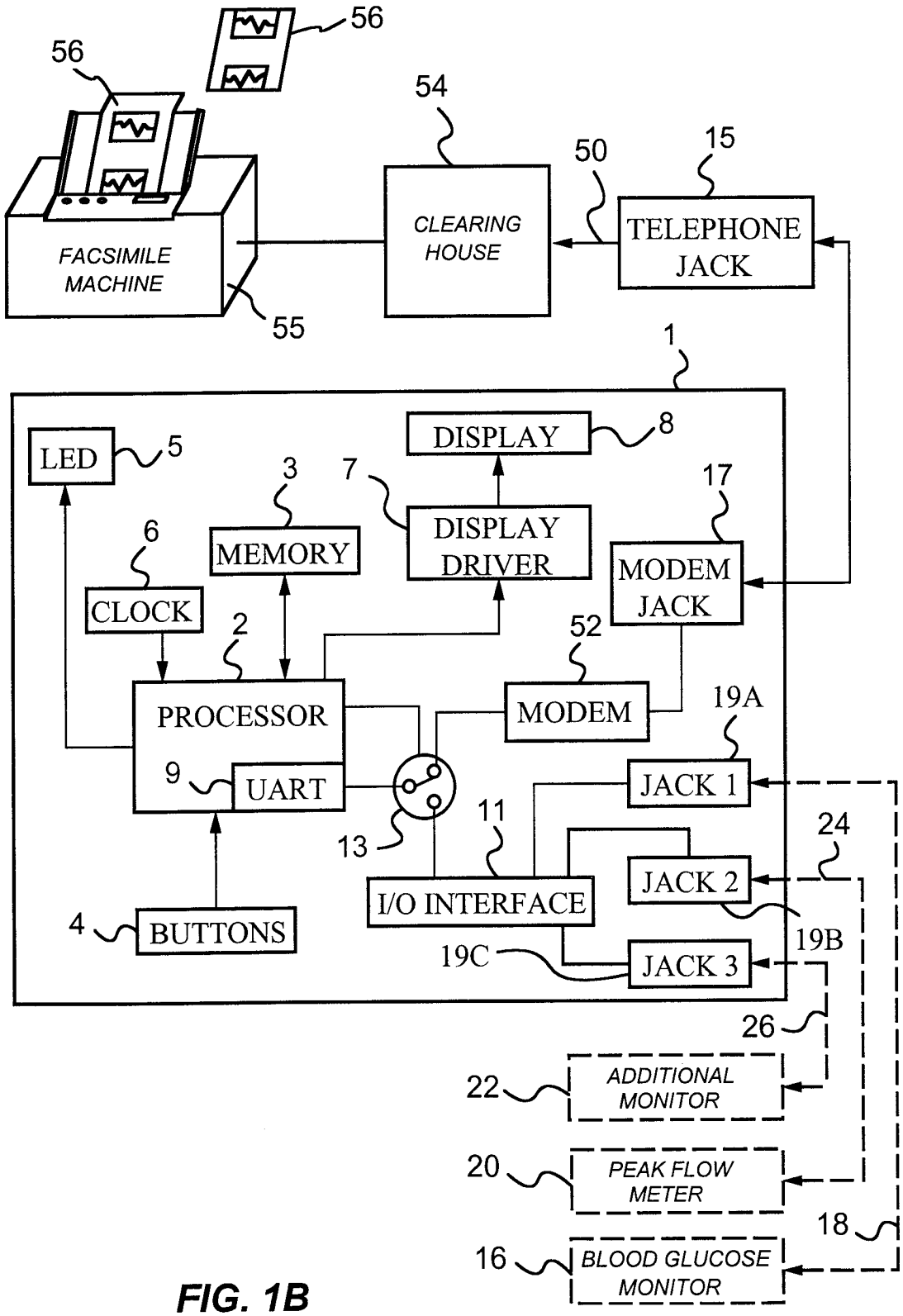
56
56
54
50
15
CLEARING HOUSE
TELEPHONE JACK
FACSIMILE MACHINE
55
1
LED
5
DISPLAY
8
3
7
17
MEMORY
DISPLAY DRIVER
6
MODEM JACK
CLOCK
2
52
PROCESSOR
MODEM
19A
9
UART
JACK 1
11
24
13
JACK 2
I/O INTERFACE
4
BUTTONS
19B
19C
JACK 3
26
22
ADDITIONAL MONITOR
20
PEAK FLOW METER
18
16
BLOOD GLUCOSE MONITOR

FIG. 1B

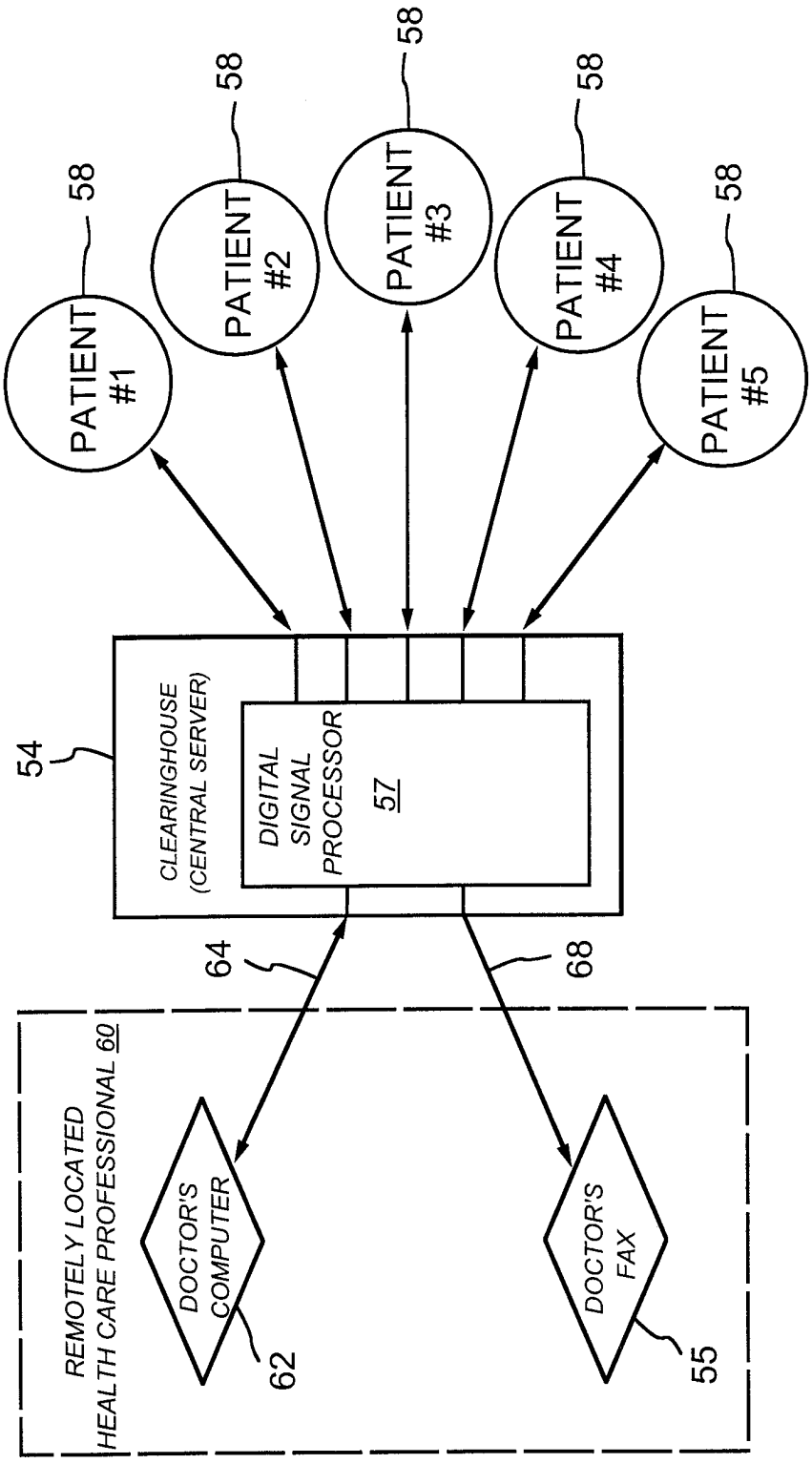
PATIENT #1
PATIENT #2
PATIENT #3
PATIENT #4
PATIENT #5
58
58
58
58
58
54
CLEARINGHOUSE (CENTRAL SERVER)
DIGITAL SIGNAL PROCESSOR 57
64
68
REMOTELY LOCATED HEALTH CARE PROFESSIONAL 60
DOCTOR'S COMPUTER
62
DOCTOR'S FAX
55

FIG. 2

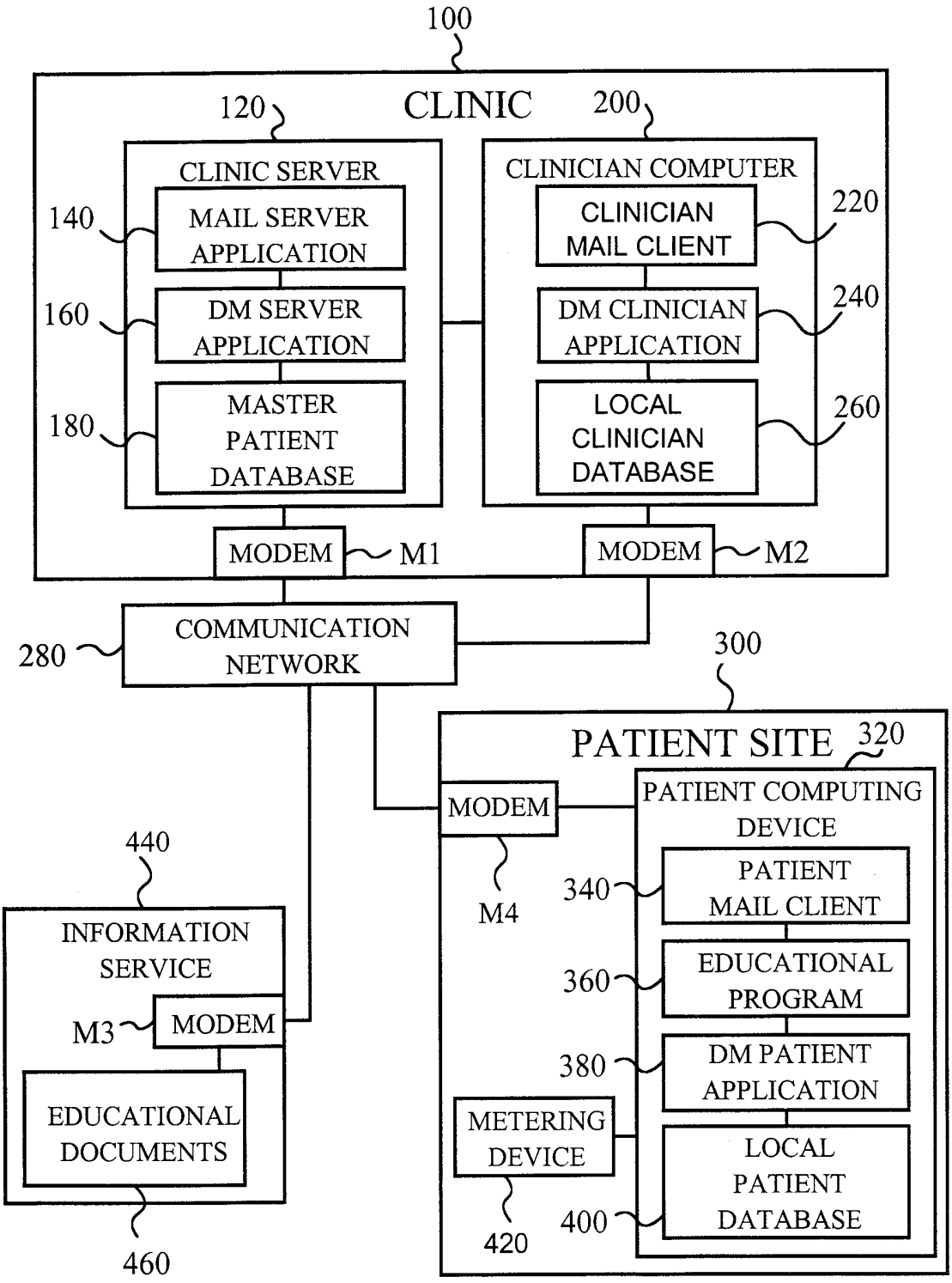
100
CLINIC
120
200
CLINIC SERVER
CLINICIAN COMPUTER
140
MAIL SERVER APPLICATION
CLINICIAN MAIL CLIENT
220
160
DM SERVER APPLICATION
DM CLINICIAN APPLICATION
240
180
MASTER PATIENT DATABASE
LOCAL CLINICIAN DATABASE
260
MODEM
M1
MODEM
M2
280
COMMUNICATION NETWORK
300
PATIENT SITE
320
MODEM
PATIENT COMPUTING DEVICE
440
M4
340
PATIENT MAIL CLIENT
INFORMATION SERVICE
360
EDUCATIONAL PROGRAM
M3
MODEM
380
DM PATIENT APPLICATION
METERING DEVICE
EDUCATIONAL DOCUMENTS
LOCAL PATIENT DATABASE
400
420
460

FIG. 3

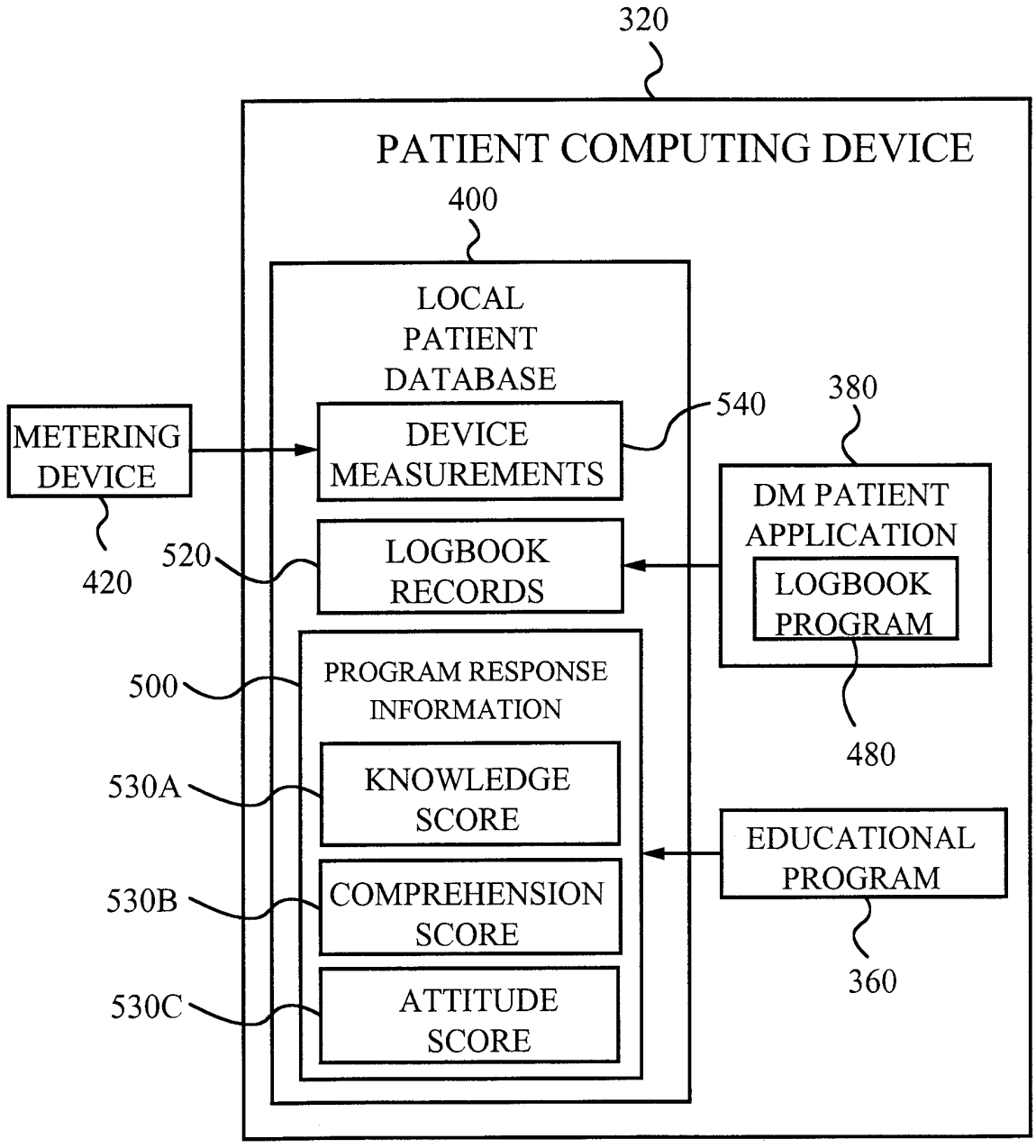
320
PATIENT COMPUTING DEVICE
400
LOCAL PATIENT DATABASE
METERING DEVICE
420
DEVICE MEASUREMENTS
540
380
DM PATIENT APPLICATION
LOGBOOK PROGRAM
480
520
LOGBOOK RECORDS
500
PROGRAM RESPONSE INFORMATION
530A
KNOWLEDGE SCORE
530B
COMPREHENSION SCORE
530C
ATTITUDE SCORE
EDUCATIONAL PROGRAM
360

FIG. 4

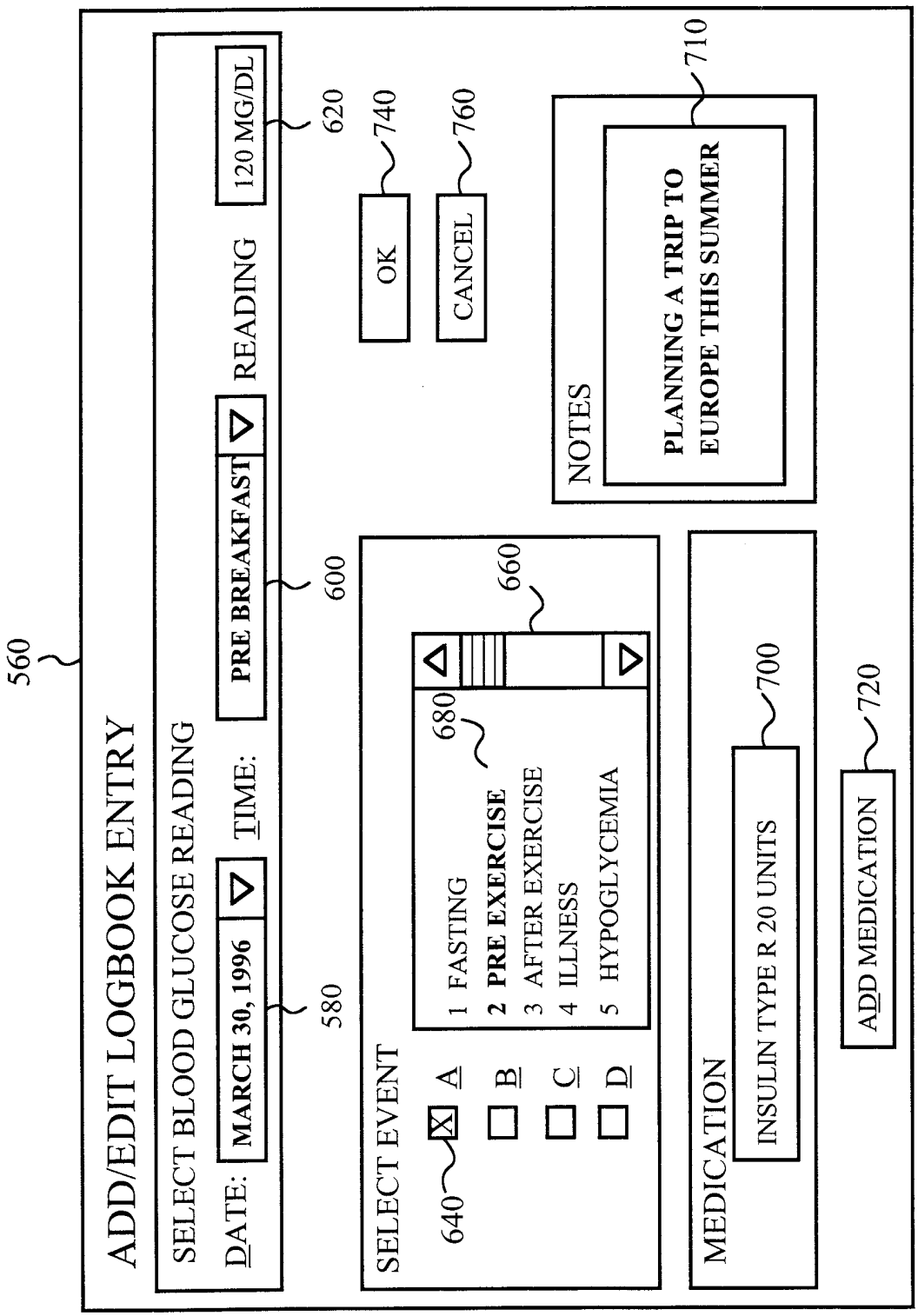
560
ADD/EDIT LOGBOOK ENTRY
SELECT BLOOD GLUCOSE READING
DATE: MARCH 30, 1996
TIME: PRE BREAKFAST
READING 120 MG/DL
580
600
620
OK
740
CANCEL
760
NOTES
PLANNING A TRIP TO EUROPE THIS SUMMER
710
SELECT EVENT
640
A
B
C
D
1 FASTING
2 PRE EXERCISE
3 AFTER EXERCISE
4 ILLNESS
5 HYPOGLYCEMIA
680
660
MEDICATION
INSULIN TYPE R 20 UNITS
700
ADD MEDICATION
720

FIG. 5

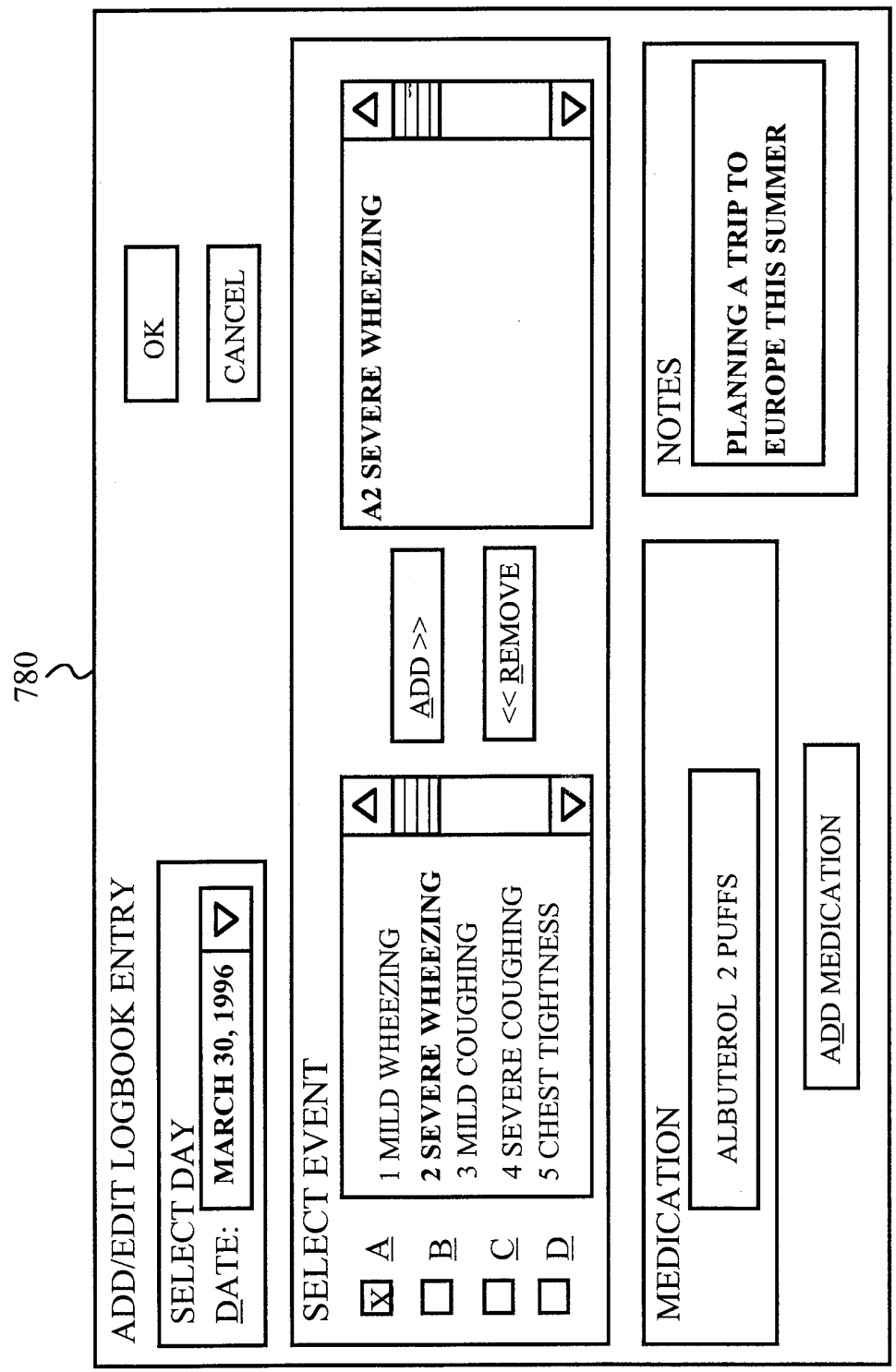
780
ADD/EDIT LOGBOOK ENTRY
SELECT DAY
DATE: MARCH 30, 1996
OK
CANCEL
SELECT EVENT
A
B
C
D
1 MILD WHEEZING
2 SEVERE WHEEZING
3 MILD COUGHING
4 SEVERE COUGHING
5 CHEST TIGHTNESS
ADD >>
<< REMOVE
A2 SEVERE WHEEZING
NOTES
PLANNING A TRIP TO EUROPE THIS SUMMER
MEDICATION
ALBUTEROL 2 PUFFS
ADD MEDICATION

FIG. 6

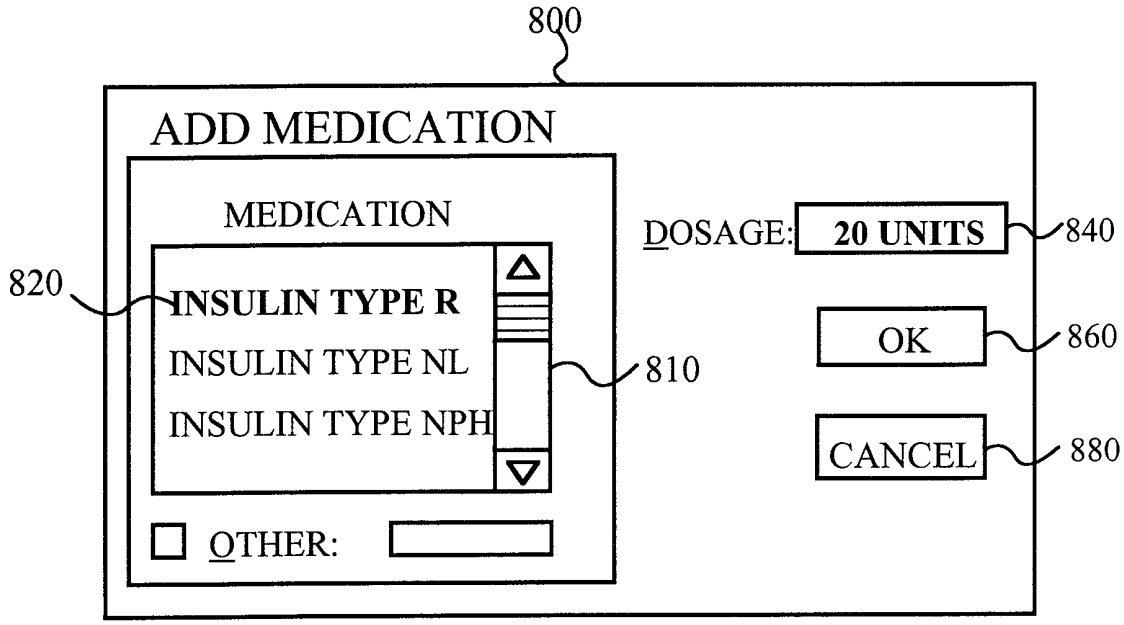
800
ADD MEDICATION
MEDICATION
820
INSULIN TYPE R
INSULIN TYPE NL
INSULIN TYPE NPH
810
OTHER:
DOSAGE:
20 UNITS
840
OK
860
CANCEL
880

FIG. 7

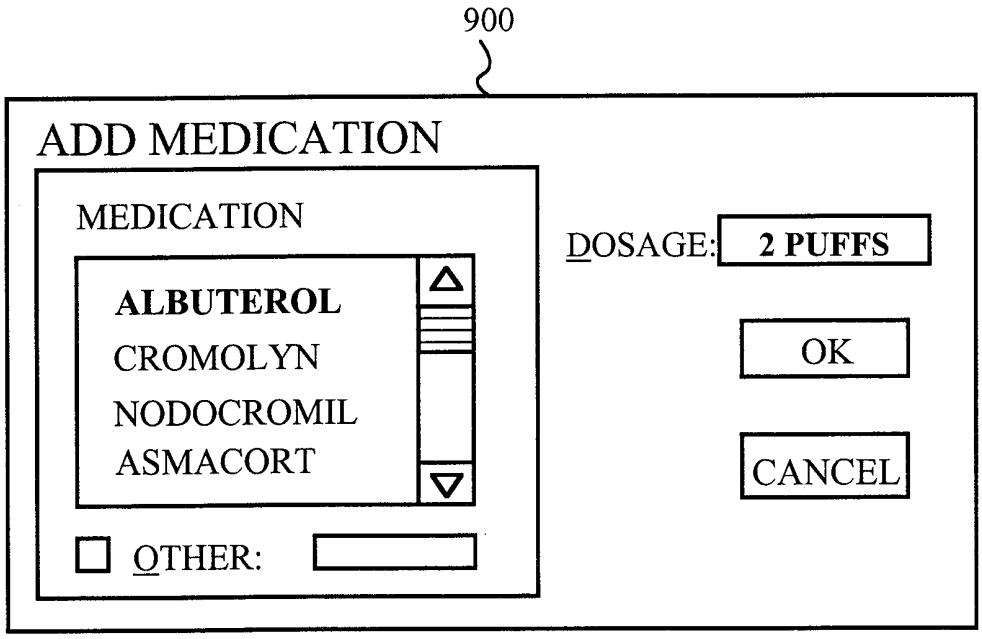
900
ADD MEDICATION
MEDICATION
ALBUTEROL
CROMOLYN
NODOCROMIL
ASMACORT
OTHER:
DOSAGE:
2 PUFFS
OK
CANCEL

FIG. 8

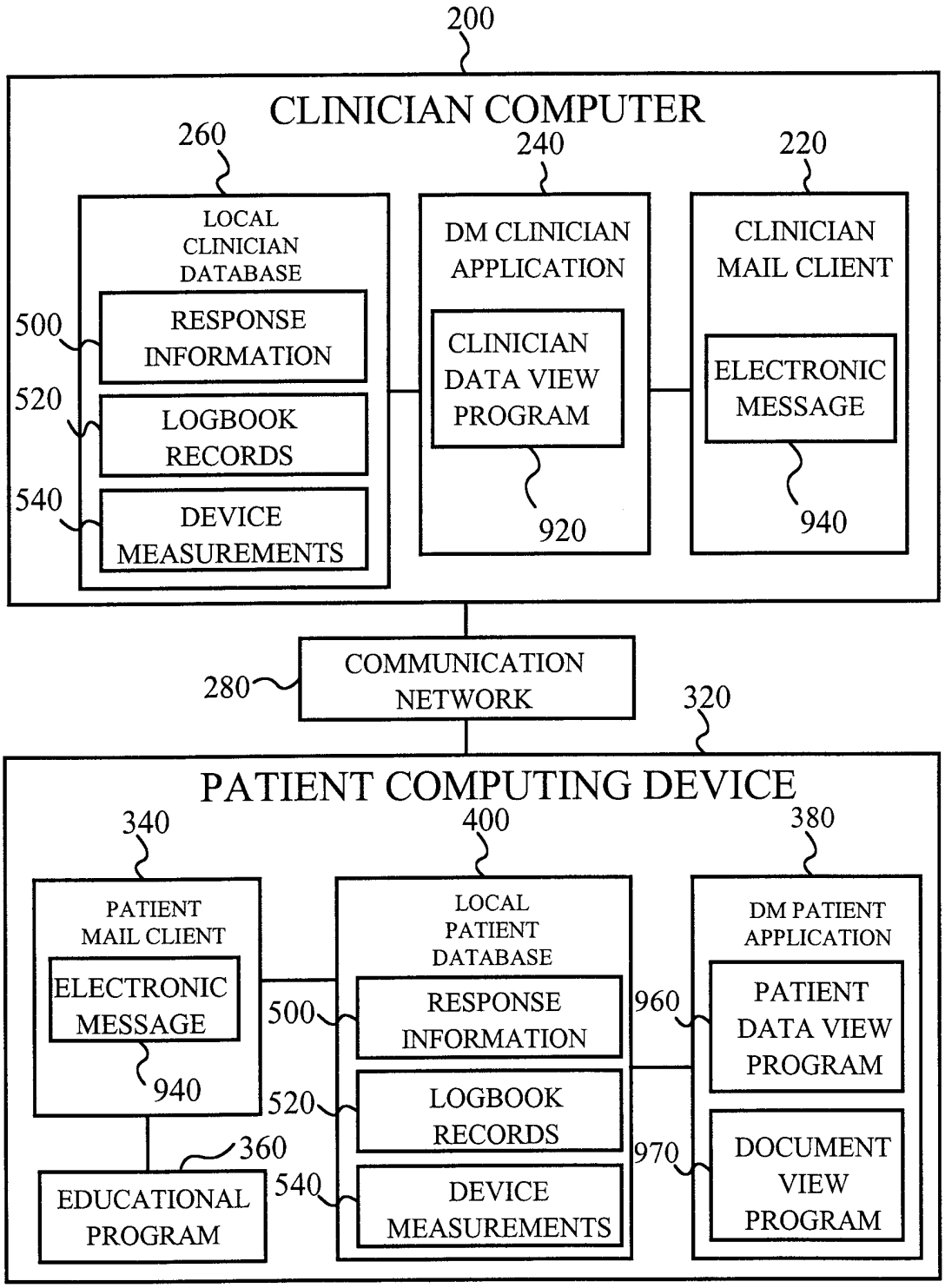
200
CLINICIAN COMPUTER
260
240
220
LOCAL CLINICIAN DATABASE
DM CLINICIAN APPLICATION
CLINICIAN MAIL CLIENT
500
RESPONSE INFORMATION
CLINICIAN DATA VIEW PROGRAM
ELECTRONIC MESSAGE
520
LOGBOOK RECORDS
920
940
540
DEVICE MEASUREMENTS
280
COMMUNICATION NETWORK
320
PATIENT COMPUTING DEVICE
340
400
380
PATIENT MAIL CLIENT
LOCAL PATIENT DATABASE
DM PATIENT APPLICATION
ELECTRONIC MESSAGE
500
RESPONSE INFORMATION
960
PATIENT DATA VIEW PROGRAM
940
520
LOGBOOK RECORDS
360
970
DOCUMENT VIEW PROGRAM
EDUCATIONAL PROGRAM
540
DEVICE MEASUREMENTS

FIG. 9

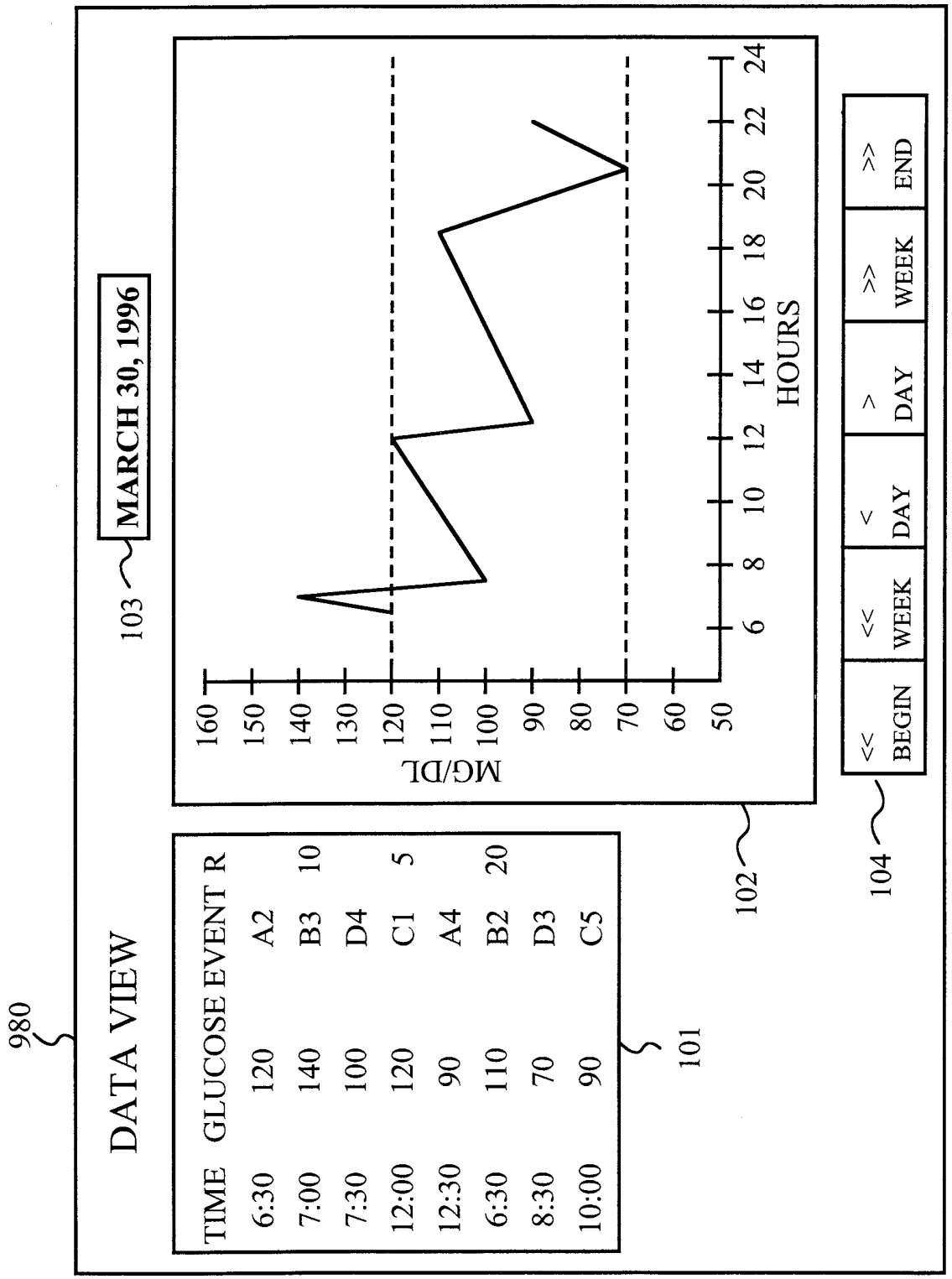
980
DATA VIEW
MARCH 30, 1996
103
TIME GLUCOSE EVENT R
6:30 120 A2
7:00 140 B3 10
7:30 100 D4
12:00 120 C1 5
12:30 90 A4
6:30 110 B2 20
8:30 70 D3
10:00 90 C5
101
102
MG/DL
160 150 140 130 120 110 100 90 80 70 60 50
6 8 10 12 14 16 18 20 22 24
HOURS
104
<< BEGIN
<< WEEK
< DAY
> DAY
>> WEEK
>> END

FIG. 10

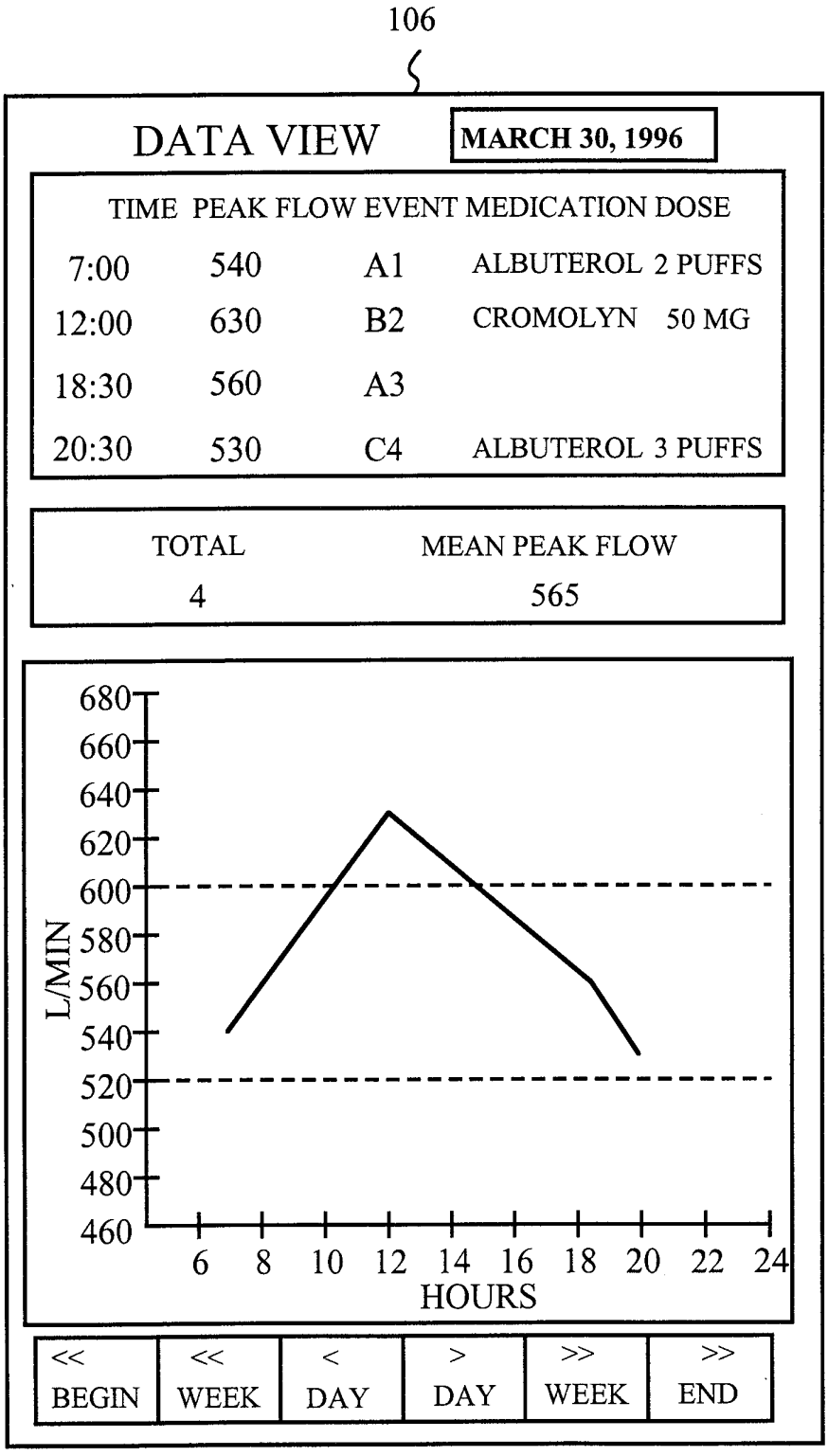
106
DATA VIEW
MARCH 30, 1996
TIME PEAK FLOW EVENT MEDICATION DOSE
7:00 540 A1 ALBUTEROL 2 PUFFS
12:00 630 B2 CROMOLYN 50 MG
18:30 560 A3
20:30 530 C4 ALBUTEROL 3 PUFFS
TOTAL
4
MEAN PEAK FLOW
565
L/MIN
680
660
640
620
600
580
560
540
520
500
480
460
6 8 10 12 14 16 18 20 22 24
HOURS
<< BEGIN
<< WEEK
< DAY
> DAY
>> WEEK
>> END

FIG. 11

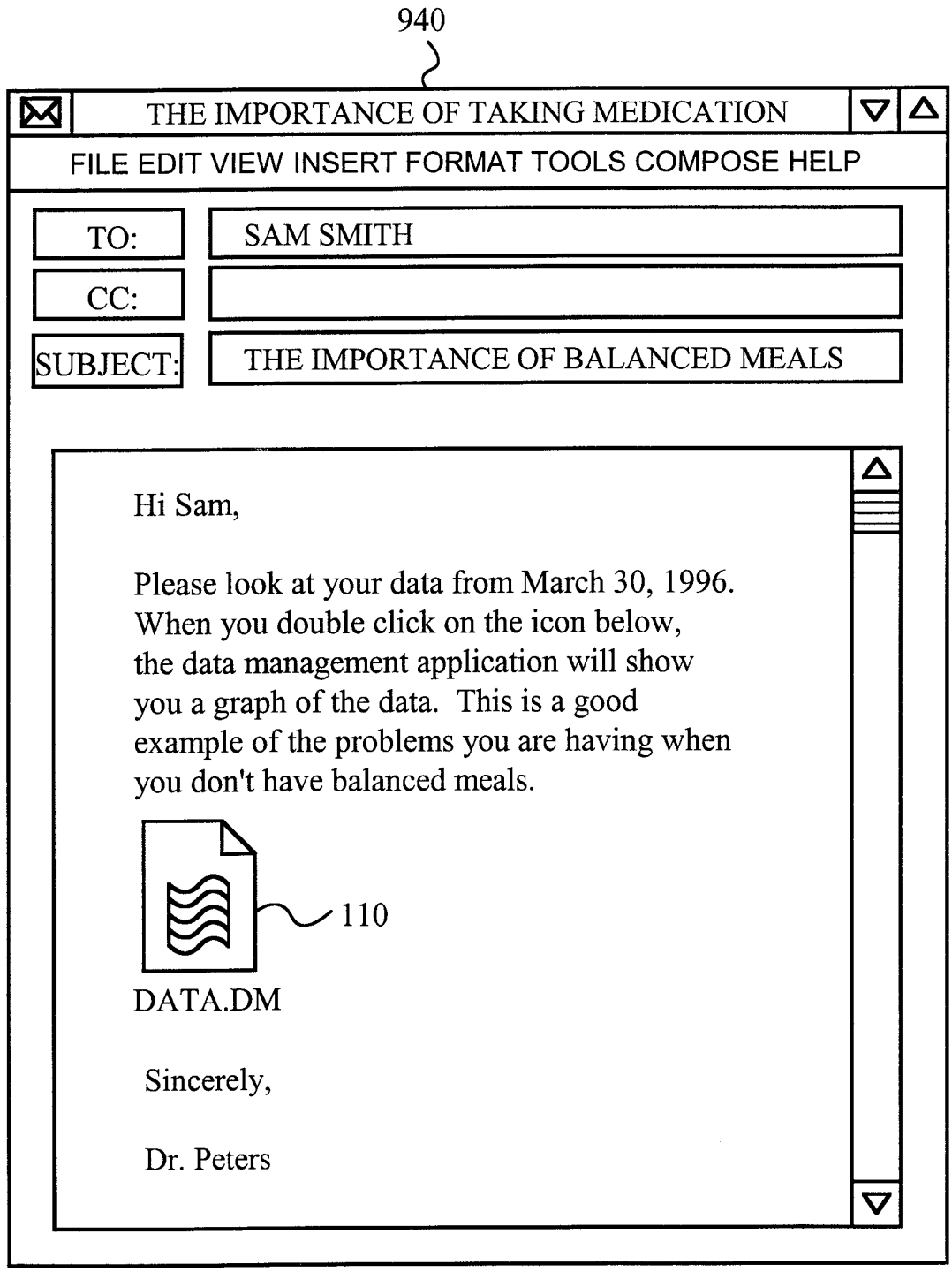
940
THE IMPORTANCE OF TAKING MEDICATION
FILE EDIT VIEW INSERT FORMAT TOOLS COMPOSE HELP
TO:
SAM SMITH
CC:
SUBJECT:
THE IMPORTANCE OF BALANCED MEALS
Hi Sam,
Please look at your data from March 30, 1996. When you double click on the icon below, the data management application will show you a graph of the data. This is a good example of the problems you are having when you don't have balanced meals.
110
DATA.DM
Sincerely,
Dr. Peters

FIG. 12

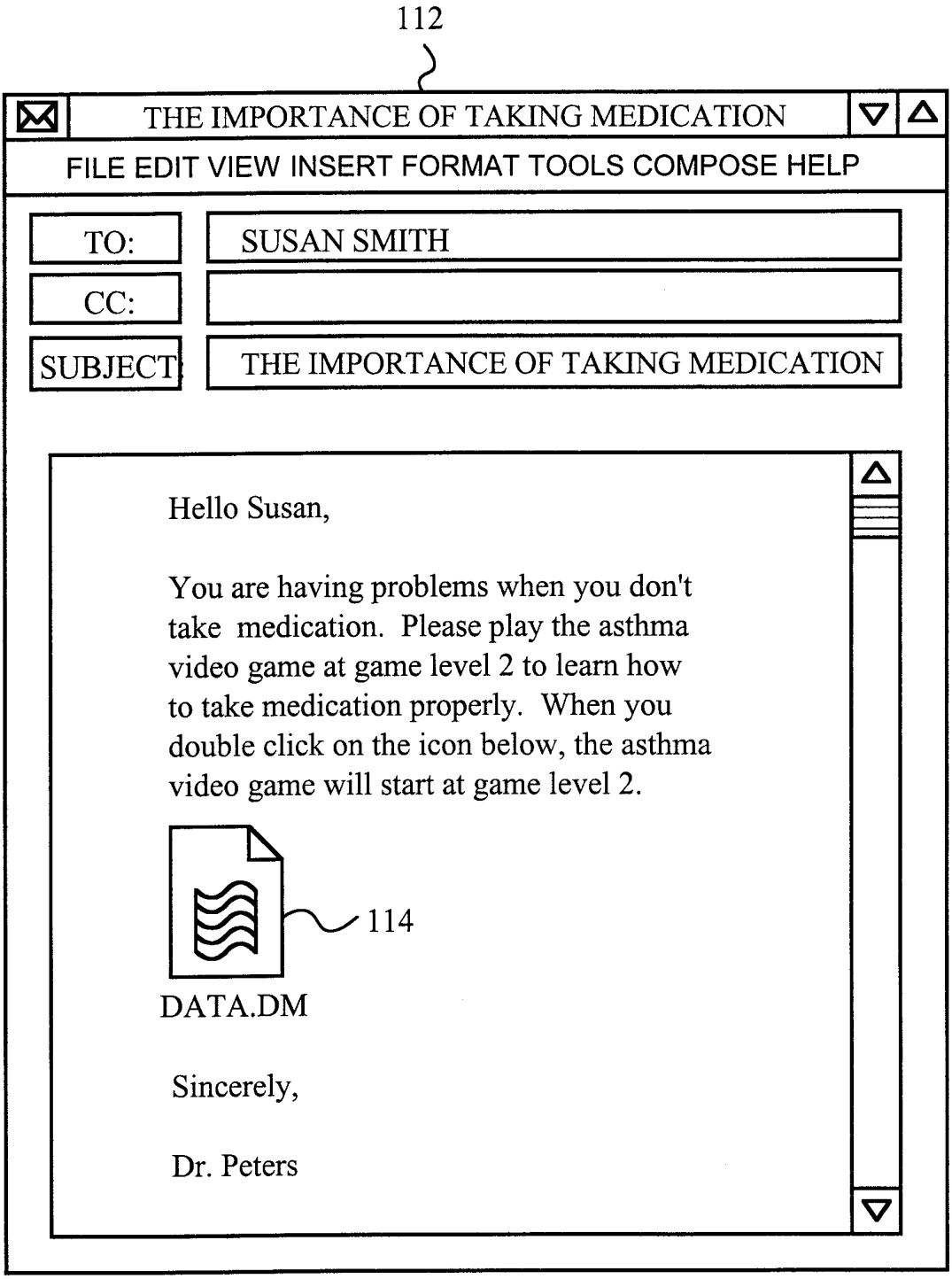
112
THE IMPORTANCE OF TAKING MEDICATION
FILE EDIT VIEW INSERT FORMAT TOOLS COMPOSE HELP
TO:
SUSAN SMITH
CC:
SUBJECT
THE IMPORTANCE OF TAKING MEDICATION
Hello Susan,
You are having problems when you don't take medication. Please play the asthma video game at game level 2 to learn how to take medication properly. When you double click on the icon below, the asthma video game will start at game level 2.
114
DATA.DM
Sincerely,
Dr. Peters

FIG. 13

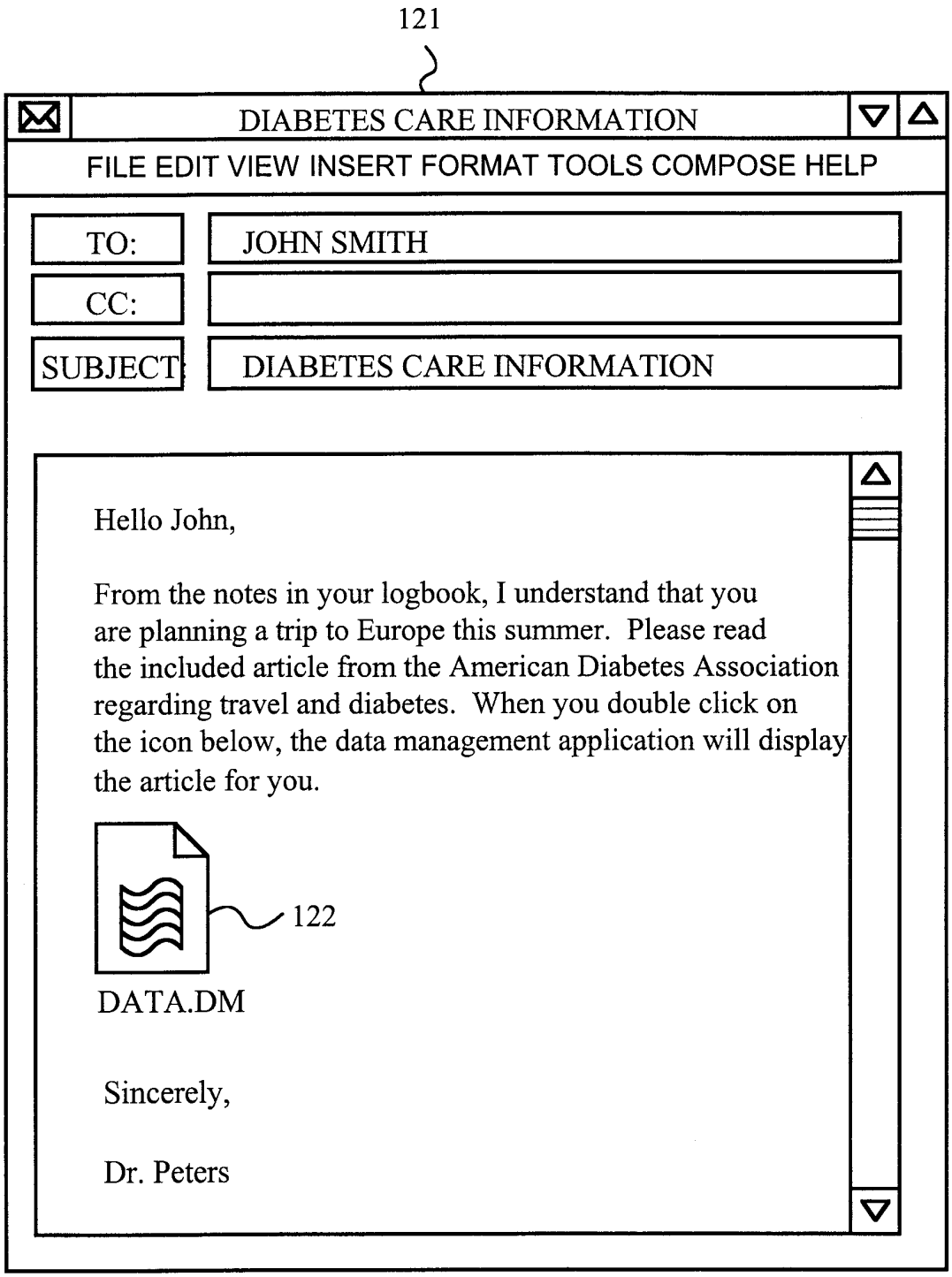
121
DIABETES CARE INFORMATION
FILE EDIT VIEW INSERT FORMAT TOOLS COMPOSE HELP
TO:
JOHN SMITH
CC:
SUBJECT:
DIABETES CARE INFORMATION
Hello John,
From the notes in your logbook, I understand that you are planning a trip to Europe this summer. Please read the included article from the American Diabetes Association regarding travel and diabetes. When you double click on the icon below, the data management application will display the article for you.
122
DATA.DM
Sincerely,
Dr. Peters

FIG. 14

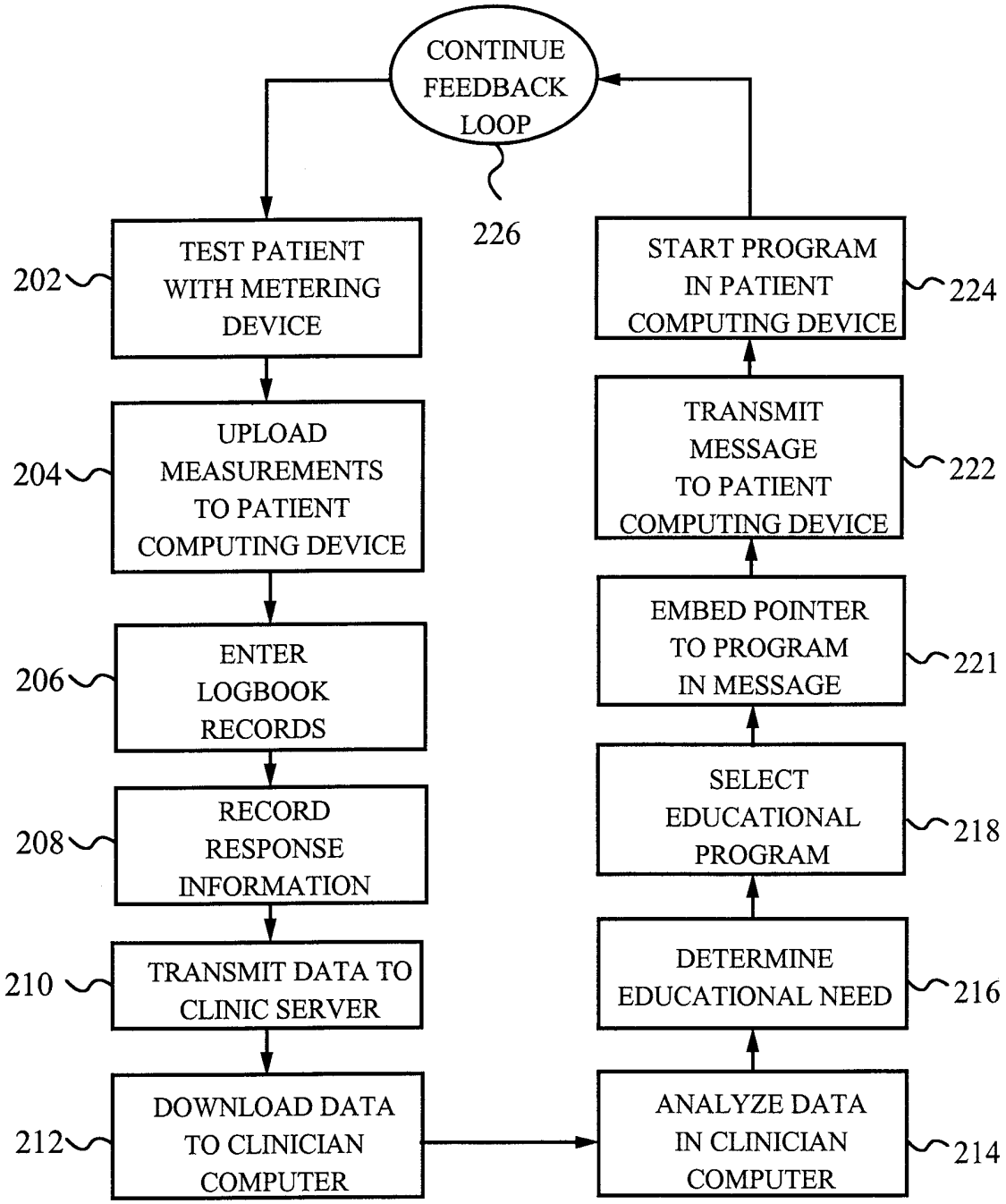
CONTINUE FEEDBACK LOOP
226
202
TEST PATIENT WITH METERING DEVICE
204
UPLOAD MEASUREMENTS TO PATIENT COMPUTING DEVICE
206
ENTER LOGBOOK RECORDS
208
RECORD RESPONSE INFORMATION
210
TRANSMIT DATA TO CLINIC SERVER
212
DOWNLOAD DATA TO CLINICIAN COMPUTER
214
ANALYZE DATA IN CLINICIAN COMPUTER
216
DETERMINE EDUCATIONAL NEED
218
SELECT EDUCATIONAL PROGRAM
221
EMBED POINTER TO PROGRAM IN MESSAGE
222
TRANSMIT MESSAGE TO PATIENT COMPUTING DEVICE
224
START PROGRAM IN PATIENT COMPUTING DEVICE

FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18779

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 17/40
US CL :705/2

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/2, 3; 345/326, 336, 337, 338; 709/208, 209, 211; 600/300

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

NONE

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

APS:
master, slave, clinician, patient, help, educational, link, url, hyperlink

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,731,726 A (ALLEN, III) 15 MARCH 1988 see entire document	1-29
A	US 4,803,625 A (FU et al.) 07 FEBRUARY 1989 see entire document	1-29
A	US 5,016,172 A (DESSERTINE) 14 MAY 1991 see entire document	1-29
A	US 5,109,974 A (BEER et al.) 05 MAY 1992 see entire document	1-29
A	US 5,390,238 A (KIRK et al.) 14 FEBRUARY 1995 see entire document	1-29
A	US 5,501,231 A (KAISH) 26 MARCH 1996 see entire document	1-29

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

20 DECEMBER 1999

Date of mailing of the international search report

04 FEB 2000

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer

STEPHEN R. TKACS

Telephone No. (703) 305-3900

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