(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 028 999 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.01.2010 Bulletin 2010/02

(21) Application number: **07761623.3**

(22) Date of filing: **01.05.2007**

(51) Int Cl.:
A61B 5/00 *(2006.01)*

(86) International application number:
PCT/US2007/067851

(87) International publication number:
WO 2007/143300 (13.12.2007 Gazette 2007/50)

(54) **DISPLAY OF TRENDS AND ANTICIPATED TRENDS FROM MITIGATION**

ANZEIGE VON VERLÄUFEN UND ERWARTETEN VERLÄUFEN VON MITIGATION

AFFICHAGE DES TENDANCES ET DES TENDANCES ANTICIPÉES D'ATTÉNUATION

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **31.05.2006 US 803512 P**

(43) Date of publication of application:
04.03.2009 Bulletin 2009/10

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EP 2 028 999 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present application is directed to making the significance of displays, particularly diagnostic displays, more immediately meaningful to the viewer. It finds particular application in conjunction with medical displays, particularly medical displays of trends and anticipated trends and will be described with particular reference thereto. However, it is to be appreciated, that the present application will also be applicable to other types of displays.

[0002] Patients, particularly patients in a hospital or other care facility, are commonly monitored by one or a plurality of monitors. The sensor unit which senses a physiological condition, such as blood pressure, temperature, blood oxygen, and the like is typically connected with a display unit. Commonly, the display unit is a printer which prints an elongated paper strip or chart which displays a plot or graph of the monitored physiological condition versus time. When plural physiological conditions are monitored, individual charts can be generated for each condition or two or more of the conditions can be displayed superimposed or offset on the same paper chart, typically with a different color ink. To facilitate interpretation, the paper chart is pre-printed with a scale or scales if designed for multiple physiological conditions.

[0003] Although paper charts are still commonly used, many have been replaced by electronic charts which emulate the paper chart on a video display. A graph of the monitored physiological condition versus time is displayed on a monitor superimposed on a background scale which relates the graph of the physiological condition versus time to a scale with the normal range for that physiological parameter, such as a temperature scale from 95°-105° F for a temperature sensor. The most recently monitored data is displayed, while older data is stored in memory for later recall, if necessary. Again, multiple physiological conditions can be monitored and displayed on the same display, such as with graphs or curves of different colors.

[0004] These displays, although accurate and correct, require interpretation. The examining doctors, nurses, respiratory therapists, patients and/or patients' families in for home monitoring, paramedics and/or EMTs on ambulances, etc., hereinafter clinician, must determine whether the value of the monitored physiological condition is normal, high, or low and, if high or low, whether the value is acceptable or in a danger zone. This can be time-consuming and is subject to human error.

[0005] To assist in recognizing and providing a warning if the value of a physiological condition reaches a danger zone, many monitors have an audio or visual alarm, such as a buzzer or flashing light. If the graph of the measured physiological condition enters a danger zone, the alarm is sounded.

[0006] While effective, the conditions for which some patients are hospitalized cause one or more of their monitored physiological conditions to be in a danger zone. The monitored physiological condition may remain in the danger zone for some time while medical treatments are applied to correct the problem. To have the alarm sound or flash continuously during this extended time conveys little meaningful information to the clinician. Indeed, because the alarms can be annoying, they are often turned OFF, thereby providing no additional information to the clinician.

[0007] Further, the current displays provide a graphical display of the current and past values of the monitored physiological conditions. Projections of future trends are absent. That is, as the medical treatment is being provided to bring the monitored physiological condition out of the danger zone, there is no display of the expected trend or reaction to the treatment. A clinician must analyze the chart and make a mental determination regarding whether the patient is reacting as anticipated or whether the medical treatment should be modified.

[0008] WO 2005/057175A describes a system and method for dynamically and intelligently estimating analyte data from a continuous analyte sensor, including employing an algorithm to estimate analyte values. For example, a visual representation of the variation of estimated analyte values may include exemplary paths representative of the analyzed variation of estimated analyte values that illustrates a range of possible future analyte values.

[0009] The present application provides a new and improved display technique which overcomes the above-referenced problems and others.

[0010] In accordance with one aspect, a method of generating an electronic display according to claim 1 is provided. A graph displays a physiological condition value or amplitude versus time. For example, a background for the graph includes at least one range which is delineated, e.g., color-coded, to indicate a normal range for the sensed physiological condition and at least a second range which is delineated to indicate an abnormal value of the monitored physiological condition.

[0011] In accordance with another aspect, an apparatus for displaying sensed physiological conditions according to claim 6 is provided. The apparatus includes a means for sensing a current value of a physiological condition, an electronic display, and a means for generating a graph representing the magnitude of the sensed physiological condition on the electronic display. A means is provided for inputting a selected medication or treatment for administration to the patient. A means generates an expectation range which is displayed on the electronic display to illustrate a range within which the sensed physiological condition is expected to move after administration of the input medication or treatment.

[0012] One advantage resides in a display of data in such a way that both trends and expectations are clear.

[0013] Another advantage is in the generation of dynamically varying norms or expected values over time.

[0014] In accordance with another aspect, the electronic display includes a plurality of temporally aligned

medical treatment displays, each of the medication/treatment indicating markers indicative of the time when a medical treatment was administered being a line superimposed on the plurality of displays and an expectation range extending from each medication/treatment indicating display forward in time, the sensed medical condition graph being superimposed on at least some of the displayed expectation range

[0015] In accordance with another aspect, each of the medication/treatment indicating displays and the corresponding expectation range have corresponding delineated sections.

[0016] In accordance with another aspect, the normal and abnormal ranges can be delineated by color-coding.

[0017] In accordance with another aspect of the method, the method can include a plurality of expectations displays. In accordance with another aspect the method includes generating visual markers of each medication or treatment and a time of commencing administration.

[0018] Still further advantages of the present invention will be appreciated to those of ordinary skill in the art upon reading and understand the following detailed description.

[0019] The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating the preferred embodiments and are not to be construed as limiting the invention.

FIGURE 1 is a graphic display of an exemplary patient's temperature over time as compared to expected ranges;

FIGURE 2 is a graph showing degrees of severity within each of the expected ranges;

FIGURE 3 is a graph showing expected blood pressure response to medication;

FIGURE 4 is a graph showing multiple monitored parameters and their responses to selected treatments or medications;

FIGURE 5 is a diagrammatic illustration of a system for generating the displays of FIGURES 1-4;

FIGURE 6 illustrates an alternate system of generating the displays of FIGURES 1-4.

[0020] FIGURES 1 and 2 show examples to which the invention may be applied.

[0021] With reference to FIGURE 1, a display **10,** temperature in the illustrated embodiment of FIGURE 1, includes a graph **12** displayed on a vertical axis representative of temperature and a horizontal axis representative of time. An end position **14** of the graph is indicative of the current time. The time scale can be predefined or selectable to view the graph over a longer or shortened time period. The graph **12** is superimposed on a background in which a normal temperature range **20** is delineated in a first manner, e.g., color-coded green, an abnormally high temperature range **22** is delineated in a second manner, e.g., color-coded in red, and an abnormally low temperature range **24** is delineated in a third manner, e.g., color-coded in blue. Other delineated selections may, of course, be selected as may be appropriate to connote the normal and abnormal ranges. Although the delineations are described in terms of color, other delineations, such as cross-hatching, labeling, patterning, and the like are also contemplated. The other delineations can also be used in conjunction with color-coding to assist color-blind clinicians.

[0022] Instead of denoting merely normally, high, and low ranges, further gradations can be provided. For example, an interface between normal and abnormal might be color-coded in yellow to denote warning, but possibly not danger. With reference to FIGURE 2, finer grain ranges for the normal and abnormal values can be produced. In FIGURE 2, the high range has been broken down into three sub-ranges **22a, 22b, 22c** which are color-coded in progressively more intense shades of red for subranges from slightly high to very high. Similarly a slightly low range **24a** and a very low range **24b** are also color-coded in a lighter shade and a more intense shade of blue. The acceptable range is also segmented into sub-ranges with lighter and darker shades of green **20a, 20b.** Preferably, finer grain ranges are selected such that each has associated with it actions to be carried out when a patient's actual physiological condition value being measured enters that range. The interfaces between the finer grain ranges are selected to correspond with temperatures, in the illustrated, which trigger such medical action. These ranges can also represent standard deviations in specific populations, medical opinion, and the like.

[0023] Although FIGURES 1 and 2 show graphs of temperature, by way of example, it is to be appreciated that the information shown on the graph is typically based on the condition on which the patient is being evaluated, such as mean arterial pressure, heart rate, respiratory rate, blood oxygen, or the like. For different physiological conditions, the units for both of the value or the magnitude of the condition and time will typically change as will the normal and abnormal ranges. Moreover, the various ranges can be labeled with superimposed text or other indications that are readily recognized, particularly by observers who suffer from color blindness.

[0024] Unlike FIGURES 1 and 2 in which the previously described displayed ranges of data categories are set by static functions, i.e., ranges staying the same over time, the ranges may also be dynamic to show an expected response. With reference to FIGURE 3, a display **10'** depicts a graph **12'** depicting mean arterial pressure, by way of example. The display is color-coded to denote a normal region **20'** and an abnormal region **22'.** An end **14'** of the graph indicates the current time, or 'now'. In this exemplary FIGURE, the plot of the patient's actual mean arterial pressure has dropped too low, calling for a medical response. In the present example, the medical response is to give the patient crystalloid at the current time. A graphic marker or indicator **30** indicates the time

at which a medical treatment is administered and a label **32** indicates the nature of the medical treatment. As described in greater detail below, the clinician inputs the medical treatment administered. Given the patient's current physiological condition level and the nature of the treatment, a graphical indication **34** of the expected range of the monitored physiological condition is displayed superimposed on the normal and abnormal range displays. The values for the ranges can be generated by data mining of patients with similar conditions and backgrounds that have had a known positive outcome with the selected medication or treatment in question, a database loaded in accordance with the opinions of expert panels, the expectations of the prescribing clinician, chemical or physiological research and analysis, or the like. The expected displayed range **34** and the start-up treatment marker 30 are like color-coded to facilitate easy understanding of displays in which multiple medications are administered at different times.

[0025] In a "inquiry mode" method of use, the diagnosing clinician selects each of a plurality of potential treatments or medications and reviews the generated expectation display range. In this manner, the diagnosing clinician can try several potential treatments or medications and use the generated display to help select the most appropriate. As an enhancement, a probability of success indication **36** is also added to the display. That is, when the expectation range **34** is based on successful applications of the designated treatment, the probability of success number is based on the proportion of patients, in like conditions, who were successfully treated with this medication or treatment. In the illustrated embodiment, the probability of success is represented by a graphical depiction of the percentage of patients successfully treated. Of course, other indications could also be used, such as a green-yellow-red color coding to show very high, marginal, and poor probabilities of success compared to other potential treatments. Probabilities of success can also be provided for each expectation range or portions of each expectation range. For example, the expectation range can be subdivided into subranges, such as subranges indicative of a 50%, 75%, and 95% likelihood of success. Various other probability of success indicators are also contemplated.

[0026] With reference to FIGURE 4, frequently a plurality of parameters will be monitored concurrently and a plurality of treatments or medications will be applied to the monitored patient. In the present example, four conditions are monitored - temperature, heart rate, respiratory rate, and mean arterial pressure. It will be seen in display **10"** that about four days ago, the patient's temperature moved up into the abnormally high range as did the patient's respiratory rate. By about three days ago, the patient's temperature was recovering slightly, but the respiratory rate was still increasing and the mean arterial pressure was approaching the abnormally low range. About 2-1/3 days ago, the patient's temperature started rising again, the respiratory rate continued to climb in the abnormally high range, and the mean arterial pressure trended downward deeper into the abnormally low range. As indicated by marker $\mathbf{40_1}$, a first treatment was administered, amoxicillin in the present example. When the amoxicillin as administered, correspondingly color-coded expectation range displays **42a, 42b, 42c, 42d** were generated and overlaid on the displays. Soon thereafter, a second treatment denoted by marker $\mathbf{40_2}$, aspirin in the illustrated example, was administered. Because aspirin is only expected to have an effect on temperature and not the other monitored conditions, a second treatment expectation range **44a** was overlaid on the temperature chart.

[0027] About a day ago, the temperature and heart rate were both nicely in the normal range and the mean arterial blood pressure was approaching the normal range. Respiration rate was still abnormally high. At the present time, the temperature and heart rate appear in the normal range but the respiration rate still remains abnormally high and was not decreasing according to the expectation display **42c.** The mean arterial blood pressure is still in the abnormally low range, but within the expected range **42d.** To bring the patient's vital signs back towards normal, the decision is made to start a third treatment, in the present example, administer oxygen, which is denoted by a third treatment marker $\mathbf{40_3}$. A third treatment expectation curve **46c** is added to the graphs. Specifically, since oxygen is only expected to improve the respiratory rate, the third treatment expectation curve **46c** is generated and superimposed on the respiratory rate display. Looking out one day, it is seen that by that time, the amoxicillin, which is a slower temperature reducer than is aspirin because it addresses to the underlying cause of the elevated temperature rather than the symptom, is expected to have brought the temperature into the normal range. Hence, the symptom-only treatment of aspirin is scheduled to be terminated. With these three treatments, the expected ranges are predicting that all four illustrated vital signs will be in the normal range by tomorrow. Of course, if the graphs **12** fail to remain within the expected ranges **42a, 42b, 42c, 42d, 46c,** additional or different future treatments/medications can be expected to be administered. Optionally, the attending clinician can turn OFF the expectation range for any one or more of the treatments. By toggling the expectation ranges ON and OFF, the clinician can check whether each treatment is working as expected.

[0028] In the example of FIGURE 4, aspirin and amoxicillin are complementary drugs in that aspirin addresses the symptoms rapidly while amoxicillin addresses the underlying cause more slowly. In other instances, interacting drugs or treatments may be administered in which the two together act synergistically to achieve a different expectation that either one individually or the sum of the two. For interacting drugs, the pair or more of interacting drugs can be treated as a single treatment or medication denoted by a single expectation range display.

[0029] With reference to FIGURE 5, the display unit

10, 10', 10", (hereinafter **10)** associated with each patient includes a graphics controller **50** which converts signals from one or more physiological condition sensors **52** and other electronic information into the displays discussed above. In one embodiment, each of the sensors identifies itself to a range display generator or algorithm **54** which recognizes whether the sensor is a temperature sensor, heart rate sensor, etc. and causes the graphics processor **50** to generate the corresponding normal and abnormal ranges, as well as the appropriate units, e.g., degrees C or F, beats per minute, etc. Alternately, an operator input device **56** can be used to identify the sensors and select or modify the normal and abnormal condition ranges. A recent history memory **58** stores the sensed condition values for at least the duration of the graph **12** shown on the display **10** and preferably longer. The display may be adjacent the patient, at a nurses' station, at a clinician's remote office, or the like. For example, the display can be communicated over the Internet to a display terminal at a remote hospital(s) where a team of experts can be consulted. Multiple displays, connected by wire, wirelessly, etc. are also contemplated. Further, alarms may be provided at the monitor or at a remote location(s) using wired or wireless protocols. The alarm information can be sent over the data channel to a remote monitor location.

[0030] To generate the expectation ranges discussed in conjunction with FIGURES 3 and 4, an operator uses the input device **56** to input proposed or actually administered medications or treatments into a database **60,** which database is pre-programmed with corresponding expectation ranges **34, 42a,** ..., **46c** for each of a plurality of medications and treatments based on the opinions of expert panels. Preferably, the database **60** is pre-programmed with a plurality of expectation ranges for each medication or treatment corresponding to different current patient conditions. The database can be a preprogrammed memory in the bedside device, a remote database, such as one in the clinic's intranet. Multiple databases which might be remotely accessed, such as a database maintained by the manufacturer of each treatment, by a medical journal, by trade groups, by medical schools, etc. are also contemplated. In order to select among the plurality of expectation ranges for each medication or treatment, the database also receives the recent patient condition values from the memory **58** and other patient background information from a patient information or record file **62.** An expectation range display generator **64** converts the information from the database **60** into appropriate instructions for the graphics processor **50.** Optionally, the current physiological condition readings from the sensor are conveyed to the range generator in order to match the starting point of the expectation range with the current condition values. For example, if the database only has a fixed plurality of discrete expectation ranges, the expectation range generator **64** may interpolate between the two closest expectation ranges to move the origin into alignment with the current values.

[0031] With reference to FIGURE 6, the potential drug or treatment from the input device **56,** and the patient condition information from the memory **58,** and the patient information database **62** are input into a search engine **70.** The search engine searches a medical history database **72** for patients with similar medical histories to whom the input medication or treatment was administered. In one embodiment, the database **72** is the database of the hospital at which the treatment is given. In another embodiment, the database is a larger database, such as a database of all patients of the network with which the hospital is associated. The database can also be a national database; such as a database which specializes is specific types of illnesses, databases at the Center for Disease Control, or the like. The charts from patients with similar medical conditions treated with the same medicine or treatment are collected in a memory or buffer **74.** The expectation range generator **64** includes an algorithm or routine for determining the mean or median versus time response of the successfully treated patients from the buffer **74.** An algorithm or routine determines the spread or range versus time of the various physiological conditions of the successfully treated patients from the buffer **74.** A probability of success routine or algorithm analyzes the patient data in the buffer **74** to determine a probability that the treatment will be successful, e.g., the percentage of patients with whom the treatment was successful. When multiple physiological conditions are displayed, the mean or median versus time and the range versus time calculations are performed for each displayed physiological condition or at least those physiological conditions which the medication or treatment was intended to address. The information is conveyed to the graphics processor **50** which converts the expectation range data into the appropriate expectation range display on the displays **10.** The graphics processor also receives the normal/abnormal background range displays from the normal/abnormal range generator **54,** the current sensed physiological condition values from the sensors **52,** and prior sensed condition values from the memory **58.**

[0032] In addition to devices assigned and built to perform these functions, older monitors can be upgraded by software reprogramming, plug-in upgrades, interfacing with an add-on or remote device to add functionality, or the like.

[0033] The invention has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be constructed as including all such modifications and alterations insofar as they come within the scope of the appended claims.

Claims

1. A method for generating an electronic display, comprising:

   generating a background on the electronic display including at least one range **(20, 20a, 20b, 20')** delineated to indicate a normal range for a physiological condition and an abnormal range **(22, 22', 22a, 22b, 22c, 24, 24a, 24b)** for the physiological condition;
   sensing a current value of the physiological condition;
   generating a graph **(12, 12')** on the electronic display superimposed on the background representing a magnitude of the sensed physiological condition versus time;
   selecting, from a plurality of medications and medical treatments, a medication or medical treatment to be administered to the patient;
   retrieving expectation data corresponding to the selected medication or medical treatment from a database (60) which stores medical information regarding expected responses to each of said plurality of medications and medical treatments;
   generating an expectation range **(34, 42a, 42b, 42c, 42d, 44a, 46c)** and displaying the expectation range on the electronic display **(10, 10', 10")** illustrating a range within which the sensed physiological condition is expected to move after administration of the selected medication or treatment, the expectation range being superimposed on the background.

2. The method according to claim 1, further including:

   generating expectation ranges **(42a, 42b, 42c, 42d, 44a, 46c)** for each of a plurality of medications or treatments;
   using the displayed expectation ranges to set a course of treatment.

3. The method according to claim 1 or 2, further including:

   displaying a marker **(30, 40_1, 40_2, 40_3)** on the electronic display indicative of when a medication or treatment was administered and a display **(32)** of the nature of the medication.

4. The method according to any one of the claims 1 to 3, wherein the background includes the normal physiological condition range **(20, 20a, 20b,)** in a first characteristic delineation and the abnormal range **(22, 22a, 22b, 22c, 24, 24a, 24b)** in a second characteristic delineation.

5. The method according to any one of the claims 1 to 4, further including:

   selecting each of a plurality of candidate medications or treatments;
   generating the corresponding expectation range for each candidate medication or treatment;
   selecting one or more of the candidate medications or treatments based on the generated expectation ranges.

6. An apparatus for displaying sensed physiological conditions comprising:

   an electronic display **(10, 10', 10");**
   means **(**5**2)** for sensing a current value of a physiological condition;
   means **(50)** for generating a graph **(12, 12')** on the electronic display representing magnitude of the sensed physiological condition versus time;
   a database **(60) which** stores medical information regarding expected responses to each of a plurality of medications and medical treatments;
   means **(56)** for inputting a medication or medical treatment for administration to the patient; the inputting means **(56)** including an operator input device for inputting into the database a selected medication or medical procedure to retrieve corresponding expectation data;
   means **(50, 64**) for generating an expectation range display **(34, 42a, 42b, 42c, 42d, 44a, 46c)** on the electronic display illustrating a range within which the sensed physiological condition is expected to move after administration of the input medication or treatment;

   the means for generating an expectation range display including:

   an expectation range display generator **(64)** which converts the data from the database into instructions for the expected range display;
   a graphics processor **(50)** which converts the instructions from the expectation range display generator **(64)** into appropriate control signals for the electronic monitor **(10, 10', 10").**

7. The apparatus according to claim 6, further including:

   a patient information electronic record **(62),** the database **(60)** being connected with the patient information electronic record **(62)** to receive patient information and with the sensing means **(62)** to receive recent values of the sensed physiological condition.

8. The apparatus according to claim 6 or 7, further including:

a database **(72)** of actual patient responses to each of a plurality of medications or medical treatments;
a search engine **(70)** which receives an input indicative of a medication or medical treatment to be administered to the patient and searches the database to find graphs of patients to whom medication or medical treatment had been administered;

the means for generating an expectation range display including:

an expectation range display generator **(64)** which receives at least some of the retrieved graphs and generates instructions for the expectation range display;
a graphics processor **(50)** which converts the instructions from the expectation range display generator **(64)** into appropriate control signals for the electronic monitor **(10, 10', 10").**

9. The apparatus according to claim 8, wherein the expectation range display generator **(64)** includes:

a routine or algorithm for determining a mean or median of the sensed physiological condition versus time from the retrieved patient graphs;
a routine or algorithm for calculating a range or deviation versus time of the sensed condition from the retrieved graphs.

10. The apparatus according to claim 8 or 9, wherein the expectation range display **(64)** further includes:

a routine or algorithm **(20)** which determines at least one probability of success from the retrieved patient graphs.

11. The apparatus according to any one of the claims 6 to 10, further including:

a graphics processor **(50)** for controlling the electronics display, the graphics processor being adapted to be connected with at least one sensor **(52)** for sensing the physiological condition and converting the sensed physiological condition into the graph of the physiological condition amplitude versus time;
a normal/abnormal range generator **(54)** for generating instructions to the graphics processor concerning a normal range of the sensed physiological condition and at least one abnormal range, the graphics processor color-coding a background to the graph **(12, 12')** indicating the normal range **(20, 20a, 20b)** in a first color and the abnormal range **(22, 22a, 22b, 22c; 24, 24a, 24b)** in a second color.

Patentansprüche

1. Verfahren zum Erzeugen einer elektronischen Anzeige, das Folgendes umfasst:

Erzeugen eines Hintergrunds auf der elektronischen Anzeige, der mindestens einen Bereich (20, 20a, 20b, 20') umfasst, welcher skizziert ist, um einen normalen Bereich für einen physiologischen Zustand und einen abnormalen Bereich (22, 22', 22a, 22b, 22c, 24, 24a, 24b) für den physiologischen Zustand anzugeben;
Messen eines aktuellen Wertes des physiologischen Zustands;
Erzeugen eines Graphen (12, 12') auf der elektronischen Anzeige, der dem Hintergrund überlagert ist und der eine Größe des gemessenen physiologischen Zustands als Funktion der Zeit darstellt;
Auswählen einer dem Patienten zu verabreichenden Medikation oder medizinischen Behandlung aus einer Vielzahl von Medikationen und medizinischen Behandlungen;
Abrufen von der ausgewählten Medikation oder medizinischen Behandlung entsprechenden Erwartungsdaten aus einer Datenbank (60), in der medizinische Informationen in Bezug auf erwartete Reaktionen auf jede der genannten Vielzahl von Medikationen und medizinischen Behandlungen gespeichert sind;
Erzeugen eines Erwartungsbereichs (34, 42a, 42b, 42c, 42d, 44a, 46c) und Anzeigen des Erwartungsbereichs auf der elektronischen Anzeige (10, 10', 10"), um einen Bereich zu veranschaulichen, in dem sich der gemessene physiologische Zustand nach der Verabreichung der ausgewählten Medikation oder Behandlung voraussichtlich bewegen wird, wobei der Erwartungsbereich dem Hintergrund überlagert wird.

2. Verfahren nach Anspruch 1, das weiterhin Folgendes umfasst:

Erzeugen von Erwartungsbereichen (42a, 42b, 42c, 42d, 44a, 46c) für jede von einer Vielzahl an Medikationen oder Behandlungen;
Verwenden der angezeigten Erwartungsbereiche, um einen Behandlungsablauf festzulegen.

3. Verfahren nach Anspruch 1 oder 2, das weiterhin Folgendes umfasst:

Anzeigen einer Markierung (30, 40_1, 40_2, 40_3)

auf der elektronischen Anzeige, die angibt, wann eine Medikation oder Behandlung verabreicht wurde, und eine Anzeige (32) der Art der Medikation.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei der Hintergrund den normalen physiologischen Zustandsbereich (20, 20a, 20b) in einer ersten charakteristischen Skizze und den abnormalen Bereich (22, 22a, 22b, 22c, 24, 24a, 24b) in einer zweiten charakteristischen Skizze umfasst.

5. Verfahren nach einem der Ansprüche 1 bis 4, das weiterhin Folgendes umfasst:

Auswählen jeder von einer Vielzahl in Frage kommender Medikationen oder Behandlungen;
Erzeugen des entsprechenden Erwartungsbereichs für jede in Frage kommende Medikation oder Behandlung;
Auswählen von einer oder mehreren der in Frage kommenden Medikationen oder Behandlungen ausgehend von den erzeugten Erwartungsbereichen.

6. Gerät zum Anzeigen gemessener physiologischer Zustände, das Folgendes umfasst:

eine elektronische Anzeige (10, 10', 10");
Mittel (52) zum Messen eines aktuellen Wertes eines physiologischen Zustands;
Mittel (50) zum Erzeugen eines Graphen (12, 12') auf der elektronischen Anzeige, der die Größe des gemessenen physiologischen Zustands als Funktion der Zeit darstellt;
eine Datenbank (60), in der medizinische Informationen in Bezug auf erwartete Reaktionen auf jede einer Vielzahl von Medikationen und medizinischen Behandlungen gespeichert sind;
Mittel (56) zum Eingeben einer dem Patienten zu verabreichenden Medikation oder medizinischen Behandlung, wobei die Eingabemittel (56) eine Bedienereingabevorrichtung zur Eingabe einer ausgewählten Medikation oder medizinischen Prozedur in die Datenbank umfassen, um die entsprechenden Erwartungsdaten abzurufen;
Mittel (50) zum Erzeugen einer Erwartungsbereichanzeige (34, 42a, 42b, 42c, 42d, 44a, 46c) auf der elektronischen Anzeige, um einen Bereich zu veranschaulichen, in dem sich der gemessene physiologische Zustand nach der Verabreichung der eingegebenen Medikation oder Behandlung voraussichtlich bewegen wird;

wobei die Mittel zum Erzeugen einer Erwartungsbereichanzeige Folgendes umfassen:

einen Erwartungsbereichanzeige-Generator (64), der die Daten aus der Datenbank in Anweisungen für die Erwartungsbereichanzeige konvertiert;
einen Graphikprozessor (50), der die Anweisungen aus dem Erwartungsbereichanzeige-Generator (64) in geeignete Steuersignale für den elektronischen Monitor (10, 10', 10") konvertiert.

7. Gerät nach Anspruch 6, das weiterhin Folgendes umfasst:

eine elektronische Krankenakte (62), wobei die Datenbank (60) mit der elektronischen Krankenakte (62) verbunden ist, um Patientendaten zu empfangen, und mit den Messmitteln (52) verbunden ist, um neue Werte für den gemessenen physiologischen Zustand zu empfangen.

8. Gerät nach Anspruch 6 oder 7, das weiterhin Folgendes umfasst:

eine Datenbank (72) mit tatsächlichen Patientenreaktionen auf jede einer Vielzahl von Medikationen oder medizinischen Behandlungen;
eine Suchmaschine (70), die eine Eingabe empfängt, welche eine dem Patienten zu verabreichende Medikation oder medizinische Behandlung angibt und die Datenbank durchsucht, um Graphen von Patienten zu finden, denen die Medikation oder medizinische Behandlung verabreicht worden ist;

wobei die Mittel zum Erzeugen einer Erwartungsbereichanzeige Folgendes umfassen:

einen Erwartungsbereichanzeige-Generator (64), der mindestens einige der abgerufenen Graphen empfängt und Anweisungen für die Erwartungsbereichanzeige erzeugt;
einen Graphikprozessor (50), der die Anweisungen aus dem Erwartungsbereichanzeige-Generator (64) in geeignete Steuersignale für den elektronischen Monitor (10, 10', 10") konvertiert.

9. Gerät nach Anspruch 8, wobei der Erwartungsbereichanzeige-Generator (64) Folgendes umfasst:

eine Routine oder einen Algorithmus zum Ermitteln eines Mittel- oder Medianwertes des gemessenen physiologischen Zustands als Funktion der Zeit anhand der abgerufenen Patientengraphen;
eine Routine oder einen Algorithmus zum Berechnen eines Bereichs oder einer Abweichung des gemessenen Zustands als Funktion der Zeit von den abgerufenen Graphen.

10. Gerät nach Anspruch 8 oder 9, wobei die Erwartungsbereichanzeige (64) weiterhin Folgendes umfasst:

eine Routine oder einen Algorithmus (20), die bzw. der mindestens eine Erfolgswahrscheinlichkeit anhand der abgerufenen Patientengraphen ermittelt.

11. Gerät nach einem der Ansprüche 6 bis 10, das weiterhin Folgendes umfasst:

einen Graphikprozessor (50) zum Steuern der elektronischen Anzeige, wobei der Graphikprozessor vorgesehen ist, um mit mindestens einem Sensor (52) zum Messen des physiologischen Zustands verbunden zu werden und den gemessenen physiologischen Zustand in den Graphen der Amplitude des physiologischen Zustands als Funktion der Zeit zu konvertieren; einen Normal-/Abnormalbereich-Generator (54) zum Erzeugen von Anweisungen für den Graphikprozessor bezüglich eines Normalbereichs des gemessenen physiologischen Zustands und mindestens eines abnormalen Bereichs, wobei der Graphikprozessor einen Hintergrund für den Graphen (12, 12'), welcher den Normalbereich (20, 20a, 20b) angibt, in einer ersten Farbe farbig codiert, und den Abnormalbereich (22, 22a, 22b, 22c; 24, 24a, 24b) in einer zweiten Farbe farbig codiert.

Revendications

1. Procédé destiné à générer un affichage électronique, consistant à :

générer un arrière-plan sur l'affichage électronique comprenant au moins une plage (20, 20a, 20b, 20') délimitée pour indiquer une plage normale pour un état physiologique et une plage anormale (22, 22', 22a, 22b, 22c, 24, 24a, 24b) pour l'état physiologique ;
détecter une valeur actuelle de l'état physiologique ;
générer un graphique (12, 12') sur l'affichage électronique, superposé sur l'arrière-plan et représentant une grandeur de l'état physiologique détecté en fonction du temps ;
choisir à partir d'une pluralité de médicaments et de traitements médicaux, un médicament ou un traitement médical à administrer au patient ;
extraire des données de prévision correspondant au médicament ou au traitement médical choisi, à partir d'une base de données (60) qui contient des informations médicales concernant les réactions prévues à chacun de ladite pluralité de médicaments et de traitements médicaux ;
générer une plage de prévision (34, 42a, 42b, 42c, 42d, 44a, 46c) et afficher ladite plage de prévision sur l'affichage électronique (10, 10', 10") illustrant une plage à l'intérieur de laquelle il est prévu que l'état physiologique détecté évolue après l'administration du médicament ou du traitement choisi, la plage de prévision étant superposée sur l'arrière-plan.

2. Procédé selon la revendication 1, consistant en outre à :

générer des plages de prévision (42a, 42b, 42c, 42d, 44a, 46c) pour chacun d'une pluralité de médicaments ou de traitements ;
utiliser des plages de prévision affichées pour établir un traitement.

3. Procédé selon la revendication 1 ou 2, consistant en outre à :

afficher un repère (30, 40_1, 40_2, 40_3) sur l'affichage électronique indiquant à quel moment un médicament ou un traitement a été administré et un affichage (32) de la nature du médicament.

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel l'arrière-plan comprend la plage normale de l'état physiologique (20, 20a, 20b) dans une première délimitation caractéristique et la plage anormale (22, 22a, 22b, 22c, 24, 24a, 24b) dans une seconde délimitation caractéristique.

5. Procédé selon l'une quelconque des revendications 1 à 4, consistant en outre à :

choisir chacun d'une pluralité de médicaments ou de traitements possibles ;
générer la plage de prévision correspondante pour chaque médicament ou traitement possible ;
choisir un ou plusieurs des médicaments ou traitements possibles en fonction des plages de prévision générées.

6. Appareil destiné à afficher des états physiologiques détectés, comprenant : un affichage électronique (10, 10', 10") ;

des moyens (52) pour détecter une valeur actuelle d'un état physiologique ;
des moyens (50) pour générer un graphique (12, 12') sur l'affichage électronique représentant la grandeur de l'état physiologique détecté en fonction du temps ;
une base de données (60) qui contient des informations médicales concernant les réactions

prévues à chacun d'une pluralité de médicaments et de traitements médicaux ;
des moyens (56) pour entrer un médicament ou un traitement médical à administrer au patient ; lesdits moyens d'entrée (56) comprenant un dispositif d'entrée par un opérateur pour entrer dans la base de données un médicament ou un acte médical choisi afin d'extraire les données de prévision correspondantes ;
des moyens (50, 64) pour générer l'affichage d'une plage de prévision (34, 42a, 42b, 42c, 42d, 44a, 46c) sur l'affichage électronique illustrant une plage à l'intérieur de laquelle il est prévu que l'état physiologique détecté évolue après l'administration du médicament ou du traitement entré ;

les moyens destinés à générer un affichage de la plage de prévision comprenant :

un générateur d'affichage de plage de prévision (64) qui transforme les données issues de la base de données en instructions pour l'affichage de la plage prévue ;
un processeur graphique (50) qui transforme les instructions provenant du générateur d'affichage de plage de prévision (64) en signaux de commande appropriés pour le moniteur électronique (10, 10', 10").

7. Appareil selon la revendication 6, comprenant en outre :

un enregistrement électronique d'informations sur le patient (62), la base de données (60) étant reliée avec l'enregistrement électronique d'informations sur le patient (62) pour recevoir des informations sur le patient et avec les moyens de détection (62) pour recevoir les valeurs récentes de l'état physiologique détecté.

8. Appareil selon la revendication 6 ou 7, comprenant en outre :

une base de données (72) des réactions effectives du patient à chacun d'une pluralité de médicaments ou de traitements médicaux ;
un moteur de recherche (70) qui reçoit une entrée indiquant un médicament ou un traitement médical à administrer au patient et parcourt la base de données pour rechercher les graphiques des patients auxquels ce médicament ou ce traitement médical a été administré ;

les moyens destinés à générer un affichage de la plage de prévision comprenant :

un générateur d'affichage de plage de prévision (64) qui reçoit au moins une partie des graphiques extraits et génère des instructions pour l'affichage de la plage de prévision ;
un processeur graphique (50) qui transforme les instructions provenant du générateur d'affichage de plage de prévision (64) en signaux de commande appropriés pour le moniteur électronique (10, 10', 10").

9. Appareil selon la revendication 8, dans lequel le générateur d'affichage de plage de prévision (64) comprend :

une routine ou un algorithme pour déterminer une valeur moyenne ou médiane de l'état physiologique détecté en fonction du temps à partir des graphiques de patients extraits ;
une routine ou un algorithme pour calculer une plage ou un écart en fonction du temps de l'état détecté à partir des graphiques extraits.

10. Appareil selon la revendication 8 ou 9, dans lequel l'affichage de la plage de prévision (64) comprend en outre :

une routine ou un algorithme (20) qui détermine au moins une probabilité de succès à partir des graphiques de patients extraits.

11. Appareil selon l'une quelconque des revendications 6 à 10, comprenant en outre :

un processeur graphique (50) pour commander l'affichage électronique, ledit processeur graphique étant apte à être relié à au moins un capteur (52) pour détecter l'état physiologique et transformer l'état physiologique détecté en un graphe de l'amplitude de l'état physiologique en fonction du temps ;
un générateur de plages normales ou anormales (54) pour générer des instructions destinées au processeur graphique concernant une plage normale de l'état physiologique détecté et au moins une plage anormale, le processeur graphique affectant un code couleur à un arrière-plan du graphique (12, 12') indiquant la plage normale (20, 20a, 20b) dans une première couleur et la plage anormale (22, 22a, 22b, 22c ; 24, 24a, 24b) dans une seconde couleur.

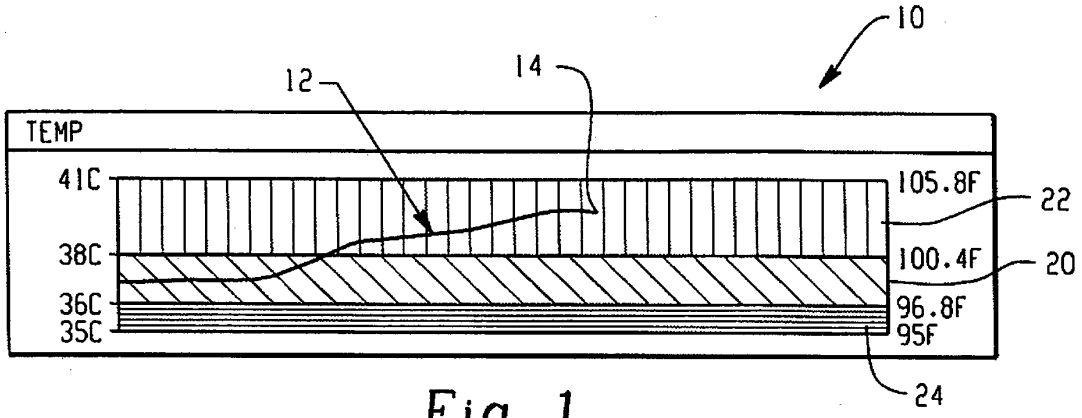


Fig. 1

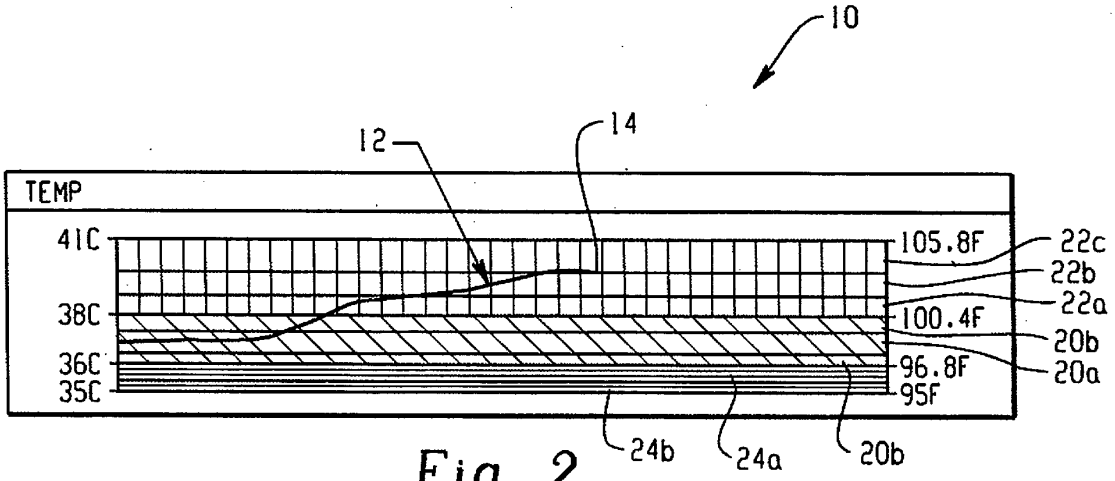
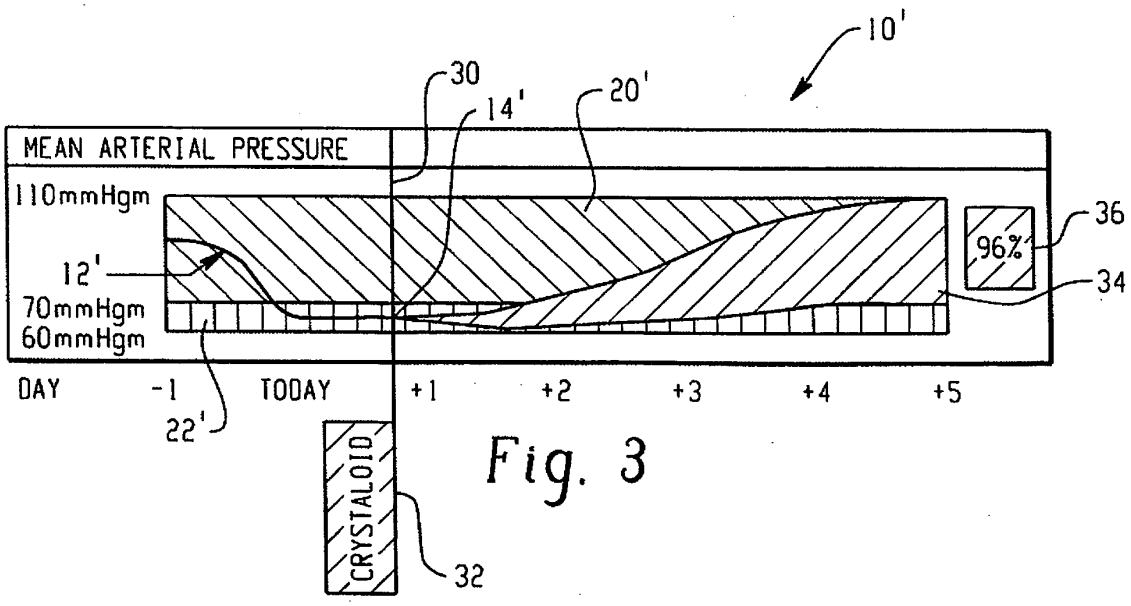


Fig. 2



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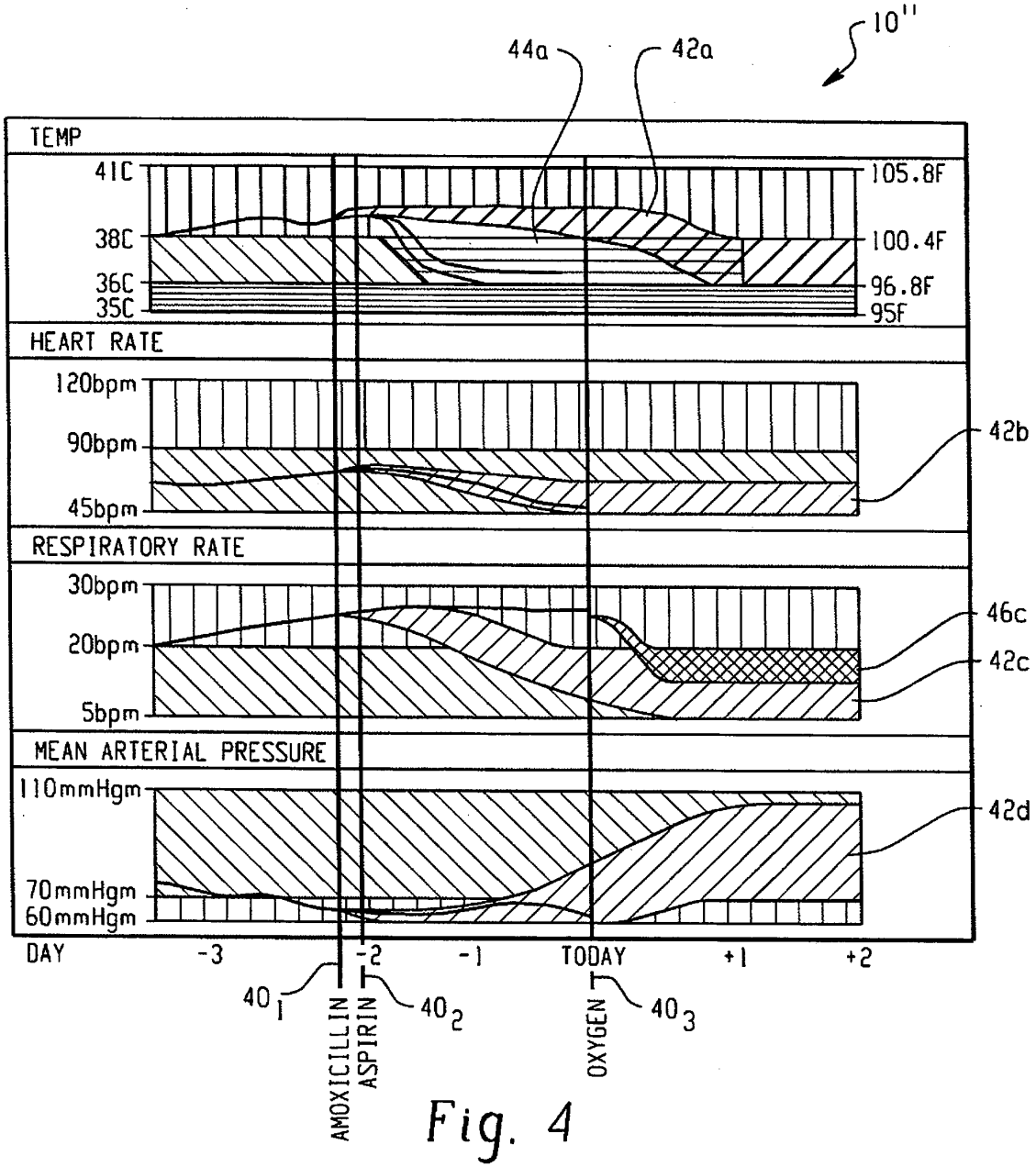
10''
44a
42a
TEMP
41C
38C
36C
35C
105.8F
100.4F
96.8F
95F
HEART RATE
120bpm
90bpm
45bpm
42b
RESPIRATORY RATE
30bpm
20bpm
5bpm
46c
42c
MEAN ARTERIAL PRESSURE
110mmHgm
70mmHgm
60mmHgm
42d
DAY
-3
-2
-1
TODAY
+1
+2
40 1
40 2
40 3
AMOXICILLIN
ASPIRIN
OXYGEN

Fig. 4

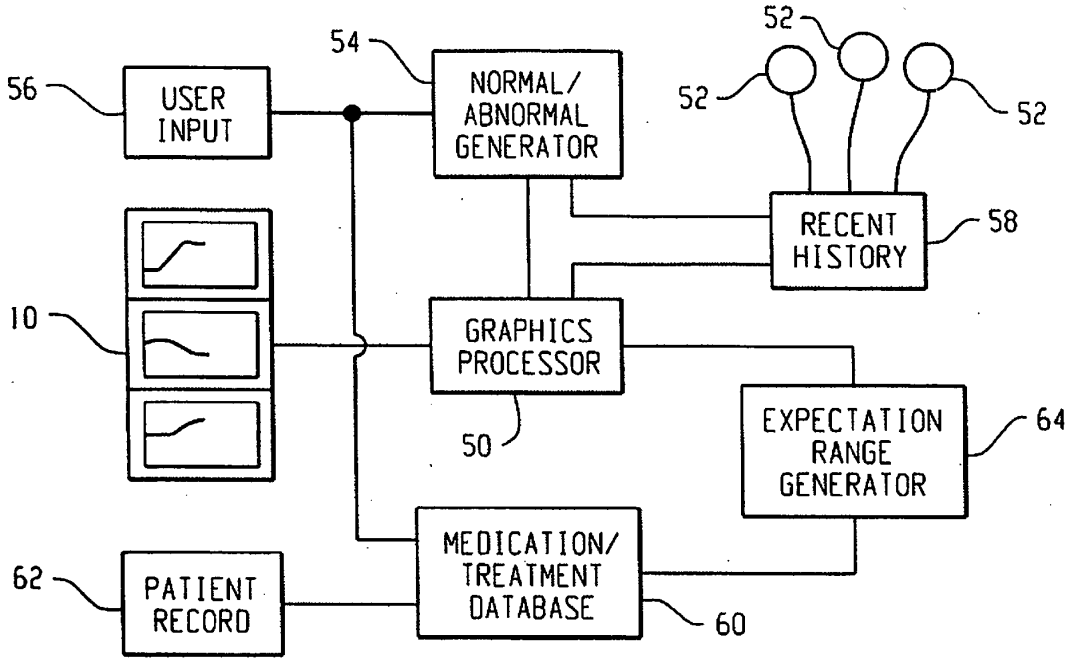
52
54
56
USER INPUT
NORMAL/ ABNORMAL GENERATOR
52
52
RECENT HISTORY
58
10
GRAPHICS PROCESSOR
50
EXPECTATION RANGE GENERATOR
64
MEDICATION/ TREATMENT DATABASE
62
PATIENT RECORD
60

Fig. 5

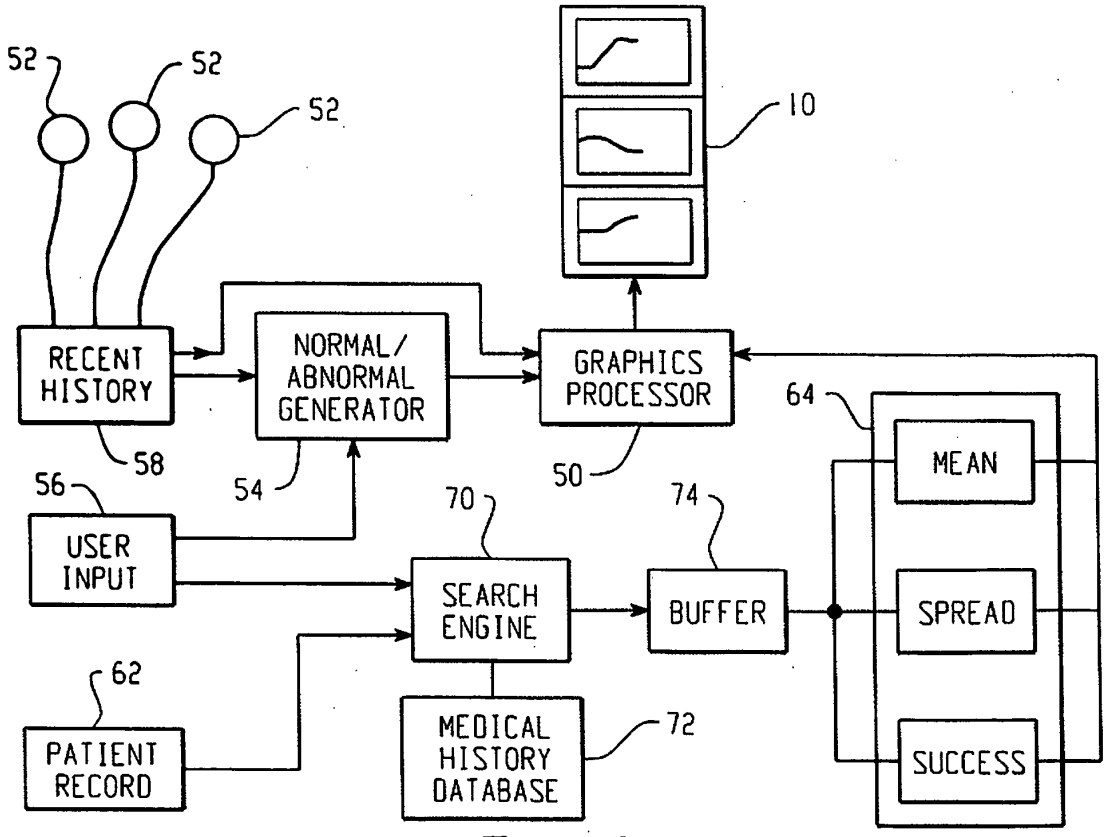
52
52
52
10
RECENT HISTORY
NORMAL/ ABNORMAL GENERATOR
GRAPHICS PROCESSOR
64
MEAN
58
54
50
56
USER INPUT
70
74
SEARCH ENGINE
BUFFER
SPREAD
62
PATIENT RECORD
MEDICAL HISTORY DATABASE
72
SUCCESS

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2005057175 A **[0008]**

专利名称(译)	通过缓解显示趋势和预期趋势		
公开(公告)号	EP2028999B1	公开(公告)日	2010-01-13
申请号	EP2007761623	申请日	2007-05-01
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
当前申请(专利权)人(译)	皇家飞利浦电子N.V.		
[标]发明人	LORD WILLIAM P ZHU XINXIN		
发明人	LORD, WILLIAM, P. ZHU, XINXIN		
IPC分类号	A61B5/00		
CPC分类号	A61B5/00 A61B5/01 A61B5/02 A61B5/021 A61B5/024 A61B5/08 A61B5/743 A61B5/7445		
优先权	60/803512 2006-05-31 US		
其他公开文献	EP2028999A2		
外部链接	Espacenet		

摘要(译)

电子显示器（10“）包括表示感测的生理状况与时间的大小的图表。图形背后的背景是描绘的颜色编码，例如描绘生理条件和一个或多个异常范围的正常范围。这为临床医生提供了图的含义的即时颜色编码反馈。当临床医生选择药物或治疗时，搜索数据库以产生期望范围（42a，42b，42c，42d，44a，46c），其描绘在施用药物或治疗之后预期感测的生理状况如何移动。这使得临床医生能够比较治疗，并且在选择治疗之后，接收关于所感测的生理状况是否如治疗预期的那样响应的易于解释的反馈。

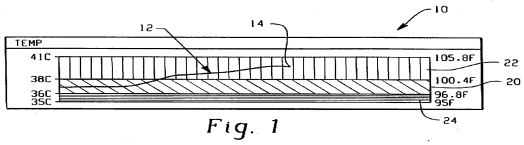

Fig. 1

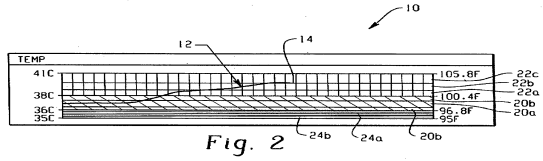

Fig. 2

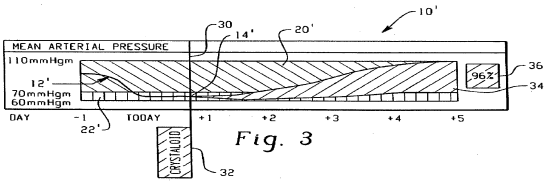

Fig. 3