US008292807B2

(12) **United States Patent**
Perkins et al.

(10) **Patent No.: US 8,292,807 B2**
(45) **Date of Patent: Oct. 23, 2012**

(54) **MOBILE MEDICAL WORKSTATION**

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(73) Assignee: **Welch Allyn, Inc.**, Skaneateles Falls, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/873,765**

(22) Filed: **Sep. 1, 2010**

(65) **Prior Publication Data**

US 2010/0324380 A1 Dec. 23, 2010

Related U.S. Application Data

(60) Division of application No. 11/131,015, filed on May 17, 2005, now abandoned, which is a continuation-in-part of application No. 10/643,487, filed on Aug. 19, 2003, now abandoned.

(60) Provisional application No. 60/404,601, filed on Aug. 20, 2002, provisional application No. 60/601,450, filed on Aug. 13, 2004, provisional application No. 60/658,626, filed on Mar. 4, 2005.

(51) **Int. Cl.**

A61B 5/00	(2006.01)
A61B 5/05	(2006.01)
G09G 1/14	(2006.01)
G08B 5/22	(2006.01)
G08B 23/00	(2006.01)

(52) **U.S. Cl.** **600/301**; 600/365; 345/26; 340/286.07; 340/573.1

(58) **Field of Classification Search** .... None
See application file for complete search history.

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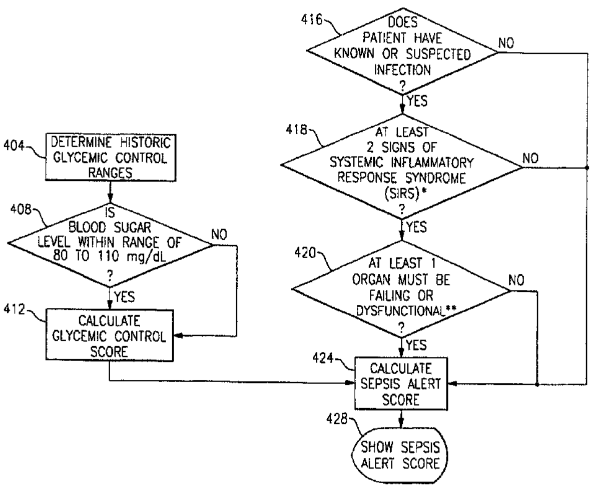
Primary Examiner — Henry M Johnson, III
Assistant Examiner — Shirley Jian

(57) **ABSTRACT**

A medical workstation is defined by a supporting structure having at least one medical diagnostic instrument disposed thereupon. A first display is further disposed on a first side of the supporting structure and a second display is disposed on a second side of the supporting structure in a manner substantially opposite from the first display. Each of the first and second displays are interconnected to the at least one medical diagnostic instrument to permit at least one of the displays in order to display diagnostic results and are tandemly or independently controllable.

7 Claims, 24 Drawing Sheets



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2006/0276695	A9 *	12/2006	Lynn et al.	600/300

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WO	WO-2004/017831	A1	3/2004

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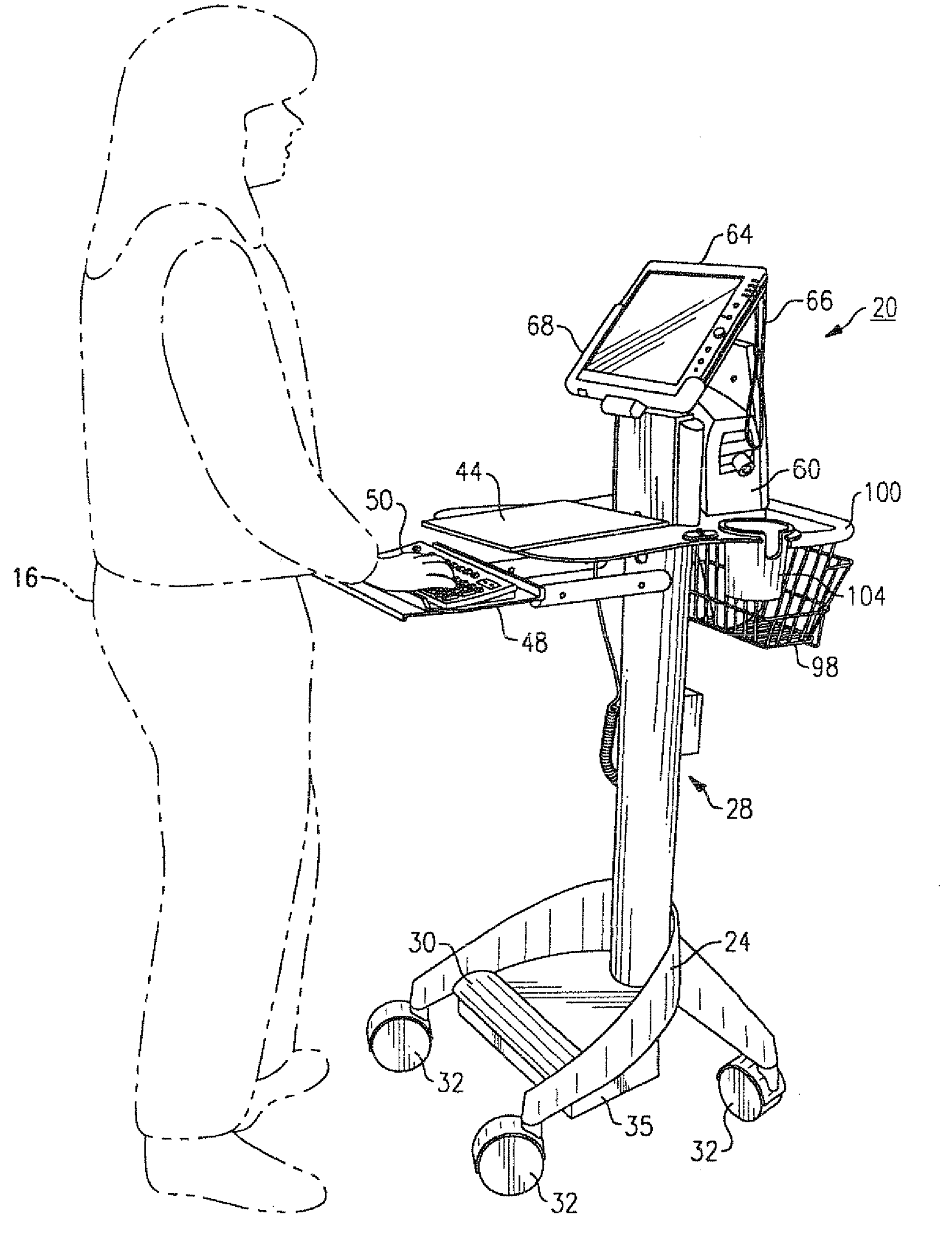


FIG.1

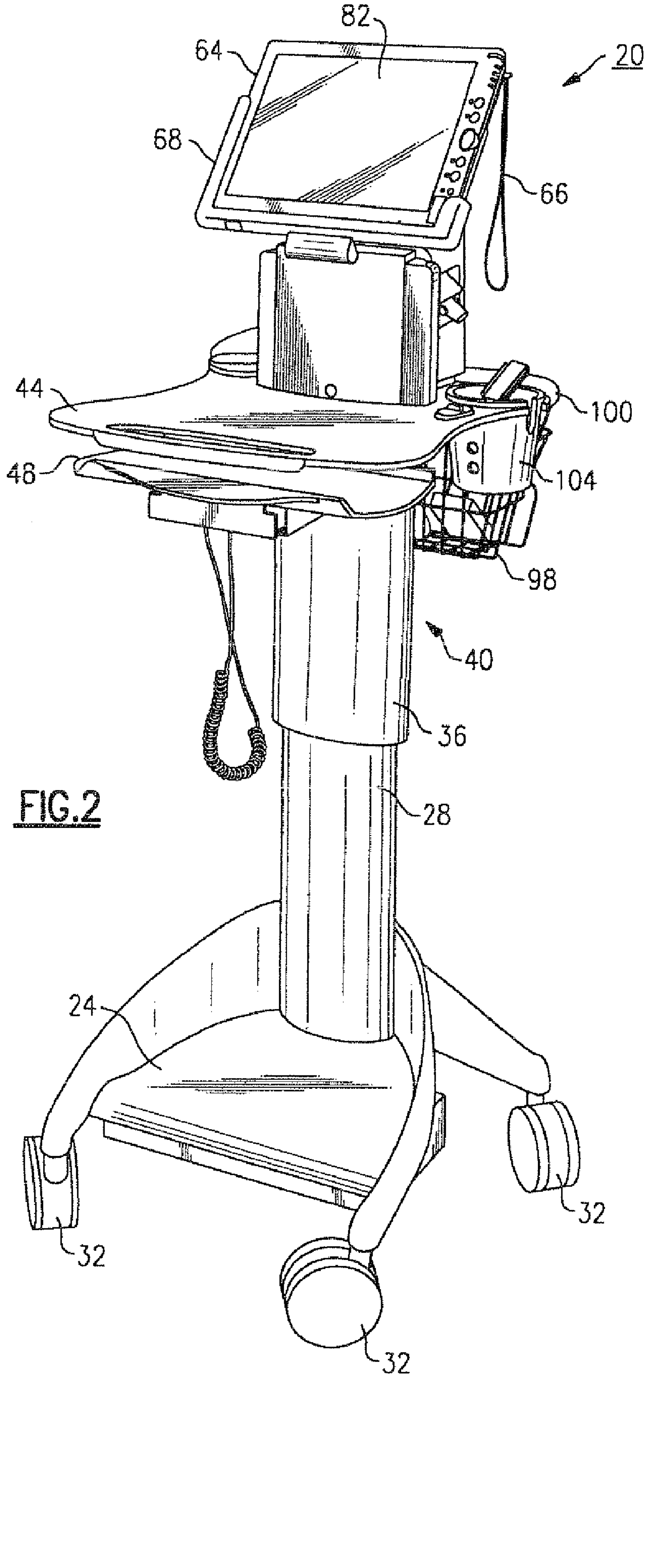


FIG.2

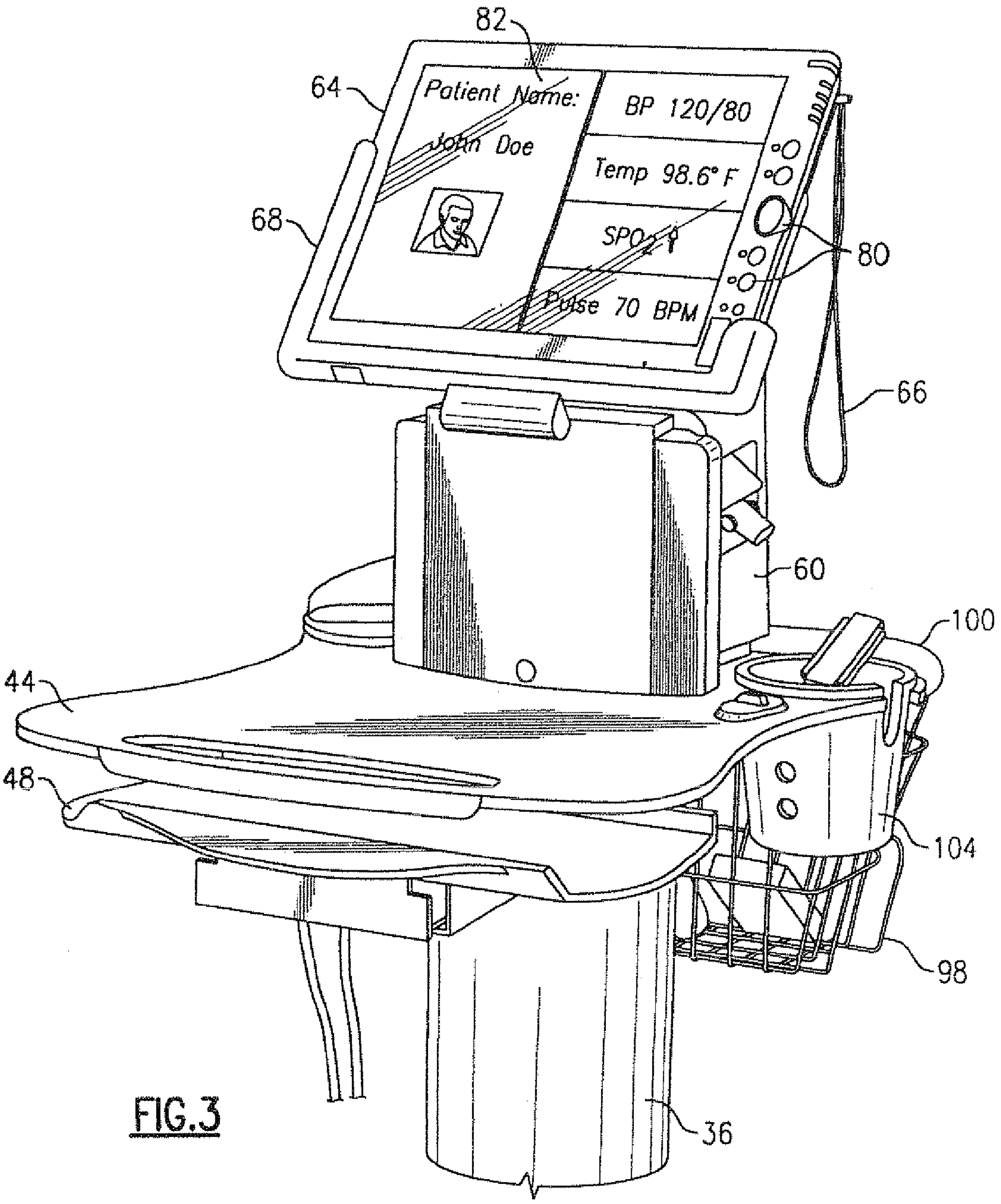

82
64
68
Patient Name:
John Doe
BP 120/80
Temp 98.6° F
SPO2
Pulse 70 BPM
80
66
60
100
44
48
104
98
36

FIG.3

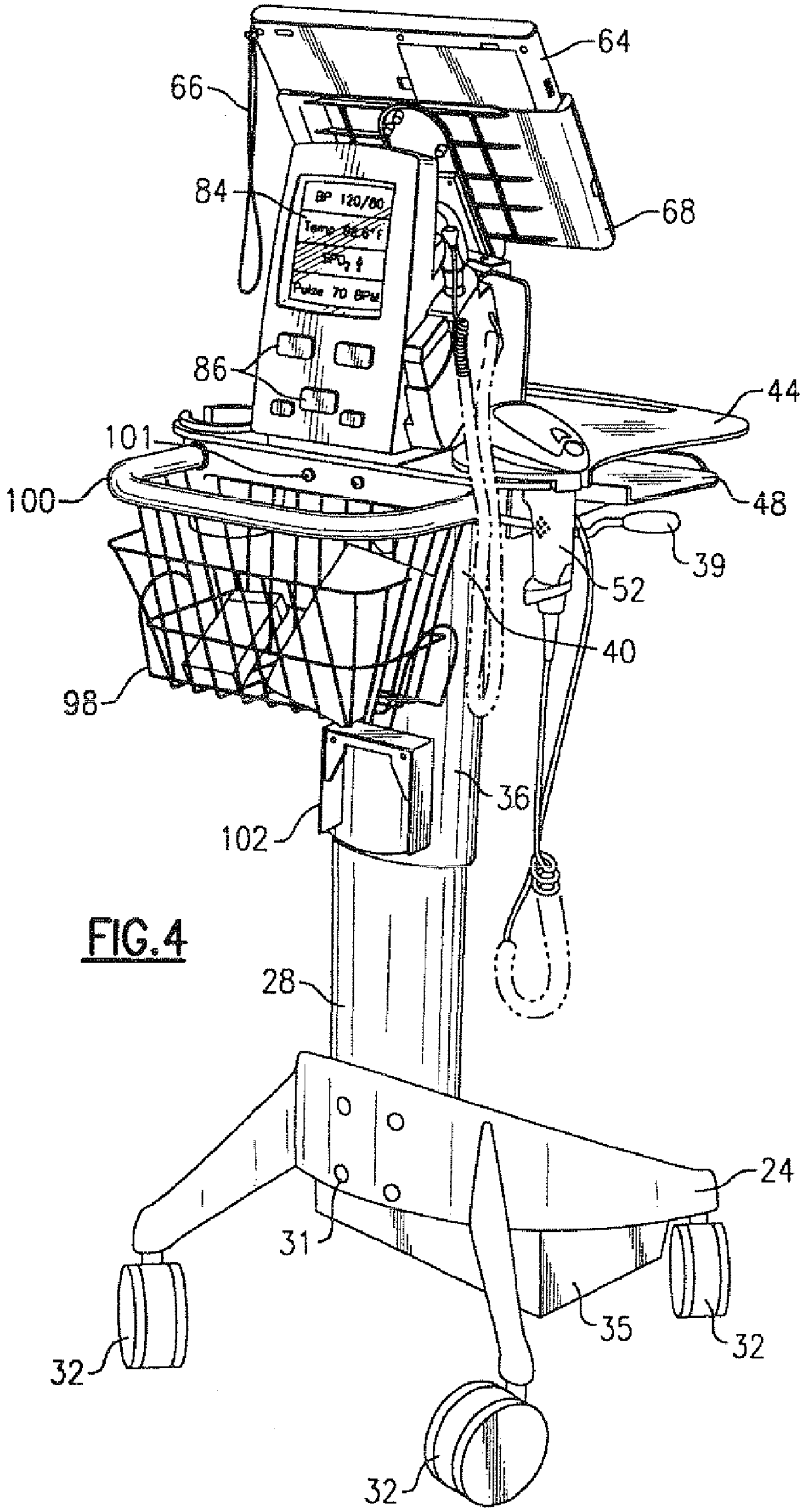

64
66
84
68
BP 120/80
Temp 98.6°F
SPO2
Pulse 70 BPM
86
44
101
100
48
39
52
40
98
36
102
28
24
31
35
32
32
32

FIG.4

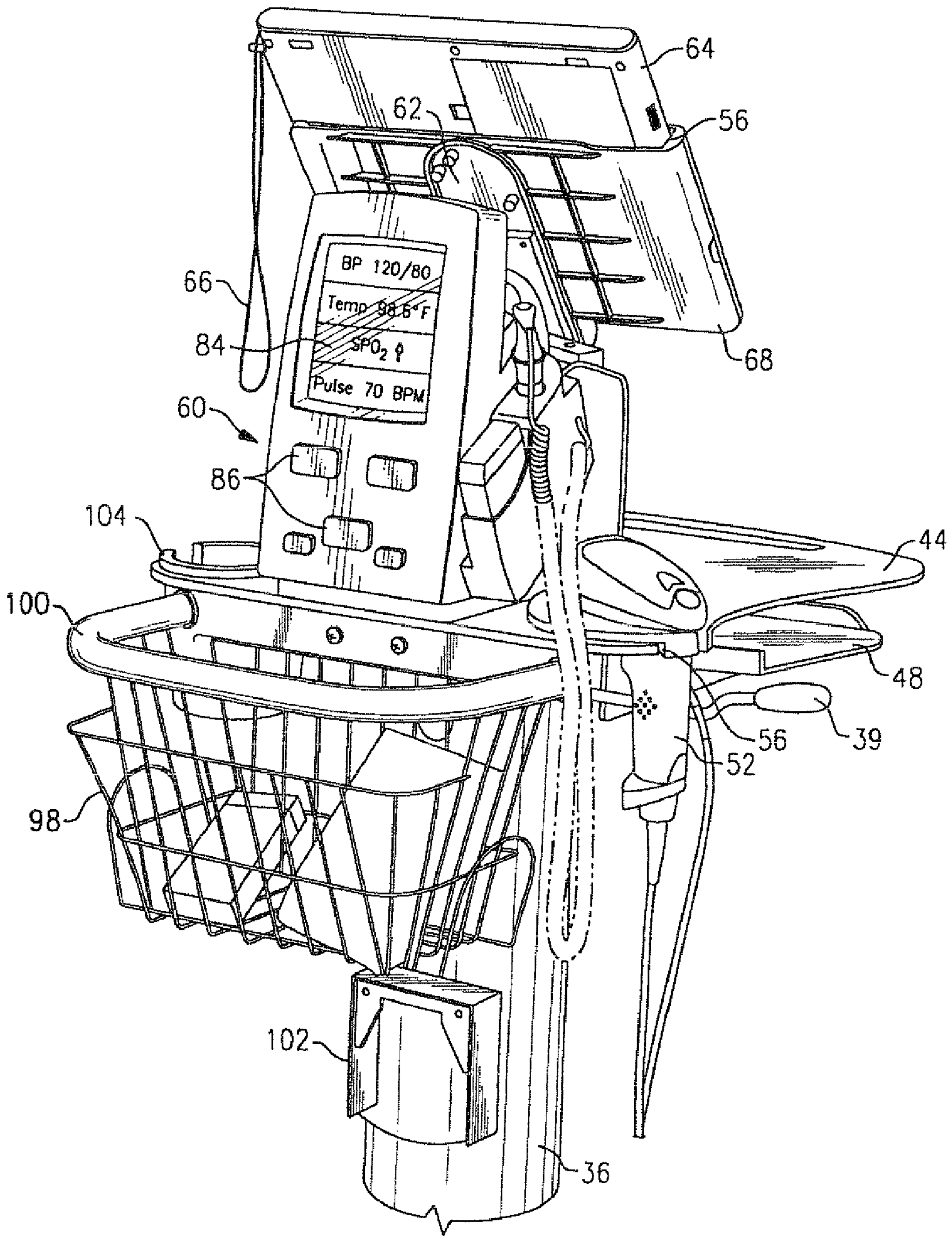

64
56
62
66
84
68
60
86
104
44
100
48
56
39
52
98
102
36
BP 120/80
Temp 98.6°F
SPO2
Pulse 70 BPM

FIG.5

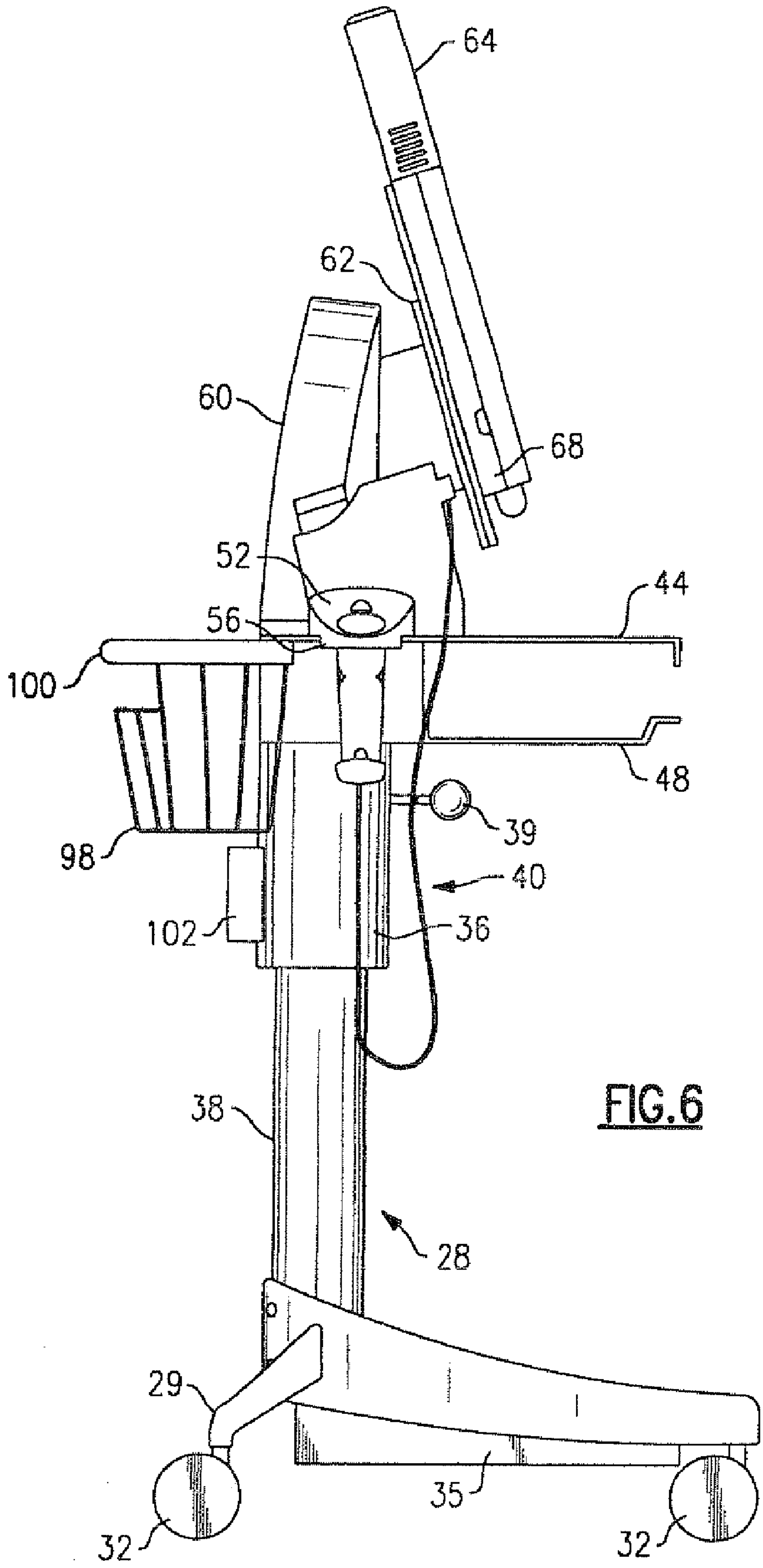


FIG.6

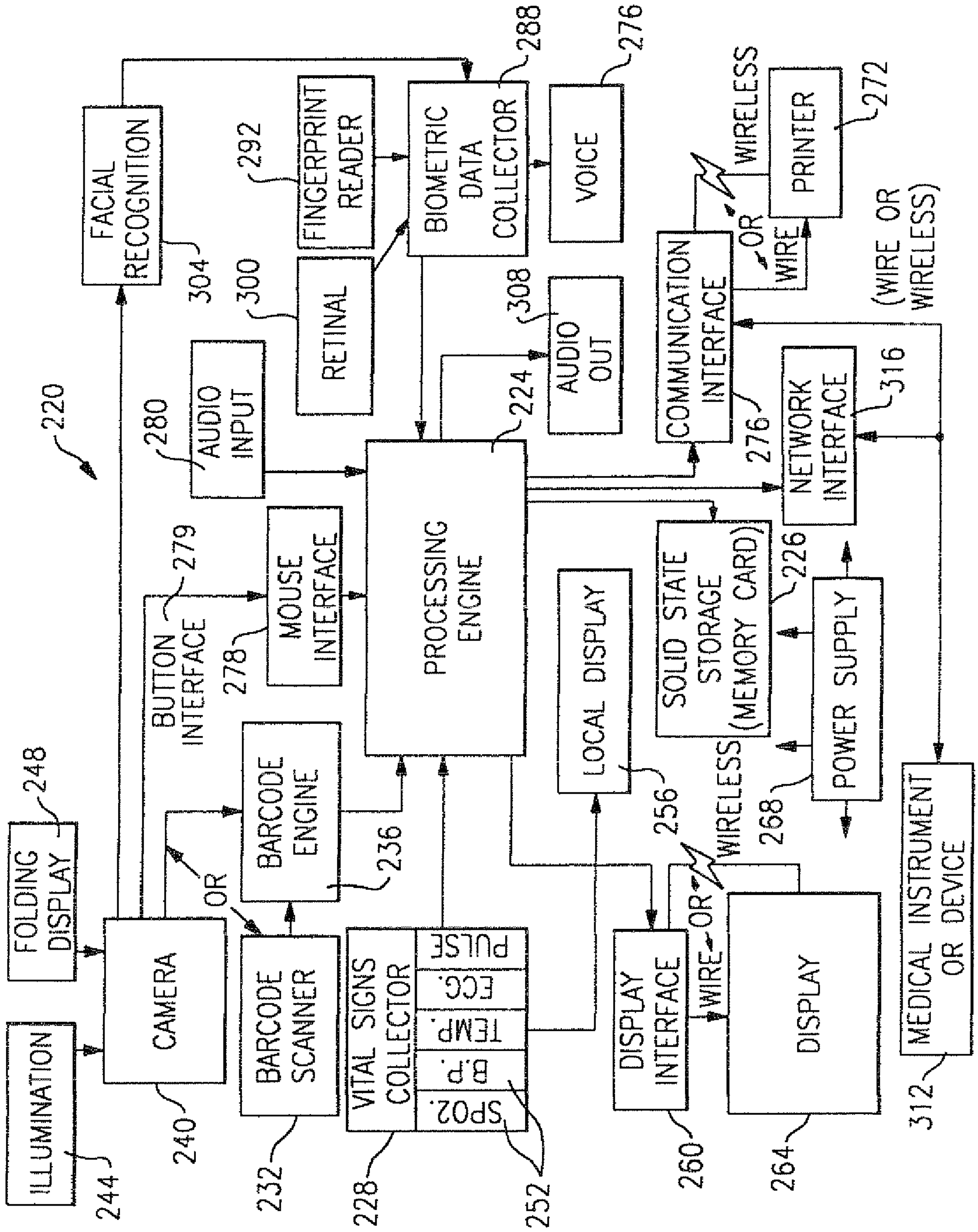
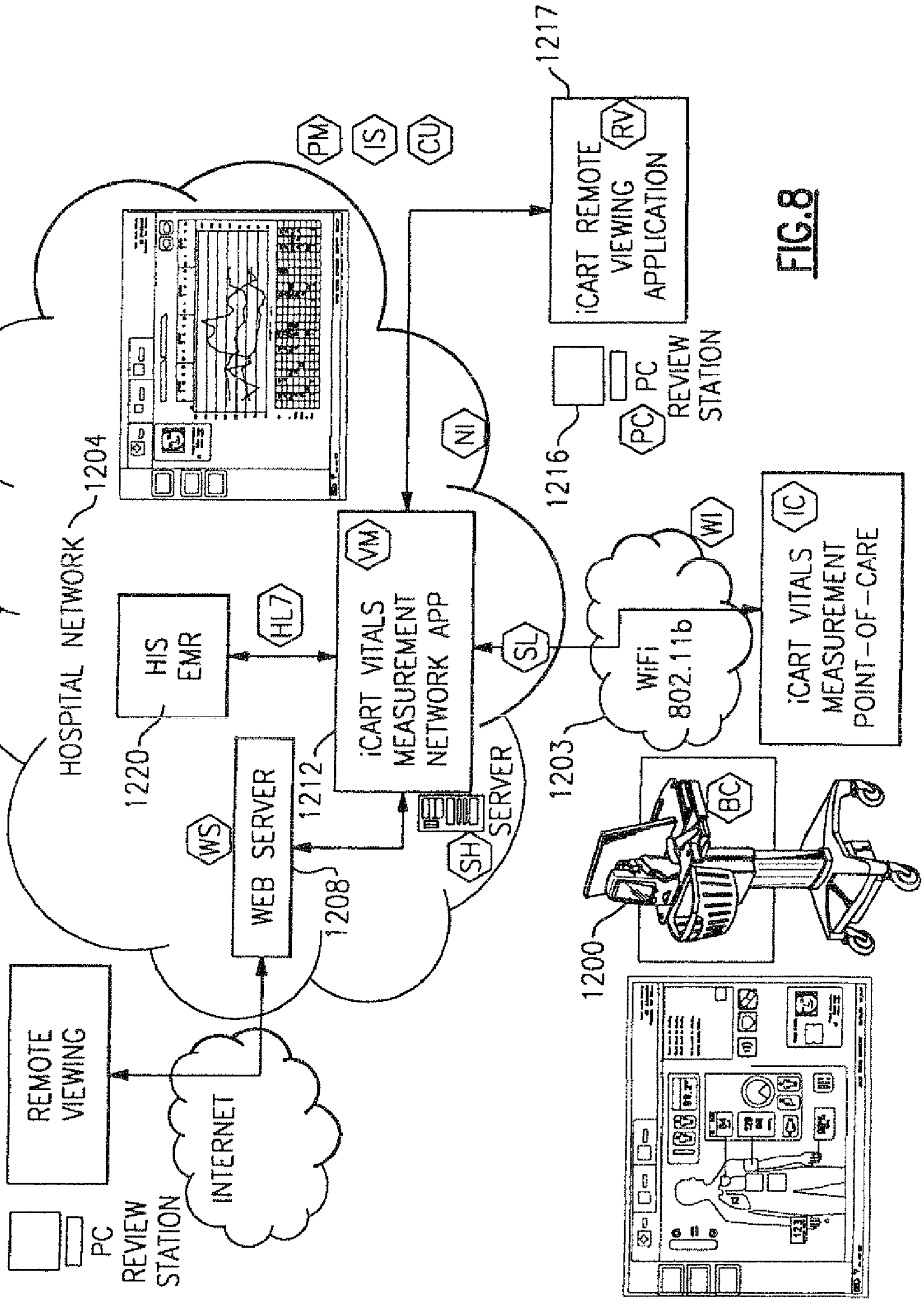
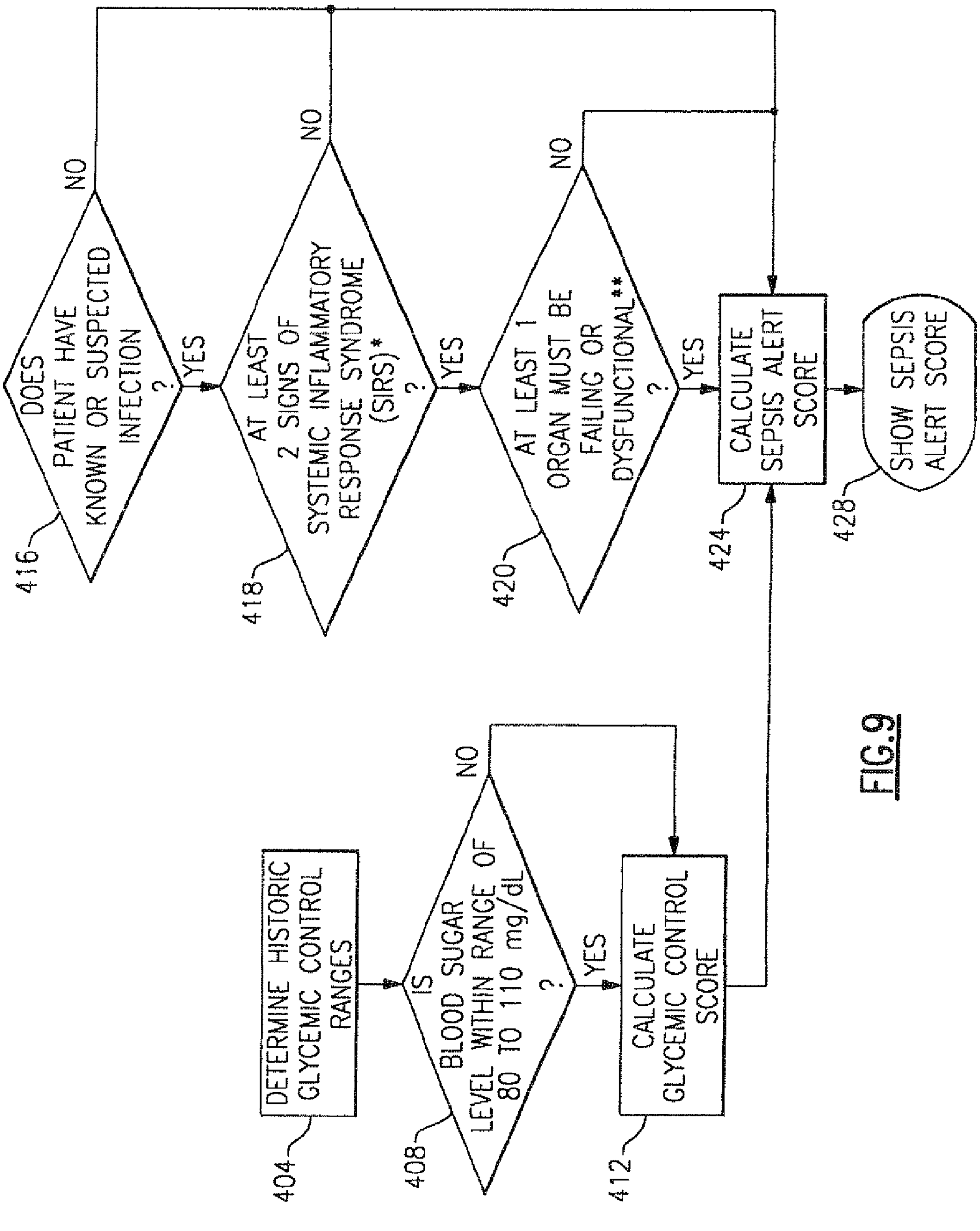

220
ILLUMINATION
244
FOLDING DISPLAY
248
CAMERA
240
FACIAL RECOGNITION
304
BARCODE SCANNER
232
OR
BARCODE ENGINE
236
BUTTON INTERFACE
279
MOUSE INTERFACE
278
AUDIO INPUT
280
RETINAL
300
FINGERPRINT READER
292
BIOMETRIC DATA COLLECTOR
288
VITAL SIGNS COLLECTOR
228
SPO2.
B.P.
TEMP.
ECG.
PULSE
252
PROCESSING ENGINE
224
VOICE
276
AUDIO OUT
308
LOCAL DISPLAY
256
DISPLAY INTERFACE
260
WIRE
OR
WIRELESS
DISPLAY
264
SOLID STATE STORAGE (MEMORY CARD)
226
COMMUNICATION INTERFACE
276
WIRELESS
OR
WIRE
PRINTER
272
NETWORK INTERFACE
316
POWER SUPPLY
268
(WIRE OR WIRELESS)
MEDICAL INSTRUMENT OR DEVICE
312

FIG.7



HOSPITAL NETWORK
1204
1220
HIS
EMR
HL7
iCART VITALS
MEASUREMENT
NETWORK APP
VM
1212
WEB SERVER
WS
1208
SH
SERVER
SL
NI
PM
IS
CU
1217
iCART REMOTE
VIEWING
APPLICATION
RV
1216
PC
PC
REVIEW
STATION
WI
WiFi
802.11b
1203
iCART VITALS
MEASUREMENT
POINT-OF-CARE
IC
BC
1200
REMOTE
VIEWING
INTERNET
PC
REVIEW
STATION

FIG.8



DOES PATIENT HAVE KNOWN OR SUSPECTED INFECTION ?
416
NO
YES
AT LEAST 2 SIGNS OF SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS)* ?
418
NO
YES
AT LEAST 1 ORGAN MUST BE FAILING OR DYSFUNCTIONAL** ?
420
NO
YES
CALCULATE SEPSIS ALERT SCORE
424
SHOW SEPSIS ALERT SCORE
428
DETERMINE HISTORIC GLYCEMIC CONTROL RANGES
404
IS BLOOD SUGAR LEVEL WITHIN RANGE OF 80 TO 110 mg/dL ?
408
NO
YES
CALCULATE GLYCEMIC CONTROL SCORE
412

FIG.9

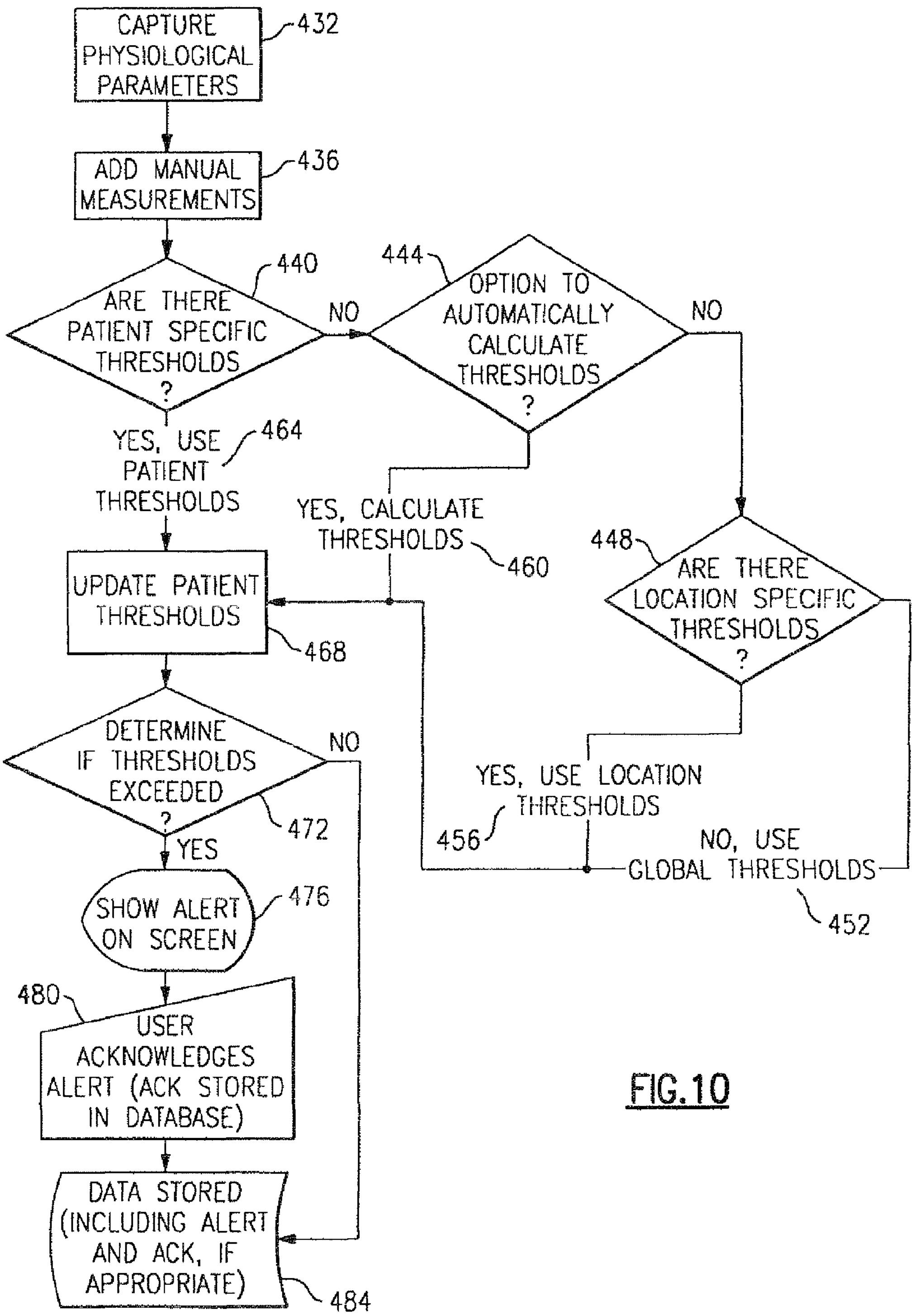

CAPTURE PHYSIOLOGICAL PARAMETERS
432
ADD MANUAL MEASUREMENTS
436
ARE THERE PATIENT SPECIFIC THRESHOLDS ?
440
NO
444
OPTION TO AUTOMATICALLY CALCULATE THRESHOLDS ?
NO
YES, USE PATIENT THRESHOLDS
464
YES, CALCULATE THRESHOLDS
460
448
ARE THERE LOCATION SPECIFIC THRESHOLDS ?
UPDATE PATIENT THRESHOLDS
468
DETERMINE IF THRESHOLDS EXCEEDED ?
NO
472
YES
YES, USE LOCATION THRESHOLDS
456
NO, USE GLOBAL THRESHOLDS
452
SHOW ALERT ON SCREEN
476
480
USER ACKNOWLEDGES ALERT (ACK STORED IN DATABASE)
DATA STORED (INCLUDING ALERT AND ACK, IF APPROPRIATE)
484

FIG.10

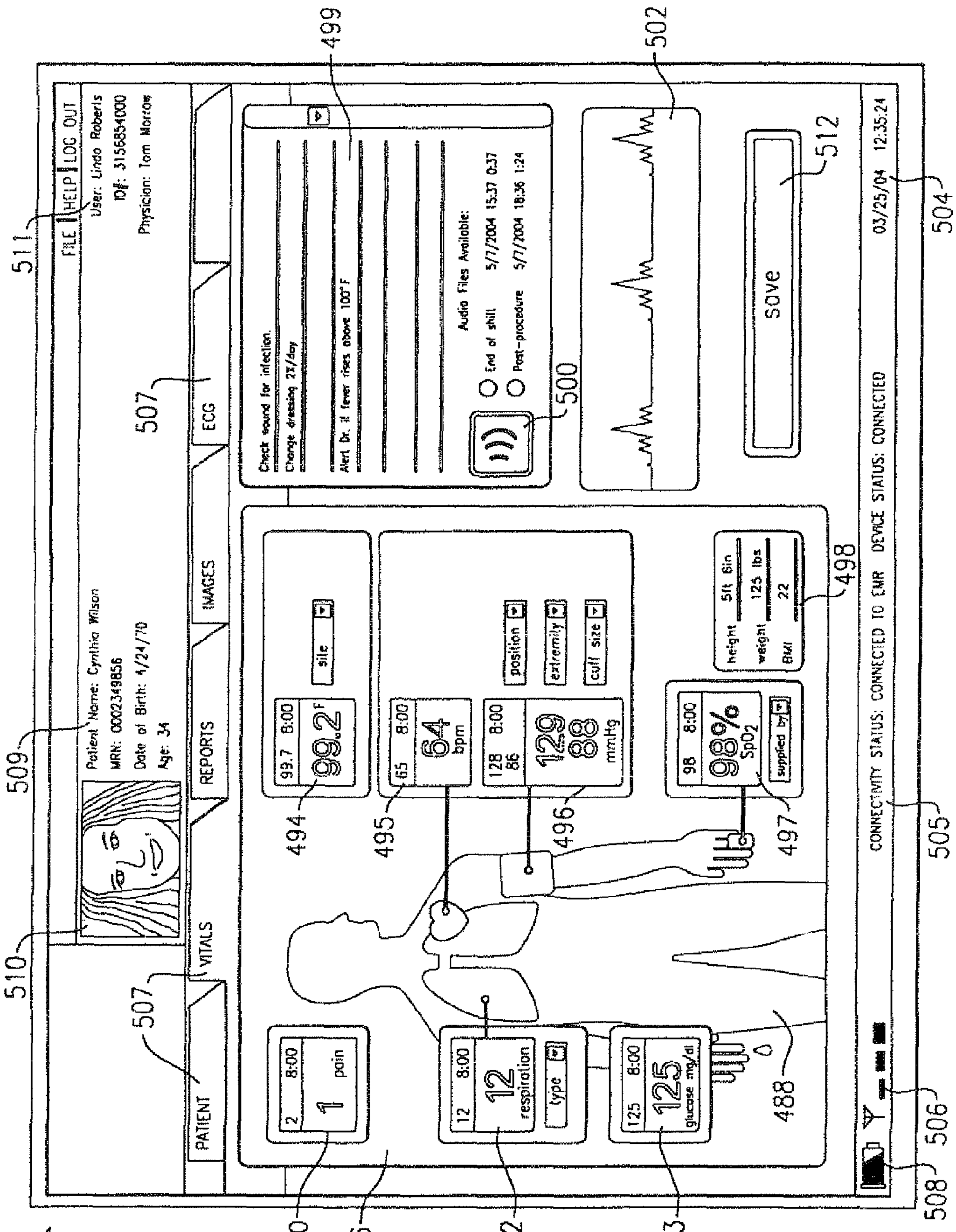

FILE
HELP
LOG OUT
User: Linda Roberts
ID#: 3156854000
Physician: Tom Morrow
Patient Name: Cynthia Wilson
MRN: 0002349856
Date of Birth: 4/24/70
Age: 34
PATIENT
VITALS
REPORTS
IMAGES
ECG
Check wound for infection.
Change dressing 2X/day
Alert Dr. if fever rises above 100°F
Audio Files Available:
End of shift 5/7/2004 15:37 0:37
Post-procedure 5/7/2004 18:36 1:24
save
pain
respiration
type
glucose mg/dl
site
bpm
position
extremity
cuff size
mmHg
SpO2
supplied by
height 5ft 6in
weight 125 lbs
BMI 22
CONNECTIVITY STATUS: CONNECTED TO EMR
DEVICE STATUS: CONNECTED
03/25/04 12:35:24
485
486
488
490
492
493
494
495
496
497
498
499
500
502
504
505
506
507
508
509
510
511
512

FIG.11

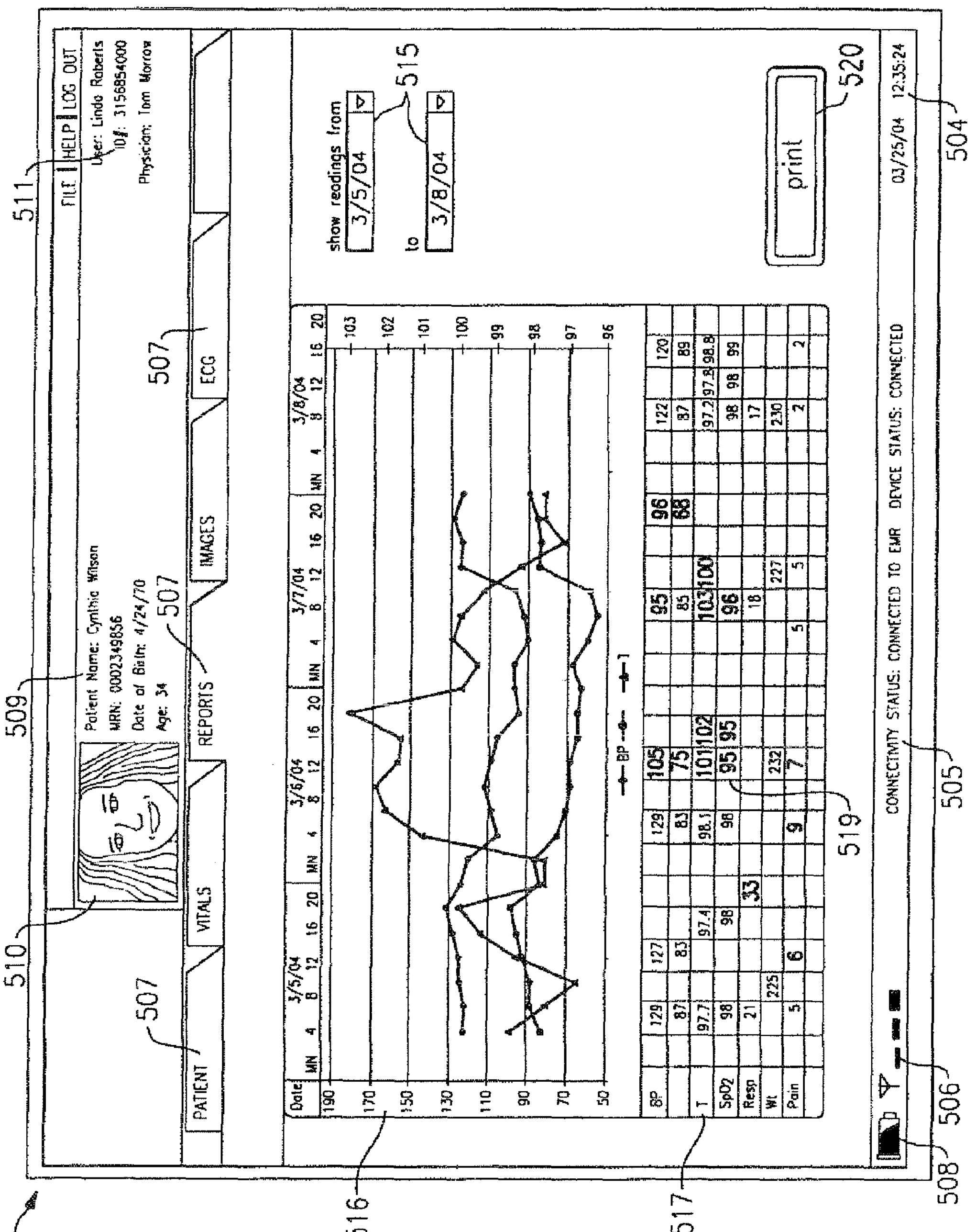

489
FILE HELP LOG OUT
User: Linda Roberts
ID#: 3156854000
Physician: Tom Morrow
Patient Name: Cynthia Wilson
MRN: 0002349856
Date of Birth: 4/24/70
Age: 34
PATIENT
VITALS
REPORTS
IMAGES
ECG
show readings from
3/5/04
to
3/8/04
print
BP
T
SpO2
Resp
Wt
Pain
CONNECTIVITY STATUS: CONNECTED TO EMR DEVICE STATUS: CONNECTED
03/25/04 12:35:24
504
505
506
507
508
509
510
511
515
516
517
519
520

FIG.12

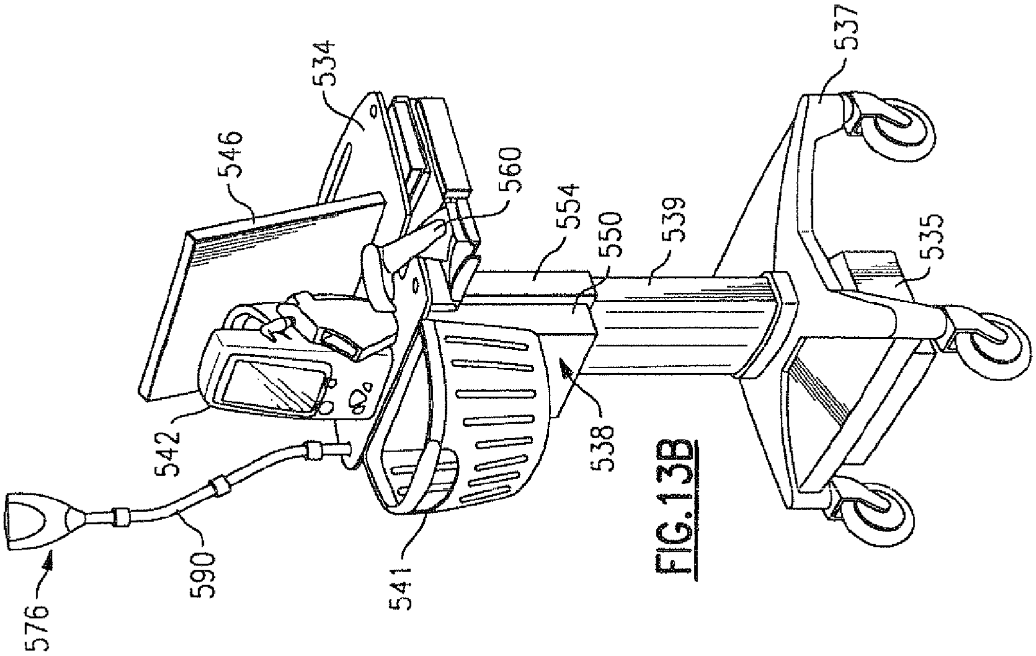


FIG.13B

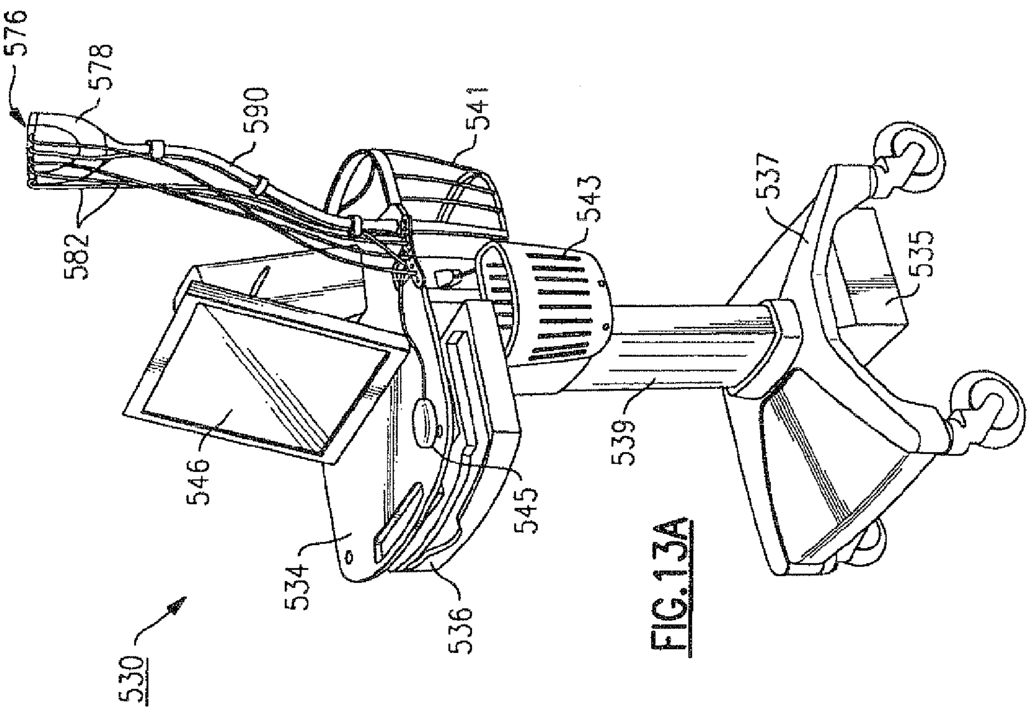


FIG.13A

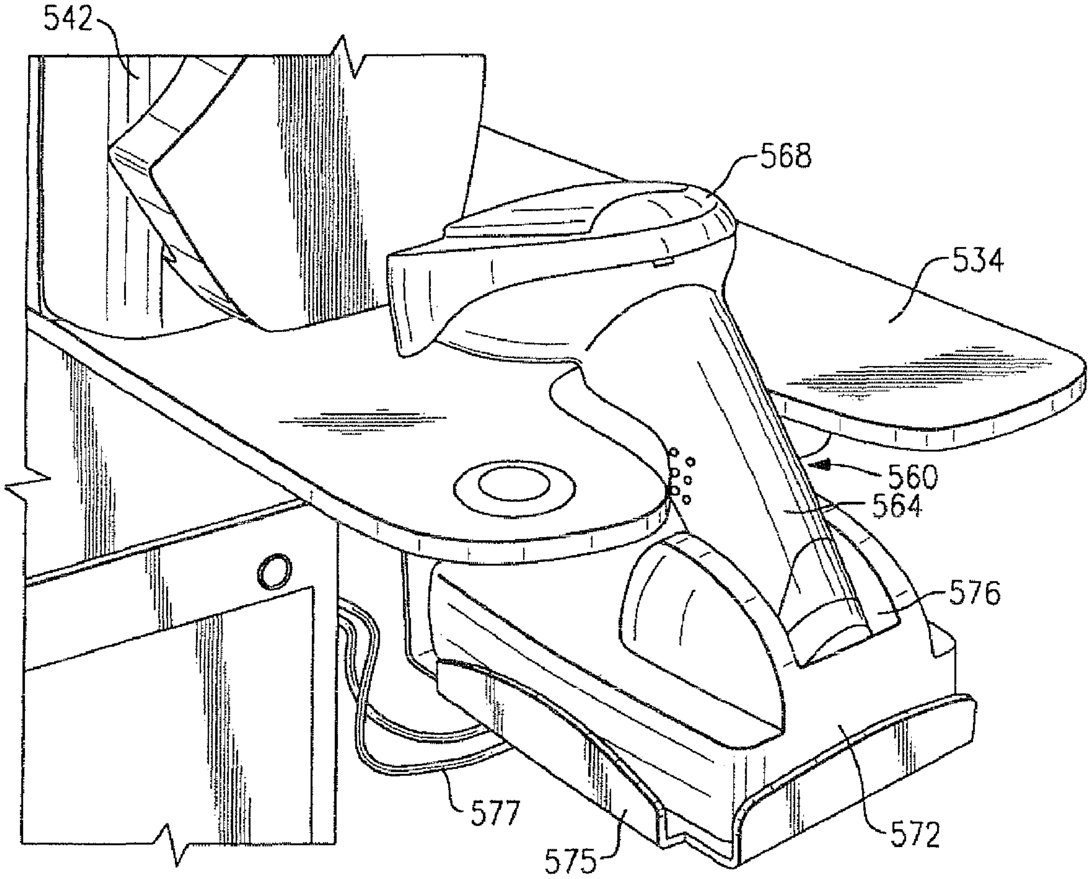


FIG.14

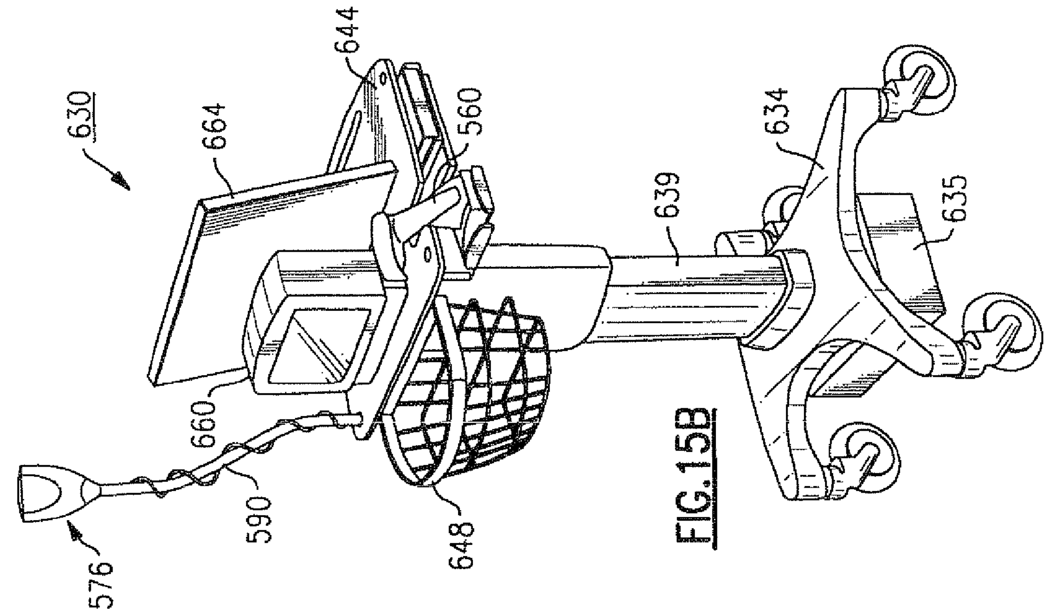


FIG.15B

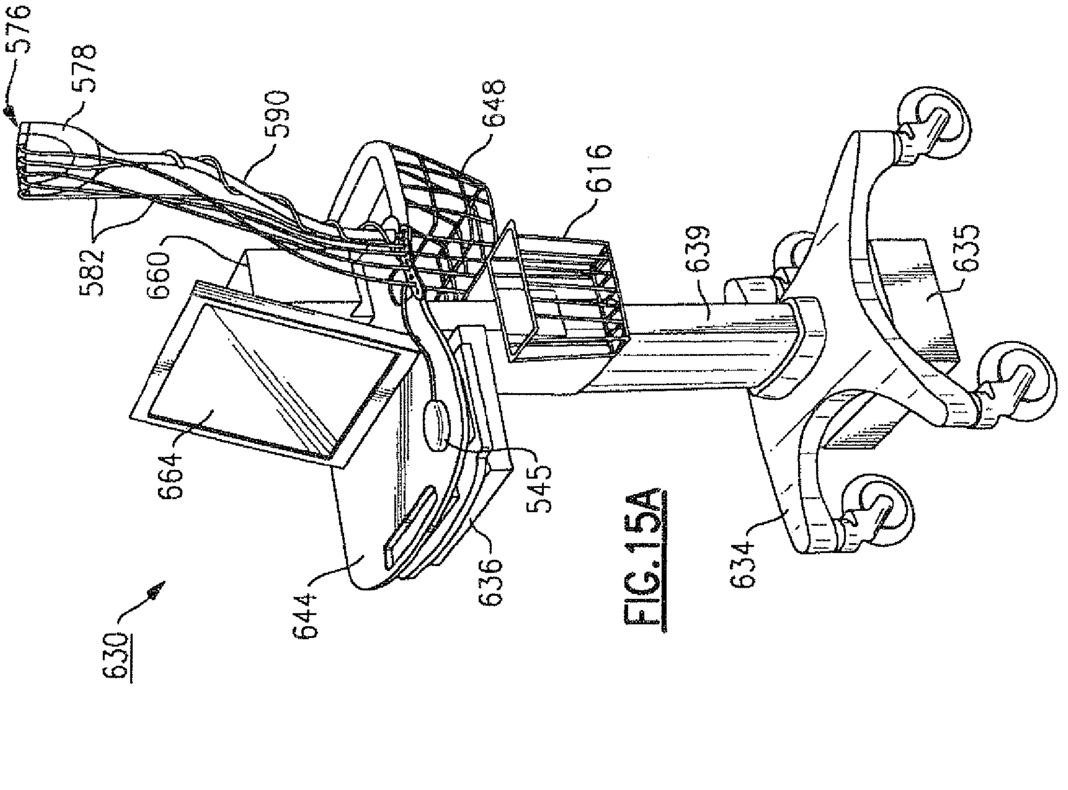


FIG.15A

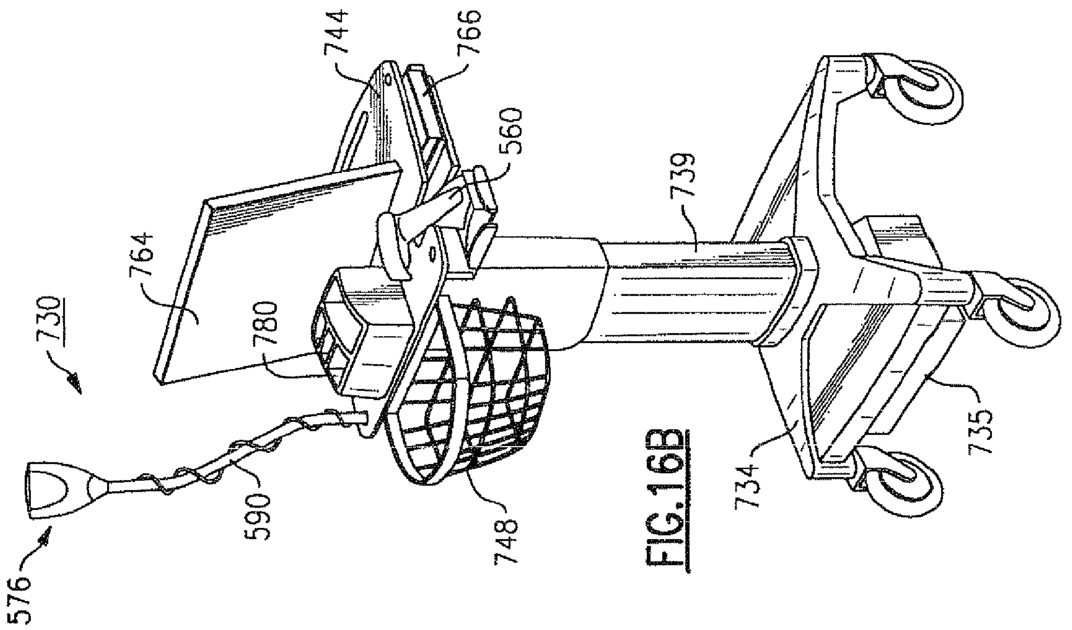


FIG.16B

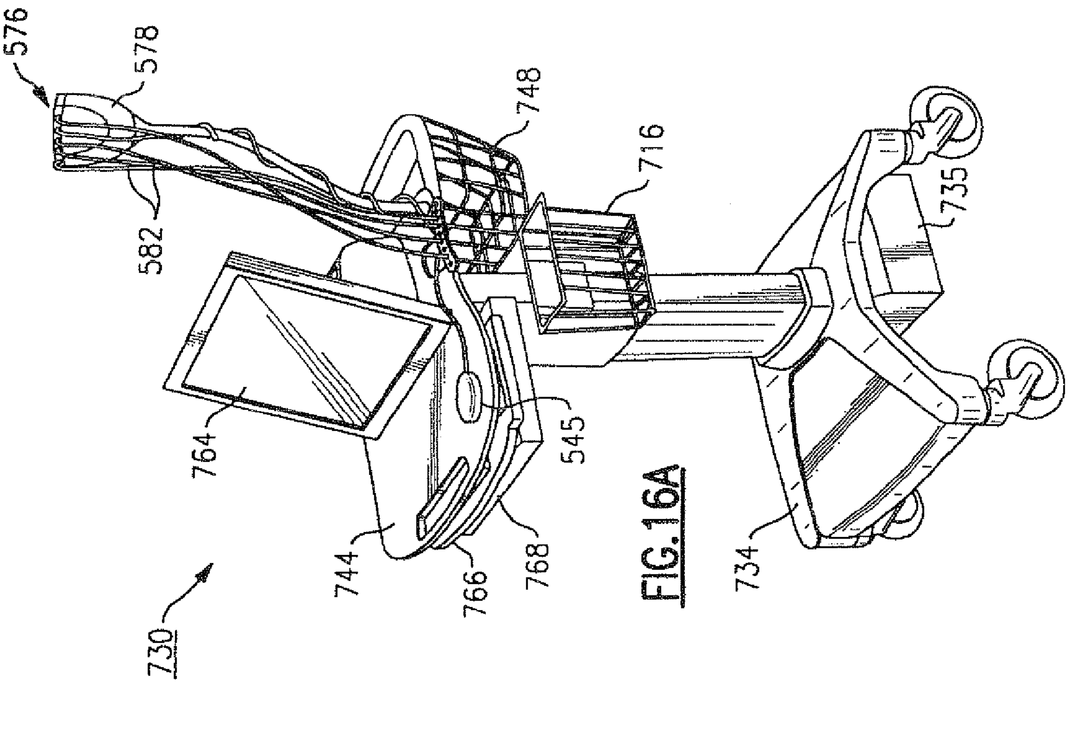


FIG.16A

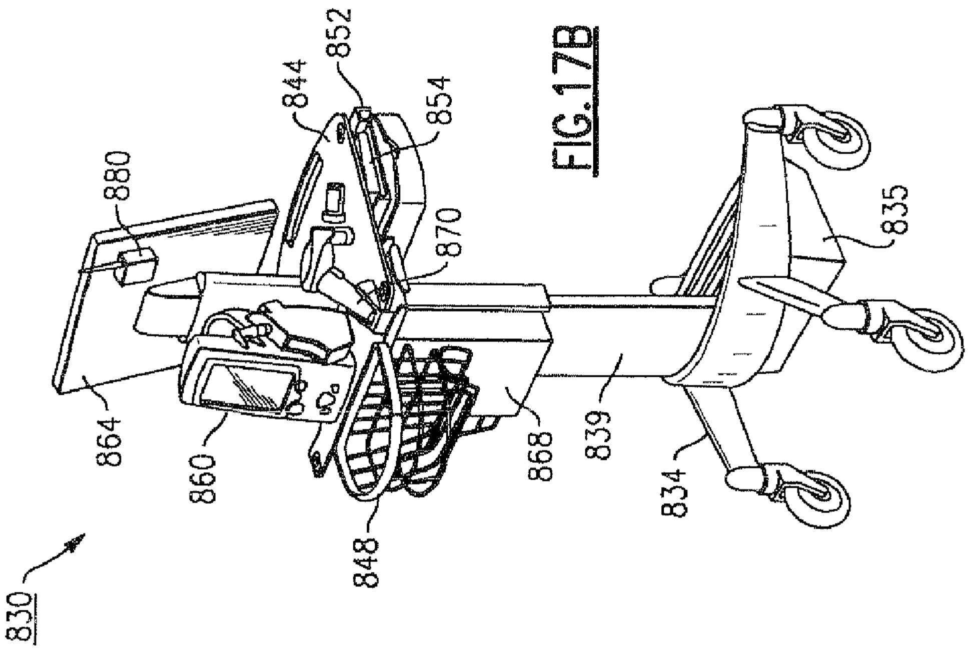


FIG.17B

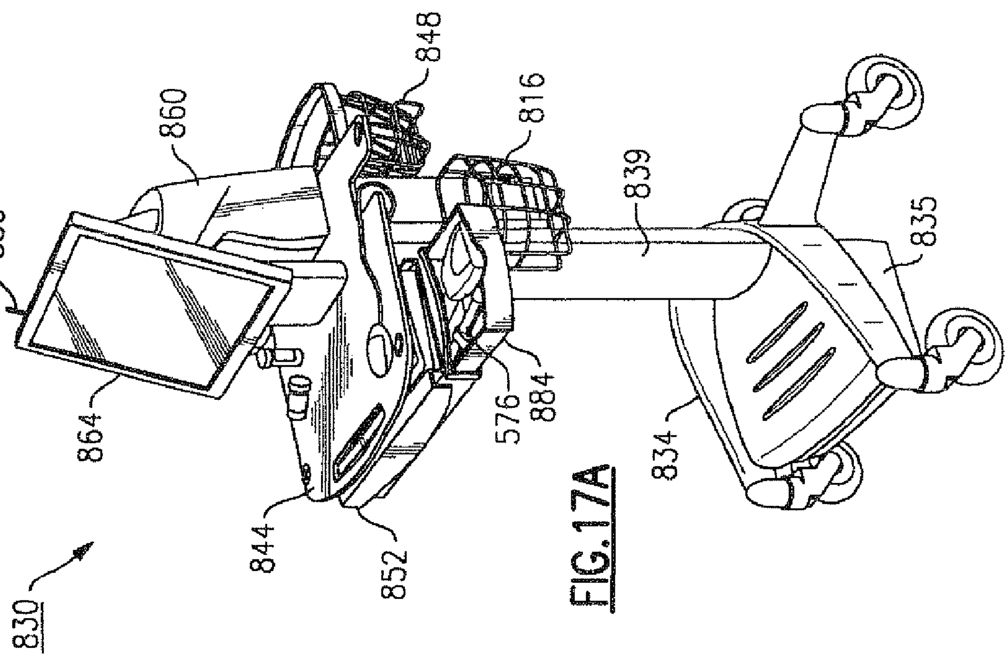


FIG.17A

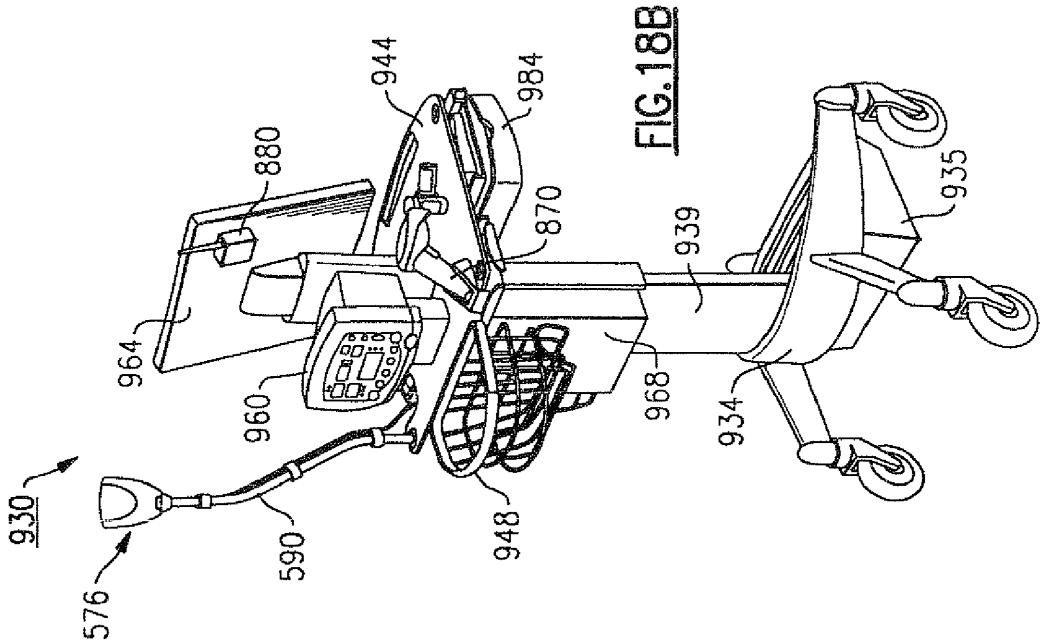


FIG.18B

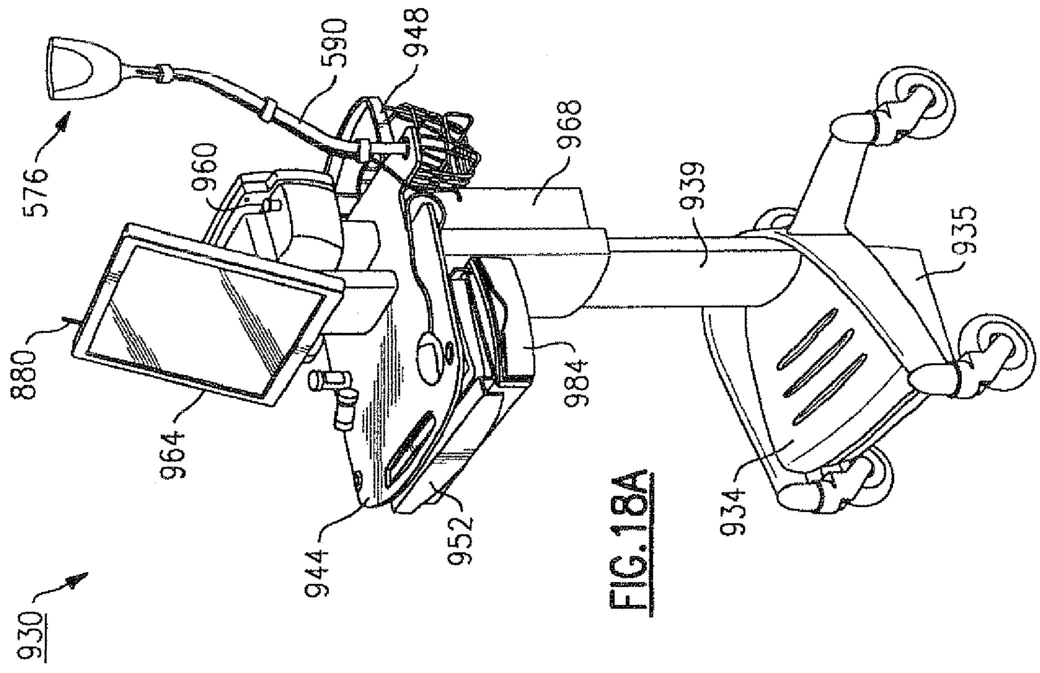


FIG.18A

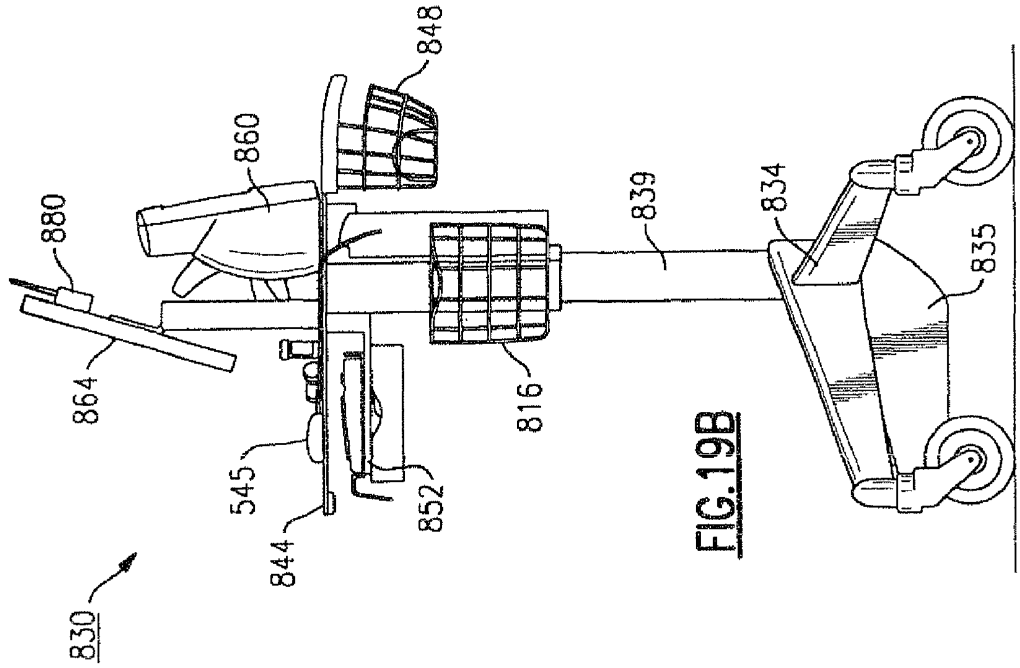


FIG.19B

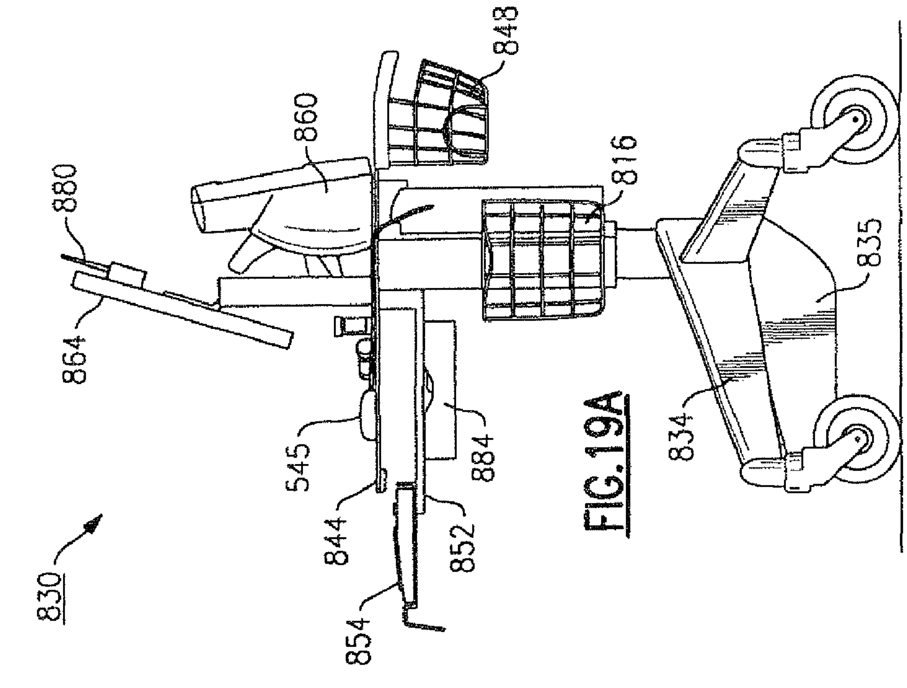


FIG.19A

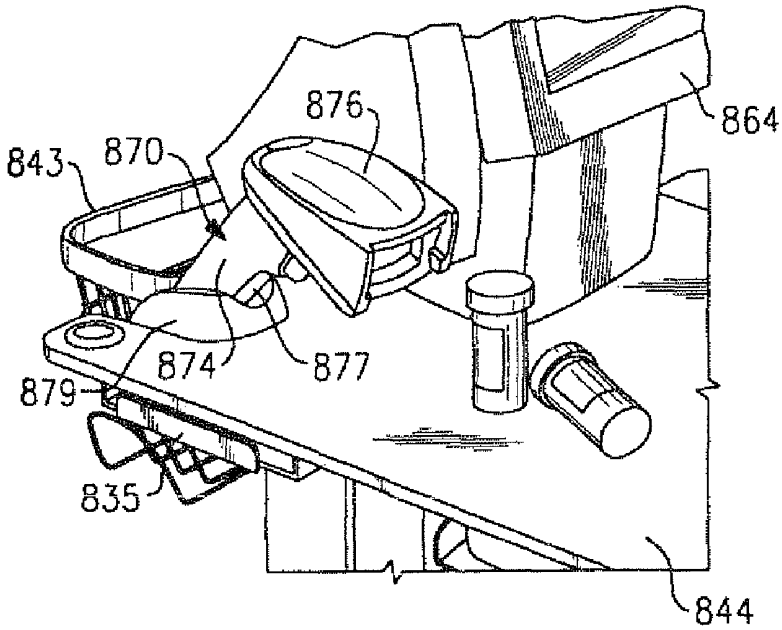


FIG.20

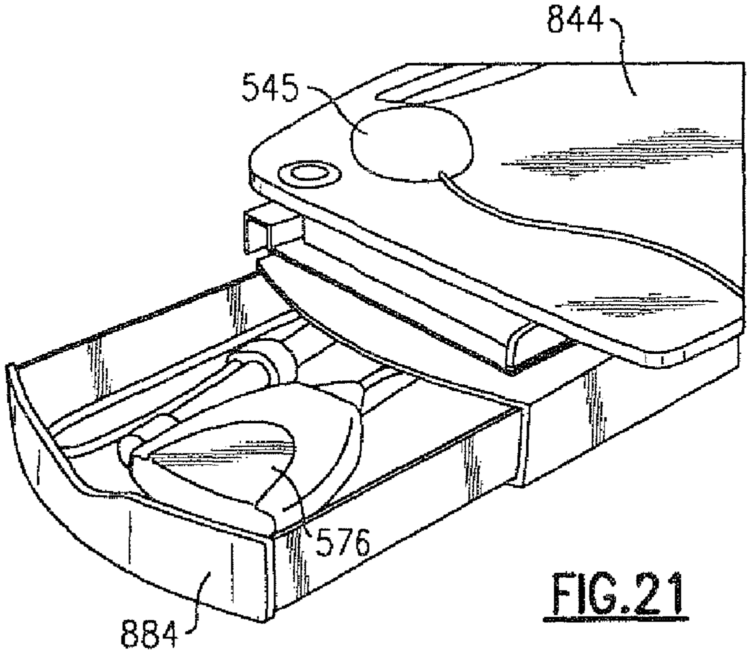


FIG.21

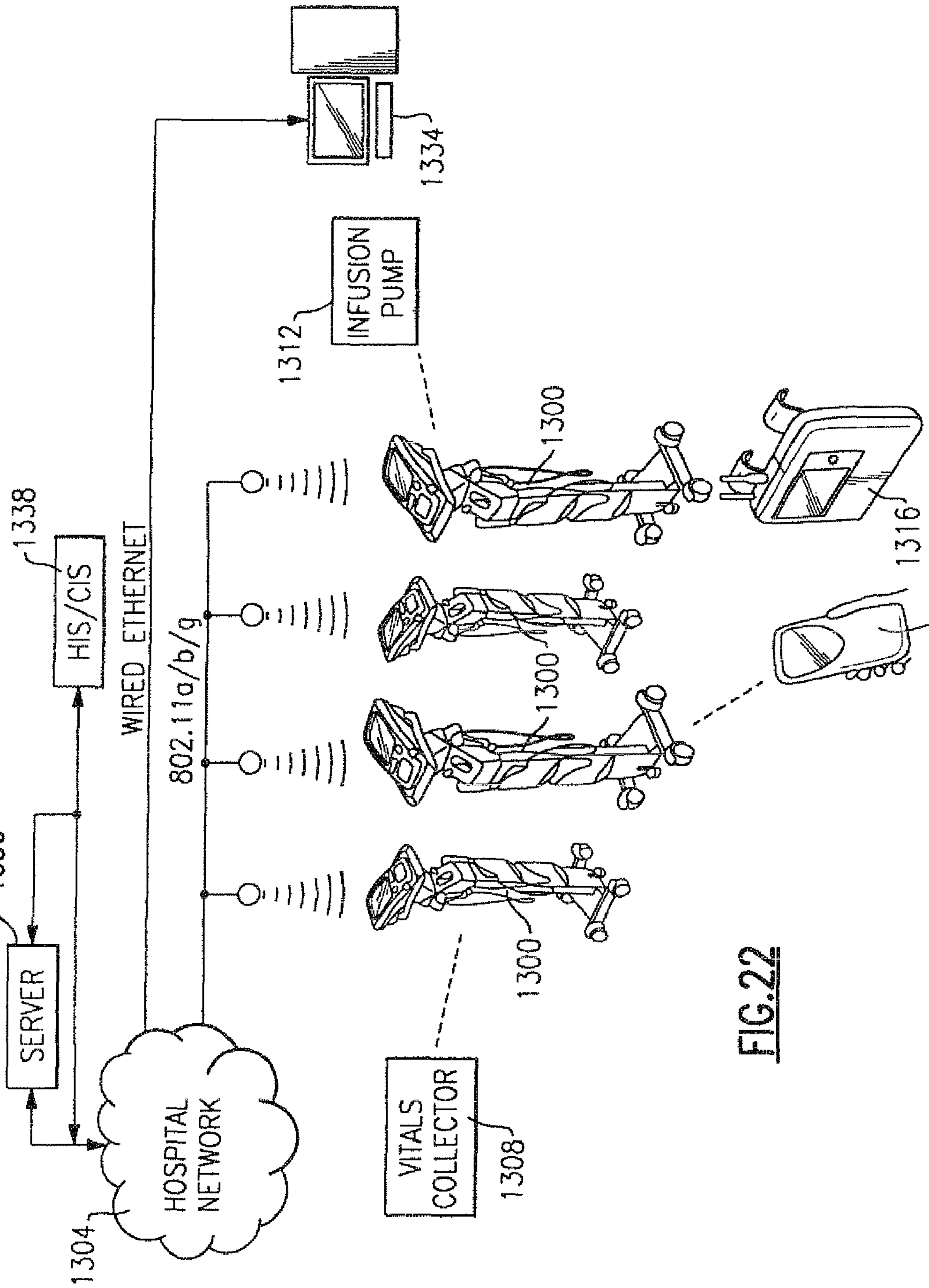

1330
SERVER
1338
HIS/CIS
WIRED ETHERNET
802.11a/b/g
HOSPITAL NETWORK
1304
VITALS COLLECTOR
1308
1300
1300
1300
1300
1312
INFUSION PUMP
1334
1316
1320

FIG.22

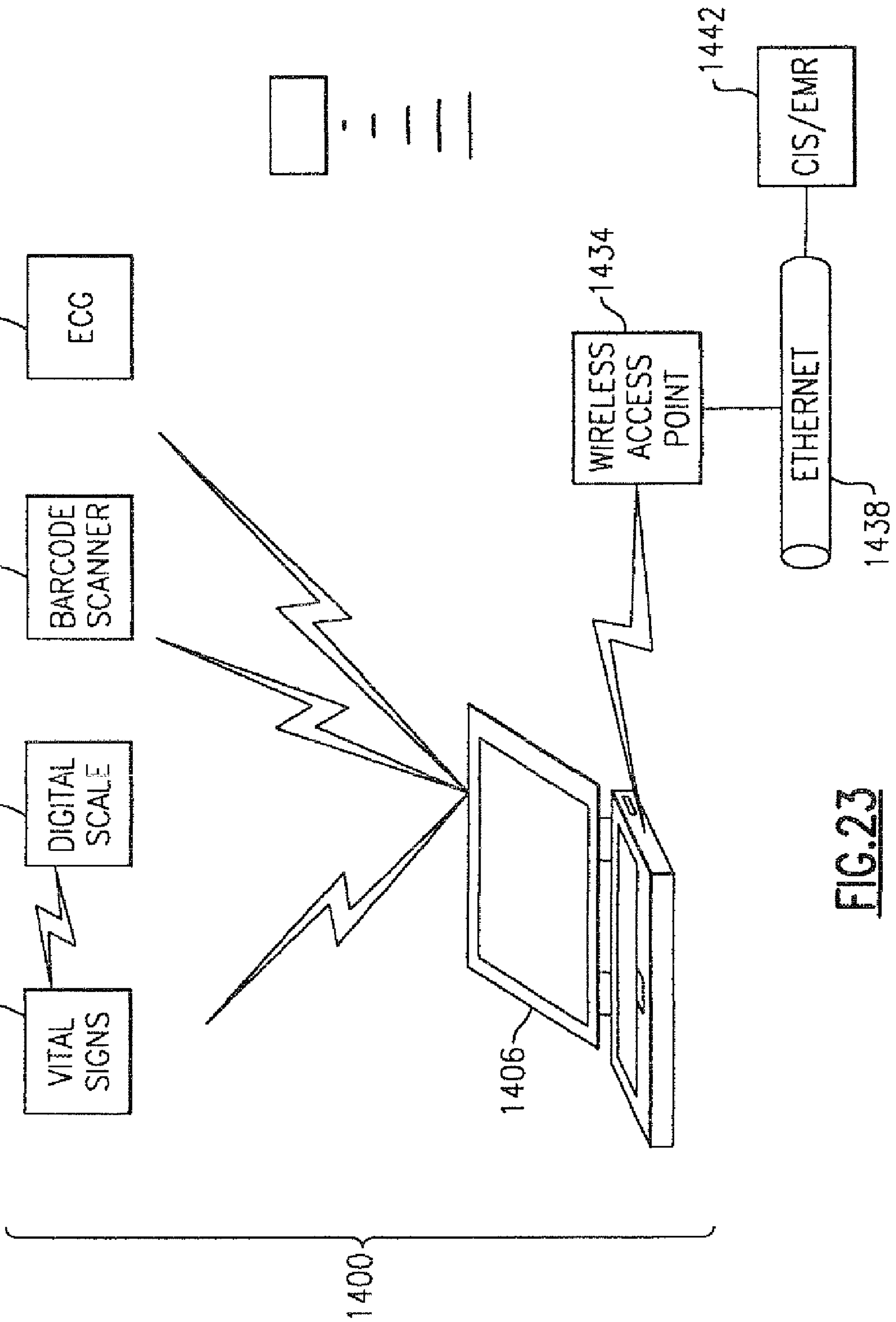

VITAL SIGNS
1430
DIGITAL SCALE
1412
BARCODE SCANNER
1408
ECG
1418
WIRELESS ACCESS POINT
1434
ETHERNET
1438
CIS/EMR
1442
1406
1400

FIG. 23

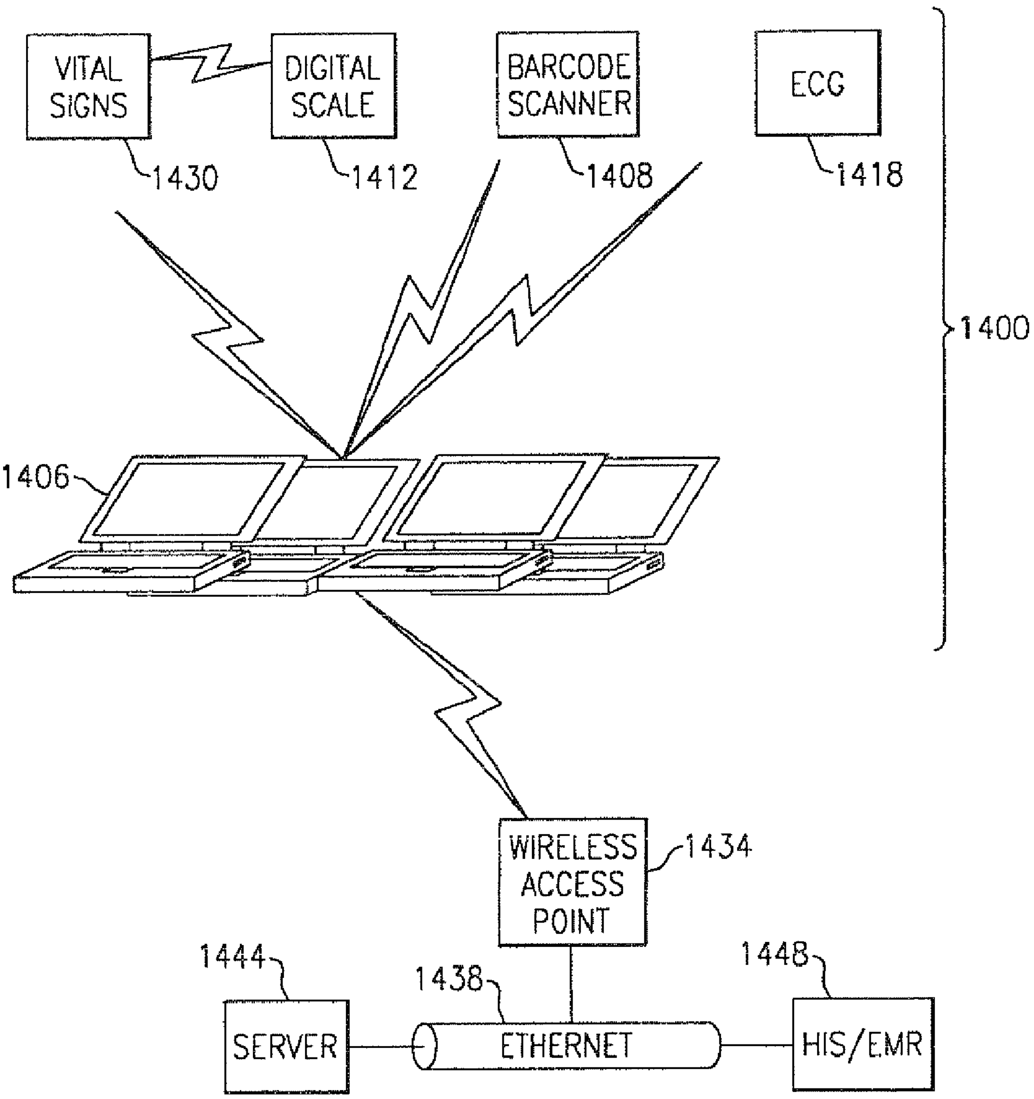

VITAL SIGNS
DIGITAL SCALE
BARCODE SCANNER
ECG
1430
1412
1408
1418
1400
1406
WIRELESS ACCESS POINT
1434
1444
1438
1448
SERVER
ETHERNET
HIS/EMR

FIG.24

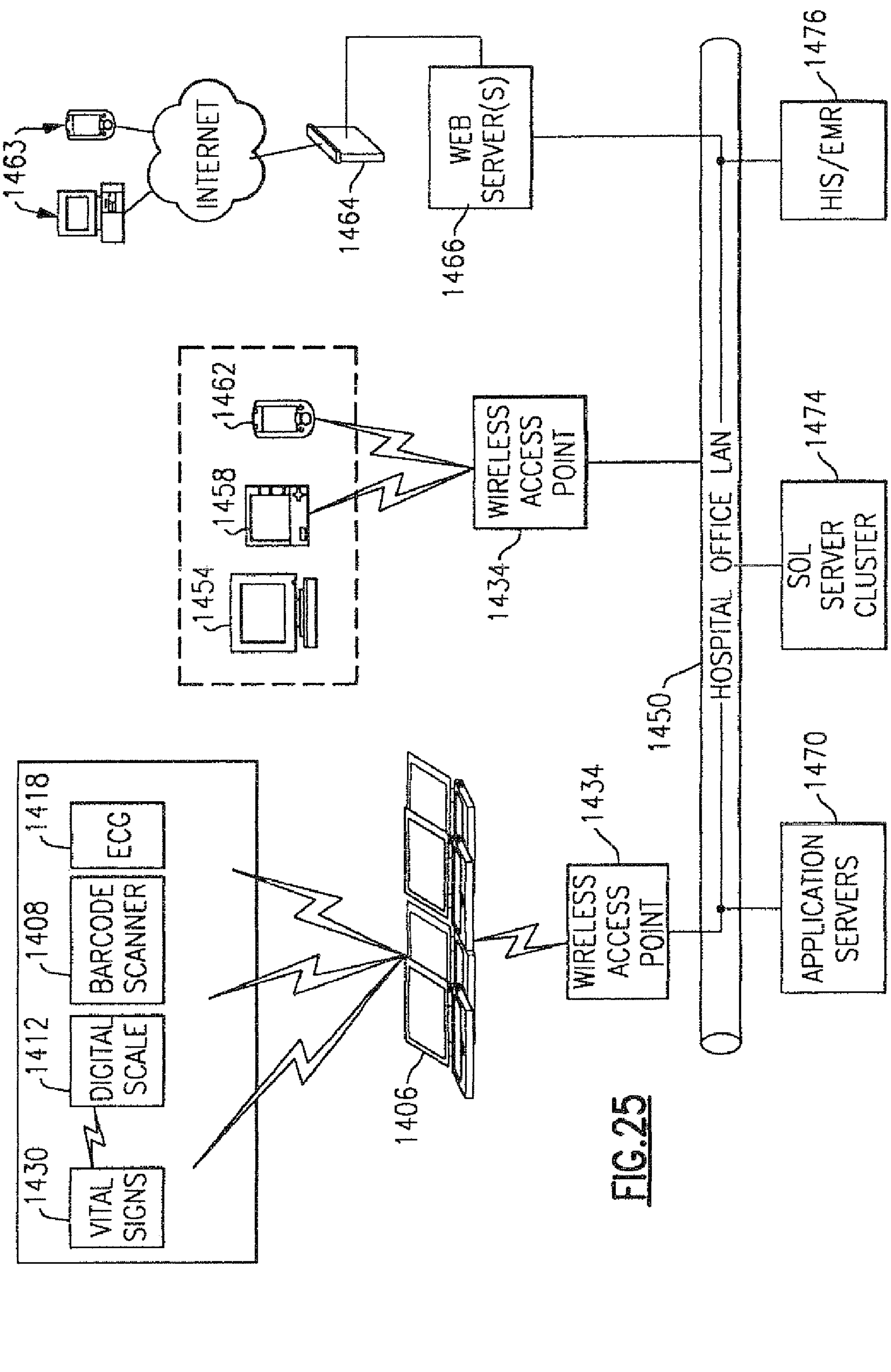

1463
INTERNET
1464
WEB SERVER(S)
1466
1476
HIS/EMR
1462
1458
1454
WIRELESS ACCESS POINT
1434
HOSPITAL OFFICE LAN
1450
1474
SQL SERVER CLUSTER
1418
ECG
1408
BARCODE SCANNER
1412
DIGITAL SCALE
1430
VITAL SIGNS
1406
1434
WIRELESS ACCESS POINT
1470
APPLICATION SERVERS

FIG. 25

MOBILE MEDICAL WORKSTATION

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a divisional application of U.S. Ser. No. 11/131,015, filed May 17, 2005, which claims priority based upon U.S. Ser. No. 60/658,626, entitled: MOBILE MEDICAL WORKSTATION, filed Mar. 4, 2005, and U.S. Ser. No. 60/601,450, entitled: MOBILE MEDICAL WORKSTATION, filed Aug. 13, 2004, the entire contents of which are herein incorporated by reference in their entirety. This application is also a continuation-in-part application of U.S. Ser. No. 10/643,487, entitled: DIAGNOSTIC INSTRUMENT WORKSTATION, filed Aug. 19, 2003 (now abandoned), which is based upon U.S. Ser. No. 60/404,601, filed Aug. 20, 2002, the entire contents of each being herein incorporated by reference. This patent application further incorporates by reference the entirety of commonly owned and U.S. Ser. No. 11/032,625 (now abandoned), entitled "A PORTABLE VITAL SIGNS MEASUREMENT INSTRUMENT AND METHOD OF USE THEREOF", filed Jan. 10, 2005, and U.S. Pat. No. 7,429,245, filed Jul. 14, 2003 and entitled: MOTION MANAGEMENT IN A BLOOD PRESSURE MEASUREMENT DEVICE", each of the preceding being subject to assignment to the common assignee of the present application.

FIELD OF THE INVENTION

This relates to the field of diagnostic medicine and more particularly to a mobile medical diagnostic workstation used in connection with at least one patient for measuring and storing a number of physiologic parameters.

BACKGROUND OF THE INVENTION

The staff of a medical/surgical floor of a typical hospital is under an increasing amount of pressure. Contributing to these pressures is the pervasive nursing shortage that has translated into a lower nurse to patient ratio, with longer hours and increased overtime. As a result, errors due to oversight and the like are likely to increase. Formerly, patient vital signs data were taken by a registered nurse (RN), but now these readings are often taken numerous times per day (as many as six or more readings) by nursing aides (also referred to as Patient Care Technicians (PCTs)) who must cover more patients and often have no or little clinical training. In addition and in an effort to ease the above staffing strains, many hospitals utilize more temporary contract or "traveler" nurses who float between sites. As a result, users of the monitoring equipment are transitory and must learn new internal procedures very quickly, exacerbating the above problems.

Currently, PCTs often use a cart having a number of patient diagnostic devices that can include automated blood pressure, thermometry, and pulse oximetry apparatus used to take patient vital signs over a length of stay. As noted, a PCT may likely take six readings (or more) per day over an average hospital stay of about five days. Typically, the above devices are not integrated on a cart, but rather are arranged in a piecemeal fashion, though integrated vital sign monitoring (VSM) devices, such as those manufactured by Welch Allyn, Inc. of Skaneateles Falls, N.Y. are commonly known in the field.

Vital sign readings, when taken, are often written onto a loose worksheet or often onto scraps of paper. At the end of rounds, these readings are then copied onto the patient's chart

on a "vitals" sheet. If anomalous readings are detected, the RN is notified. Otherwise, the RN is usually not consulted and often will not or may not get the chance to review any of the readings which have been taken.

Upon examination and if the vital signs readings are suspect in any way, the RN will often send the PCT back to the patient and request that another reading(s be taken. In the meantime, even if a significant change in the patient's vitals has been detected, time has been wasted and therefore lost. It is possible that in the current manner of testing described above, that many vital signs variations are not caught or otherwise detected or noted until the patient's condition has significantly changed.

Though the problems are arguably less involved, there are similar generalized needs in other clinical settings, such as the physician's offices, in order to be able to better conduct and document patient clinical encounters more efficiently and with better accuracy.

SUMMARY OF THE INVENTION

It is therefore one object of the present invention to improve upon the above-noted deficiencies of the prior art.

It is another object of the present invention to improve the manner of conducting patient clinical encounters, whether in a doctor's office and/or in the hospital environment.

It is yet another object of the present invention to provide an integrated medical diagnostic workstation that provides simple, efficient and improved operation for both the patient and the user(s) whether the user is a nurse, nursing aide, clinician or doctor.

It is another object of the present invention to facilitate the flow of information between caregivers.

It is yet another object of the present invention to be able to integrate general computing technology into the workflow of patient encounters along with the use of medical devices, thereby permitting applications, such as electronic medical records (EMRs) and/or medication delivery applications, to be utilized.

It is yet another object of the present invention to be able to integrate equipment within a workstation that optimizes workspace; that is, permitting various procedures to be performed effectively while maintaining a convenient footprint wherein the workstation is suitably rugged and stable to permit reliable use in a number ° C. varied environments.

Therefore and according to an aspect of the present invention, there is provided a medical workstation comprising a supporting structure, at least one medical diagnostic instrument disposed on the supporting structure, a first display disposed on a first side of said supporting structure, and a second display disposed on a second side of said supporting structure substantially opposite from said first side. Each of the first and second displays are interconnected to the at least one medical diagnostic instrument to permit at least one of said displays to display diagnostic results.

Preferably, the at least one medical diagnostic instrument is a vital signs device having the first display integrated therein. A computing device, such as a tablet PC, is also preferably included and is supported by the herein described workstation, the PC being attached to the second side of the supporting structure and having the second display. A docking station is preferably provided for the PC on the workstation to supply power and provide interconnection with the at least one medical diagnostic instrument using either a wired or wireless connection.

Preferably, at least one of the displays is adjustable about a horizontal axis in order to permit likability thereof relative to the user. Additionally, the height of the devices and a horizontal work surface can also selectively be adjusted as needed.

According to one variation, the devices are removable to permit their use either with the workstation or as free standing. Alternatively, free standing devices can also be integrated with the workstation according to another version thereof.

Moreover, the workstation includes control means to selectively control the operation of at least one aspect of the workstation including selective control of the first and second displays. The control means can either be included within the vital signs measuring device, the PC, or separately such as through another device or via a network.

For example, at least one input device can also be provided, such as a keyboard. a mouse, a touchscreen, or an automatic identification and data collection device, such as a bar code scanner, that is interconnected to at least one of the at least one medical diagnostic instrument and the PC. The at least one input device can also be used as a control means for the workstation and provide remote control of either display and/or the medical diagnostic instrument to cause automated vital readings to be taken, for example. Additionally, the at least one input device permits manual input of certain parameters, such as patient demographics and/or patient qualifiers (e.g., whether the patient is sitting or prone, the last meal prior to a glucose reading, and/or other information having a bearing on a particular measurement). Moreover, the control means can control the amount of data being presented on either display, for example, the control means can selectively remove certain data from one of the displays for security or other reasons or can disable the function of one or both displays, as needed.

In the instance in which the input device is an AIDC scanning device, such as a 1D or 2D bar code scanner, the device can be provided, according to one version, as a presentation scanner that is oriented on the work surface of the workstation. In this manner, it is not required to manually remove the scanner each time that it is desired to obtain information, such as a patient record, medication information, or other data. As such, the data can simply be brought to a scanning station.

According to another aspect of the present invention, there is provided a method for manufacturing a mobile medical workstation, said method comprising the steps of:

supporting a first display on said workstation, said first display facing a first side of said workstation; and

supporting a second display on said workstation, said second display facing a second side of said workstation and oppositely from said first display wherein each of said first and said second displays are connected to at least one medical diagnostic instrument such that each said display is capable of displaying results of said at least one medical diagnostic instrument.

According to yet another aspect of the present invention, there is described an integrated apparatus for use in a patient encounter, and in which the apparatus comprises: at least one medical diagnostic instrument, including a vital signs device having a sphygmomanometer; and a computing device connected to the at least one medical diagnostic instrument, said computing device including means for determining the size of the cuff of the sphygmomanometer utilized.

According to yet another aspect of the present invention, there is provided an integrated apparatus for use in a patient encounter. The apparatus according to this aspect comprises at least one medical diagnostic instrument, including a vital signs device and a sphygmomanometer; and a computing device connected to at least one medical diagnostic instrument, wherein said sphygmomanometer includes an inflatable sleeve having a pressure control assembly for inflating and deflating said sleeve, said pressure control assembly being connected to said computing device so as to inflate the sleeve to a predetermined pressure depending on the patient whose blood pressure is being measured.

According to yet another aspect of the present invention, there is provided an integrated apparatus for use in a patient encounter. The apparatus comprises at least one medical diagnostic instrument including a vital signs device for measuring various physiological parameters of a said patient; and a computing device connected to said at least one medical diagnostic instrument, wherein at least one of said computing device and said at least one medical diagnostic instrument are programmed to detect changes in a patient condition based on changes in measured parameters.

According to still another aspect of the present invention, there is provided an integrated apparatus for use in a patient encounter. The apparatus comprises at least one medical diagnostic instrument, including a vital signs device; and a computing device connected to at least one medical diagnostic instrument for measuring a physiologic parameter of a patient, wherein said at least one medical diagnostic instrument further includes a portable EKG assembly.

In one version, the EKG monitoring assembly is connected to the computing device.

According to still another version of the present invention, there is provided an integrated apparatus for use in a patient encounter. The apparatus comprises at least one medical diagnostic instrument, including a vital signs device; an input device having means for reading machine-readable information; and a computing device connected to at least one medical diagnostic instrument and said input device, said apparatus further including means for determining the amount of fluid inputs and outputs of a patient.

According to still another version of the present invention, there is provided an integrated apparatus for use in a patient encounter. The apparatus comprises at least one medical diagnostic instrument, including a vital signs device; and a computing device connected to at least one medical diagnostic instrument, wherein at least one of said computing device and said at least one medical diagnostic instrument include memory means that includes means for storing at least audio data added during said patient encounter.

At least one audio message can be transmitted by the workstation to a remote location and/or the audio message can be played back at the workstation. The latter is a preferred means for handling coordination of a patient between shifts wherein pertinent notes concerning the patient can be left for playback by the oncoming attending shift nurse or aide. Text messages providing pertinent or updated patient information or notes, can also be left for subsequent users on the workstation, in addition to the audio notes.

In the instance of transmitting the at least one audio message remotely, the computing device can be connected to the remote location by way of a bidirectional communication link. This link can be a wireless or a wired link or can include a WiFi or other Internet connection for transmission of the audio data, for example, by means of .audio files. Alternately, the workstation can include a speakerphone using VOIP for receiving audio messages to and from the remote location.

According to still another version of the present invention, there is provided an integrated apparatus for use in a patient encounter, the apparatus comprising at least one medical diagnostic instrument, including a vital signs device; means for selectively capturing images during a patient encounter; and a computing device connected to said at least one medical diagnostic instrument and said image capture means.

In this version, the computing device can include a display and the apparatus can include means for displaying an image of a user that is logged onto the apparatus. This image capturing means can, for example, be an imaging bar code scanning device wherein the apparatus further includes means for preventing unauthorized access to or operation of the herein described apparatus. In one version, this biometric means can include memory means that includes storage of images of authorized users of the apparatus and in which operation of the apparatus can occur only if a successful comparison between a stored image and that of the user are attained.

According to still another version of the present invention, there is provided an integrated apparatus for use in a patient encounter, the apparatus comprising at least one medical diagnostic instrument, including a vital signs device; and a computing device connected to at least one medical diagnostic instrument, at least one of said computing device and said vital signs device including a graphical display wherein said display includes a graphical user interface, said graphical user interface including a body image format permitting a user to readily identify the patient physiological parameters being measured.

In one version, the body image format includes a body representation wherein physiological parameter readings of a monitored patient are disposed in proximity to the actual location on the body that is being measured.

The user interface provides visual indications of regions that are currently being measured or provides a user with the information concerning areas or regions that are not being measured in connection with the patient. The visual indication can include highlighting or other forms of notification or indication of out of range readings. The interface permits both current and trended data to be displayed.

According to yet another aspect of the present invention, there is provided a medical workstation comprising a supporting structure; at least one medical diagnostic instrument disposed on said supporting structure; and a computing device disposed on said supporting structure, said supporting structure being mobile and including a wheeled chassis permitting said workstation to be mobile and in which said supporting structure is foldable to permit storage thereof.

In one version thereof, the supporting structure includes a movable upper portion supporting the at least one medical diagnostic instrument and the computing device, wherein the apparatus further includes adjustment means for selectively adjusting the height of the upper portion relative to the remainder of the supporting structure.

An advantage of the present invention in providing dual displays on the workstation is that displayed results can be presented simultaneously to both the patient and to the user, providing redundancy for example, in the event one of the displays is not visible from the caretaker's current location.

Another advantage provided is that the herein described mobile workstation improves response time and provides ease of use for all users, whether PCTs, RNs, doctors, clinicians or others.

Still another advantage provided by the present invention is that the at least one medical diagnostic instrument can be controlled for either automated and/or manual taking of patient vitals wherein the results can be automatically logged without requiring transcription, thereby improving time, efficiency and accuracy. Moreover, the data can be stored for trend analysis and alerts can be created automatically to permit additional readings to be taken if a patient's condition changes significantly.

Yet another advantage is that each of the displays can be separately controlled in order to select which information is shown on each display for ease of use and for security/privacy (HIPAA) concerns. For example, the user could utilize the controls of the medical diagnostic instrument when the user is on that side of the workstation, and disable the computer display. When the user is on the computer side of the workstation, the display of the at least one medical diagnostic instrument can be caused to dim or turned off to protect patient confidential information. In fact, the user could operate the at least one medical device from the computer without requiring the instrument display, selectively.

Another advantage of the present workstation is the utilization of a docking station for the computer and/or at least one medical diagnostic instrument, permitting the devices to be utilized separate from the workstation. For example, some patients are isolated for contagious diseases—a dockable vitals device allows them to bring only the device into the patient's room, to simplify decontamination later. Further, nurses may want to remove the computer to complete documentation in areas where a wheeled cart may not be optimal, such as, for example, a breakroom.

These and other objects, features, and advantages will become readily apparent from the following Detailed Description which should be read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side perspective view of a mobile medical workstation made in accordance with a preferred embodiment of the present invention as shown in a use environment;

FIG. **2** is a front perspective view of the mobile medical workstation of FIG. **1**;

FIG. **3** is a partial front perspective view of the upper portion of the mobile medical workstation of FIGS. **1** and **2**;

FIG. **4** is a rear perspective view of the mobile medical workstation of FIGS. **1-3**;

FIG. **5** is an enlarged rear perspective view of the upper portion of the mobile medical workstation of FIGS. **1-4**;

FIG. **6** is a side elevation view of the mobile medical workstation of FIGS. **1-5**;

FIG. **7** depicts a functional block diagram for a mobile medical workstation made in accordance with one version of the present invention;

FIG. **8** is a diagrammatic representation of an exemplary communications platform for the mobile workstation defined according to the present invention;

FIG. **9** is a flow chart relating the methodology of a specific alert algorithm for use with the mobile medical workstation, the algorithm relating to severe sepsis;

FIG. **10** is a flow chart relating the methodology of the setting of alert thresholds for the mobile medical workstation of the present invention according to one version thereof.

FIG. **11** depicts a graphical user interface of the mobile medical workstation according to one display mode for a monitored patient;

FIG. **12** depicts the graphical user interface of the mobile medical workstation according to another display mode that provides trended patient data;

FIG. **13**A is a front perspective view of a mobile medical workstation in accordance with a second embodiment of the present invention;

FIG. **13**B is a rear perspective view of the mobile medical workstation of FIG. **13**A;

FIG. **14** depicts an enlarged side perspective view of the mobile medical workstation of FIGS. **13**A and **13**B, showing a presentation scanning device;

FIG. **15**A is a front perspective view of a mobile medical workstation in accordance with a third embodiment of the present invention;

FIG. **15**B is a rear perspective view of the mobile medical workstation of FIG. **15**A;

FIG. **16**A is a front perspective view of a mobile medical workstation in accordance with a fourth embodiment of the present invention;

FIG. **16**B is a rear perspective view of the mobile medical workstation of FIG. **16**A;

FIG. **17**A is a front perspective view of a mobile medical workstation in accordance with a fifth embodiment of the present invention;

FIG. **17**B is a rear perspective view of the mobile medical workstation of FIG. **17**A;

FIG. **18**A is a front perspective view of a mobile medical workstation in accordance with a sixth embodiment of the present invention; and

FIG. **18**B is a rear perspective view of the mobile medical workstation of FIG. **18**A;

FIGS. **19**A and B are side views of the mobile medical workstation of FIGS. **17**A and B, respectively;

FIG. **20** is a partial side perspective view of the mobile medical workstation depicting a presentation scanning device;

FIG. **21** is an enlarged side perspective view of the mobile medical workstation of FIG. **17**A, illustrating an alternative embodiment for storing an ECG monitoring assembly;

FIG. **22** is a pictorial representation, partially diagrammatic, illustrating a mobile medical workstation in accordance with the present invention as used in clinical environment; and

FIGS. **23-25** represent diagrams of single and multiple configurations involving the mobile medical workstation in accordance with the present invention.

DETAILED DESCRIPTION

The following description relates to a mobile medical workstation made in accordance with several varied embodiments of the present invention. It should be readily apparent from the following discussion to those of adequate skill that there are numerous configurations that can utilize the inventive concepts related herein. In addition, several terms are used in order to provide a suitable frame of reference with regard to the accompanying drawings. These terms are not intended, unless expressly noted, to be limiting with regard to the intended scope of the invention.

A number of other terms are used throughout the following discussion which bear additional clarification prior to providing a detailed description of the particular embodiments, as follows:

The term "medical instrument" is used to include any device that can be used in conjunction with a patient for purposes of documentation, diagnosis, treatment or therapy during a patient encounter.

The term "computing device" as used herein refers to any form of processing engine, such as a portable laptop computer, personal data assistant (PDA), tablet PC, monitor with a separate hard drive unit, or other similar device. It is intended that this definition should not necessarily limit structure to that having a defined housing. That is, a suitable I/O integrated circuit board linked, for example, to other circuitry and having solid state memory can be conveniently utilized herein for purposes of the invention.

The term "vital signs device", "vital signs collector", and "vital signs measuring device" or "instrument" as used herein refers to any device or apparatus that is capable of collecting one or a varied number of physiologic parameter readings from a patient(s), including but not limited to at least one of blood pressure, ECG, pulse oximetry, body temperature, heart rate, and respiration rate.

The term "supporting structure" refers to any sort of frame or other means capable of receiving, retaining and/or holding a number of discrete components.

The term "wireless" refers to any communication technique which does not require a hardwired connection. Radio frequency protocols such as Bluetooth, WiFi (802.11(b)), Zigbee, frequency hopping, and 802.11(a) and (g) are included in this definition, as well as any other RF, IR, optical or other non-wired communication system.

The term "machine readable" or "machine scannable" refers to information which can be read by a machine. This can include, but is not limited to, one dimensional (1D) and two dimensional (2D) bar code symbologies, as well as optical character recognition (OCR) symbols. The above term can further refer more simply to identification of any other machine perceivable information, such as color or physical parameters, such as sound, light and the like by means of any AIDC (automatic identification and data collection) device. For example, the above definition can further apply to a passive radio frequency (RF) tag that can be used to identify the location of an article or a device using an interrogatory device.

Referring to FIGS. **1-6**, the mobile medical workstation **20** according to a first embodiment is a lightweight portable apparatus that includes a wheeled chassis which is defined by a lower base **24** and a supporting structure **28** extending upwardly therefrom. The lower base **24** includes a set of wheels or casters **32** which depend from corresponding legs **29** of the lower base **24** to enable movement of the workstation **20**, for example, between patient examination rooms. A foot-actuable pedal **30** is further provided on the lower base **24** to provide braking action and to prevent movement of the mobile medical workstation **20** when the pedal is depressed. A power supply **35**, such as a rechargeable battery, is attached to the bottom of the lower base **24**. Connections are provided extending through the supporting structure **28** of the workstation **20** to provide an electrical connection to a number of supported components, the components being described in greater detail below, the workstation further having a power cord (not shown) that alternatively permits the workstation to be powered by an AC power supply (not shown) when the battery is uncharged.

The herein described workstation **20** is constructed with a relatively low center of gravity to prevent tipping wherein the lower base **24** is attached to the bottom of the support structure **28** by a set of fasteners **31** according to this embodiment, though alternatively the lower base could be formed integrally therewith or be otherwise attached to the workstation by other suitable means.

The supporting structure **28** of the herein described workstation **20**, according to this specific embodiment, comprises an upwardly (vertically) extending main post member **38** which receives the lower base **24** at a lower portion thereof. The supporting structure **28** further includes a translatably (e.g., vertically) movable upper portion **40** defined by a large diameter post member **36** placed in overlaying relation onto the exterior of an upper section of an upwardly extending main post member **38**. The upper portion **40** further includes a horizontal work surface **44** as well as a pull-out keyboard tray **48** that are each attached to the large diameter post member **38**. Alternatively, the keyboard tray **48** could be attached to a lower surface of the horizontal work surface **44**.

The translatably adjustable upper portion **40** of the herein described mobile medical workstation **20** supports a number of items, including a vital signs measuring device **60** and a computing device, in this instance, a tablet PC **64**. Each of the devices **60**, **64** include an integrated display **84**, **82**, respectively, each of the devices being attached by suitable means to the top of the horizontal work surface **44**. It will be apparent from the following discussion and embodiments that follow that additional or alternative instruments, such as medical diagnostic instruments, can be supported by the workstation **20** wherein attachment of these instruments can be done through several techniques. For example, the vital signs measuring device **60** could be attached via a quick release thumbscrew which is inserted through the post member **36**. Other similar techniques, however, can be utilized, such as a set of sliding rails, or other means to effectively retain the device on the workstation **20** which permits releasable attachment thereto.

The vital signs measuring device **60** used in this embodiment is a vital signs monitor such as those, for example, manufactured by Welch Allyn Inc., of Skaneateles Falls, N.Y., or any other instrument that is capable of taking at least one patient physiologic measurement (e.g., blood pressure, pulse rate, respiratory, blood oxygen, body (axillary, rectal, oral, tympanic) temperature, ECG, glucose, among others). The vital signs measuring device **60** according to this embodiment includes a housing to which a plurality of various probes or modules are attached, including an oral thermometer probe, a pulse oximeter probe, and a non-invasive blood pressure (NIBP) module that includes an inflatable cuff or sleeve (not shown). Additional details relating to a particular vital signs device for use with herein described mobile medical workstation, including the above-noted physiologic measuring modules contained thereupon, are provided in copending and commonly assigned U.S. Ser. No. 11/032,625, previously incorporated in its entirety. It will be readily apparent, however, that other vital sign devices such as a Welch Allyn Spot Vital Signs device (Model 53106), a Welch Allyn VSM-300 (Model 53NT0), a Welch Allyn Atlas Monitor (Model 623NP) or a Welch Allyn Propaq Monitor (Model Propaq CS), and in fact other medical diagnostic instruments can be used in lieu of or in addition to those described herein.

According to this specific embodiment and referring back to FIGS. **1**-**6**, a docking station **68** includes an angled bracket **62** at the top of the upper portion **40** of the supporting structure **28**, the docking station further including a contoured recess **76** that is sized for receiving the tablet PC **64** wherein the PC is secured at the bottom and side edges thereof. The tablet PC **64** includes a display **82** and a set of control buttons **80** that are disposed on a user interface. Alternatively, the PC **64** can include a touch screen having a tethered stylus **66**, providing a graphical user interface an example of which is shown in FIG. **11**, described in greater detail below. It should be noted that the vital signs measuring device **60** or other medical diagnostic instrument used in conjunction with the herein described workstation **20** can also he similarly provided with a docking station (not shown).

The angled bracket **62** enables adjustment of the viewing angle of the tablet PC **64** about a horizontal axis and rotates it to switch between landscape and portrait mode. Preferably, the tablet PC **64** is set a predetermined height above the horizontal work surface **44** wherein the display **82** of the PC **64** and the display **84** of the vital sign measuring device **60** are juxtaposed; that is, the displays face away from each other in opposing directions.

As previously noted, the workstation **20** preferably includes at least one contained battery **35**, such as a rechargeable NiMH battery, that is used to power each of the supported devices **64**, **60** in lieu of or in addition to their onboard batteries. The workstation **20** also includes a cord (not shown) that permits attachment to an AC power supply (not shown), if needed. Preferably, a single power cord enables recharging of the at least one contained battery **35** and operation during times when the onboard battery power is low. Such power supplies are described in previously incorporated U.S. Ser. No. 10/643,487.

The keyboard tray **48** is disposed substantially beneath the horizontal work surface **44**, the tray being deployable from a support to enable a user to pull out a retained keyboard **50** for use, as shown in FIG. **1**, the keyboard being used with the tablet PC **64** and interconnected through the docking station **68**, although alternatively the keyboard could be a wireless keyboard. As is described in a later portion of this description, the keyboard **50** provides functionality as an input device for the workstation **20**, for example, to add manual input concerning a patient to a record. Alternatively, a mouse or trackball could be used as an input device in lieu of or in combination with the keyboard **50**, such as shown in the alternate embodiment of FIG. **13**A.

The tablet PC **64** and the vital signs measuring device **60** are interconnected according to this embodiment by means of a serial connection, though alternative wired connections, such as USB and wireless connectivity such as Bluetooth or Zigbee could easily be utilized. As will be described in greater detail below, the vital signs measuring device **60** can include a separate microcontroller therein and/or can directly receive input commands via software contained with the tablet PC **64**. According to this embodiment, an automatic identification and data collection (AIDC) scanning device, such as a bar code scanner **52**, is retained in a lateral slot **56** provided in the horizontal work surface **44**. The bar code scanner **52** according to this embodiment preferably includes an imager, such as a CCD, to permit the device to capture images as well as scan and interpret barcodes. According to the herein described embodiment, the bar code scanner is an Image Team 1D (one-dimensional) linear scanner, manufactured by Hand Held Products, Inc., of Skaneateles Falls, N.Y. Details relating to the bar code scanner as an input device for the herein described workstation **20** are briefly described below. Additional details are provided in the previously incorporated U.S. Ser. No. 10/643,387 application.

It should be pointed out that the operational workings and design details of the scanning device do not themselves form an essential part of the present invention in that these details are already acknowledged as being well known. In addition and though a wired barcode scanner is shown for use with the present embodiment, it should be noted that a wireless (e.g., cordless) version thereof would also be suitable, provided any reasonable connection (RF, IR, or other) is made in order to transmit any scanned input to the PC **60**. An example of a cordless scanner implementation is depicted in the workstation embodiments of FIGS. **17**A and **17**B. Each of the above devices **60**, **64**, **50** and **52** are removable from the herein described workstation **20** for replacement, reconfiguring, or other purposes, as needed, as are any attachments or accessories to the herein described devices.

The supporting structure **28** of the herein described mobile medical workstation **20** further includes at least one storage container in the form of a supporting basket **98** that is attached to the upper portion **40** of the workstation and proximate to the rear edge of the horizontal work surface **44**, the basket being sized to permit items such as thermometry probe covers, blood pressure cuffs and other accessories to conveniently be carried. The horizontal work surface **44** of the present embodiment also includes a storage container **104** used for storing a number of device probes, such a pulse oximetry probe for the vital signs measuring device **64**, ECG cabling, and the like. The basket **98** is attached by means of fasteners **101** for attaching to the post **36** and includes a handle **100** permitting the workstation **20** to easily be rolled between patient rooms.

It should be readily apparent that other suitable storage containers and/or carriers can be provided on the supporting structure or otherwise on the workstation. For example, a bracket **102** permitting attachment of at least one other storage container or basket (not shown) is provided on the vertical post member **36**. Numerous alternative embodiments of various examples of storage containers and receptacles are further shown, for example, in previously cross referenced U.S. Ser. No. 10/643,387 as well as later embodiments described herein, such as those of FIGS. **17**A and **19**A. It will be apparent that nearly limitless combinations exist and that merely illustrative examples are provided herein.

As noted, the entire upper portion **40** of the herein described workstation **20** is translatably (e.g., vertically) movable permitting the devices **60**, **64**, **52**, the horizontal working surface **44** and the keyboard **50** to be adjustable as needed, depending on the user and the application. This adjustment further permits each of the displays **82**, **84** to be adjusted to enhance viewing by means of a connected lever **39**. The lever **39** is connected to an internal gas assist spring (not shown) which is designed to counterbalance the weight of the movable upper portion **40**. It should be noted herein that other suitable height adjustment mechanisms, such as those driven by electric motors, could be utilized for selectively adjusting the height of the horizontal work surface **44** and devices **60**, **64**.

A functional block diagram of a version of the mobile medical workstation **20** is shown in FIG. **7** to aid in understanding the interconnectivity of the supported components of the herein described embodiments. The workstation, identified in this figure as **220**, includes a processing engine **224** which for purposes of the present embodiment is included in the tablet PC **64**, collectively of the first embodiment. The engine **224** includes memory such as RAM, ROM and a harddrive, shown as **226**, to which the remaining functional components are interconnected including a vital signs collector or device **228** and a bar code (or AIDC) seamier **232**. The bar code scanner **232** includes a control interface/engine **236** and can further optionally include an integral digital or electronic camera or the workstation **220** can include a separate camera **240** wherein the camera can include an illumination system **244** and optionally, a fold-out or other display **248**. The vital signs device **228** includes a number of resident instrument modules **252** such as S_pO_2, NIBP, temperature and the like, as well as a local display **256**. A display interface **260** and workstation display **264** are also connected to the processing engine **224**, wherein the interface can be either a hardwired or a wireless link. In the first embodiment and referring to FIGS. **1-6**, the interface between the display of the vital signs device and the computing device **64** is wireless. All of the above are interconnected to a power supply **268**, wherein the internal batteries of each of the tablet PC **64** and the vital signs measuring device **60** are not required. Inputs can be made to the processing engine **224** via a mouse interface **278** or through other inputting means, such as a button interface **279**, including for example, use of a keyboard **50** of the computing device **64** or the keypad **86** of the vital signs device **60**.

Referring back to FIG. **7** with regard to outputs other than those displayed, a printer **272** can also be attached to the processing engine **224** through a separate communication interface **276** which can be hardwired (using USB, for example) or wireless (RF, IrDA, etc) to permit image and/or vital signs readings and other data to be outputted as needed.

According to this system depiction, audio data or input **280** can be added through a microphone or other input means (not shown) to the processing engine **224** which can similarly output any captured audio data via a speaker on the computing device with which audio files can be retrieved, all being shown as **308**.

A biometric data collector **288** links to the processing engine **224** whereby specific authorization is guaranteed only through a specific biometric which can include a finger print reader **292**, voice signature module **296**, retinal scanner **300**, or through the use of facial recognition of a user, shown as **300**, using the camera **240** or imager of the scanner **232**. Other techniques could be included as this diagram is merely indicating examples.

Other medical devices or instruments, represented by **312**, can also be interconnected to the workstation **220**, including remotely located instruments, which can receive and transmit data over the communication interface **276** such as through a network interface **316**, through either a hardwired or wired connection. As such, for example, the workstation **220** can add data concerning a patient(s) from a remote location. In addition, the workstation can further interconnect wirelessly with any patient information system using the network interface. Examples are shown in FIGS. **8** and **22-25**.

For purposes of the present invention, the computing capability of the tablet PC **64** can be included separately or redundantly in the vital signs measuring device **60**. Communication between the portable vital signs device and a scanner device is also supported wherein the portable vital signs device. Additional details relating to each of the above are provided, in commonly owned and copending U.S. Ser. No. 11/032,625, previously incorporated herein in its entirety.

According to one embodiment of the flow of communications between one or more portable vital signs devices and a server, in this instance the server being an information server that is operational and that has at least one communication access point that operates according to 802.11b wireless interface protocols. In some settings, such as a hospital, there may be a plurality of 802.11b wireless interface access points connected to the server. A portable vital signs device initiates a communication session by attempting to discover a server access point in us vicinity, and thereby initiate a communication session with the server. In the initial attempt to discover a server, the portable vital signs device transmits a message containing a payload that is understood to be a request to open a session. The server responds to a properly formatted initial message by sending an authorization as the payload of the reply message. The authorization in one embodiment is an authentication message encrypted using a "public key encryption" system, for which the portable vital signs device is provided a decryption algorithm. Each facility can arrange its own encryption and decryption method, for example using at least one 128-bit key that is provided to all portable vital signs devices and all servers of the facility. In addition to the encryption of communications, there is a provision for identifying the authorization type or level of any individual who uses a portable vital signs device, to assure that the requirements of HIPPA are fulfilled. Once a specific portable vital signs device has been provided an authorization by the server, the server sends a message that contains as its payload information enumerating the services that the portable vital signs device can request from the server. Having successfully established bi-directional communications with a server, the portable vital signs device communicates information to, and receives information from, the server. The term information is to be construed broadly, and can include any of data, commands, computer programs or files, and signals related to the good order of the communications, such as signals requesting that the communication pause or resume, that a message or a portion thereof be repeated, that a time signal be provided, or other signals that may be needed to assure proper operation of the system. In some embodiments a plurality of portable vital signs devices can be in communication with the server simultaneously. This means that, in intervals of time perceived by humans as substantially instantaneously, any of portable vital signs devices can send or receive information even though another of portable vital signs devices is also in communication with the server.

In operation, the portable vital signs devices can send information relating to one or more patient encounters, including information identifying the patient, and information relating to the measurements performed and their outcomes. The server can acknowledge the information. When the portable vital signs device receives an acknowledgement that the information it sent has been received and recorded by the server, the portable vital signs device can delete the locally stored information and reclaim the memory space so free for use in another patient encounter.

Diagrams of example interconnection schemes between at least one mobile workstation and a remote hospital server and/or information systems are provided in FIGS. **8** and **22-25**, discussed in greater detail below.

With this preceding background being provided of the preferred vital signs device **60** used in the first embodiment, reference is again made of FIGS. **1-6** and **8** wherein the tablet PC **64** is a Wintel computer according to this embodiment; this being any platform preferably consisting of a version of Microsoft Windows running on an Intel 80×86 processor or compatible.

In operation and prior to taking of vitals of a patient, the user **16** would initially log in to the workstation **20** using either the bar code scanner **52**, for example, by scanning a user's badge (not shown) or through a password entry via the computing device **64** using the keyboard **50** or using a touch screen (not shown) of the PC using the tethered stylus **66**. The display **82** of the tablet PC **64** then indicates whether an existing patient record should be accessed or a new patient record should be created. The bar code scanner **52**, according to one version, could be also used wherein a patient's identification bracelet (not shown) or other identification could be swiped or presented thereto wherein the patient identification is matched up with a stored list. If the matchup is successful and results in an existing patient, then the existing patient record can be accessed or alternately, if the patient is not on a matching list, then a new patient record can be created. According to one version, the bar code scanner is an imaging bar code scanner, such as the model Model Image Team 2D scanner that is manufactured by Hand Held Products, Inc. of Skaneateles Falls, N.Y. This imaging bar code scanner includes a housing that includes a handle and an imaging head, the imaging head retaining an illumination system as well as electronic imaging element, such as a CCD, in order to obtain digital images in addition to being able to scan items for machine readable symbologies that can be processed and decoded by the apparatus.

According to this version, the scanner also captures an image of the patient whose vitals are being measured by the workstation. This image is stored into memory and can be displayed during a patient encounter, FIG. **11**. Additionally, the scanner can also capture other data in image form, including wounds, rashes, range of motion, and other patient-related data. In addition, the memory of the computing device (or the vitals device) can include a list of authorized users wherein the scanner is used to obtain an image of the user which is compared against stored information before a user can log in to the workstation.

Typical hospitals require the patients to sign a photo release form, even for wound care. The software of the herein described workstation can be used to track these forms and to disable the camera of the scanner if the patient has not yet signed a release. This feature protects the patient's privacy and also provides insulation for liability for the hospital or other medical care facility.

As noted previously, the vital signs device used according to this embodiment can also include a feature for patient identification using an interconnected bar code or other scanning device.

In the instance in which the patient record is new, or in the instance that basic patient demographics need to be added to the record, these demographics can be uploaded from a remote station, such as, for example an Acuity central monitoring station, manufactured by Welch Allyn, Inc., or from a health information system, as shown for example in FIGS. **22-25**. Preferably, this transfer can occur through an HL7 or other suitable interface. These patient demographics which are stored into memory can include the patient name, identification number, date of birth, the date the patient checked into the hospital, location, social security number, and gender, among other data. The patient record is then displayed as shown, including the captured patient image and patient demographics, for example, according to that shown in FIGS. **11** and **12** in the display **82** of the supported PC **64** and/or the display **84** of the vital signs measuring device **60**. It should be noted that the parameters depicted in the displays **82**, **84** according to the Figs. are merely exemplary and can easily be varied.

The user can then by means of the computing device **64** control use or program the vital signs measuring device **60** to either manually or automatically take vitals or other patient readings (e.g., temperature, blood pressure, blood oxygen, glucose, ECG and/or other readings) as needed, once the appropriate sensors of the vital signs measuring device **60** have been attached in a known and accepted manner to the patient. According to an alternative technique, the user can also perform measurements remotely using the bar code scanner **52** which is swiped against an encoded list of menu labels, as described in greater detail in previously cross referenced U.S. Ser. No. 10/643,487.

The workstation **20** permits both automated as well as manual operation of the vital sign measuring device **60** by the user. As such and when the user is operating the vital signs measuring device **60**, the user can selectively deactivate the computer display **82**, since the user is not using that display which is on the opposite side of the workstation **20**. This feature, which can be activated through a button on the user interface **86** of the device **60**, addresses privacy and security concerns in the hospital environment. Conversely, the user can control either through the stylus **66** with a touch screen (not shown) or through input via the keyboard **50** or a dedicated hard key thereupon, a similar control to dim or deactivate the display **84** of the vital signs measuring device **60**. In fact, the user can totally control the operation via the PC **64** in lieu of the vital signs measuring device **60** to perform measurements. Alternately, and based on similar privacy and security concerns, such as those relating to the Health Insurance and Portability and Accountability Act of 1996 (HIPPA), the user can control the amount of information such that the computer display **82** at the time the user is using the PC **64** may include more information that that of the vital signs measuring device **60** for security and/or privacy concerns.

According to one variation of the invention, the workstation **20** can default to using only the display that the user is working from (the computer **64** or the vital signs device **60**) unless a control feature is specifically activated by the user to enable the remaining display (and optionally disabling the remaining display). For example, when the user is performing blood pressure readings and presses the blood pressure measurement button on the console of the vital signs measuring device **60**, the processing engine will automatically cause the display **82** of the computing device **64** to dim, since this device is not currently being used. Alternatively, if the user touches the keyboard **50** relating to the computing device **64**, then the processing engine will cause the display **84** of the vital signs measuring device **60** to similarly be dimmed. Such dimming of the dormant device can be selected according to this embodiment until the user presses a predetermined button or buttons on either device interface. Alternatively, the user can elect to dim both displays **82**, **84** when the workstation **20** is not in use or when the station is in a patient area, for privacy purposes, such as those relating to HIPPA.

Sample graphical user interface displays are illustrated in FIGS. **11** and **12** relating to two different display modes of the herein described workstation **20**. For purposes of this discussion, the display that is described refers specifically to that of the computing device **64** for ease of explanation.

FIG. **11** represents a graphical user interface for a single patient encounter covering a current situation, wherein the encounter can be recorded using a plurality of display windows. This particular display is obtained by opening one of a plurality of folders **507** provided at the top of the display. For the display mode of FIG. **11**, the "Vitals" folder is opened. In a first display window **486**, a body representation **488** is provided along with a plurality of data entry boxes that are provided to the user. Several of the data entry boxes **490**, **492**, **493**, **494**, **495**, **496**, and **497** are specifically arranged in relation to portions of the body scale representation **488** to provide a proper guide to the user in the taking of specific physiologic parameters, including pain, respiration, glucose, body temperature, heartrate, blood pressure and pulse oximetry, respectively. An additional data entry box **498** is provided to enter weight and height measurements, as well as body mass index (BMI) which can be calculated by the processing engine of the workstation or the vital signs device. Each of the boxes is labeled, wherein certain of the boxes are shown in relation to representations on the body to assist the user. For example, the pulse oximetry data entry box **497** is disposed in proximity to a depicted finger sensor and the blood pressure data entry box **496** is disposed in relation to an arm cuff depiction on the body representation **488**.

The first box **490** representative of pain requires manual entry by the user from a scale of 0-10, in which 0-2 indicates no or little pain and 5-10 indicates higher levels of pain. The second data entry box **492** is representative of respiration rate in breaths/minute, the values also being entered manually along with the type qualifier. Using a touchscreen, the type qualifier can be entered from a menu of choices provided, as discussed below. A third data entry box **493** is representative of glucose, as measured in mg/dL, the value also being manually entered according to this embodiment. On the right hand side of this display window **486** are additional boxes **494**, **495**, **496**, and **497** for entry of body temperature, heart rate, blood pressure, and Sp02, respectively, as automatically or manually obtained by the vital signs device **60**. It should be pointed out that patient heart rate can be obtained by either of the temperature, pulse oximeter or blood pressure modules. Typically, one of these modules is preset as the preferred module (e.g., thermometry when axillary). In addition to the readings as communicated from the vital signs device, qualifiers can also be added, such as position or method qualifiers, for example, for blood pressure, the data entry box permits the cuff size (adult, large adult, pediatric) extremity (left arm, right arm, left leg, right leg) and position (lying, sitting, standing) to also be added in addition to the reading, each of the qualifiers being accessed if using a touchscreen using the stylus **66** or through cursor control if using a keyboard **50**. As noted, each of the boxes point to representative parts of the represented body display **488** in order to assist the operator. Though the body scale representation is illustrated to provide a suitable means for indicating whether each of the readings has been take, it should be noted that alternative means can be used to indicate the measured values. For example, a blood pressure reading could be represented as they would appear on an actual dial gauge in addition to the measured readings.

As noted, this display window **486** also permits entry of other measurements such as height, weight and body mass index in a separate data entry box **498** using a physical keyboard or using a simulated keypad provided on the touchscreen.

Still referring to FIG. **11**, another display window **499** provided on the graphical user interface permits written annotated notes relating to the patient. In addition to the above, the herein described workstation includes means for audio recording, for example, during rounds. As such, notes can be made by a first caregiver pertaining to a particular patient(s) in the instance when a nurse leaving a shift may not have sufficient time in order to speak with the oncoming nurse. According to this embodiment, audio files can be stored with other patient data and can be accessed by a user when the vitals information of the patient is accessed. The audio file can then played back through the user interface on the display. In addition, the user can prioritize audio messages that are left on the workstation, for example, so that the oncoming nurse is aware of the most important issues concerning specific patients first.

The preceding permits notes to be easily captured, for example, in the middle of a procedure such that the nurse or other caregiver does not have to jot the information or message on the back of the patient record, on the back of a paper towel, or even on their hands. As such, capturing this information in the above manner assists the clinician in logging their memory for later documentation. A button **500** is provided to enable recording of a new audio message, the workstation further having at least one indicator (not shown) providing an oncoming nurse or staff member information as to whether any audio files are presently available for playback, the audio files being time and date stamped.

The display further permits other data, such as ECG waveform data, from another instrument connected to the workstation to be displayed in a separate display window **502**. The incorporation of an ECG monitoring assembly **576** for use with the workstation is depicted, for example, in FIGS. **13**A, **13**B, and **14**.

The heart rate and the respiration numbers as each appear on the graphical user display are caused to flash, according to one version of the invention, at the same rate as the currently measured rate, even if the measured rate includes irregularities. This form of indication is highly useful in that it easily permits doctors or other users to quickly gauge the status of the patient. For example, a patient with a high heart rate will be indicated with a fast flashing rate. Other parameters, such as respiration rate, could similarly be represented.

In addition, the graphical user interface **485** depicts a time and date stamp **504** as well as providing a connectivity status message **505** with regard to a remote site, such as an EMR, a pictorial depiction **506** of the strength of the radio connection with a remote site through a wireless link, as well as a similar depiction **508** of the state of the battery **35**, FIG. **1**, of the workstation **20**.

In addition to the above, the patient display includes a listing of patient arid user demographics **509**, **511** in addition to a captured image **510** of the patient.

Values on the data capture screen that have been already recorded are highlighted; those that still need to be measured are highlighted in a different manner. For example, those that need to still be captured can be shown in gray scale. This will assist a user who is distracted or otherwise interrupted in mid-reading, such as by an emergency, a conversation with the patient or staff member, or other cause.

After all patient information is captured, the user can elect to save the information for storage by the processing engine of the workstation by pressing a save button **512** provided on the interface **485**. Alternatively, the saving process can be automated after a predetermined time or when the user switches to a new patient context.

FIG. **12** illustrates a second display mode in which historical patient data can be shown, as reports selected as a folder **507**, both tabularly and graphically, for a specific predetermined period of time, selected by the user through menu window **515**. A representative set of blood pressure readings are illustrated graphically, shown as **516**, with tabular data being provided for each of temperature, blood pressure, Sp02, respiration, weight, and pain, the values being shown as **518**.

The display interface **489** further includes a print button **520** that can be accessed to print the trended data. As shown in FIG. **12**, values that are outside of a normal range, the range being stored internally, are highlighted, shown as **519**. These highlighted values are indicated, whether on the trended data or in the table which readings are being measured, recorded, or automatically measured and recorded.

Prior to describing additional features, alternative structural embodiments of the herein described workstation are now herein briefly described for the sake of completeness. A second embodiment of a mobile medical workstation in accordance with the present invention is shown in FIGS. **13**A, **13**B, and **14**. In this embodiment, the mobile medical workstation **530** is similarly constructed to the first embodiment in that the workstation is defined by a wheeled chassis having a vertically movable upper portion and a lower base **537** interconnected by a vertically extending post member **539**. The upper portion includes a horizontal working surface **534** and supports a number of components including a computing device **538** and a vital signs device **542**. The vital signs device **542** according to this embodiment is the identical device used in the preceding embodiment. The computing device **538** is similar in terms of processing capability, but instead includes a monitor **546** that is separately disposed relative to a hard drive **550** that is secured to an upper post member **554**.

The workstation **530**, according to this embodiment, further includes a bar code scanning device **560**. Unlike the preceding embodiment, however, the bar code scanner **560** used in this embodiment is a presentation scanner, such as the Model IMAGETEAM 4620 Cordless 2D Imager made by Hand Held Products, Inc., of Skaneateles Falls, N.Y. As shown most clearly in FIG. **14**, the scanner **560** includes a grippable handle **564** as well as an imaging head **568**, the scanner being disposed in a slotted portion **576** of a base member **572** set within a tray **575** that is attached to the bottom of the horizontal work surface **534**. In the attached position, the imaging head **568** is set at a preferred angled or presentation position relative to the horizontal work surface **534**. The scanner **560** is electrically connected according to this embodiment using a USB or other type of connection with the workstation **530** and the processing engine thereof, through cables **577**.

In addition, this workstation **530** further includes an ECG monitoring assembly **576**, such as a Welch Allyn CardioPerfect PC-based ECG Model CPR-UN-UB-D, which is attached to a USB port (not shown) of the workstation **530** so as to be interconnected with the processing engine of the workstation. According to this embodiment, the ECG monitoring assembly includes a digital ECG module **578** which receives a plurality of lead wires **582**, each of the lead wires having an electrode (not shown) attached for placement on the patient in a known manner. The digital ECG module **578** includes a contained processor which converts the analog electrical signals received from the patient into digital values that are transmitted along a transmission cable to the computing device via a serial, USB, or other hardware connection. The processing engine of the workstation **530** is further programmed with a software utility that permits the processed signals to be displayed as waveforms, such as shown in FIG. **12**.

Referring to FIGS. **13**A, **13**B, as well as those workstation embodiments shown in FIGS. **15**A and B, **16**A and B, and **18**A and B, the herein described ECG monitoring assembly **576** is attached to a vertically extending flexible gooseneck **590** that extends from the supporting structure of the workstation **530**, enabling the assembly to be stored conveniently for access.

In use, the ECG data can be displayed (e.g., waveforms) as opposed to having to rely solely upon a separate device or a central monitoring station. As such, the herein described workstation permits itself to effectively become an ECG cart, as needed. As in the preceding, the ECG data, like the other vitals data can be stored into memory. That is to say, a predetermined amount of waveform data can be stored for use.

The herein described workstation **530** further includes a keyboard tray **536** which retains a keyboard connected to the computing device. In addition, a mouse **545** is also provided, each being interconnected to the processing engine of the workstation to act as input devices. The workstation **530** also includes baskets **541**, **543** for the storage of accessories. The workstation works similarly wherein vitals, including temperature, blood pressure, SpO2, heart rate, and ECG can be captured along with other information in a patient encounter for storage and for transmission of stored vitals to an EMR or other information system.

A third embodiment of a mobile medical workstation **630** in accordance with the present invention is herein described with reference to FIGS. **15**A and **15**B. This embodiment is nearly identical structurally to that of FIG. **1-6**, including a wheeled chassis including a vertically movable upper portion and a lower base **634** that supports a battery **635**. The upper portion and the lower base **634** are connected by a supporting structure in the form of a vertically extending post member **639** in which the upper portion includes a horizontal working surface **644**. The upper portion supports a computing device **664** and a vital signs device **660**, as well as a bar code scanner **560**, like that previously described in FIG. **14** and similarly disposed. Storage containers in the form of baskets **616** and **648** are also provided to store accessories and disposables in connection with the supported devices. The workstation further includes a keyboard tray **636** for retaining a keyboard and a mouse **545**, each of which are interconnected to the computing device **664**.

As previously noted, other vital signs monitoring devices can be used. In this embodiment, the vital signs device **660** is a Welch Allyn VSM-300 Monitor. The workstation further includes an ECG monitoring assembly **576**, like that previously described, the assembly including a digital ECG module **578** connected to a set of leadwires **582**. As in the preceding, each of the devices **664** and **660** are mounted such that their respective displays are juxtaposed; that is, the displays face opposing directions wherein the processing engine of the workstation permits selective control of each display in order to provide privacy and security to the patient.

A fourth embodiment of a workstation **730** is depicted in FIGS. **16**A and **16**B. According to this embodiment, the workstation is similar in that it includes a lower base **734** with a contained battery **735**, an upper portion that includes a horizontal work surface **744**, the upper portion and the lower base being separated by a vertically extending post member **739**. The horizontal work surface **744** includes a keyboard tray **768** therebeneath for retaining a keyboard **766** and also includes a mouse **545** which, as in the preceding, is used as an additional input device for a computing device **764** supported on the horizontal work surface. The workstation **730** further includes a pair of storage containers or baskets **716** and **748** disposed on the side and rear facing sides thereof for retaining accessories or disposables, such as temperature probe covers and the like.

The herein described workstation **730** further includes an extending flexible gooseneck **590** which retains the previously described ECG monitoring assembly **576**. The workstation **730** further includes a bar code scanner **560**, which in this embodiment, is a presentation scanner that is similarly configured to that shown in FIG. **14** relative to the horizontal work surface **744**.

In this embodiment, the ECG monitoring assembly **576** is the only dedicated medical diagnostic instrument onboard the workstation **730**. In this embodiment, there is no dedicated vital signs device. Alternatively, a container **780** is provided on the rear side of the computing device display for providing storage for supplies needed for ECG (or other) procedures, such as disposable electrodes and skin preparation materials.

A fifth embodiment of a mobile medical workstation **830** made in accordance with the present invention is depicted in FIGS. **17**A and B, and **19**A-**21**. The workstation **830** includes a wheeled chassis that includes a lower base **834** and a vertically movable upper portion, as shown more clearly in FIGS. **19** A and B. A contained rechargeable battery **835** is retained by the lower base **834**, the upper portion and the lower base being separated by a vertically extending post member **839**. The upper portion, like the preceding embodiments, includes a horizontal working surface **844** that is used to support a plurality of components, namely a monitor **864** and vital signs monitoring device **860**. The supporting structure of the workstation **830** includes a pair of baskets **816** and **848** as well as a laterally extending drawer **884** which retains an ECG monitoring assembly **576**, the drawer being located beneath a pull-out keyboard tray **852** that retains a keyboard **854**. The workstation **830** further employs a mouse **545** as well as the keyboard as an input device for a computing device, described in greater detail below.

The herein workstation **830** includes a bar code scanner **870**, which according to this embodiment is cordless and utilizes an access point **880** mounted to the rear of the monitor **864**. The display **864** is interconnected to a computing device according to this embodiment that includes a post mounted hard drive **868**. As to the presentation scanner according to this embodiment and referring to FIG. **20**, the scanner **870** is attached to a rear portion of the horizontal work surface **844**, such that the handle **874** is retained within a angled slotted portion **877** of a bracket **879**, forming a hands-free stand, the bracket being part of a tray member **885** attached to the bottom of the horizontal work surface **844**. In this position, the imaging head **876** of the scanner **870** is aligned angularly with a front facing portion of the work surface. Presentation mode allows the scanner **870** to be left in the hands-free stand and automatically scan for barcodes as objects having barcodes are held in front of the scanner without the user having to manually enable the trigger of the scanner. When the scanner **870** senses an object in its field of view, it automatically illuminates the target and attempts to read the barcode(s).

A sixth embodiment is depicted in FIGS. **18**A and **18**B. This particular workstation **930** is similar to the preceding in that it includes several of the features thereof. The workstation **930** includes a lower base **934** as well as a vertically movable upper portion. The upper portion includes a horizontal working surface **944** that further includes a keyboard tray **952** and a lateral drawer **984** beneath the tray. The upper portion supports a plurality of components including a display **964**, a vital signs measuring device **960** and a bar code scanner **870**. An interconnected computing device **968** is attached to an upper post member of the workstation **930**. The upper portion of the workstation **930** further includes a vertically extending flexible gooseneck **590**, disposed adjacent a rear basket **948** that is used to retain an ECG monitoring assembly **576**, as described previously.

Each of the preceding embodiments relate to the system architecture previously described with reference to FIG. **7**.

One methodology for how particular thresholds can be set by the herein described workstation is depicted in FIG. **10**. First, physiologic parameters (e.g., blood pressure, glucose, pulse oximetry, body temperature, ECG, and the like) are taken and captured as described above, step **432**, using the vital signs measuring device and are displayed by the graphical interface. Any manual measurements, such as pain, respiration rate and the like, are also added to complete the patient record for the current timeframe, step **436**. Valid ranges for manual vitals measurements according to one version of the workstation are as follows:

Systolic Pressures	60-250 mm Hg
Diastolic Pressures	30-180 mm Hg
Inflation Cuff Pressures	0-300 mm Hg
Heart Rates	10-245 beats per minute
Temperatures	84 F.-108 F.
0_2 saturation	40%-100%
Mean Arterial Pressure	40-190 mm Hg
Weight Range	0-600 pounds
Glucose	0-1000 mg/dl
Height	0-120 inches

In addition, and as previously discussed with regard to the graphical user interface shown in FIG. **11**, the workstation permits the use of qualifiers for certain physiologic parameter being measured, whether manual or automatic. Qualifiers provide additional information concerning the conditions of either the patient (standing, lying, sitting on oxygen therapy, etc) and/or the procedure used to obtain the reading. Preferably, all qualifiers are capable of being deleted or modified, though preferably only through a qualified administrator and not a casual user of the workstation. As such, users of the workstation can merely select (or unselect) qualifiers, such as those as follows.

Blood pressure qualifiers, for example, can include location qualifiers such as the left arm, left leg, right arm, or right leg; position qualifiers such as sitting, standing, or lying; method qualifiers such as the cuff size used; and cuff size qualifiers such as adult, large adult, pediatric, small adult, or thigh. Temperature qualifiers can include location qualifiers such as axillary, oral, rectal, or tympanic. Glucose qualifiers can include whether the patient has had a meal and can further include details about the meal. Respiration qualifiers can include method qualifiers such as assisted ventilator, controlled ventilator, or spontaneous; and position qualifiers such as whether the patient is sitting, lying, or standing. Pulse oximetry qualifiers can include oxygen therapy method qualifiers such as aerosol/humidified mask, face tent, mask, nasal cannula, non re-breather, partial re-breather, T-piece, tracheostomy collar, ventilator, venture mask, room air, or oxymizer; and location qualifiers such as ear and finger. Heart rate qualifiers can includes location qualifiers such as whether the radial artery was used, site qualifiers such as whether the rate as determined on the right or left side of the patient; method qualifiers such as whether an auscultatory method was used; and position qualifiers such as whether the patient was lying, sitting, or standing. Weight measuring qualifiers can include quality qualifiers such as whether the weight is actual, estimated, dry, or wet and method qualifiers such as whether the weight was taken with the patient in a chair, standing or in bed. Height qualifiers can include quality qualifiers such as whether the measurement was estimated or actual.

A determination is then made as to whether there are any patient specific thresholds that have been set by the workstation, step **440**. For example, the patient may be hypotensive and therefore, the lower threshold for blood pressure may be set to a lower value than for a "normal" patient. This determination is made for all of the captured measurements, including the manually captured readings. If custom thresholds have not been made for the patient, then a determination is made, step **444**, for an option to automatically calculate the thresholds. This calculation involves the historical data of the patient for a particular parameter(s). If the option is not implemented, step **448**, then a further determination is made according to this embodiment, as to whether there are any location specific thresholds (e.g., whether the patient has had only the left arm measured for blood pressure, whether the patient has been ambulatory, and/or other similar factors).

If the answer to the above inquiry is in the negative, then global (default) thresholds are used by the workstation to create alerts, step **452**. In the instances in which there are location specific thresholds, then location thresholds are used, step **456**. Similarly, in the instances where the option has been given to automatically calculate patient specific thresholds, then those thresholds are calculated, step **460**. These thresholds could be calculated, for example, using historical patient data to estimate an expected range for future patient data (such using the average plus or minus two standard deviations). Other factors could be included, such as clinical risk of estimating either too high or too low, physiological process, and the age of the data (wherein "older" data can be discounted as compared to more recent data). Finally, in the instances in which patient specific thresholds are being used, then the current patient specific thresholds are used **464**.

Each of the above thresholds can be updated, step **468**, based on current values wherein old thresholds can be replaced with newly derived thresholds. Once the thresholds have either been updated and/or determined for a particular patient, a determination is made as to whether any of the thresholds are exceeded, step **472**. If any thresholds have been exceeded, then an alert is shown on either of the displays of the workstation, step **476**. This alert can consist, for example, in the form of highlighted numbers, such as shown in FIG. **8**, or assume other forms. A user acknowledgement of the alert, step **480**, is made on the user interface of either the computing device and/or the vital signs measuring device wherein the acknowledgement of the alert is also stored in the database of the workstation, step **484**. The alert can also be transmitted to the central monitoring station or other remote station, depending on the condition of the alert.

Referring to FIG. **9**, and in addition to providing highlights for out of range values, such as shown in FIG. **12**, the processing engine **224** of the herein described workstation can be further programmed according to this embodiment with a number of stored algorithms which are used in order to alert or otherwise apprise the user of significant changes in patient conditions based on changes in certain parameters that are being measured by the workstation and other background information, such as susceptibility to sepsis, stroke, and other conditions. Based on these alerts, users will be notified and given background on the reasons the particular alert was sounded. According to one specific example, illustrated in FIG. **9**, the methodology for severe sepsis is illustrated. According to the flow chart shown herein, and according to step **404**, a determination is made of the patient's historic glycemic control ranges. This data can be manually input, entered automatically through connected glucometers, or entered through an electronic laboratory system. According to step **408**, a decision is made as to whether the blood sugar level of the patient is within the predetermined range of 80 to 110 milligrams (mg)/deciliter (dL). If the patient's blood sugar level is within this predetermined range, then a glycemic control score is calculated, step **412**. If the blood sugar level is not within the range, the glycemic control score is also calculated, step **412**.

In parallel, a determination is made, step **416**, as to whether the patient has a known or suspected infection. If the answer to this determination is in the negative, then the glycemic control score, step **412** is used to calculate a sepsis control score, step **424**, which is displayed, step **428**. If the answer to the preceding determination is yes, then a followup determination is made, step **418**, as to whether the patient has at least two (2) signs of systemic inflammatory syndrome (SIRS). These signs include the following:

a). an elevated heart rate greater than 90 beats/minute;

b). a core body temperature which is either greater than 100.4 F or less than 96.8 F;

c). a respiratory rate greater than 20 breaths/minute; or

i). PaCO2 which is less than 32 mm/Hg; or

ii.) Mechanical ventilation for acute respiratory process;

d). a white blood cell count of greater than 12000/mm^3 or less than 4000/mm^3; or

i). 10 percent immature neutrophils.

If at least two of the above signs are not determined to exist, then step **424** ensues and the sepsis alert score is calculated using the control score determined in step **412**. If at least two of the above signs are determined to exist, step **420**, then a further determination is made to determine if at least one organ is failing or is dysfunctional. The most common organs that fail are those in the cardiovascular and pulmonary systems. Cardiovascular dysfunction is present if the patient requires a vasodepressor (e.g., norephinephrine or dopamine) to maintain blood pressure, provided that an adequate fluid challenge has been administered. Pulmonary dysfunction is present if a patient requires a fraction of inspired oxygen (FIO2) of 0.50 and has oxygen saturation measured by pulse oximetry values of less than 95 percent, or a PaO2 of less than 100 mm Hg. Patients receiving antibiotics, a vasodepressor, and/or mechanical ventilation consistently meet the criteria for severe sepsis with a high risk for fatality. If the above determination indicates that there is no failing or dysfunctional organ, then step **424** ensues and a sepsis alert score is calculated using the glycemic control score, step **412**.

Other examples of patient alerts on the herein described mobile medical workstation using stored readings and other information will be readily apparent to those in the field. For example, a similar alert can be provided when the blood pressure drops below an expected range for a hypertensive or hypertensive patient.

In addition to providing an alert for the user, each clinical parameter which is being measured by the workstation **20** can also be "graded", based on the likelihood of its estimated accuracy. For example, noisy or older blood pressure measurement readings are derated as compared to more current readings. Similarly, manual readings may be given a higher or a lower weighting, for example, depending on whether the manual reading has actually changed. That is to say, a respiration reading that indicates there has been no change may in fact indicate that no reading has been taken at all, as has been known to happen.

The user can be given feedback on the likelihood of getting alerts or false alarms, based on historical data. This will help users set patient specific alerts and help reduce the chance that the alerts will be set too loosely or too tightly. The latter provides guidance for an acceptable range for setting alerts.

According to the present embodiment, the alerts can default to floor level alerts, but the thresholds for the alerts can be moved to more specific values as more is learned about the patient and expected and typical variations in parameter readings.

According to another version, the present medical mobile workstation is equipped to inform the use of the correct inflation cuff or sleeve size for use in measuring blood pressure, since readings can be inaccurate with the wrong cuff size (e.g., use of a pediatric cuff on an adult). The cuff size can be determined by measuring the amount of air being pumped into the cuff at the time of inflation.

Alternatively, the scanning device **52**, FIG. **1**. can be used in conjunction with the workstation to read a machine scannable label (not shown) located on the inflatable cuff (not shown) itself, which the user can scan using the device prior to taking a measurement in order to document the size of the cuff that is being used. The cuff can be read by either removing the scanner from the workstation or alternately using the presentation mode, as shown in the embodiment of FIG. **18**.

According to one version of the invention, the software provided in the workstation (e.g., either in the computing device and/or in the vital signs device) can be programmed such that the user must first scan the machine readable label using the scanning device **52**, FIG. **1**, each time a blood pressure measurement is to be taken. Alternatively, the scanning of the label could take place after the cuff has been secured to the patient wherein the scanning of the label itself initiates the inflation of the cuff and the measurement of the patient. According to the preceding, the scanning step herein described can be used to accomplish multiple tasks; that is, to document the cuff being used and identify the cuff size, as well as to initiate the measurement by starting the inflation pump.

In the presentation mode, the scanner can effectively scan any item placed on the horizontal work surface, such as prescription bottles, patient records (not shown), and the like. The scanner can also be removed as needed from the socket wherein the scanner can either be attached to the computing device of the workstation by means of a wired connection or alternatively through an RF or other wireless (e.g., cordless) connection.

The use of the herein referred to scanner permits an additional feature with regard to the herein described mobile medical workstation. This feature relates to the measurement of a patient's fluid balance though the relative measurements of intakes and outputs. According to previously known methods, measurement of a patient's fluid balance has required manual, imprecise methods, such as the gauging of the amount of fluid contained in a urine bag or alternately, the amount of fluid remaining in a cup of water. The nurse or clinician would be pressed to perform arithmetic operations based on the above gauged measurements resulting in a labor intensive and often error prone process.

According to a version of the present invention, each fluid container used by a patient can include a series of bar-code or other machine codable labels. These labels are predisposed at specified locations, preferably along the exterior of the container, so as to indicate a predetermined amount of fluid. In use, the user would scan the bar code label at the location of the container closest to that of the resulting fluid level. Among the encoded information contained on the label would be the type of liquid (e.g., water, urine, etc) within the container, as well as the volume of fluid in the container based on the location thereof.

In operation, the user scans a container label, which is then decoded by the scanner, and the processed results are stored within the microprocessor of the workstation and or selectively displayed on either the display of the computing device and or the display of the vital signs measuring device. Upon repeated readings, depending on whether the fluid indicates inputs or outputs, the workstation is further programmed to update previous results and store current results. A tabular or other listing of all fluids for a predetermined period can also be accessed from memory for display, if required, wherein the results can also be transmitted along the wireless link to the EMR or other remote station, as needed.

In addition to the preceding as to determination of the cuff size, the herein described workstation **20** can further be programmed to more efficiently and reliably take blood pressure readings based on the already known history of a patient(s). According to this version of the invention, the microprocessor of either the computing device and/or the vital signs measuring device can effectively record a trended history of the patient, including the patient's blood pressure readings, such as shown according to FIG. **8**. A patient specific history can be developed using these measurements wherein it can be ascertained whether a patient is hypotensive (i.e., having low blood pressure) or hypertensive (i.e., having high blood pressure).

By reference to the already existing record of patient readings, such as those shown in FIG. **12**, the workstation **20** can be programmed such that the blood pressure measuring module can be set to inflate an attached cuff to a predetermined inflation pressure, as based on the historical data of the patient. For example, if a patient is hypotensive and has not had a systolic blood pressure reading that has exceed 100 mm Hg, then the workstation **20** can be programmed such that the patient will not have his or her cuff inflated above 120 mm Hg, instead of the normal 160 mm Hg that the blood pressure module is typically set (the default pump setting). According to this embodiment, a sufficient or predetermined number of readings within a specified time period would first have been accumulated prior to implementing any customized inflation pressure setting.

Alternatively and for hypertensive patients, the blood pressure module can be programmed by instructions stored in either the computing device and/or the vital signs measuring device, also based on historical data, to inflate the attached cuff to a predetermined inflation pressure that is greater than the default pump setting in order to obtain a more reliable measurement, with the measurement being made in a shorter amount of time. The latter technique would avoid having to inflate the cuff at the default setting, not be able to obtain a suitable reading based on the blood pressure reading history of the patient, and having to reinflate the cuff a second time to a higher pressure in order to obtain an accurate blood pressure reading. As should be apparent, the preceding operation is less intrusive to the patient and is much more efficient.

In addition to the above, the herein described blood pressure module can be also be selectively programmed to operate as a tourniquet in order to perform venipuncture, in addition to performing blood pressure measurements. According to one version, the inflatable cuff, when attached to the patient prior to phlebotomy, can be used to measure blood pressure in the above described manner. Immediately following this measurement, the module, as programmed by the computing device, reinflates the cuff to a precise pressure (e.g., preferably to that pressure where the pressure vacillates due to heart pressure pulse). At this pressure, the cuff permits the nearby blood vessels to distend, making these vessels much easier to detect and to puncture, such as for the taking of blood samples. The cuff automatically deflates after a predetermined period of time, for patient safety, or alternatively the procedure can be stopped manually at the user interface.

The herein described workstation provides a mobile communications portal for the hospital environment setting. According to one version, the workstation includes a speakerphone or a headset that enables the user to make or place VOIP (Voice on Internet Protocol) calls directly from the patient's bedside.

In addition, the computing device of the workstation permits email access by way of the above described Internet connection wherein the user can further access, for example, the message system of an EMR, a consulting physician, or other contact, as needed. To handle HIPAA concerns, the e-mail can have any reference to patient demographics removed and instead provide the physician with a web link (requiring a password) to view the data.

Additionally, users can selectively or automatically page clinicians and staff through the PC-based system at the patient's bedside. For example, the user can selectively page housekeeping when a room needs to be cleaned, or the workstation can be configured to automatically page the nurse's station when anomalous readings are confirmed, or the pharmacy can be similarly paged in order to obtain a prescription. Varied other uses can be imagined, as the preceding list is merely one example.

Referring now to FIGS. **8** and **22-25**, additional discussion is made concerning the potential connectivity of the herein described workstation in a hospital or physician office environment.

Referring first to FIG. **8**, there is depicted a pictorial representation of a mobile workstation **1200**, as previously described herein, linked to a hospital network **1204** by way of a WiFi (802.11(b)) bi-directional wireless connection **1203** wherein the network includes a web server **1208** configured with a measurement database network application **1212** that synchronizes data from the workstation and permits communication with other remote stations, such as remote PC stations **1216** equipped with software **1217** to allow viewing and editing of data obtained over the network. The network application software **1212** further permits interconnection to a Health Information System (HIS) or Electronic Medical Record (EMR) database **1220** wherein vital trending and archiving can be performed. In addition, the software application **1212** permits notification of abnormal readings while the web server permits remote access of data by review stations **1224** over the Internet.

Additional examples of remote interconnection schemes are depicted in FIGS. **22-25**, these examples being described in greater detail in U.S. Ser. No. 10/643,487, previously incorporated above in its entirety. For example, FIG. **22** represents, by way of example, a plurality of workstations **1300** in connectivity with a plurality of physiological parameter measuring instruments and a hospital network **1304**.

Still referring to FIG. **22**, the workstation(s) **1300** can be placed into wireless communication linkage using Bluetooth, WiFi (802.11(b)) or other wireless protocol with other components, and particularly with other devices found in the patient room, for example a vital signs collector **1308**, such as the Spot vital signs collector manufactured by Welch Allyn, Inc., and an infusion pump **1312**, such as, for example those manufactured by Abbott Laboratories, Inc. As previously noted, the specific details of any of the above noted wireless communications protocol are known in the field and of themselves are not considered part of the invention. Similar connections can also be made between the workstation **1300** and other portable devices **1316**, **1320**, such as other vital sign monitors such as the Welch Allyn Propaq and Welch Allyn Micropaq monitors, for example.

The workstations **1300** in this example are further configured into a computer network **1326** wherein data from the workstations is transmitted by means of a 802.11a/b/g protocol using a workstation server **1330** that is further linked by an Ethernet connection to a remote computer review station **1334** and a Computer Information System or Health Information System (CIS/HIS) **1338**, such as an Electronic Medical Record (EMR) system. In operation, the wireless connection between the instruments **1308**, **1312** and the workstation **1300** permits patient data to be acquired using the contained scanning device or keyboard controls, or alternately a specific control button on the console of the workstation **1300**. As to the wireless control of each of the infusion pump **1312** and the vital signs collector **1308**, the communications linkage with the workstation(s) **1300** enables control of each so as to provide a virtual control interface at the workstation **1300**. Readings are taken, in the case of the vital signs collector **1308** and are transmitted to the workstation **1300**. The readings are stored into memory of the computing device on board the workstation **1300** and can then be uploaded onto the hospital network **1304**, either automatically when the workstation **1300** passes an appropriate wireless access point (not shown) in the hospital, or selectively by way of a control button or by keyboard control enabling same on the workstation, for example.

Referring to FIGS. **23-25**, there are shown other alternative embodiments for network connections involving the herein described mobile medical workstation. For purposes of these embodiments, by way of example, certain specific integrated instruments have been selected for use with the workstation, shown herein as **1400**. In FIG. **23**, a single workstation **1400** is shown only diagrammatically. According to this embodiment, the workstation **1400** includes an integrated bar code scanner **1408**, a digital scale **1412**, such as those manufactured by Tanita, mc, and an ECG assembly **1418**, such as Welch Allyn's Cardio Control Module, each of the foregoing components being hard wired in this example, such as through a USB or other suitable connection, to the computing device within the supporting structure (not shown) of the workstation **1400**. A vital signs collector **1430** is wirelessly connected via Bluetooth or other suitable protocol thereto. In this embodiment as shown, the digital scale data is collected by the vital signs collector **1430**, with both sets of data being transmitted wirelessly to the workstation **1400**. Alternately, the digital scale **1412** could communicate directly with the workstation **1400**.

The workstation **1400**, being mobile, is capable of uploading information when it passes an appropriate wireless access point **1434** through connection with a hospital network, as previously noted, using an 802.11(b) or other suitable protocol in which the data can be transmitted to an CIS/EMR system **1442** through an Ethernet connection **1438**.

Referring to FIG. **24**, a small plurality of workstations **1400** (approximately 3-10 workstations) are shown for connection, each of the workstations also similarly including the wired connections with the scanning device, ECG monitoring assembly **1418** and the digital scale **1412** with the computing device **1406** of the workstation **1400**. Only one each of the above devices is shown for clarity purposes. The computing devices **1406** are linked through an access point **1434** (only one of which is shown) in the hospital setting to a server **1444** and a Health Information System/Electronic Medical Record (HIS/EMR) system **1448**, the latter being suitably linked through a wired Ethernet connection **1438**.

Referring to FIG. **25**, a larger plurality (greater than 20) of workstations **1400** are depicted for use in a hospital/office local area network (LAN) **1450** in which the computing devices **1406** are linked wirelessly thereto by means of wireless access points **1434**. The network **1450** further includes an interconnection whereby data from the workstation **1400** can be uploaded to one of a computer workstation **1454**, a tablet PC **1458**, and/or a pocket PC **1462**, each of these components also being wirelessly linked to the network **1450** by means of an 802.11 protocol. The network **1450** also provides a remote Internet connection through a firewall **1464** to a number of similar devices **1463**, the data being managed by an appropriate web server **1466**.

The network **1450** also includes multiple servers in the form of application servers **1470**, an SQL (Structured Query Language) Server Cluster **1474**, and an HIS/EMR System **1476**, which allow for remote viewing and analysis of data collected by the workstation **1400**. It should be readily apparent that other variations are possible within the intended scope of the present invention.

PARTS LIST FOR FIGS. 1-25

16	user
20	mobile medical workstation
24	lower base
28	support structure
29	legs
30	brake lever
31	fasteners
32	wheels (casters)
35	battery
36	larger diameter post member
38	main post member
39	lever
40	upper portion
44	horizontal work surface
48	keyboard tray
50	keyboard
52	bar code scanner
56	slot
60	vital signs measuring device
62	angled bracket
64	tablet PC
66	stylus
68	docking station
76	conformed recess

-continued

PARTS LIST FOR FIGS. 1-25

80	controls
82	display
84	display
86	user interface
94	thermometry unit
98	basket
100	handle
101	fasteners
102	bracket
104	storage container
220	workstation
224	processing engine
228	vital signs collector
232	barcode scanner
236	barcode control interface
240	camera
244	illumination system
248	folding display
252	instrument modules
256	local display
260	display interface
264	display
268	power supply
272	printer
276	communication interface
278	mouse interface (keyboard)
279	button interface
280	audio input
288	biometric data collector
292	fingerprint reader
296	voice encryption module
300	retinal scanner
304	facial recognition
308	audio output
312	medical instrument or device
316	network interface
404	step
408	step
412	step
416	step
420	step
424	step
428	step
432	step
436	step
440	step
444	step
448	step
452	step
456	step
460	step
464	step
468	step
472	step
476	step
480	step
484	step
485	graphical user interface
486	display window
488	body scale representation
489	display interface
490	data entry box
492	data entry box
493	data entry box
494	data entry box
495	data entry box
496	data entry box
497	data entry box
498	data entry box
499	display window - annotation
500	indicator - audio note
502	ECG display window
504	time/date stamp
505	connectivity status
506	radio signal strength indicator
507	folders
508	power indicator
509	patient demographics

-continued

PARTS LIST FOR FIGS. 1-25	
511	user demographics
512	"save" button
515	date range of readings
516	graphical trend data
517	tabular trend data
519	highlighted values
520	"Print" button
530	mobile medical workstation
534	horizontal work surface
535	battery
536	keyboard tray
537	lower base
538	computing device
539	vertically extending post member
541	basket
542	vital signs device
543	basket
545	mouse
546	monitor
550	hard drive
554	post member
560	barcode scanner
564	grippable handle
568	imaging head
572	base member
576	slotted area
578	digital ECG module
590	gooseneck
616	basket
630	mobile medical workstation
634	lower base
635	battery
636	keyboard tray
639	vertical extending post member
644	horizontal work surface
648	basket
660	vital signs device
664	computing device
716	basket
730	mobile medical workstation
734	lower base
735	battery
739	vertically extending post member
744	horizontal work surface
748	basket
764	computing device
766	keyboard
768	keyboard tray
816	basket
830	mobile medical workstation
834	lower base
835	battery
839	vertically extending post member
844	horizontal work surface
848	basket
852	keyboard tray
854	keyboard
864	monitor
868	hard drive
870	bar code scanner
880	access point
884	drawer
930	mobile medical workstation
934	lower base
935	battery
939	vertically extending post member
944	horizontal work surface
952	keyboard tray
960	vital signs monitor
964	hard drive
984	drawer
1200	mobile medical workstation
1203	WiFi wireless connection
1204	hospital network
1208	web server
1212	network software application package
1216	remote PC station
1217	viewing software

-continued

PARTS LIST FOR FIGS. 1-25	
1220	Health Information Systems (Electronic Medical Record) database
1300	mobile medical workstation
1304	hospital network
1308	vital signs collector
1312	infusion pump
1316	medical device
1320	medical device
1330	server
1334	PC station
1338	Health Information Systems
1400	mobile medical workstation
1406	computing device
1408	barcode scanner
1412	digital scale
1418	ECG monitoring assembly
1430	vital signs collector
1434	wireless access point
1438	Ethernet connection
1442	CIS/EMR
1450	Hospital LAN
1454	computing station
1458	PC
1462	tablet PC
1463	devices
1464	firewall
1466	web server
1470	application servers
1474	SQL Server Cluster
1476	HIS/EMR

It will be readily apparent to one of adequate skill that there are numerous variations and modifications that embody the inventive concepts which have been described herein as referred to in the following claims.

The invention claimed is:

1. An integrated apparatus for use in a patient encounter, said apparatus comprising:

at least one medical diagnostic instrument including a vital signs monitoring device for measuring various physiological parameters of a patient, said physiological parameters including blood pressure, glucose, body temperature, pulse rate and blood oxygen saturation; and

a computing device connected to said at least one medical diagnostic instrument, wherein at least one of said computing device and said at least one medical diagnostic instrument are programmed to detect changes in a patient condition based on changes in two or more parameters of said patient and in which said computing device is programmed to alert the user that changes in said patient condition have exceeded at least one predetermined threshold, and

in which the changes in said at least two physiological parameters are used by said computing device to predict the onset of sepsis, wherein said computing device is programmed to calculate a glycemic control score of a patient based on historical data and to determine whether a patient's blood sugar level is within a predetermined range.

2. An integrated apparatus as recited in claim **1**, wherein said computing device is programmed to perform an independent determination as to whether the patient has had an infection.

3. An integrated apparatus as recited in claim **2**, wherein the computing device is programmed to make a further determination to whether the patient has at least two signs of Systemic Inflammatory Response Syndrome (SIRS) if the existence of a known or suspected infection has been determined.

4. An integrated apparatus as recited in claim 3, wherein the computing device is programmed to make a determination as to whether at least one organ of the patient is failing or dysfunctional if at least two signs of SIRS have been identified.

5. An integrated apparatus for use in a patient encounter, said apparatus comprising:

at least one medical diagnostic instrument including a vital signs monitoring device for measuring various physiological parameters of a patient, said physiological parameters including blood pressure, glucose, body temperature, pulse rate and blood oxygen saturation; and

a computing device connected to said at least one medical diagnostic instrument, wherein at least one of said computing device and said at least one medical diagnostic instrument are programmed to detect changes in a patient condition based on changes in two or more parameters of said patient and in which said computing device is programmed to alert the user that changes in said patient condition have exceeded at least one predetermined threshold, and

in which the changes in said at least two physiological parameters are used by said computing device to predict the onset of sepsis, wherein said apparatus is programmed to determine a first control score based on a first parameter and a second alert score based on at least a second parameter.

6. An integrated apparatus as recited in claim 5, wherein said first control score is based on the patient's blood sugar level.

7. An integrated apparatus as recited in claim 5, wherein said first control score is used to determine said second alert score in which said computing device is programmed to alert a user of said apparatus if the alert score exceeds a predetermined value.

* * * * *

专利名称(译)	移动医疗工作站		
公开(公告)号	US8292807	公开(公告)日	2012-10-23
申请号	US12/873765	申请日	2010-09-01
[标]申请(专利权)人(译)	伟伦公司		
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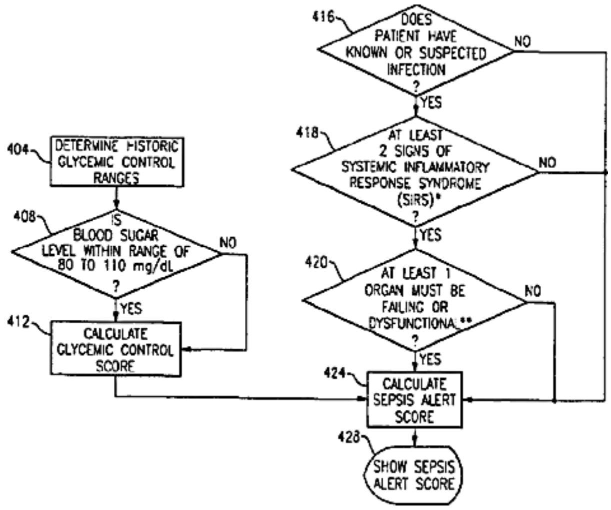
IPC分类号	A61B5/00 A61B5/05 G09G1/14 G08B5/22 G08B23/00 A61B5/02 A61B5/0402 A61B5/117 A61B19/00 A61B19/02		
CPC分类号	A61B5/0002 A61B5/412 A61B5/742 A61B5/7475 A61B19/0248 A61B19/26 A61B5/02 A61B5/0402 A61B5/1172 A61B5/14532 A61B5/1455 A61B5/7435 A61B2019/025 A61B2560/0437 A61B2560/0456 A61B5/743 A61B50/10 A61B50/13 A61B90/50		
优先权	60/404601 2002-08-20 US 60/601450 2004-08-13 US 60/658626 2005-03-04 US		
其他公开文献	US20100324380A1		
外部链接	Espacenet USPTO		

摘要(译)

医疗工作站由支撑结构限定，该支撑结构具有设置在其上的至少一个医疗诊断仪器。第一显示器还设置在支撑结构的第一侧上，第二显示器以与第一显示器基本相对的方式设置在支撑结构的第二侧上。第一和第二显示器中的每一个与至少一个医疗诊断仪器互连，以允许至少一个显示器显示诊断结果并且串联或独立可控。



404
DETERMINE HISTORIC GLYCEMIC CONTROL RANGES
408
IS BLOOD SUGAR LEVEL WITHIN RANGE OF 80 TO 110 mg/dL ?
NO
YES
412
CALCULATE GLYCEMIC CONTROL SCORE
416
DOES PATIENT HAVE KNOWN OR SUSPECTED INFECTION ?
NO
YES
418
AT LEAST 2 SIGNS OF SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS)* ?
NO
YES
420
AT LEAST 1 ORGAN MUST BE FAILING OR DYSFUNCTIONAL** ?
NO
YES
424
CALCULATE SEPSIS ALERT SCORE
428
SHOW SEPSIS ALERT SCORE