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(71) Demandeur/Applicant:
PIBED LIMITED, GB
(72) Inventeurs/Inventors:
ALPER, PAUL, US;
MATTHEWS, SHAUN KERRY, GB
(74) Agent: HILL & SCHUMACHER

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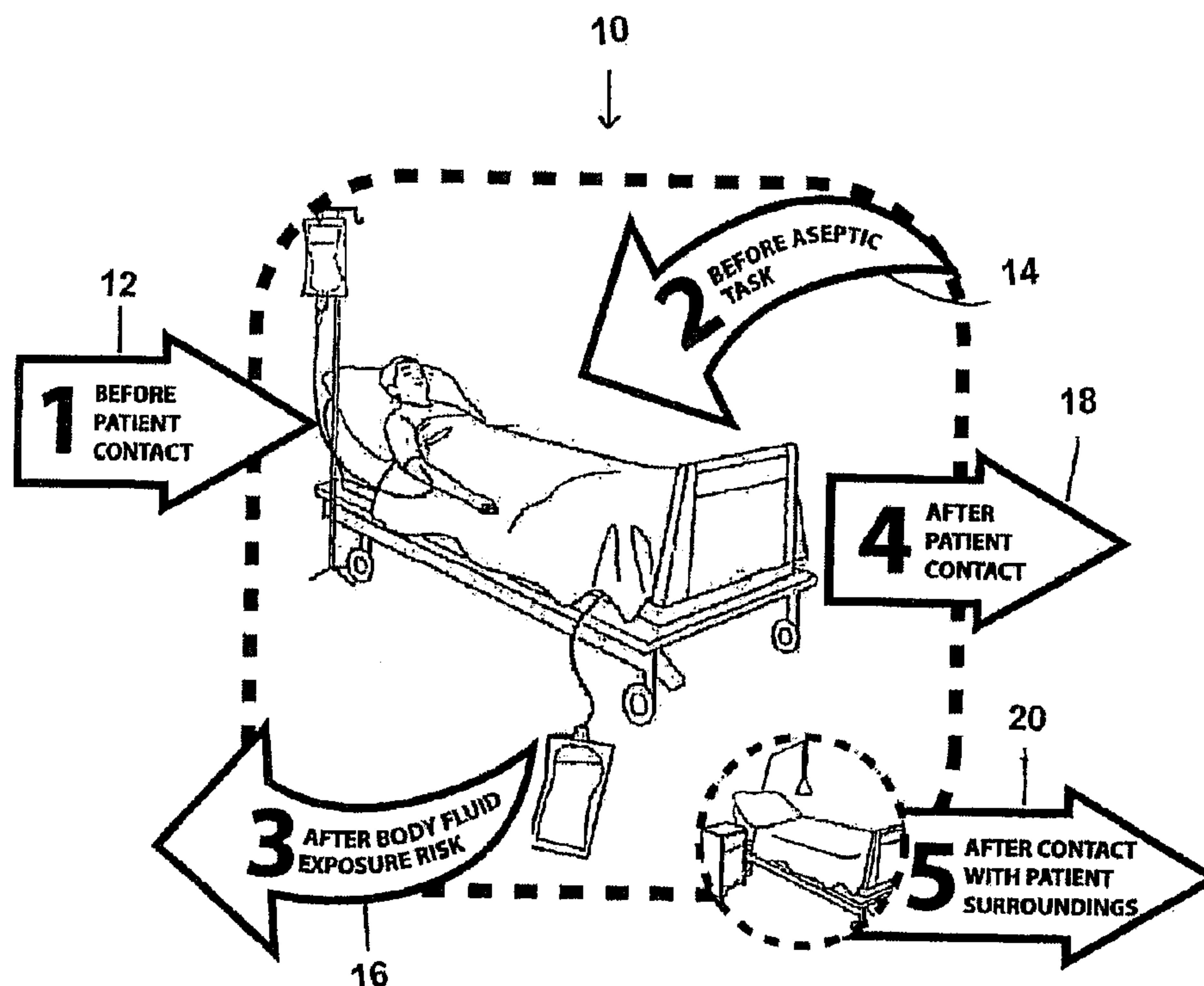


FIG. 1

(57) Abrégé/Abstract:

A group monitoring system for dispenser usage compliance is provided. The system is for a predetermined group of interest in a predetermined facility type. A dispenser data collection system is operably connected to a plurality of dispensers and is capable of

(57) **Abrégé(suite)/Abstract(continued):**

providing information. The information includes a unique dispenser identifier and a number of dispenser usage events. The information from the data collection system is received and the predetermined group within which each dispenser is associated is determined. The number of dispenser usage events is determined. A benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period is determined. The dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period is determined by dividing the dispenser usage events for the predetermined group and the predetermined time period by a denominator which equals the benchmark.

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(71) Applicant (for all designated States except US): **PIBED LIMITED** [GB/GB]; Denby Hall Way, Denby Derbyshire DE5 8JZ (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **ALPER, Paul** [US/US]; 505 Sabine Circle, Wynnewood, Pennsylvania 19096 (US). **MATTHEWS, Shaun Kerry** [GB/GB]; 5 Chapel Lane, Gaddesby Leicestershire LE7 4WB (GB).

(74) Agents: **WITHERS & ROGERS LLP** et al.; 4 More London Riverside, London SE1 2AU (GB).

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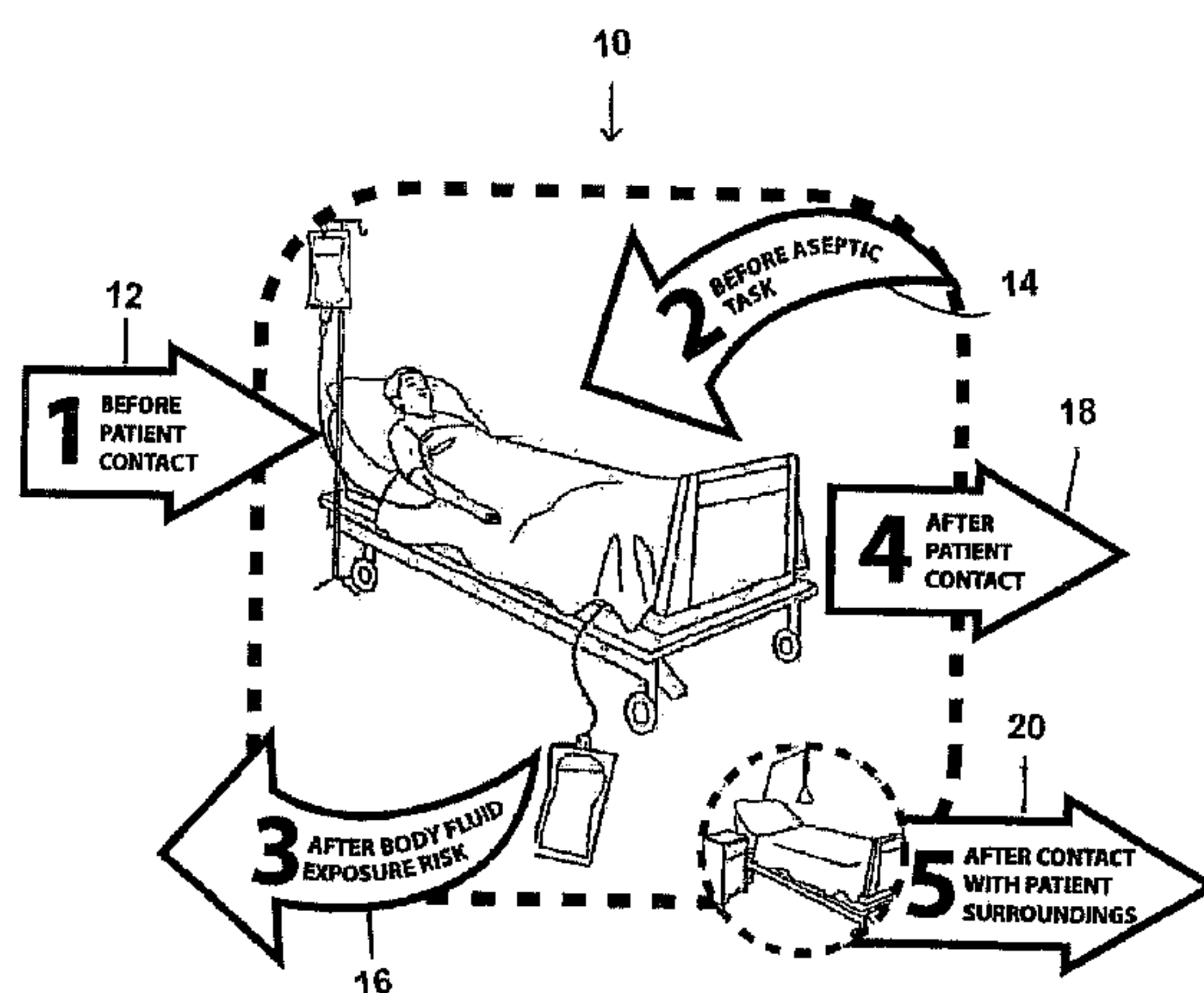


FIG. 1

(57) Abstract: A group monitoring system for dispenser usage compliance is provided. The system is for a predetermined group of interest in a predetermined facility type. A dispenser data collection system is operably connected to a plurality of dispensers and is capable of providing information. The information includes a unique dispenser identifier and a number of dispenser usage events. The information from the data collection system is received and the predetermined group within which each dispenser is associated is determined. The number of dispenser usage events is determined. A benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period is determined. The dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period is determined by dividing the dispenser usage events for the predetermined group and the predetermined time period by a denominator which equals the benchmark.

MONITORING SYSTEM

FIELD OF THE INVENTION

This invention relates to dispenser usage and in particular to a method
5 of monitoring dispenser usage which can be correlated to hand hygiene compliance
or other dispenser usage compliance.

BACKGROUND OF THE INVENTION

The spread of healthcare acquired infections also known as HAI's has
10 been an ever increasing challenge in health care facilities. HAI's include the
transmission of bacteria, viruses and other disease-causing micro-organisms from
various sources such as a patient or environmental surfaces to another patient or
surface via the hands of healthcare workers which results in an infection of a patient
that was previously not infected. These problems have been more apparent in
15 recent years with the SARS (severe acute respiratory syndrome) outbreak and the
influenza A virus H1N1 pandemic. As well, health care facilities have battled MRSA
(methicillin-resistant staphylococcus aureus) and VRSA (vancomycin-resistant
staphylococcus aureus) and other drug resistant micro-organisms for many years.
Accordingly, there is a need to ensure that health care professionals comply with
20 hand hygiene best practices. Hand hygiene can be accomplished using liquids such
as a sanitizing product which does not require water or rinsing off or alternatively it
can be accomplished using a soap and water.

As well there are other types of liquids that can be dispensed such as
sun screen wherein the use of the sun screen similarly needs a method of

monitoring, tracking and reporting. For example such a method could be very important in schools in Australia where the incidences of skin cancer are very high.

SUMMARY OF THE INVENTION

5 In a first aspect, there is provided a group monitoring system for dispenser usage compliance within a predetermined group of interest in a predetermined facility type comprising the steps of: providing a plurality of dispensers, providing a dispenser data collection system operably connected to each dispenser, capable of providing information, the information including a unique
10 dispenser identifier for each dispenser, a number of dispenser usage events that each dispenser was used; receiving the information from the data collection system and determining the predetermined group within which each dispenser is associated; determining the number of dispenser usage events within the predetermined group within a predetermined time period; determining a benchmark
15 which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period; calculating a dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period by dividing the dispenser usage events for the predetermined group and the predetermined time period by a denominator wherein
20 the denominator equals the benchmark.

The number of dispenser usage events within a predetermined time period may equal a number of times the dispenser has been activated however a plurality of activations within a predetermined activation period is considered a single dispenser usage event. The predetermined activation period is typically

between 1 and 4 seconds.

The information may include the type of product in the dispenser and the type of product is typically one of hand soap, sanitizer, lotion, cream, sunscreen and body wash.

5 The predetermined time period may be one of a shift, a weekday, a weekend day, a holiday day each of the predetermined group in the predetermined facility type.

 The benchmark may vary depending on the predetermined facility type. The predetermined facility type may be one of a health care facility, a food
10 processing facility, a food service facility, an educational facility and a manufacturing facility. Alternatively, the predetermined facility type may be one of a teaching hospital, a non-teaching hospital, a long term care facility, rehabilitation facility, a free standing surgical center, a health care professional office, a dental office, a veterinarian facility and a community care facility.

15 Similarly, the benchmark may vary dependent on predetermined group of interest. The predetermined group of interest may be one of a medical unit, a surgical unit, a critical care unit, an intensive care unit, an emergency care unit, a pediatric unit, an emergency unit, an outpatient unit, a specialty care unit, a dermatology unit, an endocrinology unit, a gastroenterology, an internal medicine
20 unit, an oncology unit, a neurology unit, an orthopedic unit, an ophthalmic unit, an ear nose and throat unit, a neonatal unit, an obstetrics and gynecology unit, a cardiac unit, a psychiatric unit, a post-operative recovery unit, a radiology unit, a plastic surgery unit and an urology unit. The predetermined group may be one of a bed, a room, a ward, a unit, a floor, a facility and a hospital group.

The benchmark in the denominator may be multiplied by census data. The census data may be one of bed occupancy rate in the predetermined group, patient days in the predetermined group, patient visits in the predetermined group, bed-hours of care in the predetermined group and staff in the predetermined group.

5 The group monitoring system for dispenser usage compliance may include the step of determining a hand hygiene compliance index. The hand hygiene compliance index may include information from dispenser usage only; weighted information from the dispenser usage compliance index and one of survey compliance data or direct observation compliance data. Alternatively, the hand
10 hygiene compliance index includes weighted information from the dispenser usage compliance index and survey compliance data and direct observation compliance data.

The dispenser data collection system may use a frequency chosen from the group consisting of between 400 and 450 MHz system, between 850 and
15 950 MHz system and between 2.4 and 2.5 GHz. Alternatively, the dispenser data collection system may be a hard wired system.

The dispenser data collection system may use a frequency between 850 and 950 MHz system and has a transmission power of up to 1000 milliwatts. The dispenser data collection system may include a plurality of hubs for receiving
20 data from the plurality of dispensers. Each hub receives data from one or more dispensers and the distance between each dispenser and its associated hub is no greater than 5740 feet. The data may be encrypted.

In another aspect of the group monitoring system for dispenser usage data collection comprising: a plurality of dispensers each having a sensor operably

attached thereto for collecting data from the dispenser; a plurality of hubs capable of receiving data from a plurality of dispensers; and wherein the data is transmitted at between 850 and 950 MHz.

The data may be encrypted. Each dispenser may have a power
5 usage of up to 1000 milliwatts.

Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sketch showing the five moments for hand hygiene in a healthcare setting;

Fig. 2 is a graph showing the compliance index of pediatrics as
15 compared to the facility goal and the hospital aggregate;

Fig. 3 is a graph showing the compliance index of the intensive care unit as compared to the facility goal and the hospital aggregate;

Fig. 4 is flow chart showing different methods for calculating the hand hygiene compliance index;

20 Fig. 5 is a sample dashboard showing an example of the way information may be presented to a user;

Fig. 6 is a diagram showing a wired dispenser data collection system;

Fig. 7 is a diagram showing a wireless dispenser data collection system similar to that shown in figure 6:

Fig. 8 is a flow diagram showing the steps in a low frequency, low power wireless dispenser data collection system;

Fig. 9 is a flow diagram showing the steps in a higher frequency, higher power wireless dispenser data collection system;

5 Fig. 10 is a diagram showing a lower power and lower frequency dispenser data collection system over a specific area; and

Fig. 11 is a diagram showing a higher power and higher frequency dispenser data collection system over the same specific area as covered in figure 10.

10

DETAILED DESCRIPTION OF THE INVENTION

Measuring healthcare worker adherence to hand hygiene compliance guidelines is not a simple matter. There are no proven standards or benchmarks that may be used. However there is a very clear need to monitor and measure hand hygiene compliance. Accordingly there is a need to determine whether or not a hand hygiene action occurred when there was an indication for a hand hygiene action. The five moments for hand hygiene actions in a healthcare setting are shown in figure 1. These five moments of hand hygiene were developed by the World Health Organization. Hand hygiene actions can be sanitizing with a sanitizing product which does not require water or rinsing off or alternatively it can be washing with soap and water.

15
20

As used herein, the term “hub” refers to any network device capable of sending and receiving packets of information and is not to be interpreted as limited to Ethernet hubs, network hubs, or repeater hubs traditionally described in computer

network literature.

As used herein, the phrase “operably connected” or “operably attached”, e.g. “X is operably connected to Y” or “X is operably attached to Y”, indicates that *X and Y* may causally influence each other in operation, though *X* and *Y* do not necessarily have to be physically connected or physically attached. In this phrase, the terms “connected” and “attached” are to be interpreted in an operational sense, and not necessarily a physical sense. For example, if *X* and *Y* are devices capable of sending packets to one another either directly or through a network, then *X* and *Y* are operably connected. As a further example, if *X* is a device and *Y* is a sensor, and *Y* is capable of sensing one or more events occurring as a result of the operation of *X*, then *X* and *Y* are operably connected.

Referring to figure 1 the five moments of hand hygiene action are shown generally at 10. Specifically they are before patient contact 12, before aseptic task 14, after body fluid exposure risk 16, after patient contact 18 and after contact with patient surroundings 20. When considering compliance, if a health care worker only washes or sanitizers his or her hands 6 out of the 10 times that they should have, they are said to exhibit a compliance rate of 60%.

There are a number of ways to measure compliance namely direct observation, remote observation, self-reporting and dispenser usage data or product usage data. Each way has its own benefits and challenges. Specifically direct observation provides specific information on hand hygiene behaviors, techniques and indication. However, the labor and resources required to collect such data is intensive. Generally if this type of data is collected it is only collected for a small sample of the total of hand hygiene opportunities and thus has a typically low level

of statistical reliability. The data is subject to bias from over or under sampling of certain shifts and units. As well, it has been shown that there are also issues regarding inter-rater (observer) reliability and therefore it is difficult to compare the results from one observer or rater with another.

5 Further, it has been shown that if people know they are being watched or studied there is a greater likelihood that the compliance rate will be artificially higher than in reality. This is known as the Hawthorne Effect. Evidence supporting this is found in a 2009 German study that compared product usage data with direct observation data and found that the direct observation compliance rate was 2.75
10 times higher than that for product usage. Thus product usage is gaining acceptance by professionals as a more accurate measure of true compliance rates.

 In regard to remote observation such as video the advantage is that it is less subject to bias and it can operate at any time of day or night and in any unit. However, such a method of data collection is expensive because of the installation
15 and maintenance of the video equipment as well as the time to review the video, such review is then subject to the same lack of inter-rater reliability as direct observation. Further, it can be subject to bias based on the video location. Further, there may be privacy issues in regard to video locations.

 In regard to the self-reporting option, this has the advantage of being
20 low cost and it encourages health care workers with respect to hand hygiene self-awareness. However, in general this type of data collection has poor reliability and most experts in the field consider this method of little, if any, value.

 In typical healthcare environments, hand hygiene liquids are stored and dispensed onto the hands from dispensers, therefore there is a direct

correlation between dispenser usage or activations and hand hygiene events being performed. Dispenser usage data can provide the product volume used per patient day or the number of times the dispenser was used per patient day. This has the advantage of being less costly to monitor. Further, it provides an overall measure of use and it is not subject to selection bias. However, it does not provide feedback for indications or technique. Further, it does not identify low-performing individual staff members. There are a number of further advantages to measuring dispenser usage. Specifically in addition to being less costly it is less resource intense and therefore more efficient than observation. As well it can be done manually or electronically. It allows organization-wide trends to be tracked over time. It can be unobtrusive and designed to take up little additional space. Dispenser usage can be easily measured across all shifts, twenty-four hours a day, and seven days a week. It requires minimal staff training. It can easily be done in many different healthcare settings.

15 In the embodiments herein the dispensers are capable of determining when the dispensers are activated. The number of dispenser usage events within a predetermined time period equals the number of times the dispenser has been activated and a plurality of activations within a predetermined activation period is considered a single dispenser usage event. It will be appreciated by those skilled in the art that a plurality of activations within a short period of time will typically mean one user has activated the dispensers a plurality of times rather than multiple users activating the dispenser very close together. Therefore, a plurality of activations within a 1 to 4 second time frame will be considered a single dispenser usage event. For hand soaps and hand sanitizers in a healthcare facility, this will typically be set

at 2.5 seconds. However, where dispenser usage is being monitored for different types of products indifferent types of facilities, this may be set for a different activation period. Typically dispensers are calibrated to dispense a predetermined amount of liquid for each activation. Accordingly, the dispenser activation directly
5 relates to product usage. Accordingly it will be appreciated by those skilled in the art that when determining a dispenser usage compliance index one could measure volume used or dispenser activations.

In one embodiment dispenser usage alone is used to calculate a dispenser usage compliance index. In another embodiment, a combination of two
10 or more of dispenser usage data, direct observation data and survey data (for example self reporting data or patient survey data) may be used to provide consolidated hand hygiene information. Preferably the information would be automated and in real time. In one embodiment the system would provide automated multi-modal hand hygiene compliance reports. Preferably these reports
15 could be presented by unit and or department. Such automated reporting would provide the hospital's management with the tools to give feedback on compliance adherence; target interventions designed to improve compliance; and reward improved performance.

In one embodiment the hand hygiene compliance index will include a
20 plurality of modes of determining compliance. Specifically it will include data from dispenser usage, observation and/or surveys. Each method is weighted and then combined to create a single index of compliance. The methods are weighted based on, for example, their statistical reliability

To determine the measure of compliance by dispenser usage the

facility being monitored is provided with a plurality of dispensers. The facility may be divided into predetermined groups of interest. The facility may be a teaching hospital, a non-teaching hospital, a long term care facility, a rehabilitation facility, a free standing surgical center, a health care professional office, a dental office, a
5 veterinarian facility and a community care facility as well as other health care settings in which hand hygiene compliance is an important issue. Alternatively the system herein may be used in any facility wherein the hand hygiene needs to be monitored such as at various stages in food preparation including abattoirs, preparing precooked foods and restaurants. The monitoring system could also be
10 used for monitoring compliance with applying such dispensed lotions as sunscreen.

In order to determine dispenser usage compliance one needs the number of hand hygiene events and a benchmark for a predetermined area or group and for a predetermined time. The dispenser usage compliance is the dispenser usage events divided by a denominator wherein the denominator includes at least in
15 part the benchmark. The benchmark is particular to the predetermined group and particular to the predetermined time period. The usage may be measured for each dispenser in the predetermined group in practically real time and the captured data is transmitted electronically. It will be appreciated by those skilled in the art that there is a limited amount of time required for the data to get from the dispenser, to
20 the hub to the server (described below) but this could be set for the messages to be transmitted very frequently. While access to the reports is available twenty-four hours, seven days a week, typically, however, the reports would most likely be presented no more than daily and more likely weekly or monthly. However, if there was a particular outbreak on a ward the usage of the dispenser could be monitored

more frequently by accessing the reports on demand. The number of hand hygiene events within a predetermined time period equals a number of times the dispenser has been activated and wherein multiple activations within a predetermined activation period are considered a single dispenser usage event. It is not
5 uncommon that when someone uses a dispensing system that rather than merely activating once they activate the dispenser multiple times. Accordingly to accurately determine the correct number of dispenser usage events the number of times the dispenser is activated is determined. However where there are multiple activations within a predetermined activation period that is considered a single dispenser usage
10 event. The benchmark is the number of times the dispenser should have been used for a predetermined group over a predetermined time period.

When the dispenser usage compliance relates to hand hygiene compliance in a healthcare facility, the benchmark relates to the five moments of hand hygiene for a predetermined group over a predetermined time period. To
15 determine the benchmark for the predetermined area and time, one needs to determine the hand hygiene occurrences that should occur per patient for the predetermined area and time. This is done with reference to the five moments of hand hygiene as shown in figure 1. It will be appreciated by those skilled in the art that the benchmark will be different depending on a number of variables. For
20 example if the healthcare facility is a teaching facility it is likely that more healthcare professionals will need to see the patient and therefore the benchmark may be higher. The benchmark may vary if the predetermined period is a night shift versus a day shift; if it is a weekday versus a holiday or weekend. The benchmark will likely vary depending on the type of unit. For example an intensive care unit will

likely have a higher benchmark than an orthopedic unit. The denominator may be dependent on the census data. Specifically to determine the denominator the benchmark is multiplied by the census data. For some healthcare facility units or the predetermined group of interest the census data will be the bed occupancy. In
5 some health care facilities or in particular units of the facility this may always be close to 100% whereas in other units or facilities this may vary greatly. In other units, for example, an emergency unit or an outpatient unit, the census data might be the number of patients seen during the shift or over the predetermined time period that is at issue. It may also be the number of bed-hours of care provided
10 during the predetermined time period that is at issue.

Further, it will be appreciated by those skilled in the art that the benchmark may be determined through experiments or other means by the healthcare facility or there may be default benchmarks provided which are provided to the user by the dispenser provider or a central authority.

15 The following are some of the categories which may be used to determine the correct benchmark. The group or types set out below that relate to healthcare facilities and the types of units within them are the Center for Disease Control (CDC) location labels and are by way of example only. It will be appreciated by those skilled in the art that there are a number of different ways of dividing up the
20 units in a healthcare facility.

Facility Types - Healthcare

Hospital - non teaching

Hospital - teaching (affiliated with medical school)

Rehabilitation Facility

Long Term Care Facility

Free Standing Surgical Center

Medical/physician office

5 Dental office

Veterinarian Office

Facility Types - non healthcare

School/educational

10 Correctional

Military

Food service (such as a restaurant)

Food processing (such as a manufacturer of food products)

Pharmaceutical production

15 Commercial building/organization (such as a manufacturer where workers must apply protective creams routinely)

Other facilities where spread of infections by hands is a concern

Adult Critical Care Units

Burn Critical Care

20 Medical Cardiac Critical Care

Medical Critical Care

Medical/Surgical Critical Care

Neurologic Critical Care

Neurosurgical Critical Care

Prenatal Critical Care

Respiratory Critical Care

Surgical Cardiothoracic Critical Care

Surgical Critical Care

5 Trauma Critical Care

Pediatric Critical Care Units

Pediatric Burn Critical Care

Pediatric Cardiothoracic Critical Care

10 Pediatric Medical Critical Care

Pediatric Medical/Surgical Critical Care

Pediatric Neurology Critical Care

Pediatric Neurosurgical Critical Care

Pediatric Respiratory Critical Care

15 Pediatric Surgical Critical Care

Pediatric Trauma Critical Care

Neonatal Units

Well Baby Nursery (Level I)

20 Step down Neonatal ICU (Level II)

Neonatal Critical Care (Level II/III)

Neonatal Critical Care (Level III)

Inpatient Specialty Care Areas

Long Term Acute Care (LTAC)

Bone Marrow Transplant Specialty Care Area

Acute Dialysis Unit

Hematology/Oncology SCA

5 Solid Organ Transplant SCA

Pediatric Bone Marrow Transplant SCA

Pediatric Dialysis SCA

Pediatric Hematology/Oncology SCA

Pediatric Long-Term Acute Care

10 Pediatric Solid Organ Transplant SCA

Inpatient Adult Wards

Antenatal Care Ward

15 Burn Ward

Behavioral Health/Psych Ward

Ear/Nose/Throat Ward

Gastrointestinal Ward

Gerontology Ward

20 Genitourinary Ward

Gynecology Ward

Jail Unit

Labor and Delivery Ward

Labor, Delivery, Recovery, Postpartum Room (LDRP)

- Medical Ward
- Medical/Surgical Ward
- Mixed Acuity Ward
- Mixed Age, Mixed Acuity Ward
- 5 Neurology Ward
- Neurosurgical Ward
- Ophthalmology Ward
- Orthopedic Trauma Ward
- Orthopedic Ward
- 10 Plastic Surgery Ward
- Postpartum Ward
- Pulmonary Ward
- Rehabilitation Ward
- School Infirmary
- 15 Surgical Ward
- Stroke (Acute) Unit
- Telemetry Unit
- Vascular Surgery Ward
- 20 **Inpatient Pediatric Wards**
- Adolescent Behavioral Health
- Pediatric Burn Ward
- Pediatric Behavioral Health
- Pediatric Ear, Nose, Throat

Pediatric Genitourinary

Medical Pediatric Ward

Pediatric Med/Surg Ward

Pediatric Mixed Acuity (if patients are of mixed age, use Mixed Age found in

5 Inpatient Adult Wards)

Pediatric Neurology Ward

Pediatric Neurosurgical Ward

Pediatric Orthopedic Ward

Pediatric Rehabilitation Ward

10 Pediatric Surgical Ward

Step Down Units

Step Down Unit

Pediatric Step Down Unit

15

Operating Rooms

Cardiac Catheterization Room/Suite

Cesarean Section Room/Suite

Interventional Radiology

20 Operating Room/Suite

Post Anesthesia Care Unit/Recovery Room

Long Term Care

Inpatient Hospice

Long Term Care Unit

Long Term Care Alzheimer's Unit

Long Term Care Behavioral Health/Psych Unit

Ventilator Dependent Unit

5 Long Term Care Rehabilitation Unit

Laboratory Identified Event (LabID) Only

Facility-wide Inpatient

Facility-wide Outpatient

10

Miscellaneous Areas

All Inpatient Beds Combined

Float

Sleep Studies (for in and out patients)

15 Pulmonary Function Testing

Transport Service

Treatment Room

OUTPATIENT LOCATIONS

Acute Care Settings

20 24-Hour Observation Area

Ambulatory Surgery Center

Facility-wide Outpatient

Mobile Emergency Services/EMS

Outpatient Emergency Department

Outpatient Pediatric Surgery Center

Outpatient Plastic Surgery Center

Outpatient Surgery Recovery Room/Post Anesthesia Care Unit

Pediatric Emergency Department

5 Therapeutic Apheresis Unit

Urgent Care Center

Clinic (Nonacute) Settings

Allergy Clinic

10 Behavioral Health Clinic

Blood Collection Center

Cardiac Rehabilitation Center

Cardiology Clinic

Continence Clinic

15 Dermatology Clinic

Diabetes/Endocrinology Clinic

Ear, Nose, Throat Clinic

Family Medicine Clinic

Genetics Clinic

20 Gynecology Clinic

Holistic Medicine Center

Hyperbaric Oxygen Center

Infusion Center

Neurology Clinic

- Occupational Health Clinic
- Occupational Therapy Clinic
- Ophthalmology Clinic
- Orthopedic Clinic
- 5 Ostomy Clinic
- Outpatient Dental Clinic
- Outpatient GI Clinic
- Outpatient Hematology/Oncology Clinic
- Outpatient Hemodialysis Clinic
- 10 Outpatient HIV Clinic
- Outpatient Medical Clinic
- Outpatient Rehabilitation Clinic
- Pain Clinic
- Pediatric Behavioral Health Clinic
- 15 Pediatric Cardiology Center
- Pediatric Clinic
- Pediatric Dental Clinic
- Pediatric Dermatology Clinic
- Pediatric Diabetes/Endocrinology Clinic
- 20 Pediatric Gastrointestinal Clinic
- Pediatric Hematology/Oncology Clinic
- Pediatric Nephrology Clinic
- Pediatric Orthopedic Clinic
- Pediatric Rheumatology Clinic

Pediatric Scoliosis Clinic

Physical Therapy Clinic

Physician's Office

Podiatry Clinic

5 Prenatal Clinic

Pulmonary Clinic

Rheumatology Clinic

School or Prison Infirmary

Specimen Collection Area (Healthcare)

10 Speech Therapy Clinic

Surgical Services Clinic

Well Baby Clinic

Wound Center

Wound Ostomy Continence Clinic

15 Endoscopy Suite

Radiology, includes Nuclear Medicine

Mobile Blood Collection center

Mobile MRI/CT

COMMUNITY LOCATIONS

20

Blood Collection (Blood Drive Campaign)

Home Care

Home-based Hospice

Location Outside Facility.

Specimen Collection Area (Community)

NON-PATIENT CARE LOCATIONS

Administrative Areas

5 CDC Locations and Descriptions

Assisted Living Area

Blood Bank

Central Sterile Supply

Central Trash Area

10 Clinical Chemistry

Facility Grounds

General Laboratory

Hematology Laboratory Histology/Surgical Pathology

Housekeeping/Environmental Services

15 Laundry Room

Microbiology Laboratory

Morgue/Autopsy Room

Pharmacy

Physical Plant Operations Center

20 Public Area in Facility

Serology Lab

Soiled Utility Area

Virology Laboratory

Day Parts

Day shift - weekday/weekend or holidays

Night Shift - weekday/weekend or holidays

First Shift/Second Shift/Third Shift - for both weekdays/weekends or holidays

- 5 First Shift/Second Shift/Third Shift/Fourth Shift/Fifth Shift – for both weekdays/weekends or holidays

Predetermined time period during the day

- Once the multi-modal compliance index is calculated a number of different reports could be generated. The reports can be used to help determine where more or
- 10 different hand hygiene compliance efforts such as additional training need be implemented. The reports could be presented in a simple graph format as shown in figures 2 and 3 wherein figure 2 shows the hand hygiene index in the pediatrics unit as compared to the hospital aggregate and the goal or benchmark and figure 3 shows the hand hygiene index in the intensive care unit as compared to the hospital
- 15 aggregate and the goal or benchmark. Figure 4 shows some different reporting options. Figure 5 shows a dashboard showing a more comprehensive way of presenting the information.

- It will be appreciated by those skilled in the art that there are a number of different options in regard to how the hand hygiene compliance index may be
- 20 presented. A representation of the different ways the hand hygiene compliance index may be presented is shown generally at 100 in figure 4. For example, the user may use a default benchmark 102 or a user defined benchmark 104 when determining the dispenser usage compliance. With the default benchmark the hand hygiene compliance index may be a dispenser usage compliance index on its own

106 or it may include multi-modal data. If it includes multi-modal data the dispenser usage compliance index may be combined with survey data 108; or with direct observation data 110; or with survey data and direct observation data 112.

Alternatively with the user defined benchmark the hand hygiene compliance index
 5 may be presented as the dispenser usage compliance index on its own 114; or with survey data 116; or with direct observation data 118; or with survey data and direct observation data 120. If the dispenser usage compliance index is combined with other data the data is weighted when it is combined to provide a hand hygiene compliance index.

10 The hand hygiene compliance index (HHCI) may be expressed as an equation. Hand hygiene events or dispenser usage events are used for calculation of the HHCI or the dispenser usage compliance index. An event is the same as a dispenser activation, except in the case where multiple activations occur within a predetermined activation period. The predetermined activation period is between 1
 15 and 4 seconds and preferably 2.5 seconds. Wherein multiple activations occur within the predetermined activation period the total activations occurring within the predetermined activation period constitute a single hand hygiene event. In those cases multiple activations within for example 2.5 seconds are recorded as a single event with n activations. The events are what are used for the HHCI numerator.

20

$$\left(\frac{\sum_{s}^{e} \text{events}}{\sum_{s}^{e} (\text{census}_{\{dp\}} * \text{benchmark}_{\{dp\}})} * w_1 \right) + (\text{observed} * w_2) + (\text{survey} * w_3)$$

$$\left(\frac{\sum_s^e \text{events}}{\sum_s^e (\text{census}_{dp} * \text{benchmark}_{dp})} * w_1 \right) + (\text{observed} * w_2) + (\text{survey} * w_3)$$

where:

e= end date

5 s= start date

events=number of actual hand hygiene events

dp=day part (e.g. first shift; second shift)

census=patients for the day part

benchmark=expected activations for the day part

10 w1=the weighting of the particular component. w1+w2+w3 must total to exactly 1.

w2=the weighting of the particular component. w1+w2+w3 must total to exactly 1.

w3=the weighting of the particular component. w1+w2+w3 must total to exactly 1.

Direct observation method = observed hand hygiene compliance. A whole number between 0 and 100 representing % compliance.

15 Patient survey method = patient survey hand hygiene compliance. A whole number between 0 and 100 representing % compliance.

The numerator is the sum of events for a predetermined time period.

The denominator represents the total number of expected hand hygiene events for a predetermined time period.

20 To calculate the denominator, first take the census for a day part multiplied by the benchmark for that day part. This yields the expected number of events for that day part. The expected events for each day part for the predetermined time period are then added together resulting in the total expected activations for the period of time defined by that start and end time.

The weightings are applied by multiplying the weighting by the Hand Hygiene compliance of the component.

There are three cases for calculating Hand Hygiene Compliance.

1) Dispenser Activation

- 5 In this case w_1 is equal to 1 and there is no observed or survey Hand Hygiene component to the index.

2) Dispenser Activation and Either Survey or Observed data

- In this case w_1 and w_2 or w_3 will total to 1, and the index is calculated by multiplying the weighting by the compliance component. For example, group monitoring system recorded Hand Hygiene compliance for a period of time is 90 with a weighting of 0.8. Patient Survey compliance is 70 with a weighting of 0.2. With no observed data used for the calculation of the (hand hygiene compliance index) HHCI. Recorded Hand Hygiene Compliance is 90×0.8 or 72 and patient survey Hand Hygiene Compliance is 70×0.2 or 14. The Hand Hygiene Compliance Index for the period of time is 86, or $72 + 14$.
- 10
15

3) Dispenser Activations with both Patient Survey and Observed Compliance Data

In this case $w_1 + w_2 + w_3$ will total to 1, and the index is calculated by multiplying the weighting by the compliance component.

- For example, the group monitoring system recorded hand hygiene compliance for a period of time is 90 with a weighting of 0.6. Patient survey compliance is 70 with a weighting of 0.2. and observed data compliance of 70 with a weighting of 0.2. Recorded hand hygiene compliance is 90×0.6 or 54 with patient survey hand hygiene compliance is 70×0.2 or 14 and observed compliance is $70 \times$
- 20

0.2 or 14. The hand hygiene compliance index for the period of time is 82, or 54 + 14 + 14.

It will be appreciated by those skilled in the art that there is a wide variety of ways that the information may be presented. A sample dashboard is
5 shown at 130 in figure 5. The sample dashboard includes a graphical representation of the usage 132, a summary report 134 and a chart of specific dispenser usage 136.

Each dispenser has a unique identifier and the unique identifier which may be associated with a soap dispenser versus a sanitizer dispenser. It may be
10 important to differentiate between hand hygiene events using soap versus sanitizer. This would be particularly important where the facility has a particular outbreak that requires soap versus sanitizer or vice versa such as with the disease causing organism *clostridium difficile* (also known as *c. diff.*) which is most difficult to eliminate in the spore form and can typically be removed from the hands only with
15 hand washing as there is reliable data that supports the premise that hand sanitizers are not an effective way to kill *c. diff.* spores.

The system may be designed wherein the facility has the ability to adjust the benchmark or use a benchmark of its own choosing. It will be appreciated by those skilled in the art that the facility will have a wide range of
20 reports that they can generate. For example it could generate reports by unit; by hospital; compare unit to unit; unit to hospital; or hospital to hospital by way of example. As well it will be appreciated by those skilled in the art that the dispenser usage data may be integrated with the facility purchasing department.

The system may be connected with a wired system as shown at 30 in

figure 6 or in a wireless system as shown at 50 in figure 7. In the wired system 30 a dispenser 32 is connected to a hub 34 and/or a gateway 36. The gateway is connected to the data collation server 38 which in turn is connected to a hand hygiene compliance index calculation server 40. Those skilled in the art will
5 appreciate that data collation server 38 may comprise one or more computers.

Similarly in the wireless system 50 the dispenser 52 is wirelessly connected to a hub 54 and/or a gateway 56. The gateway is wirelessly connected to a data collation server 58, preferably over the internet through GSM (Global System for Mobile Communications) or other communications standards and
10 network protocol. The data collation server 58 is connected to a hand hygiene compliance index calculation server 60. It will be appreciated by those skilled in the art that the data collation server 58 and the hand hygiene compliance index calculation server 60 may be the same server. Each dispenser 52 has a sensor therein that preferably is capable of storing data in regard to up to 100 or more
15 activations. It will be appreciated by those skilled in the art that 100 is by way of example only and that typically each dispenser may need to only store data relating to a few activations. This minimizes the chance of losing data in the event of queuing for receipt by the hub. The data is sent between the dispenser 52 and hub 54 and the hub 54 and gateway 56 in bursts which are either time or memory
20 dependent. Preferably, data is sent from the gateway 56 to the server 58 in a burst by way of GSM. Data may be sent to an offsite server 60 for data processing.

While the network is described as a plurality of network devices consisting of hubs and gateways, other network devices may be used. Some non-limiting examples include wireless hubs, Ethernet hubs, repeater hubs, switches,

ethernet switches, bridges, routers, Ethernet routers, wireless routers, and gateway routers.

Those skilled in the art will appreciate that packets may be sent within the aforementioned network using any number of protocols. Optionally, packets
5 may be sent according to the Internet Protocol Suite (IPS), which includes the Transmission Control Protocol (TCP) and the Internet Protocol (IP), often called TCP/IP. Compared to alternatives, this scheme moves much of the network complexity to the edge of the network, i.e. to each dispenser and to the server. When using this scheme, dispensers may send packets via either TCP or UDP
10 (User Datagram Protocol), though other transport-layer protocols may be used within the IPS specifications.

Alternatively, packets sent between dispensers, hubs, and gateways may have a defined format different from those specified in the IPS specifications, and may be eventually repackaged into IPS-compatible packets when to the sent
15 off-site server 60. It may be desirable to send information off-site using the Internet Protocol Suite since existing Internet network infrastructure may be used for transmission. When designing a wireless system there are a number of different considerations. Specifically there are only a limited number of frequencies that are generally available for “unlicensed” transmissions. The “unlicensed” frequencies
20 that are available in each country may be different. The “unlicensed” frequencies may have a wide range of uses, for example they are used in tag security systems at retail stores, remote control devices for garages, Wi-Fi networks and many RFID tags (radio frequency identification device tags). Preferably the system described herein would use an “unlicensed” frequency. By way of example in the USA Title 47

Part 15 of the Code of Federal Regulations covers the use of “unlicensed” transmitters within the United States. Specifically, the table below shows the frequency and associated power levels that are generally available.

Frequency Band	Power Level (dBm)	Power (mW)	Notes
216MHz-960MHz	~-10dBm	0.1	Special conditions apply and certain exclusions and exemptions are available
902-928MHz	30dBm	1000	Requires spread spectrum
2400-2484MHz	30dBm	1000	Requires spread spectrum

5 *200uV/m equates to approximately -10dBm when converted.

In contrast the European radio regulations are encapsulated by the R&TTE (Directive 1999/5/EC) and supported by CEPT Recommendation 70-03. Compliance with the R&TTE directive can be achieved in 2 ways the first is through the application of “Harmonized Standards” and the second by obtaining Notified Body Approval. The table below is based on recommendation CEPT70-03 and the Harmonized standards EN300-220 and EN300-440.

Frequency Band	Power Level (dBm)	Power (mW)	Notes
433.050-434.790 MHz	10dBm	10	<10% duty cycle
433.050-434.790 MHz	0dBm	1	-13dBm/10kHz restriction
433.040-434.790 MHz	10dBm	10	25kHz channel spacing
863.870-870 MHz	13.2dBm	20.9	<0.1% duty cycle
869.700-869.650 MHz	27dBm	501	<10% duty cycle
2400-2483.5 MHz	10dBm	10	No restrictions

15 The frequency and power that are chosen will affect the design of the

system. A flow diagram showing the steps implemented in a low frequency (between 400 and 450 MHz) low power (up to 10 mW) wireless system is shown generally at 70 in figure 8. A similar flow diagram for a higher frequency (between 850 and 950 MHz), higher power (up to 1 W) wireless system is shown generally at 140 in figure 9.

A flow diagram showing the steps implemented a low frequency (between 400 and 450 MHz) low power (up to 10 mW) wireless system is shown generally at 70 in figure 8. Once there has been a dispenser usage event the dispenser 52 ID is transmitted to any and all hubs 54 within the transmission distance 72. On receipt of the dispenser ID transmission the hub(s) reply with an acknowledgement 74. This is sometimes referred to as a “handshake”. If an acknowledgement is not received by the dispenser, the dispenser will retry until it is successful. The hub adds a date and time stamp to the ID to produce dispenser usage data. The hubs 54 send the dispenser usage data 76 on through the hub network unit it reaches a gateway 56. Each successive hub 54 in the chain acknowledges receipt of the dispenser usage data from the previous hub 78. If acknowledgement is not received by the originating hub it will retry until successful. The hubs 54 within the transmission distance of the gateway transmit the dispenser usage data through to the gateway 80. When the activation data is captured by the gateway 56, it transmits an acknowledgement back to the originating hub(s) 82. If an acknowledgement is not received by the originating hub, it will retry until successful. The gateway 56 collates all of the data it received from the rest of the system into transmission packets of a predetermined format. The predetermined format may specify a predetermined size or a predetermined header size. These

data packets are transmitted to the data collation server 84. Preferably the data is sent to the collation server 58 over the internet and preferably via GSM. When the data packet is received or captured by the data collation server 58 an acknowledgement is sent back to the gateway 86. If an acknowledgement is not received by the gateway 56, it will retry until successful. This type of system is often referred to as a mesh network.

It will be appreciated that such acknowledgements may be either dedicated packets or may be included in a designated offset within the header of packets.

Alternatively, acknowledgements may be sent from the server back to the dispenser, rather than between each hub and dispenser. In this scheme, each hub would forward the acknowledgement packets to their addressed location, e.g. dispenser or server.

Alternatively, a higher frequency (between 850 and 950 MHz) and higher power (up to 1W) system is shown generally at 140 in figure 9. On set up the dispenser 52 sends out a request to the nearest hub 54 for the hub's ID (identification) and a time update 142. The hub 54 responds with requested information 144 and this synchronizes to the dispenser. If the response is not received by the dispenser, it will retry until a successful synchronization is achieved. Once the set up is complete and there has been a dispenser usage event the dispenser 52 transmits to its synchronized hub 54 dispenser data including, dispenser ID, time, date of use, dispenser usage events 146. On receipt of the dispenser data the hub replies with an acknowledgement 148. The acknowledgement contains a time update. This is sometimes referred to as a

“handshake”. If an acknowledgement is not received by the dispenser, the dispenser will retry until it is successful. The hubs collate the data received from the dispensers to form a transmission packet of a predetermined size (predetermined number of bytes) 150. The data packet is then transmitted through the hub network until it reaches the gateway 56. As the data packet is captured by the receiving hub it transmits an acknowledgement back to the originating hub 152. This acknowledgement also contains a time update. If an acknowledgement is not received by the originating hub it will retry until successful. The hubs 54, within transmission distance of the gateway 56, transmits the data packets to the gateway 154. As the data packet is captured by the gateway it transmits and acknowledgement back to the originating hub 156. This acknowledgement contains a time update. If acknowledgement is not received by the originating hub it will retry until successful. The gateway collates all of the data it received from the rest of the system into a transmission packet of a predetermined size (bytes) 158. This data packet is then transmitted via GSM to the data collection server 58. As the data packet is captured the data collation server transmits an acknowledgement back to the gateway 160. This acknowledgement also contains a time update. If an acknowledgement is not received by the gateway 56, it will retry until successful. This type of system is often referred to as a mesh network.

Referring to figures 10 and 11, examples of dispenser data collection system are shown respectively at 90 and 96. A plurality of dispensers 52 are positioned around the unit of the facility being monitored. A plurality of receivers or hubs 54 are positioned around the unit within range of the dispensers such that each dispenser is in range of at least one receiver. As described above, when

each dispenser 52 is used it will transmit its unique identification code, date and time to the hub or hubs 54, the hubs 54 in turn transmit the data to a gateway 56 and then to a server 58. Typically in a large facility the system uses a mesh network. At each stage of data transmission there will be a "handshake" between
5 the transmitter and receiver whether that be dispenser and hub, hub and hub, hub and gateway or gateway and server. A handshake confirms the data is received and instructs the dispenser to delete the information from the memory. The server 36 may be on site or off site.

Accordingly, when designing the system herein for healthcare facility
10 usage, for example a hospital, there are a number of competing interests. Specifically the system will require a plurality (100's or more likely 1,000's) of self (battery) powered activation sensors which need to reliably transmit usage data wirelessly around sprawling, cluttered hospital buildings and the data be transmitted via a GSM link(s) to the internet for external data manipulation. Each sensor's
15 batteries preferably have long life (5+ years), are physically small (< a packet of cards) and preferably the system cost is low. It is preferable that the system not interfere with medical equipment, be legal, and utilize license free radio frequencies.

An solution is to use a low power + low cost + minimal RF interference, this suggests a system along the lines of a Zigbee® / Z wave® type network
20 architecture, utilizing ultra-low power transmitters (typically 0.1 mw) with minimal processing power. This gives low sensor hardware costs (currently approximately \$5/ node) and requires an electrical outlet powered network to be installed in each building to act as a communication and data processing 'backbone'. Knowledge of radio frequency propagation within buildings would lead those skilled in the art to

select the lowest available frequency to maximize range for a given power output (reduces the hardwired 'backbone' costs and enhances reliable communications) and consequently he would preferably choose between 400 and 450 MHz. This would give a typical indoor range of 50ft. Such a system is shown in figure 10 at
5 90. By way of example, in a facility that needs around 4000 dispensers, 200 hubs are required as shown in figure 10.

In contrast, legislation allows for higher power transmissions (c. 500 mw) when utilizing direct sequence spread spectrum techniques (DSSS) at higher frequencies (868 - 930 MHz dependant on location); this increases range (typically
10 330ft) but also cost (currently approximately \$11/ node) and power consumption. However, in another embodiment shown in figure 11 at 96, it has been determined that the reduction in the density of the electrical outlet powered network backbone gives savings that at least offset the increase in sensor cost. The additional power requirements due to the 5,000 fold increase in transmission power are able to be
15 offset by significantly more efficient firmware running in the sensor, enabled by the higher capacity microprocessor that is required to facilitate DSSS. For example by increasing unit cost and output power, in this embodiment there is a significantly decreased system cost and complexity without a noticeable battery life penalty (a single board mounted battery that fits within the space requirement gives preferably
20 a life of 5 years +).

In system 96, between approximately 20 and 40 hubs is needed with around 4000 dispensers. The distance between the dispenser and the hub can be up to 5740 feet. However inside a healthcare facility the distances are more typically 330 feet and in some cases greater than 330 feet depending on the objects

between the dispenser and the hub. Those skilled in the art will appreciate that the maximum number of dispensers per hub will be limited by available network bandwidth and by the number of bits per address. Since each dispenser will have generally low activity on the network, a larger number of dispensers may be supported than on networks in which all devices are continuously active.

Implementations of the hubs that use 8-bit addressing will be limited to connecting to 255 dispensers, though other implementations with more bits per address may allow for additional dispensers, e.g. up to 10,000 dispensers. Typically inside a healthcare facility, each hub will receive data from around 200 dispensers. In system 96 the transmission power is up to 1000 milliwatts. With system 96 higher level data encryption can be used thereby providing a higher level of security than that afforded by the lower frequency system. System 96 uses direct sequence spread spectrum transmission techniques which has a reduced rate of interference and is allowed to operate at higher powers as compared to the lower frequency system.

Accordingly the higher frequency, generally between 850 and 950 MHz is advantageous over the lower frequency generally between 400 and 450 MHz system. The higher frequency system uses higher power and higher frequency which is opposite to conventional wisdom in regard to systems of data distribution of this type. Since the dispenser uses more power, some preliminary processing may be conducted at the dispenser.

A group monitoring system for dispenser usage compliance within a predetermined group of interest in a predetermined facility comprising the steps of: providing a plurality of dispensers, providing a dispenser data collection system

operably connected to each dispenser, capable of providing information, the information including a unique dispenser identifier for each dispenser, a number of dispenser usage events that each dispenser was used; receiving the information from the data collection system and determining the predetermined group with
5 which each dispenser is associated; determining the number of hand hygiene events within the predetermined group within a predetermined time period; determining a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period; calculating a dispenser usage compliance index particular to the
10 predetermined group and particular to the predetermined time period by dividing the hand hygiene events for the predetermined group and the predetermined time period by a denominator, wherein the denominator equals the benchmark. The number of hand hygiene events within a predetermined time period equals a number of times the dispenser has been activated and wherein multiple activations
15 within a predetermined activation period are considered a single dispenser usage event. It is not uncommon that when someone uses a dispensing system that rather than merely activating once they activate the dispenser multiple times. Accordingly to accurately determine the correct number of times that the dispenser has been used, the number of times the dispenser is activated needs to be determined.
20 However where there are multiple activations within a predetermined activation period that is considered a single dispenser usage event.

The dispenser usage compliance index may further include at least one of direct observation data or survey data. The data used in the dispenser usage compliance index is weighted. The predetermined time period may

correspond to a shift of the predetermined group in the predetermined facility.

The benchmark will likely vary depending on the predetermined facility, the type of unit in the facility, the time of day, and the day of the week. The denominator may also be the benchmark multiplied by census data. The census
5 data will be dependent on the group of interest and may be bed occupancy, patient days, patient visits, the number of bed-hours of care or the staff. The predetermined group may be a bed, a room, a ward, a unit, a floor or a facility.

The dispenser data collection system uses a frequency of one of between 400 and 450 MHz system and between 850 and 950 MHz system. In one embodiment the
10 dispenser data collection system uses a frequency between 850 and 950 MHz system and has a transmission power of up to 1000 milliwatts. It further includes a plurality of hubs for receiving data from the plurality of dispensers and each hub receives data from one or more dispensers and the distance between each dispenser and its associated hub is generally no greater than 5740 feet. The data
15 between the dispenser and the hub is encrypted.

The group monitoring system for dispenser usage data collection includes a plurality of dispensers; a plurality of hubs each capable of receiving data from one or more dispensers; and wherein the distance between each dispenser and its associated hub is typically no greater than 5740 feet and the data is
20 transmitted at between 850 and 950 MHz.

Generally speaking, the systems described herein are directed to a dispenser compliance system and by way of example a hand hygiene compliance system. As required, embodiments of the present invention are disclosed herein. However, the disclosed embodiments are merely exemplary, and it should be

understood that the invention may be embodied in many various and alternative forms. The Figures are not to scale and some features may be exaggerated or minimized to show details of particular elements while related elements may have been eliminated to prevent obscuring novel aspects. Therefore, specific structural
5 and functional details disclosed herein are not to be interpreted as limiting but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention. For purposes of teaching and not limitation, the illustrated embodiments are directed to a dispenser usage compliance system.

10 As used herein, the terms “comprises” and “comprising” are to be construed as being inclusive and open rather than exclusive. Specifically, when used in this specification including the claims, the terms “comprises” and “comprising” and variations thereof mean that the specified features, steps or components are included. The terms are not to be interpreted to exclude the
15 presence of other features, steps or components.

WHAT IS CLAIMED AS THE INVENTION IS:

1. In a monitoring system, performing a method of monitoring dispenser usage compliance within a predetermined group of interest in a predetermined facility type, the system comprising a plurality of dispensers and a dispenser data collection system operably connected to each dispenser, the dispenser data collection system being capable of providing information, the information including a unique dispenser identifier for each dispenser and a number of dispenser usage events that each dispenser was used, the method comprising the steps of:

receiving the information from the dispenser data collection system and determining the predetermined group within which each dispenser is associated;

determining the number of dispenser usage events within the predetermined group within a predetermined time period;

determining a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period; and

calculating a dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period by dividing the dispenser usage events for the predetermined group and the predetermined time period by a denominator wherein the denominator equals the benchmark.

2. A method of monitoring dispenser usage compliance within a

predetermined group of interest in a facility including a plurality of dispensers, the facility having a predetermined facility type, the method comprising the steps of:

providing a dispenser data collection system operably connected to each dispenser, capable of providing information, the information including a unique dispenser identifier for each dispenser and a number of dispenser usage events that each dispenser was used;

receiving the information from the dispenser data collection system and determining the predetermined group within which each dispenser is associated;

determining the number of dispenser usage events within the predetermined group within a predetermined time period;

determining a benchmark which corresponds to dispenser usage opportunities particular to the predetermined group and particular to the predetermined time period; and

calculating a dispenser usage compliance index particular to the predetermined group and particular to the predetermined time period by dividing the dispenser usage events for the predetermined group and the predetermined time period by a denominator wherein the denominator equals the benchmark.

3. The method as claimed in claim 1 or 2 wherein the number of dispenser usage events within the predetermined time period equals a number of times the dispenser has been activated and wherein a plurality of activations within a predetermined activation period is considered a single

dispenser usage event.

4. The method as claimed in claim 3 wherein the predetermined activation period is between 1 and 4 seconds.
5. The method as claimed in any one of claims 1 to 4 wherein the information further includes the type of product in the dispenser.
6. The method as claimed in any one of claims 1 to 5 wherein the type of product in the dispenser is chosen from a group consisting of hand soap, sanitizer, lotion, cream, sunscreen and body wash.
7. The method as claimed in any one of claims 1 to 6 wherein the predetermined time period is chosen from the group consisting of a shift, a weekday, a weekend day, and a holiday day of each of the predetermined group in the predetermined facility type.
8. The method as claimed in any one of claims 1 to 7 wherein the benchmark varies dependent on the predetermined facility type.
9. The method as claimed in any one of claims 1 to 8 wherein the predetermined facility type is chosen from the group consisting of a health care facility, a food processing facility, a food service facility, an educational facility and a manufacturing facility.

10. The method as claimed in any one of claims 1 to 9 wherein the predetermined facility type is chosen from the group consisting of a teaching hospital, a non-teaching hospital, a long term care facility, a rehabilitation facility, a free standing surgical center, a health care professional office, a dental office, a veterinarian facility and a community care facility.
11. The method as claimed in any one of claims 1 to 10 wherein the benchmark varies dependent on the predetermined group of interest.
12. The method as claimed in any one of claims 1 to 11 wherein the predetermined group of interest is chosen from the group consisting of medical unit, surgical unit, critical care unit, intensive care unit, emergency care unit, pediatric unit, emergency unit, outpatient unit, specialty care unit, dermatology unit, endocrinology unit, gastroenterology, internal medicine unit, oncology unit, neurology unit, orthopedic unit, ophthalmic unit, ear nose and throat unit, neonatal unit, obstetrics and gynecology unit, cardiac unit, psychiatric unit, post-operative recovery unit, radiology unit, plastic surgery unit and urology unit.
13. The method as claimed in any one of claims 1 to 12 wherein the predetermined group is chosen from the group consisting of a bed, a room, a ward, a unit, a floor, a facility and a hospital group.
14. The method as claimed in any one of claims 1 to 13 further including the step of determining a hand hygiene compliance index wherein the hand

hygiene compliance index includes at least the dispenser usage compliance index.

15. The method as claimed in claim 14 wherein the hand hygiene compliance index includes weighted information from the dispenser usage compliance index and one of survey compliance data and direct observation compliance data.

16. The method as claimed in claim 14 or 15 wherein the hand hygiene compliance index includes weighted information from the dispenser usage compliance index and survey compliance data and direct observation compliance data.

17. The method as claimed in any one of claims 1 to 16 wherein the dispenser data collection system uses a frequency chosen from the group consisting of between 400 and 450 MHz system, between 850 and 950 MHz system and between 2.4 and 2.5 GHz.

18. The method as claimed in any one of claims 1 to 16 wherein the dispenser data collection system is a hard wired system.

19. The method as claimed in any one of claims 1 to 17 wherein the dispenser data collection system uses a frequency between 850 and 950 MHz system and has a transmission power between 10 and 1000 milliwatts.

20. The method as claimed in any one of claims 1 to 18 wherein the dispenser data collection system further includes a network device for receiving data from the plurality of dispensers.
21. The method as claimed in claim 20 wherein said network device is a hub.
22. The method as claimed in claim 20 wherein said network device is selected from the group consisting of wireless network device, wireless hub, Ethernet hub, repeater hub, switch, Ethernet switch, bridge, router, Ethernet router, wireless router, gateway, and gateway router.
23. The method as claimed in any one of claims 20 to 22 wherein said network device communicates wirelessly and the distance between each dispenser and its associated network device is no greater than 5740 feet.
24. The method as claimed in any one of claims 20 to 22 wherein the dispenser data collection system further includes a plurality of network devices for receiving data from the plurality of dispensers.
25. The method as claimed in any one of claims 1 to 22 wherein data sent by the dispenser data collection system is encrypted.
26. The method as claimed in any one of claims 1 to 25 wherein the benchmark varies dependent on the predetermined facility type.

27. The method as claimed in any one of claims 1 to 26 wherein the predetermined facility type is chosen from the group consisting of rehabilitation facility, teaching healthcare facility, non-teaching healthcare facility, chronic care facility, community care facility, school, educational facility, food service facility, food processing facility, outdoor work site and commercial facility.
28. The method as claimed in any one of claims 1 to 27 wherein the benchmark varies dependent on predetermined group of interest.
29. The method as claimed in any one of claims 1 to 28 wherein the predetermined group of interest is chosen from the group consisting of medical unit, surgical unit, critical care unit, intensive care unit, emergency care unit, pediatric unit, emergency unit, outpatient unit, rehabilitation unit, long term care unit, specialty care unit, dermatology unit, endocrinology unit, gastroenterology, internal medicine unit, oncology unit, neurology unit, orthopedic unit, ophthalmic unit, ear nose and throat unit, neonatal unit, obstetrics and gynecology unit, cardiac unit, psychiatric unit, post-operative recovery unit, radiology unit, plastic surgery unit and urology unit.
30. The method as claimed in any one of claims 1 to 29 wherein the predetermined group of interest is chosen from the group consisting of a bed, a room, a ward, a unit, a floor and a facility.
31. The method as claimed in any one of claims 1 to 30 wherein the

benchmark in the denominator is multiplied by census data.

32. The method as claimed in claim 31 wherein the census data is chosen from the group consisting of bed occupancy rate in the predetermined group, patient days in the predetermined group, patient visits in the predetermined group, bed-hours of care in the predetermined group and staff in the predetermined group.

33. A group monitoring system for dispenser usage data collection comprising:

a plurality of dispensers each having a sensor operably attached thereto for collecting data from the dispenser;

a network device capable of receiving data from one of said plurality of dispensers;

wherein said data includes a unique dispenser identifier for each dispenser and a number of dispenser usage events that each dispenser was used.

34. The group monitoring system as claimed in claim 33 wherein the data further includes the type of product in the dispenser.

35. The group monitoring system as claimed in claim 33 or 34 wherein the type of product in the dispenser is chosen from a group consisting of hand soap, sanitizer, lotion, cream, sunscreen and body wash.

36. The group monitoring system as claimed in any one of claims 33 to 35, further including a server for processing said data, said server including one or more computers capable of receiving data from said network device.

37. The group monitoring system as claimed in any one of claims 33 to 36 wherein said network device is a hub.

38. The group monitoring system as claimed in any one of claims 33 to 36 wherein said network device is selected from the group consisting of wireless network device, wireless hub, Ethernet hub, repeater hub, switch, Ethernet switch, bridge, router, Ethernet router, wireless router, gateway, and gateway router.

39. The group monitoring system as claimed in any one of claims 33 to 38 further including a plurality of network devices, each capable of receiving data from one of said plurality of dispensers.

40. The group monitoring system as claimed in any one of claims 33 to 39 wherein said data is transmitted at a frequency between 850 and 950 MHz.

41. The group monitoring system as claimed in any one of claims 33 to 40 wherein said data is encrypted.

42. The group monitoring system as claimed in any one of claims 33 to 41 wherein each dispenser has a transmission power between 10 and 1000

milliwatts.

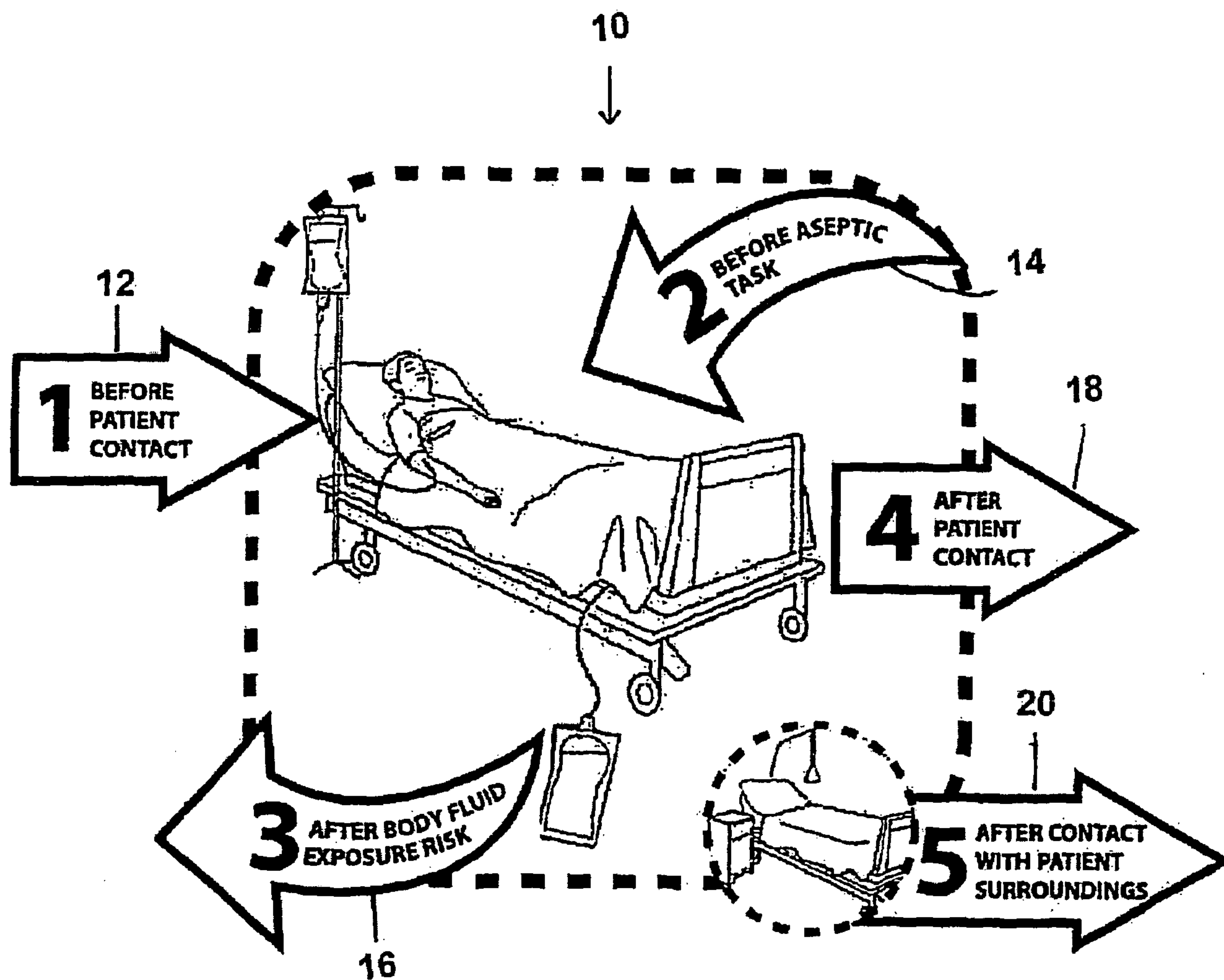
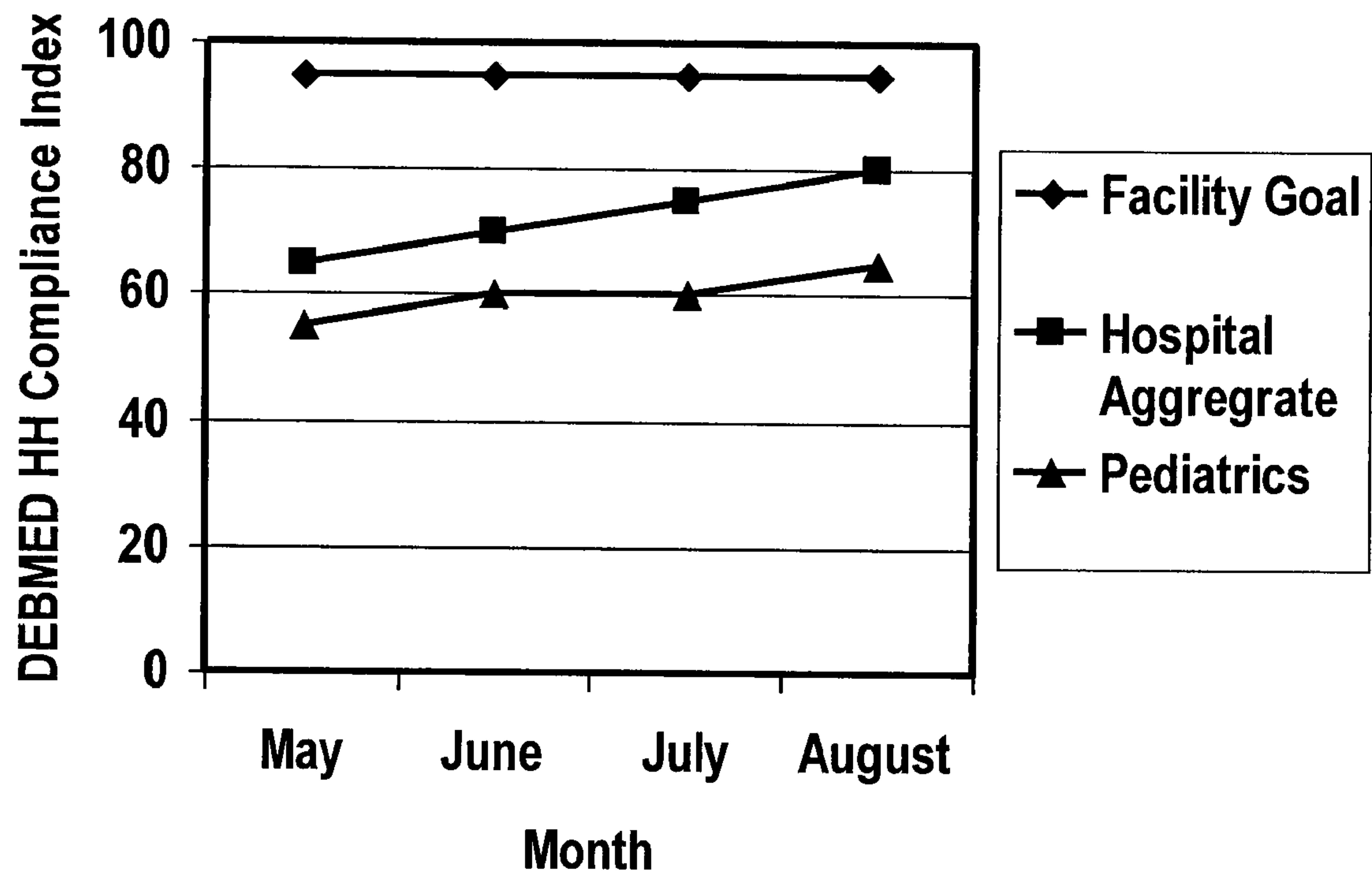
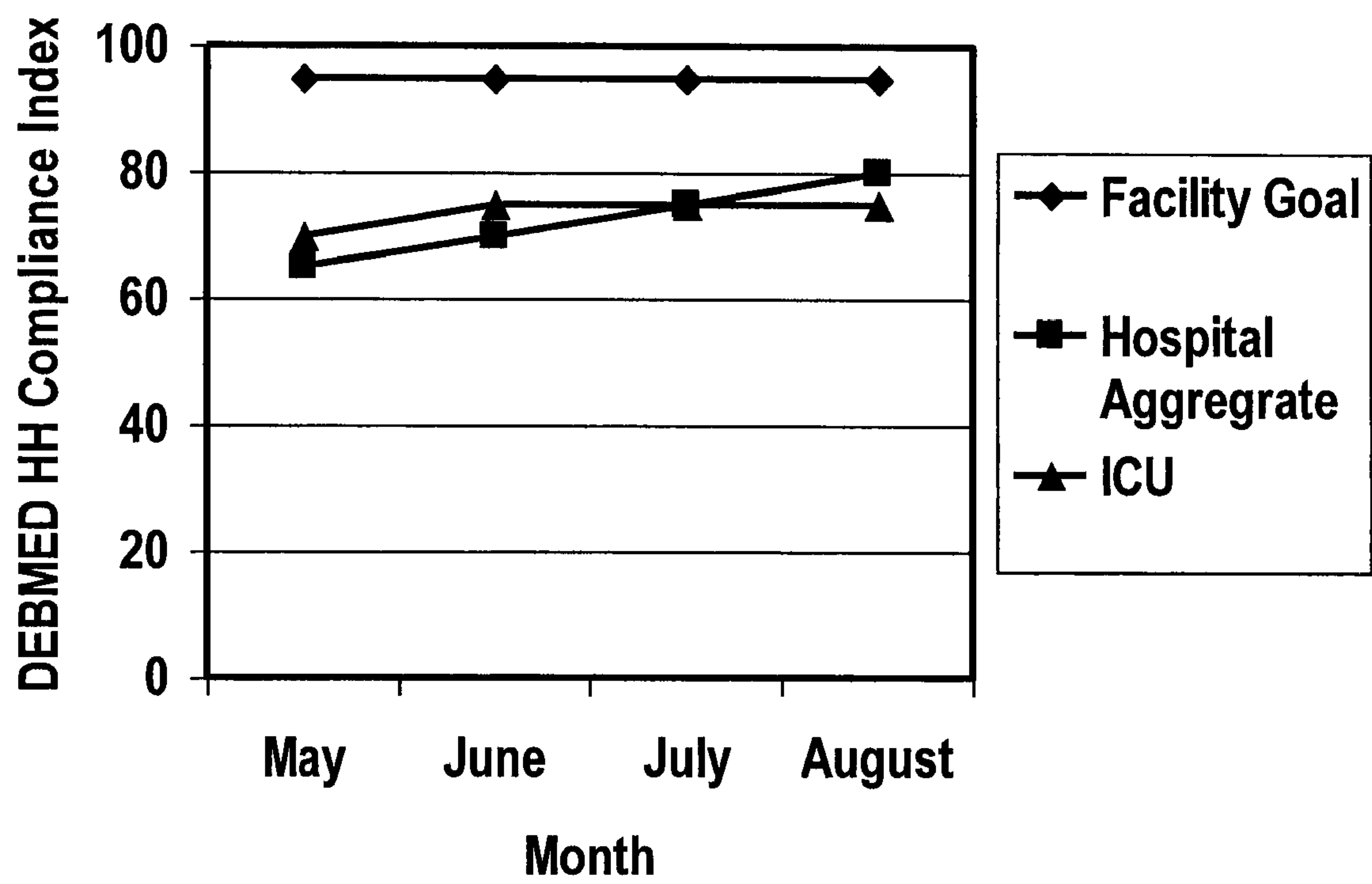


FIG. 1

2/11**FIG. 2**

3/11**FIG. 3**

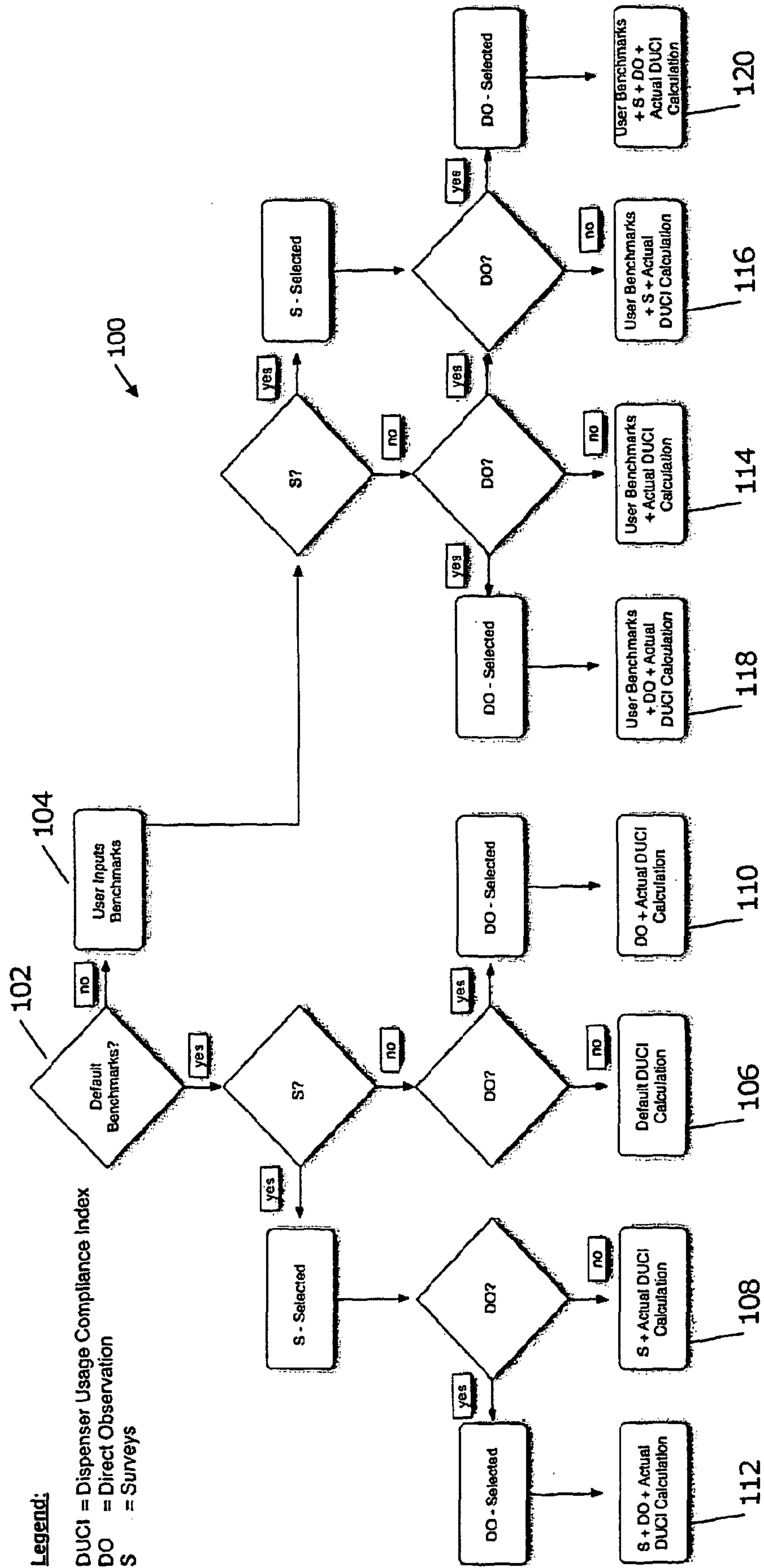


FIG. 4

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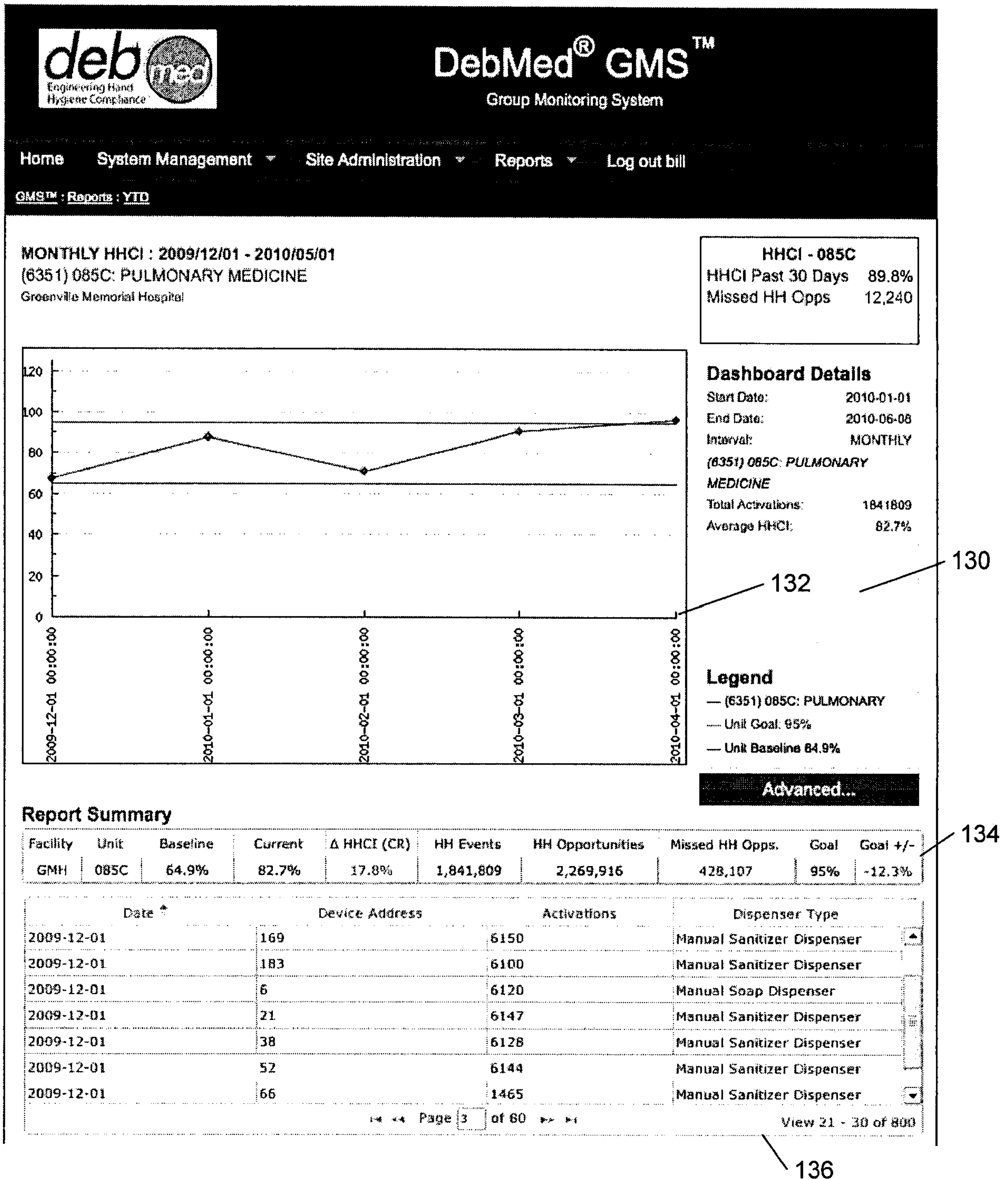


FIG. 5

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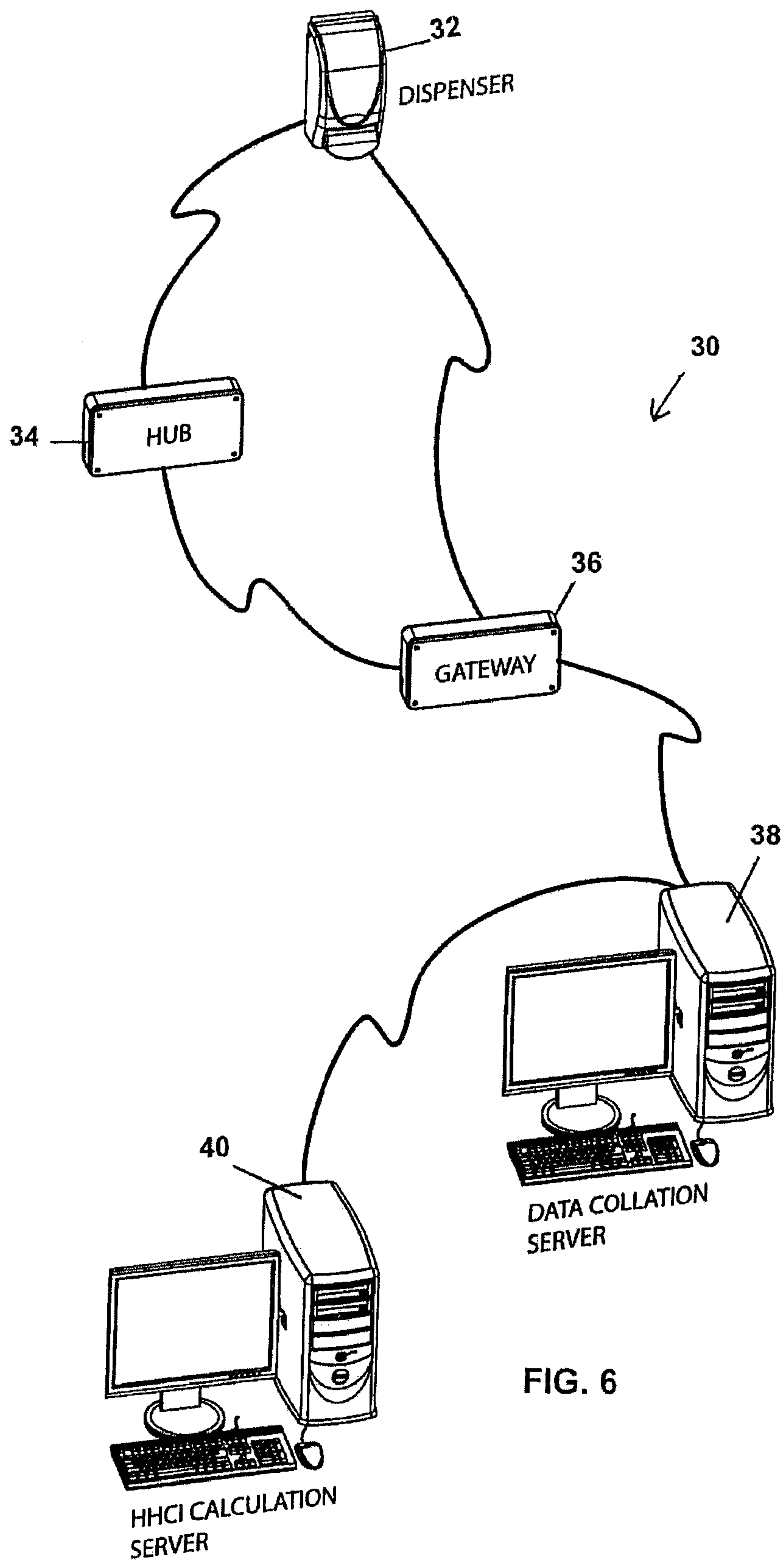


FIG. 6

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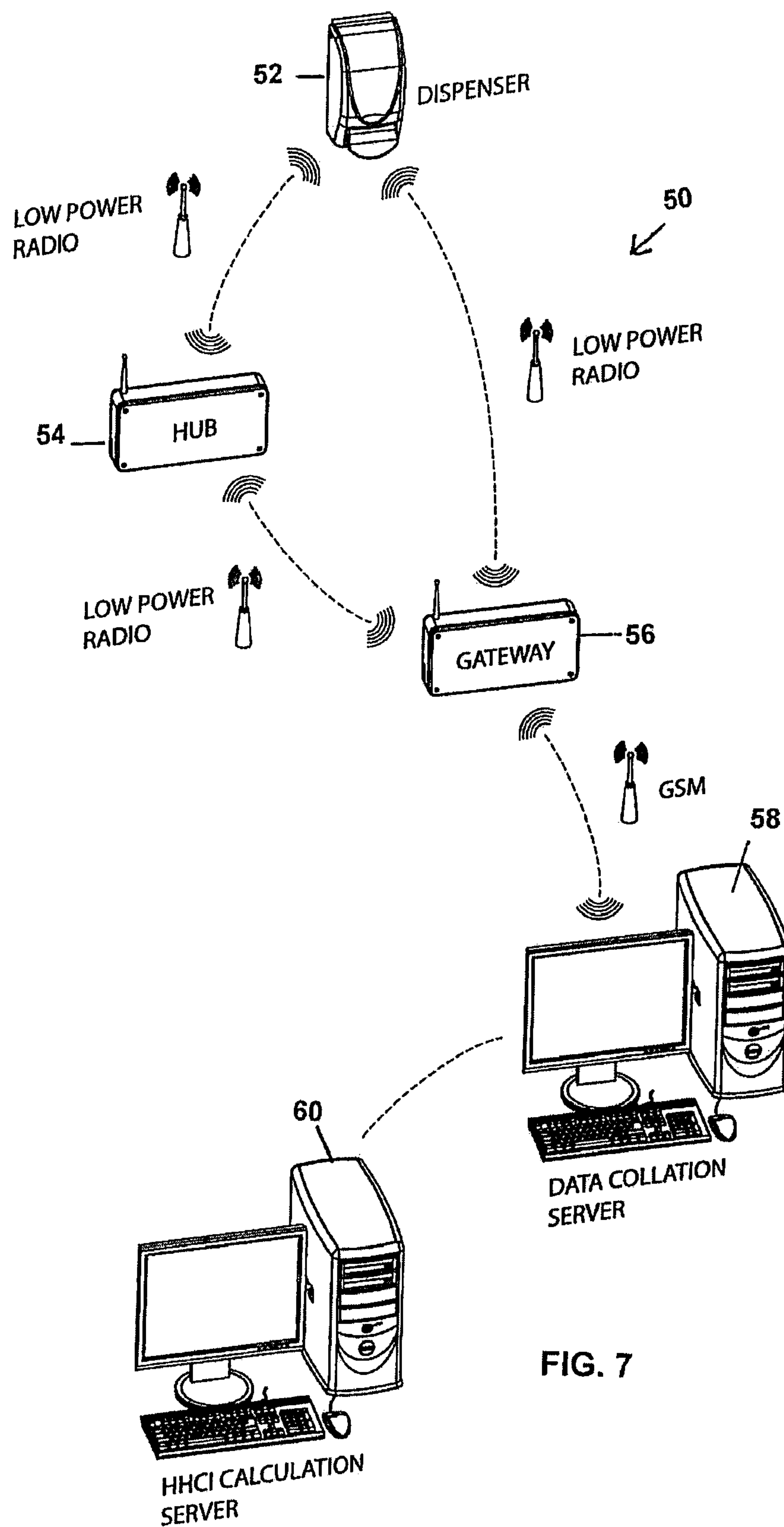


FIG. 7

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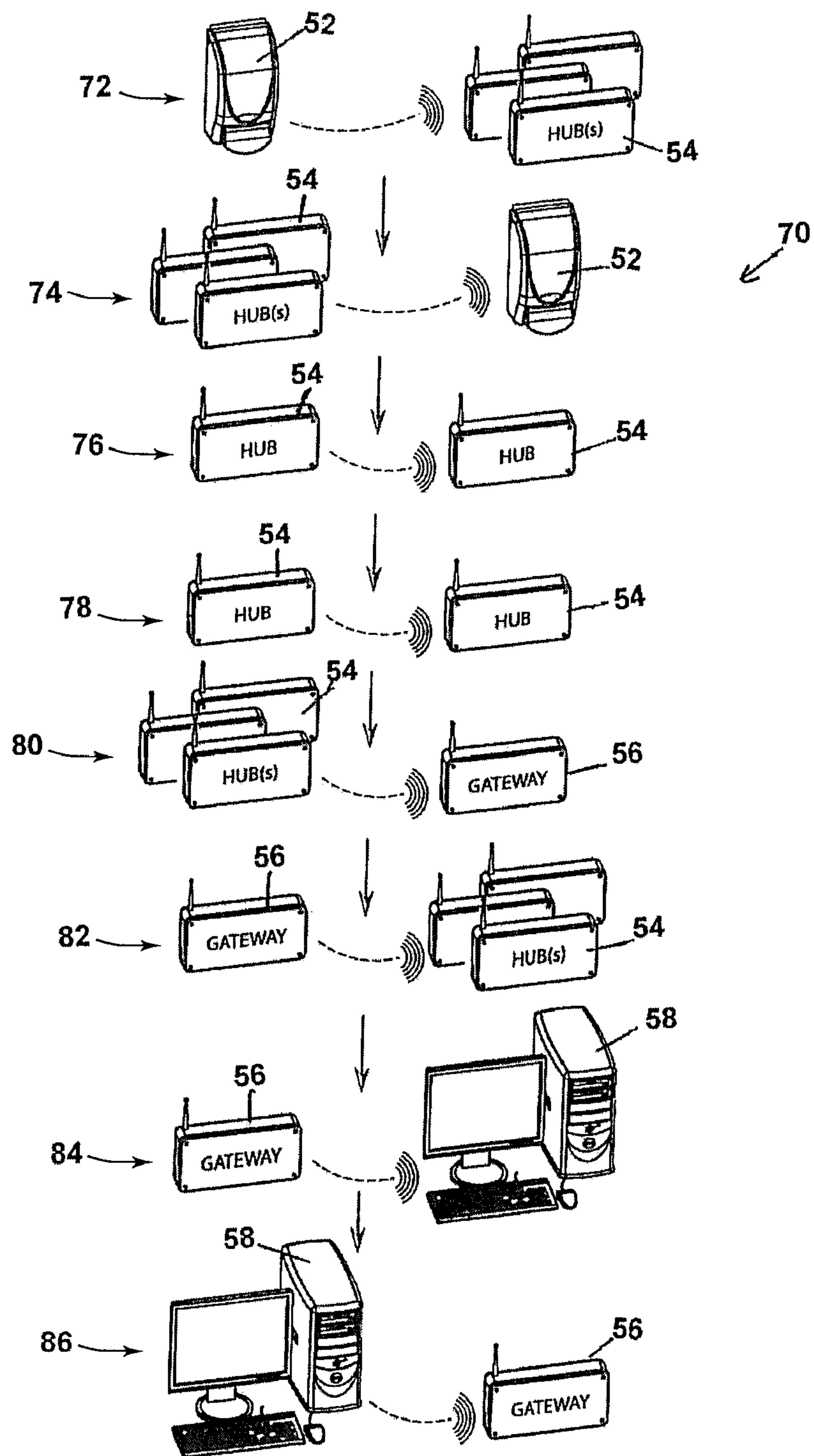


FIG. 8

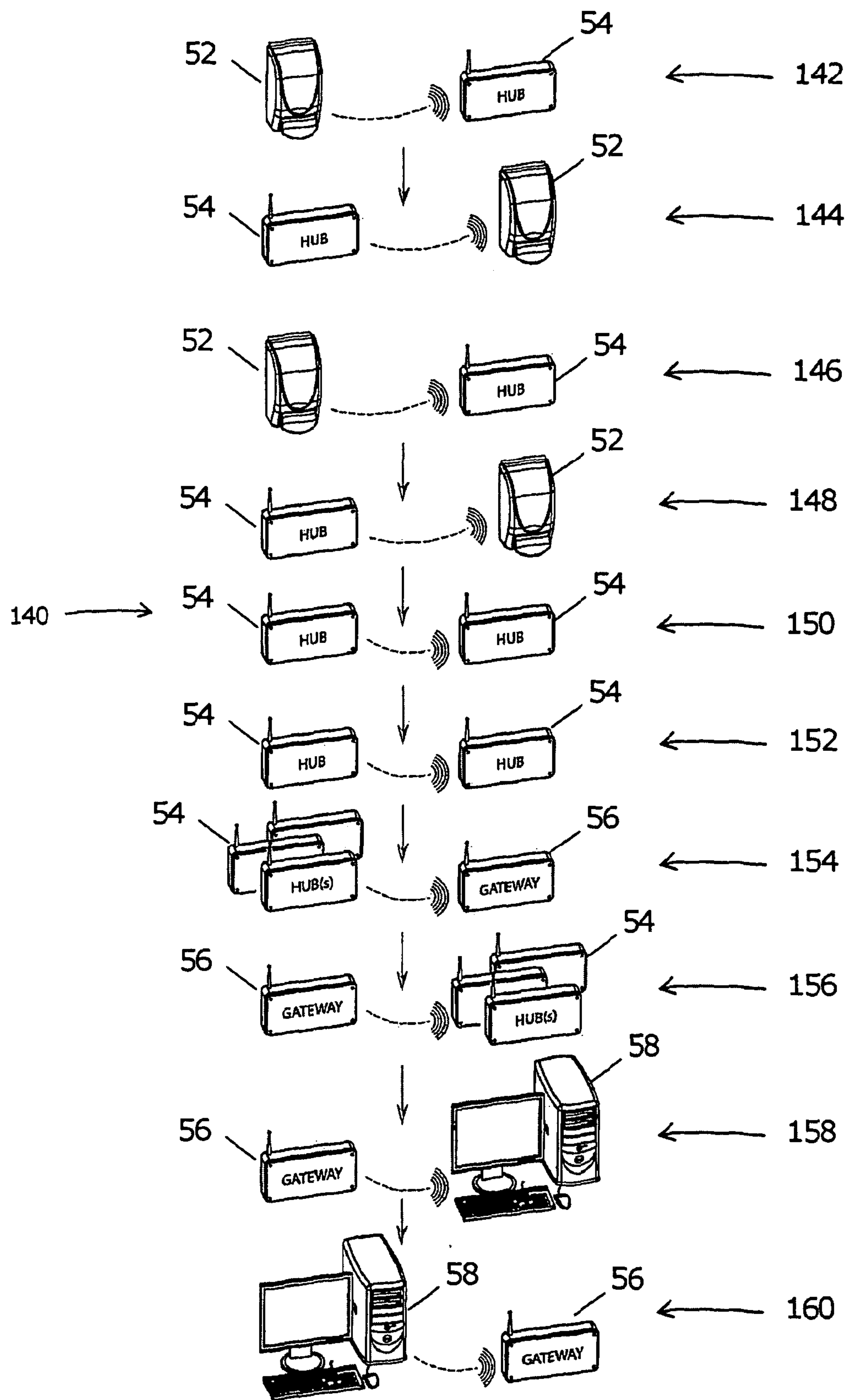


FIG 9

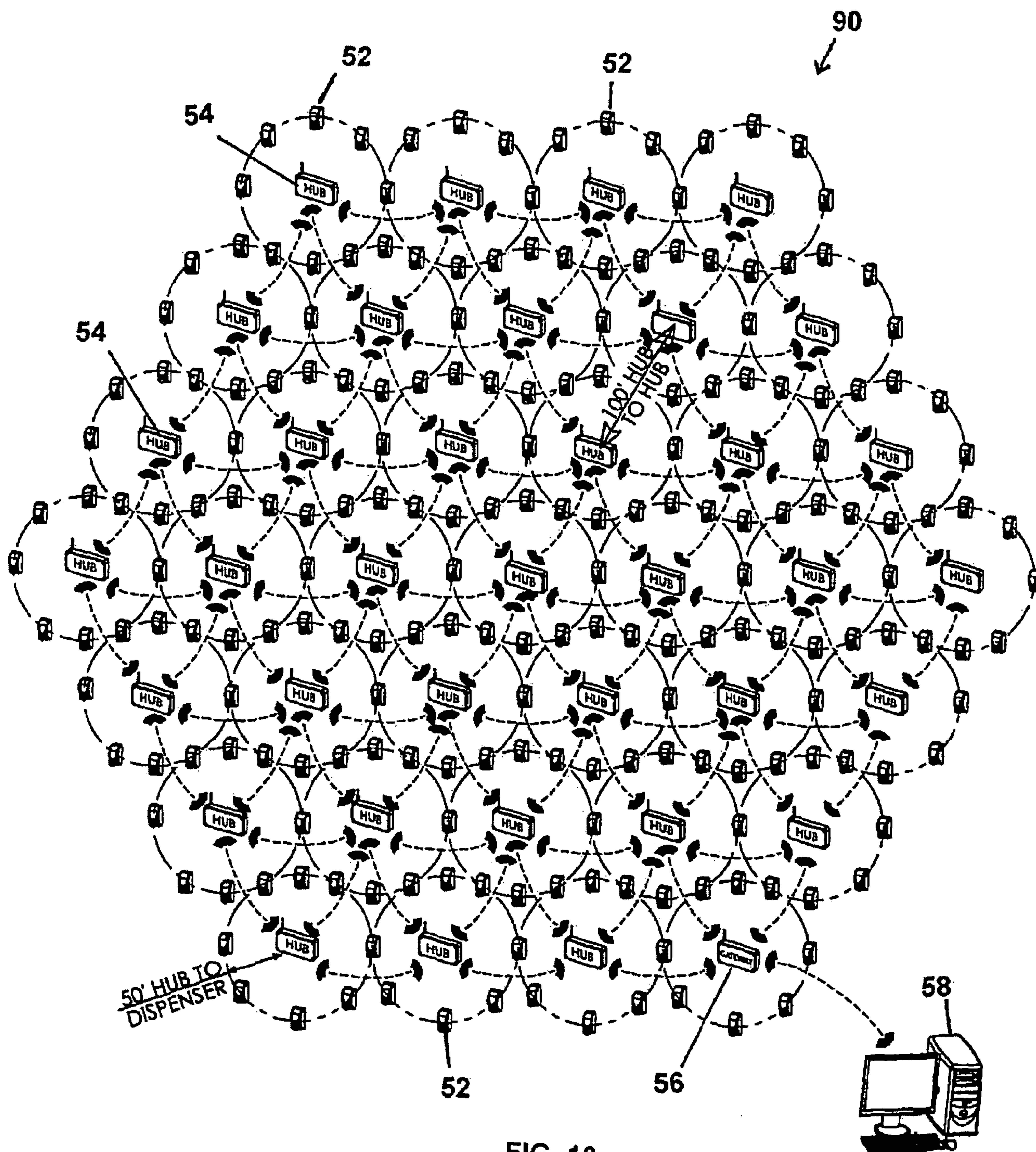


FIG. 10

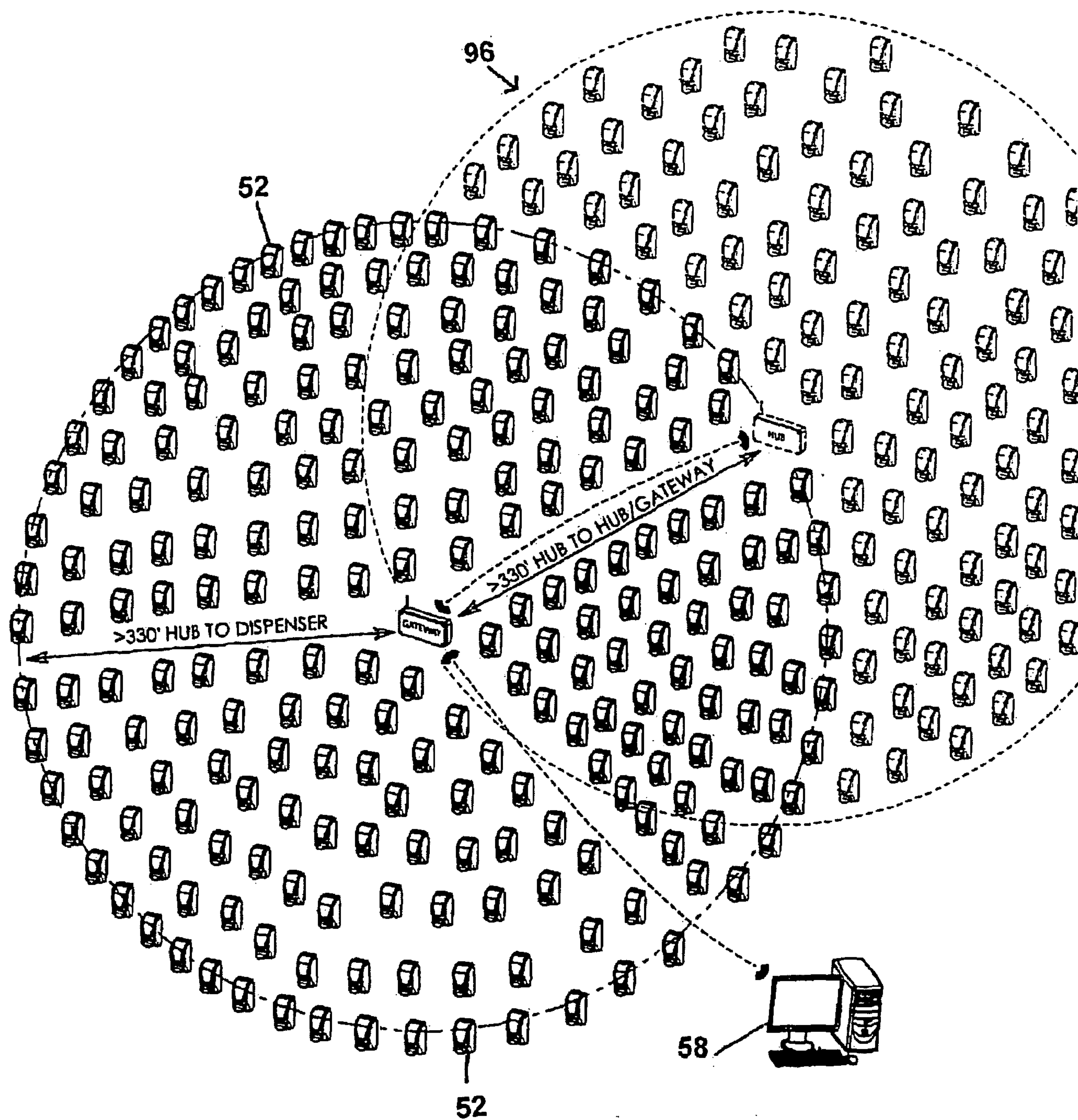


FIG. 11

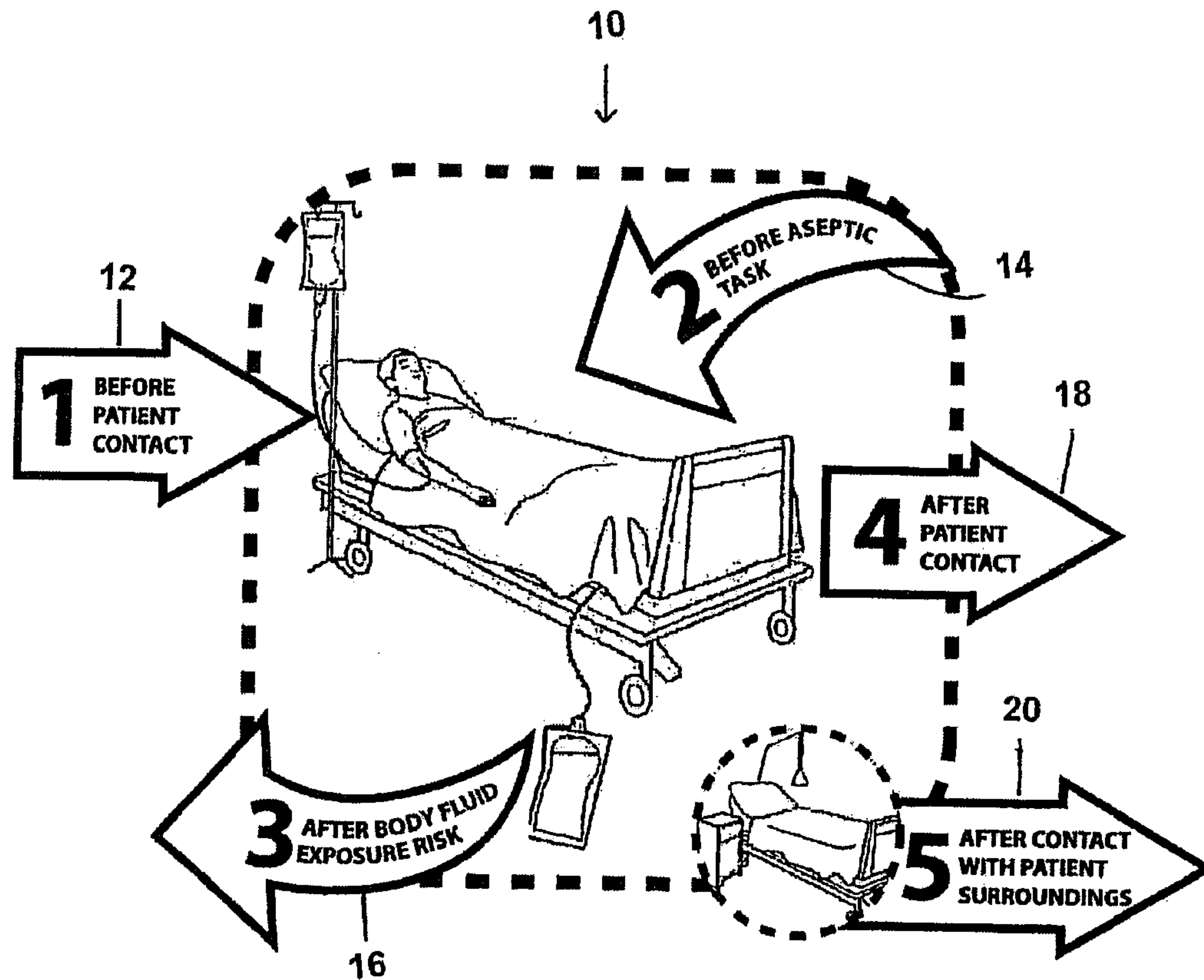


FIG. 1