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(71) Applicant *(for all designated States except US)*: **NESTICON, LLC** [US/US]; 2100 Central Avenue, Suite 5, Augusta, Georgia 30904 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **ABDULLA, Abdulla M.** [US/US]; 3415 Wheeler Road, Augusta, Georgia 30909 (US). **AMES, Philip L.** [US/US]; 704 Woodgate Drive, Augusta, Georgia 30909 (US).

(74) Agents: **PRATT, John** et al.; 1100 Peachtree Street, Suite 2800, Atlanta, Georgia 30309 (US).

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(54) Title: CREATING A REPORT HAVING COMPUTER GENERATED NARRATIVE TEXT

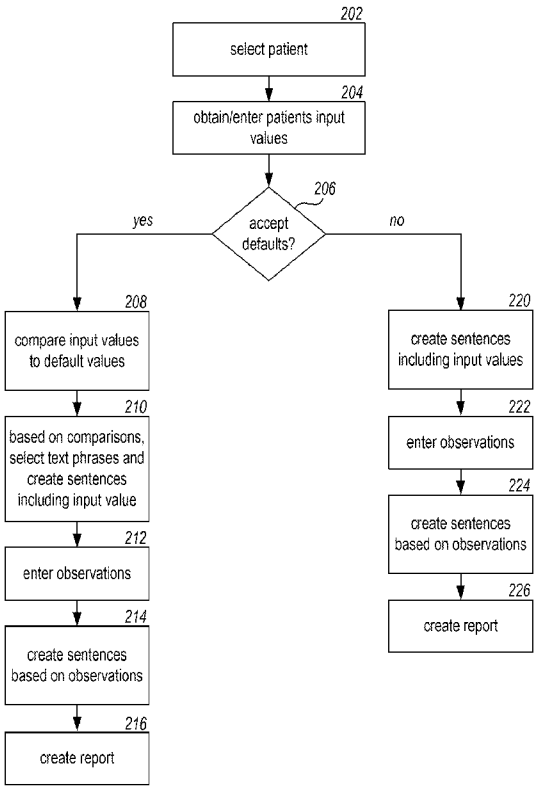

Figure 2

(57) Abstract: The present invention provides a system that creates a report that includes complete sentences based on input values that reflect measured or observed patient conditions. The system creates a sentence or a portion of a sentence that describes the patient's condition by comparing the input values for one or more attributes to the default values for those attributes. The default values are pre-determined and are usually based on medical standards. By comparing the input values to the default values the system can generate highly descriptive text that describes the patient's condition in a narrative form.

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CREATING A REPORT HAVING COMPUTER GENERATED NARRATIVE TEXT

RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 60/908,864 entitled "Electronic Health Record and Automated Clinical Reporting System" filed March 29, 2007, which is incorporated herein by reference.

TECHNICAL FIELD

The present invention is directed in general to creating a report using computer generated text, and in particular to generating a report by comparing input values to default values to create narrative text.

BACKGROUND

Healthcare providers spend a great deal of time creating medical reports to document the diagnoses, care and treatment of patients. Various options are available to create such reports, including manual creation, dictation, or template systems. In a template system a user inputs data and then the system inserts the data into a pre-existing template to create a report. A report produced by a template system generally includes rigid, disjointed text that is obviously computer-generated. When using a template system care must be taken to select the correct template given the clinical diagnosis and the patient information. Otherwise the template will guide the healthcare provider's conclusions, rather than having the patient's information and data guide the conclusions.

Since a template is not flexible, a large number of templates are required to address all the possible problems or issues that may arise. The number of templates may make it difficult for a user to select the correct template. A user may discover that the wrong template was selected after much of it has been completed. If so, then the user is required to start over with the correct template. Accordingly a needs exists for a system to support the creation of reports that is more flexible than a template system and that generates narrative text.

SUMMARY OF THE INVENTION

The present invention provides a system that creates a report that includes complete sentences based on input values entered by a user or received from medical diagnostic equipment. An input value usually corresponds to measured or observed condition of a patient and is associated with an attribute. An attribute that describes a measured condition is usually

associated with a numeric value, whereas an attribute that describes an observed condition is usually associated with a text value. The system may also include other types of attributes, such as an attribute that corresponds to patient demographic information.

The system creates a sentence or a portion of a sentence that describes the patient's condition by comparing the input values for one or more attributes to the default values or other predefined values for those attributes. The default values are pre-determined and are usually based on medical standards. By comparing the input values to the default values the system can generate highly descriptive text that describes the patient's condition in a narrative form.

These and other aspects, features and advantages of the present invention may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference to the appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A-1J are screen shots illustrating a user interface in accordance with an embodiment of the invention.

Figure 2 is a flow diagram of a method for creating text in accordance with an embodiment of the invention.

Figures 3A and 3B are screen shots for selected a user interface in accordance with an embodiment of the invention.

Figure 4 is a table illustrating the restriction of input values for an attribute that is associated with a text value in accordance with an embodiment of the invention.

Figure 5 is a table illustrating the determination of a text phrase based on attribute values in accordance with an embodiment of the invention.

Figure 6 illustrates an exemplary implementation of the determination of a text phrase based on attribute values.

DETAILED DESCRIPTION

The present invention is directed towards a system and method for creating a report, such as a medical report, by using a computer to generate text based on comparisons of input values to default values. The input values may correspond to a measured condition of a patient or an observed condition of a patient. The default values correspond to medical standards. Based on the comparisons, text phrases are selected which describe the patient's condition. The text phrases are combined with other text, such as text prefixes and/or text suffixes to create complete sentences and the sentences are organized into a report.

Exemplary User Interface

Figures 1A through 1J illustrate an exemplary user interface for guiding a user through the steps of creating a medical report. All patient information shown in Figures 1A through 1J is fictitious. Figure 1A illustrates a patient selection interface which allows a user to select a patient by name (*e.g.* by selecting the Search by Last Name option) or by date of visit (*e.g.* by selecting a date on the calendar) or to enter information for a new patient (*e.g.* by selecting the New Patient option). Once a patient is selected, the patient information interface shown in Figure 1B is displayed, which allows a user to update patient information or generate a report, such as an echocardiogram report.

If the user selects the Echo Data Page option, then Figure 1C is presented to the user. Figure 1C provides an overview of the information and data that will be used to generate an echocardiogram report for the patient. Figure 1C includes left ventricle measurements, such as mid-septum wall thickness (Septum) measured at 9.4 mm and left ventricular end-diastolic dimension (LVEDd) measured at 50 mm. The measurements can be entered by a medical technologist via the Echo Data Page or can be imported from the medical equipment that took the measurements.

If the user selects the Echo Setup option, then Figure 1D is presented to the user. Figure 1D allows the user to accept default values. A default value is a value that is predetermined and is generally based on medical standards, such as the standards set by the American Society of Echocardiography for an echocardiogram report. The measurements for a selected patient are compared to the default values or ranges of default values to create the report. Figure 1D illustrates that a user can accept or decline defaults for each subsection of the report.

Figure 1E provides additional details regarding the creation of the text for the left ventricle subsection of the report. Figure 1E shows the measurement data (also referred to herein as the input values) for a number of different attributes. The default values are shown in parenthesis next to each input value. For example, the input value for left ventricular end-diastolic dimension (LVEDd) attribute is 50 mm and the range of default values is 35-56 mm. The system uses a series of comparisons or conditional statements which compare the input value with the default values and possibly patient demographic information, such as the patient's sex, to create the following sentence, which is shown in the Report Text section:

The left ventricular end-diastolic dimension was within normal limits at 50 mm.

The sentence generated by the system provides a richer description of the patient's condition than that generated by a system that uses a template. In the foregoing example the LVEDd dimension

is 50 mm, which is within the default range of 35-56 mm. The text states that the "left ventricular end-diastolic dimension was within normal limits at 50", rather than just stating the measured left ventricular end-diastolic dimension. Additional details describing how the text is created are provided in Section entitled "Exemplary Text Creation." The other sentences in the report text shown Figure 1E are created in a similar manner.

In addition to physical measurements, the system also handles user observations of the patient's condition. Figures 1F and 1G illustrate a series of drop down menus which allows a user to enter observations for certain left ventricle characteristics or attributes. Some of the characteristics are related to the measurements, but others are independent. For example, the LV Systolic function / EF attribute shown in Figure 1F is related to the left ventricular end-diastolic dimension attribute in Figure 1E, whereas the Dyssynchrony attribute is independent of the left ventricle measurement attributes. The report includes a sentence or a portion of a sentence that reflects each observation.

Based upon the input values, the observations, the default values and the patient information, the system creates a report, as illustrated in Figure 1H. The illustrated report includes complete sentences that include text appropriate for the specific patient. In some embodiments, the report includes a conclusion subsection. The conclusion subsection includes sentences that highlight the most important measurements or observations. If the user is satisfied with the report, then the user can proceed to sign the report using the screen illustrated in Figure 1I. Once the report is completed the report can be stored as an electronic health record, printed, and/or sent to another system for further processing.

If the user wants to modify the report, then the user can select a subsection to modify. For example, if the user wants to modify the sentence "The left ventricular EF was estimated to be moderately decreased at 35%", then the user selects the Left Ventricle subsection either directly from the report or via the Menu option. By changing the input value in the drop down menu that corresponds to LV Systolic function / EF, the user can replace "moderately decreased" with "severely decreased" as shown in Figure 1J and the system dynamically updates the report text without requiring the user to update or reload the page.

Exemplary Method for Creating a Report

Figure 2 illustrates an exemplary method for creating a medical report. In step 202 a user selects a patient and the system obtains relevant patient information, such as age, sex, etc. Once a patient is selected, then in step 204 the input values are obtained from the medical equipment that performed the measurements or are entered by the user. In step 206, the user determines whether

to accept the default values. If the report includes multiple subsections, then it may be possible to accept or decline defaults on a subsection by subsection basis.

If the defaults are accepted, then the method proceeds to step 208. In step 208 an input value received in step 204 is compared to the default value or range of default values. In some instances, patient demographic information is used in the comparison. For example, some comparisons consider the sex of the patient. Based on the outcome of the comparison made in step 208, a text phrase is selected in step 210. The text phrase is used to create a sentence, which may include the input value.

In step 212 the user enters observations about the patient's condition. Typically, the observations are entered via a drop down menu. Although using a drop down menu restricts the content of the observations, it also ensures continuity across reports and allows the data in the report to be used by other systems. Once the user enters an observation, the system generates a sentence or a portion of a sentence based on the observation in step 214.

Although not shown in Figure 2, steps 208 through 214 can be repeated for each subsection of the report or for multiple attributes within a subsection of a report. If a report subsection does not include any observations, then steps 212 and 214 are skipped. Similarly, if a report subsection does not include any measurements, then steps 208 and 210 are skipped. In step 216 a report is created which includes the sentences created in steps 210 and 214.

If the user declines the defaults, then the method proceeds from step 206 to step 220. In step 220 the system generates sentences or portions of sentences using the input values received in step 204. Since the defaults were not accepted, the input values are not compared to the defaults. Instead the system generates sentences that include the input values, but are not as descriptive as those generated in step 210. For example, if defaults are not accepted and the left ventricular end-diastolic dimension is 50 mm, then the system generates a sentence stating that "The left ventricular end-diastolic dimension was 50 mm". This sentence does not include descriptive text such as "within normal limits" or "mildly dilated" which appears when the defaults are accepted.

In step 222 the user enters observations about the patient's condition, similar to that described above in connection with step 212. Once the user enters an observation, the system generates a sentence or a portion of a sentence based on the observation in step 224. Although not shown in Figure 2, steps 220 through 224 can be repeated for each subsection of the report or for multiple attributes within a subsection. If a report subsection does not include any observations, then steps 222 and 224 are skipped. Similarly, if a report subsection does not

include any measurements, then step 220 is skipped. In step 226 a report is created which includes the sentences created in steps 220 and 224.

If the user accepts defaults for some, but not all, subsections of the report, then steps 208-214 are executed for those subsections where the defaults were accepted and steps 220-224 are executed for those subsections where the defaults were declined and the report includes the sentences for all of the subsections.

There may be different users associated with different steps. If a medical technologist enters patient data, then the medical technologist is associated with steps 202 and 204. If the medical technologist also enters some observations, then the medical technologist is also associated with step 212 or 222. Typically a physician, such as a cardiologist, is associated with the steps related to accepting defaults and entering observations, as well as any steps to override text generated by the system.

Exemplary Text Creation

The system uses attributes, input values and conditional statements to create the sentences of the report. An attribute represents a single item of interest and can be assigned a value, such as text, a numeric value, or another type of value. An attribute can correspond to a patient measurement or to a patient observation.

An example of an attribute which can be assigned a text value is intra-atrial septal aneurysm (elASaneurysm) attribute. Figure 3A illustrates a drop down menu which presents options to the user for the elASaneurysm attribute. Attributes that can be assigned a text value may be restricted to a specific set of values by associating the attribute with an attribute list. Restricting the text values provides more uniform reports and allows the reports to be exported to other systems for additional processing.

The elASaneurysm attribute is restricted to five values: (1) persistent protrusion into LA, (2) persistent protrusion into RA, (3) maximal excursion into LA, (4) maximal excursion into RA, and (5) bidirectional excursion, as shown in the drop down menu of Figure 3A. If the user selects the maximal excursion into LA option, then the sentence shown in Figure 3B is generated to describe the intra-atrial septal aneurysm.

Figure 4 shows an attribute list for the elASaneurysm attribute. The attribute list includes a column, the Display column 402, that includes the options provided to a user and a column, the Text column 404, for the corresponding text phrase that is used to create a sentence for the report. Often times the text in the Display column is an abbreviation or shorthand version of the complete word or phase shown in the corresponding Text column. With reference to Figure 4, if

the user selects "Maximal excursion into LA" from a drop down menu, then the system creates a sentence that includes the text phrase "mobility and maximal excursion into the right atrium but lesser excursion into the left atrium."

The attribute list also associates a numeric value with each text value. For example, the numeric value of 115 corresponds to the display value of "persistent protrusion into LA" and the text value of "persistent protrusion into the left atrium throughout the cardiorespiratory cycle" and the numeric value of 116 corresponds to the display value of "persistent protrusion into RA" and the text value of persistent protrusion into the right atrium throughout the cardiorespiratory cycle."

An example of an attribute which can be assigned a numeric value is the left ventricular end-diastolic dimension (LVEDd) attribute. *See* Figure 1E which shows that the numeric value or input value that corresponds to the LVEDd attribute is 50 mm. Many of the attributes that can be assigned a numeric value correspond to patient measurements.

In addition to the attributes that correspond to text or to numeric values, there are also attributes that indicate whether a user has overridden text generated by the system or whether the user has accepted the default values, as well as attributes that correspond to patient demographic information, such as an attribute corresponding to the patient's sex. Attributes that correspond to check boxes, such as a check box to accept defaults or a check box to indicate that a condition is absent, typically corresponds to a Boolean value. For example, the accept defaults attribute is assigned one value if defaults are accepted and a second value if defaults are declined.

To generate a sentence or a portion of a sentence that describes the patient's condition, the system considers the input values that correspond to a predetermined set of attributes. The system compares the input values for the set of attributes to the default values to generate a sentence or a portion of a sentence.

To generate a sentence that describes the left ventricular end-diastolic dimension, the system considers four attributes. The first attribute corresponds to a user override, the second attribute corresponds to acceptance of defaults, the third attribute corresponds to the left ventricular end-diastolic dimension, and the fourth attribute corresponds to the patient's sex. If the input value for the first attribute indicates that the user has not entered an override and if the input value for the second attribute indicates that the user has accepted the defaults, then the input values corresponding to the left ventricular end-diastolic dimension and the patient's sex determine the text.

Figure 5 illustrates how the attributes for the left ventricular end-diastolic dimension and the patient's sex determine the text. In this example, the patient's sex is an attribute that is

associated with an attribute list that includes values for male, female and unknown. If the patient is a male (input value for eSex corresponds to M) and the LV end-diastolic dimension (eLVEDd) is 61.2 mm, then the system generates the text phrase of "mildly dilated at 61.2 mm." If the patient is a female (input value for eSex corresponds to F) with an LV end-diastolic dimension of 61.2 mm, then the system generates the text phrase of "severely dilated at 61.2 mm." The text phrase generated by the system can be combined with a text prefix and/or text suffix to generate a complete sentence. For example, adding a text prefix of "The left ventricular end-diastolic dimension was" to the text phrases of these examples results in "The left ventricular end-diastolic dimension was mildly dilated at 61.2 mm" and "The left ventricular end-diastolic dimension was severely dilated at 61.2 mm."

Figure 6 illustrates an exemplary implementation of the conditional statements used for generating text associated with the left ventricular end-diastolic dimension (LVEDd). Although Figure 6 illustrates a series of conditional statements in a show list concept, other implementations are possible. The user override attribute corresponds to eLVEDd_type, the default attribute corresponds to eCB_defaultLV, the left ventricular end-diastolic dimension attribute corresponds to eLVEDd, and the patient's sex attribute corresponds to eSex.

Exemplary Operating Environment

In one embodiment the system is implemented as an internet application and the user accesses the system using an internet browser. In this embodiment, the system operates on one or more centrally located servers, patient information and input values for the attributes are stored in one or more centrally located databases, and the user accesses the system using a client system. The report generated by the system can be displayed to the user via a display device associated with the client system, printed on a printer accessible to the client system, or communicated to another system or device. If the measurement data is obtained directly from the equipment, then a locally resident module interfaces with the equipment to collect the data and then uploads the data to the database. In one embodiment, the system uses Asynchronous JavaScript and XML (AJAX) protocol to store and retrieve discrete data from the database, which allows dynamic updating of the report. In some embodiments, instructions for implementing the system are stored as computer executable instructions on a computer-readable storage medium, such as a memory device or disk. Other types of computing environments and implementations are also possible, including both distributed and stand alone systems.

In addition to being displayed, the report can be stored in a file on the server while the input values used to create the report can be stored in the database. The user also can export the report to a file that can be saved elsewhere and/or sent to another system.

In one embodiment, the system is created using a content development system that supports a name-value pair methodology through which the logic can be extended or modified without changing the structure of the database tables. This type of content development system provides maximum flexibility in making changes or additions to the logic. The content development tool creates various types of phrases, such as processing logic phrases (*e.g.* conditional statement for comparing an input value to a default value), user input phrases (*e.g.* data entry via check boxes and drop down menus), element layout phrases (*e.g.* report format) and information display phrases.

Although the foregoing examples describe the generation of reports for a cardiology practice, the invention can be used to create other types of reports. Any type of medical report can be generated and the report can cover multiple encounters or physiological systems.

Additional alternative embodiments will be apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A method for creating a medical report using computer generated text, comprising:

receiving an identification of a patient;

receiving input values for a plurality of report attributes;

receiving a default selection, wherein the default selection specifies a default value or a default range that corresponds to each of the report attributes;

for each of the report attributes:

comparing the input value corresponding to the report attribute to the default value or default range corresponding to the report attribute; and

based on the comparison, selecting a text phrase;

combining the text phrase with a text prefix to create a sentence, wherein the text prefix corresponds to the report attribute;

creating the medical report that includes the sentences corresponding to the report attributes; and

providing the medical report to the user.

2. The method of Claim 1, wherein combining the text phrase with a text prefix to create a sentence further comprises inserting the input value into the text phrase.

3. The method of Claim 1, wherein combining the text phrase with a text prefix to create a sentence further comprises combining the text phrase with a text suffix, wherein the text suffix corresponds to the report attribute.

4. The method of Claim 1, wherein receiving input values for a plurality of report attributes, comprises:

for a selected report attribute:

providing a plurality of options for the selected report attribute;

receiving a selection of one of the options;

based on the selected option, selecting a numeric value that corresponds to the selected option.

5. The method of Claim 1, wherein receiving input values for a plurality of report attributes, comprises:

for a selected report attribute, receiving data transferred from medical diagnostic equipment.

6. The method of Claim 1, further comprising:

receiving override text corresponding to a selected sentence; and

modifying the selected sentence so that the override text replaces a portion of the sentence.

7. The method of Claim 1, wherein a selected report attribute corresponds to a measured condition of the patient.

8. The method of Claim 1, wherein a selected report attribute corresponds to a an observed condition of the patient.

9. The method of Claim 1, wherein comparing the input value corresponding to the report attribute to the default value or default range corresponding to the report attribute, further comprises using patient demographic information in the comparison.

10. A method for creating a medical report using computer generated text, comprising:

receiving a first input value for a first report attribute, wherein the first input value is a numeric value and the first report attribute is related to a measured condition of a patient;

receiving a default selection, wherein the default selection specifies a default value or a default range that corresponds to the first report attribute;

comparing the first input value to the default value or default range corresponding to the first report attribute;

based on the comparison, selecting a text phrase;

generating a sentence that includes the text phrase and the first input value;

displaying the sentence to a user;

receiving override text corresponding to the first sentence;

modifying the sentence so that the override text replaces a portion of the sentence;

creating the medical report that includes the modified sentence; and

providing the medical report to the user.

11. The method of Claim 10, further comprising:

receiving a second input value for a second report attribute, wherein the second input value is a text value and the second report attribute is related to an observed condition of the patient;

based on the second input value, selecting a second text phrase;

generating a second sentence that includes the second text phrase; and

displaying the second sentence to the user.

12. The method of Claim 10, wherein generating a sentence that includes the text phrase and the first input value further comprises including a text prefix that corresponds to the first report attribute before the text phrase.

13. The method of Claim 10, wherein generating a sentence that includes the text phrase and the first input value further comprises including a text suffix that corresponds to the first report attribute after the text phrase.

14. The method of Claim 10, wherein comparing the first input value to the default value or default range corresponding to the first report attribute further comprises using patient demographic information in the comparison.

15. A computer-readable medium having computer executable instructions for a method for creating a medical report using computer generated text, comprising:

receiving a first input value for a first report attribute, wherein the first input value is a numeric value and the first report attribute is related to a measured condition of a patient;

receiving a default selection, wherein the default selection specifies at least one default value that corresponds to the first report attribute;

comparing the first input value to the default value corresponding to the first report attribute;

based on the comparison, selecting a text phrase;

generating a sentence that includes the text phrase and the first input value;

displaying the sentence to a user;

receiving a second input value for a second report attribute, wherein the second input value is a text value and the second report attribute is related to an observed condition of the patient;

based on the second input value, selecting a second text phrase;

generating a second sentence that includes the second text phrase;

displaying the second sentence to the user;

creating the medical report that includes the first sentence and the second sentence; and

providing the medical report to the user.

16. The computer-readable medium of Claim 15, further comprising:

receiving override text corresponding to the sentence;

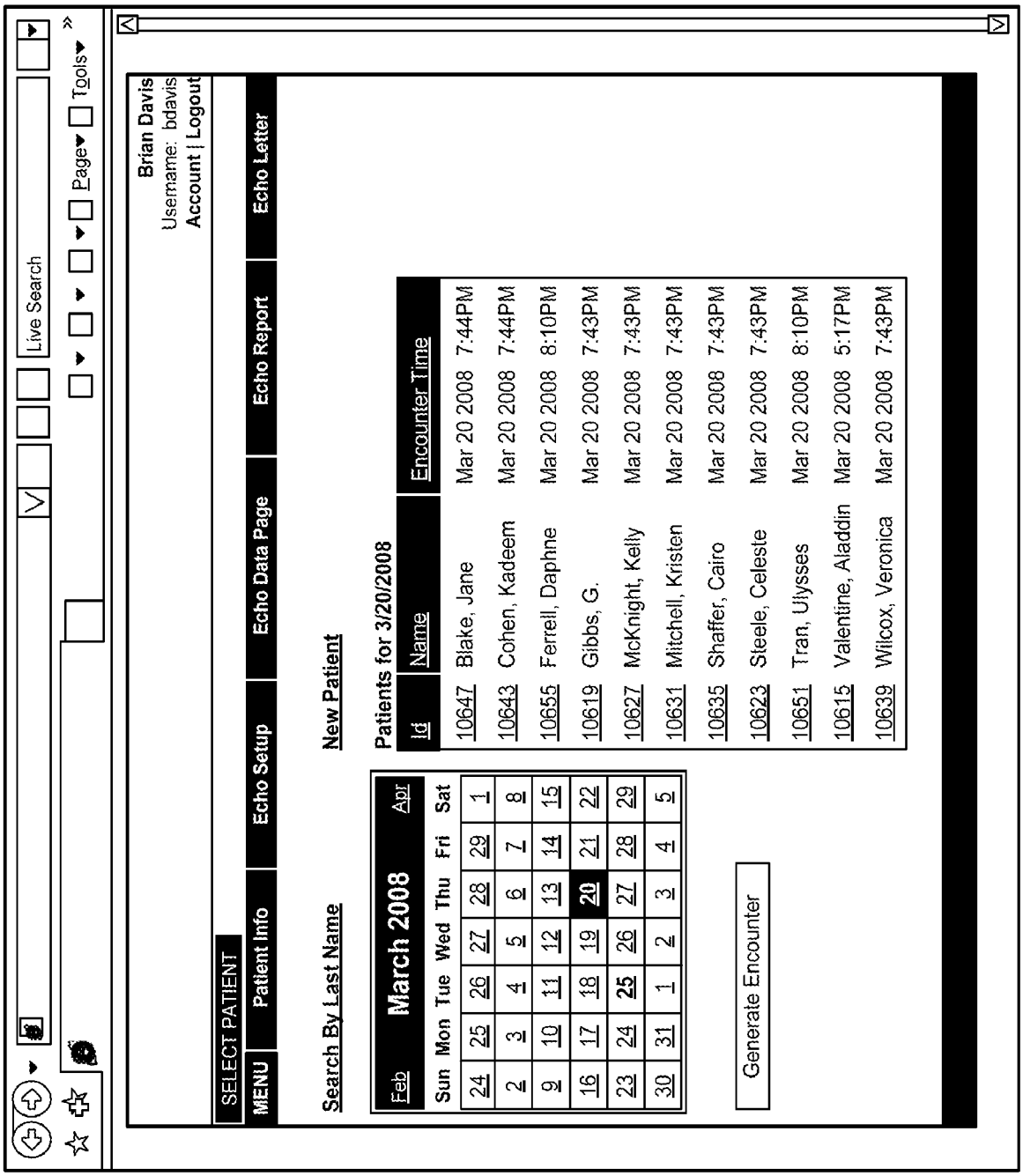
modifying the sentence so that the override text replaces a portion of the sentence; and

displaying the modified sentence to the user.

17. The computer-readable medium of Claim 15, wherein generating a sentence that includes the text phrase and the first input value further comprises including a text prefix that corresponds to the first report attribute before the text phrase.

18. The computer-readable medium of Claim 15, wherein generating a sentence that includes the text phrase and the first input value further comprises including a text suffix that corresponds to the first report attribute after the text phrase.

19. The computer-readable medium of Claim 15, wherein comparing the first input value to the default value corresponding to the first report attribute further comprises using patient demographic information in the comparison.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10643 Cohen, Kadeem Mar 20 2008 7:44PM
10655 Ferrell, Daphne Mar 20 2008 8:10PM
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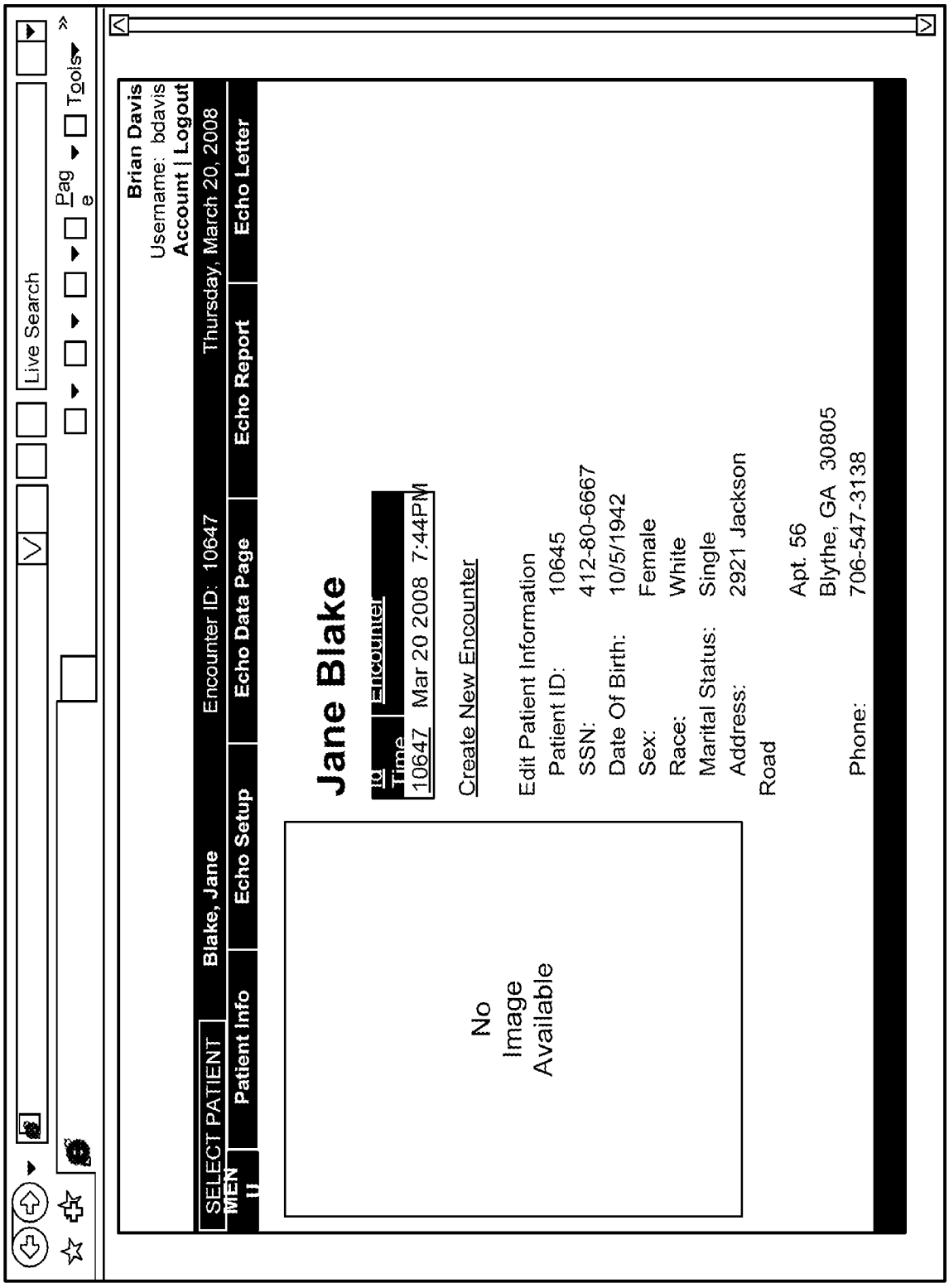
Figure 1A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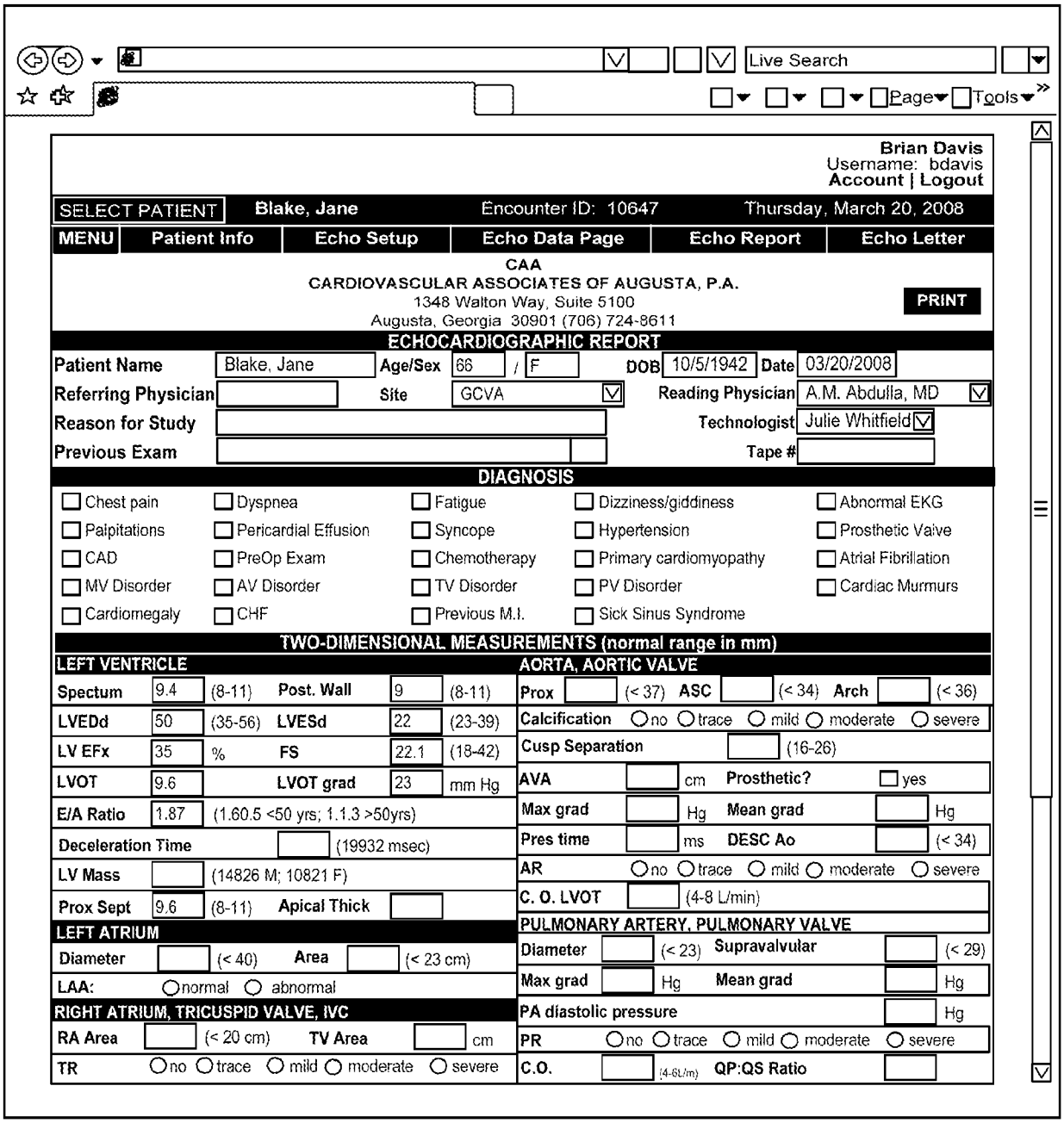
Echo Data Page
Echo Report
Echo Letter
No Image Available
Jane Blake
ID
Time
Encounter
10647 Mar 20 2008 7:44PM
Create New Encounter
Edit Patient Information
Patient ID: 10645
SSN: 412-80-6667
Date Of Birth: 10/5/1942
Sex: Female
Race: White
Marital Status: Single
Address: 2921 Jackson Road
Apt. 56
Blythe, GA 30805
Phone: 706-547-3138

Figure 1B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Thursday, March 20, 2008
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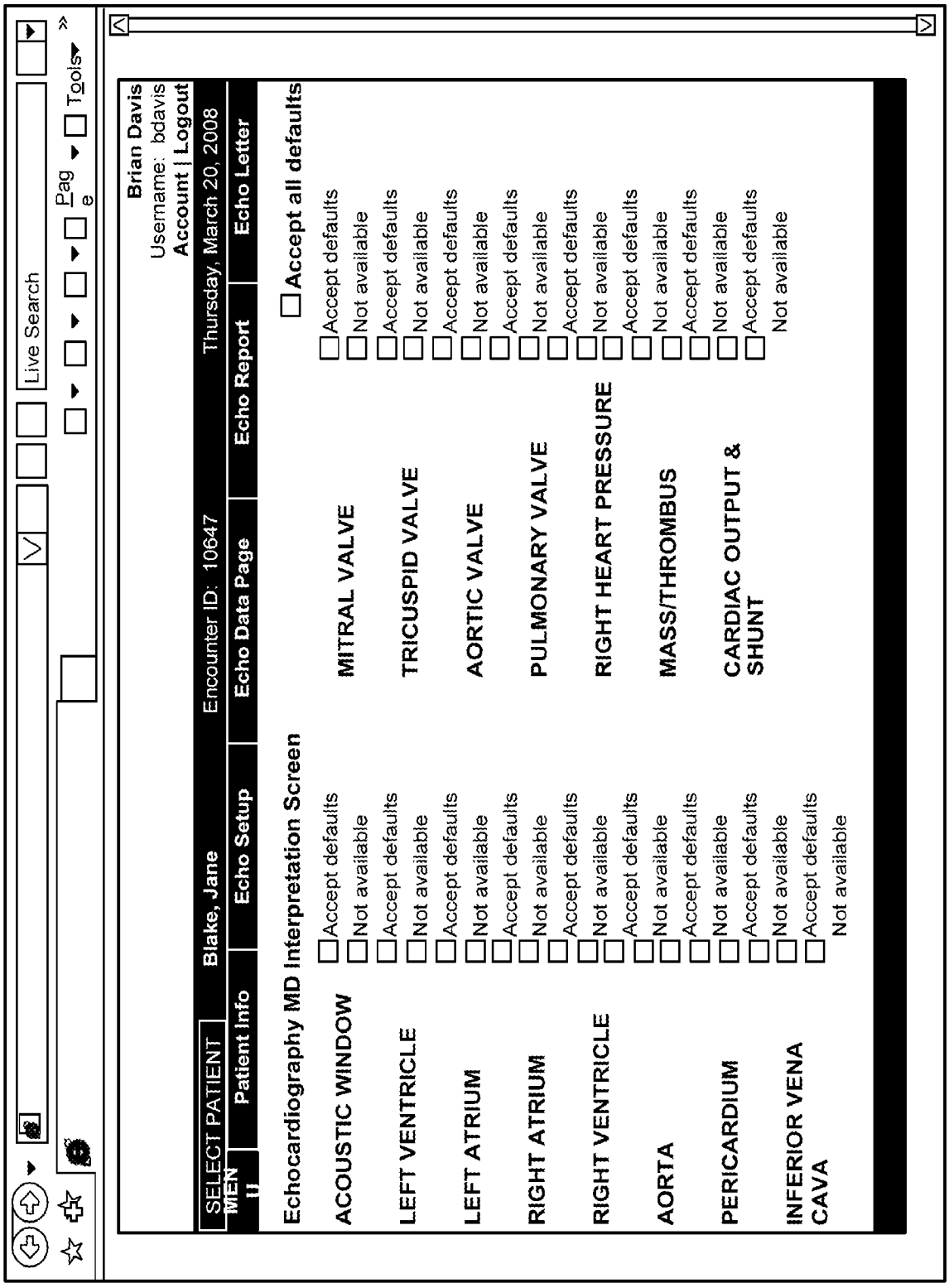
CAA
CARDIOVASCULAR ASSOCIATES OF AUGUSTA, P.A.
1348 Walton Way, Suite 5100
Augusta, Georgia 30901 (706) 724-8611
PRINT
ECHOCARDIOGRAPHIC REPORT
Patient Name Blake, Jane
Age/Sex 66 / F
DOB 10/5/1942
Date 03/20/2008
Referring Physician
Site GCVA
Reading Physician A.M. Abdulla, MD
Reason for Study
Technologist Julie Whitfield
Previous Exam
Tape #
DIAGNOSIS
Chest pain
Dyspnea
Fatigue
Dizziness/giddiness
Abnormal EKG
Palpitations
Pericardial Effusion
Syncope
Hypertension
Prosthetic Valve
CAD
PreOp Exam
Chemotherapy
Primary cardiomyopathy
Atrial Fibrillation
MV Disorder
AV Disorder
TV Disorder
PV Disorder
Cardiac Murmurs
Cardiomegaly
CHF
Previous M.I.
Sick Sinus Syndrome
TWO-DIMENSIONAL MEASUREMENTS (normal range in mm)
LEFT VENTRICLE
Spectum 9.4 (8-11) Post. Wall 9 (8-11)
LVEDd 50 (35-56) LVESd 22 (23-39)
LV EFx 35 % FS 22.1 (18-42)
LVOT 9.6 LVOT grad 23 mm Hg
E/A Ratio 1.87 (1.60.5 <50 yrs; 1.1.3 >50yrs)
Deceleration Time (19932 msec)
LV Mass (14826 M; 10821 F)
Prox Sept 9.6 (8-11) Apical Thick
LEFT ATRIUM
Diameter (< 40) Area (< 23 cm)
LAA: normal abnormal
RIGHT ATRIUM, TRICUSPID VALVE, IVC
RA Area (< 20 cm) TV Area cm
TR no trace mild moderate severe
AORTA, AORTIC VALVE
Prox (< 37) ASC (< 34) Arch (< 36)
Calcification no trace mild moderate severe
Cusp Separation (16-26)
AVA cm Prosthetic? yes
Max grad Hg Mean grad Hg
Pres time ms DESC Ao (< 34)
AR no trace mild moderate severe
C. O. LVOT (4-8 L/min)
PULMONARY ARTERY, PULMONARY VALVE
Diameter (< 23) Supravalvular (< 29)
Max grad Hg Mean grad Hg
PA diastolic pressure Hg
PR no trace mild moderate severe
C.O. (4-6L/m) QP:QS Ratio

Figure 1C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Brian Davis
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Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
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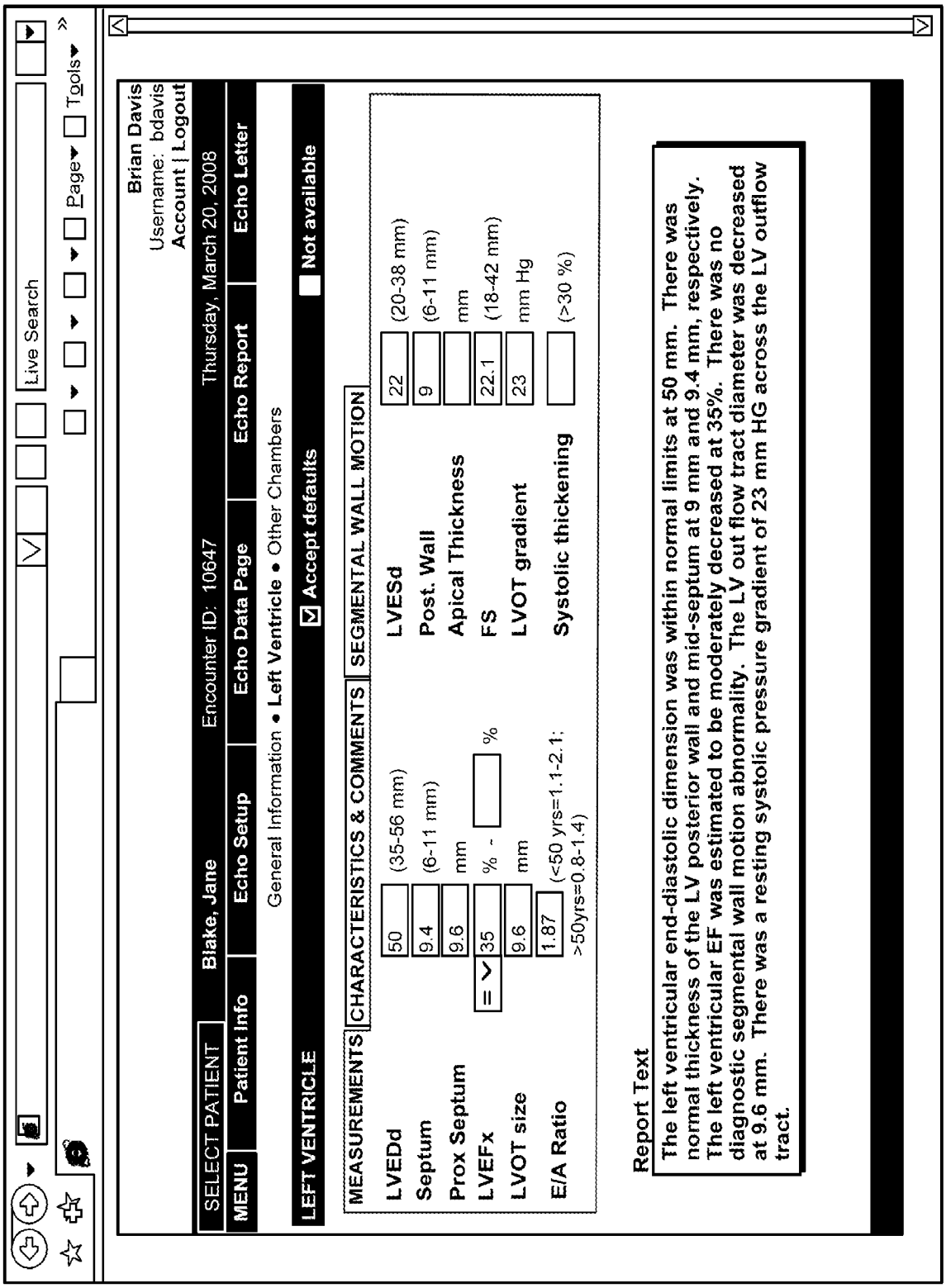
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
Echocardiography MD Interpretation Screen
Accept all defaults
ACOUSTIC WINDOW
MITRAL VALVE
TRICUSPID VALVE
AORTIC VALVE
PULMONARY VALVE
RIGHT HEART PRESSURE
MASS/THROMBUS
CARDIAC OUTPUT & SHUNT
LEFT VENTRICLE
LEFT ATRIUM
RIGHT ATRIUM
RIGHT VENTRICLE
AORTA
PERICARDIUM
INFERIOR VENA CAVA
Accept defaults
Not available

Figure 1D


Live Search
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Tools
Brian Davis
Username: bdavis
Account | Logout
SELECT PATIENT
Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
MENU
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
General Information • Left Ventricle • Other Chambers
LEFT VENTRICLE
Accept defaults
Not available
MEASUREMENTS
CHARACTERISTICS & COMMENTS
SEGMENTAL WALL MOTION
LVEDd 50 (35-56 mm)
Septum 9.4 (6-11 mm)
Prox Septum 9.6 mm
LVEFx = 35 % - % %
LVOT size 9.6 mm
E/A Ratio 1.87 (<50 yrs=1.1-2.1; >50yrs=0.8-1.4)
LVESd 22 (20-38 mm)
Post. Wall 9 (6-11 mm)
Apical Thickness mm
FS 22.1 (18-42 mm)
LVOT gradient 23 mm Hg
Systolic thickening (>30 %)
Report Text
The left ventricular end-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm HG across the LV outflow tract.

Figure 1E

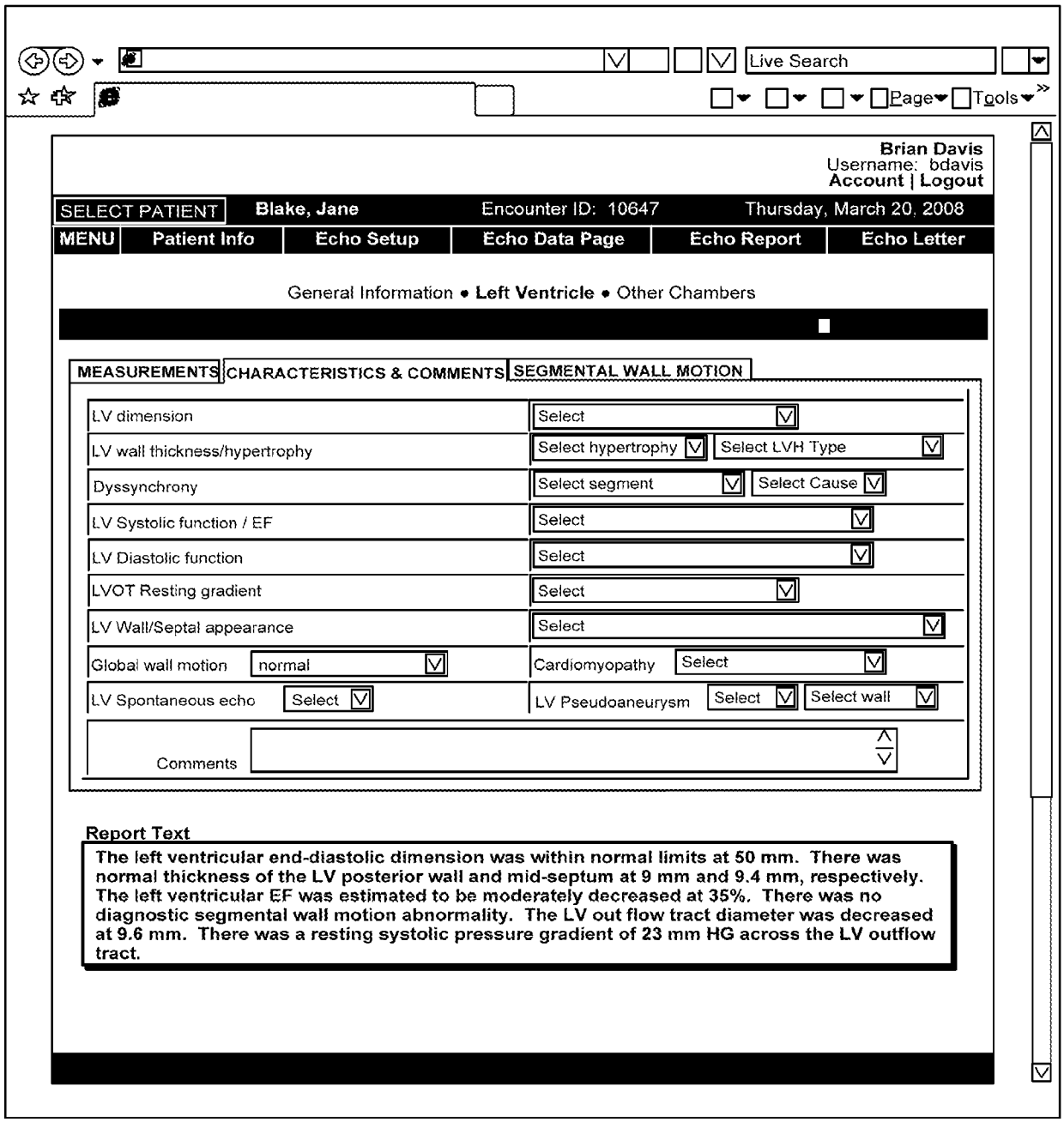
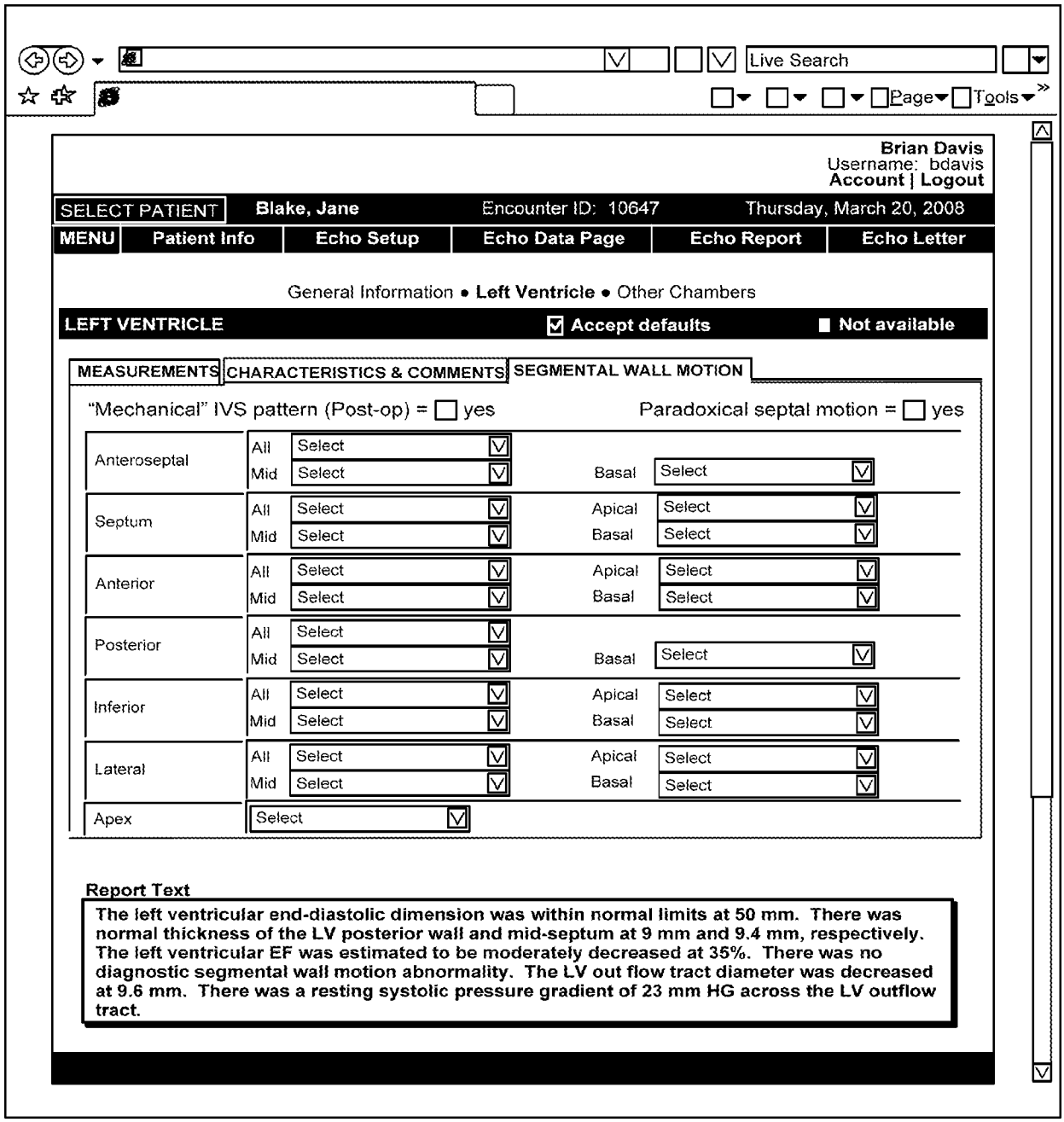

Live Search
Page
Tools
Brian Davis
Username: bdavis
Account | Logout
SELECT PATIENT
Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
MENU
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
General Information • Left Ventricle • Other Chambers
MEASUREMENTS
CHARACTERISTICS & COMMENTS
SEGMENTAL WALL MOTION
LV dimension
Select
LV wall thickness/hypertrophy
Select hypertrophy
Select LVH Type
Dyssynchrony
Select segment
Select Cause
LV Systolic function / EF
Select
LV Diastolic function
Select
LVOT Resting gradient
Select
LV Wall/Septal appearance
Select
Global wall motion
normal
Cardiomyopathy
Select
LV Spontaneous echo
Select
LV Pseudoaneurysm
Select
Select wall
Comments
Report Text
The left ventricular end-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm HG across the LV outflow tract.

Figure 1F


Live Search
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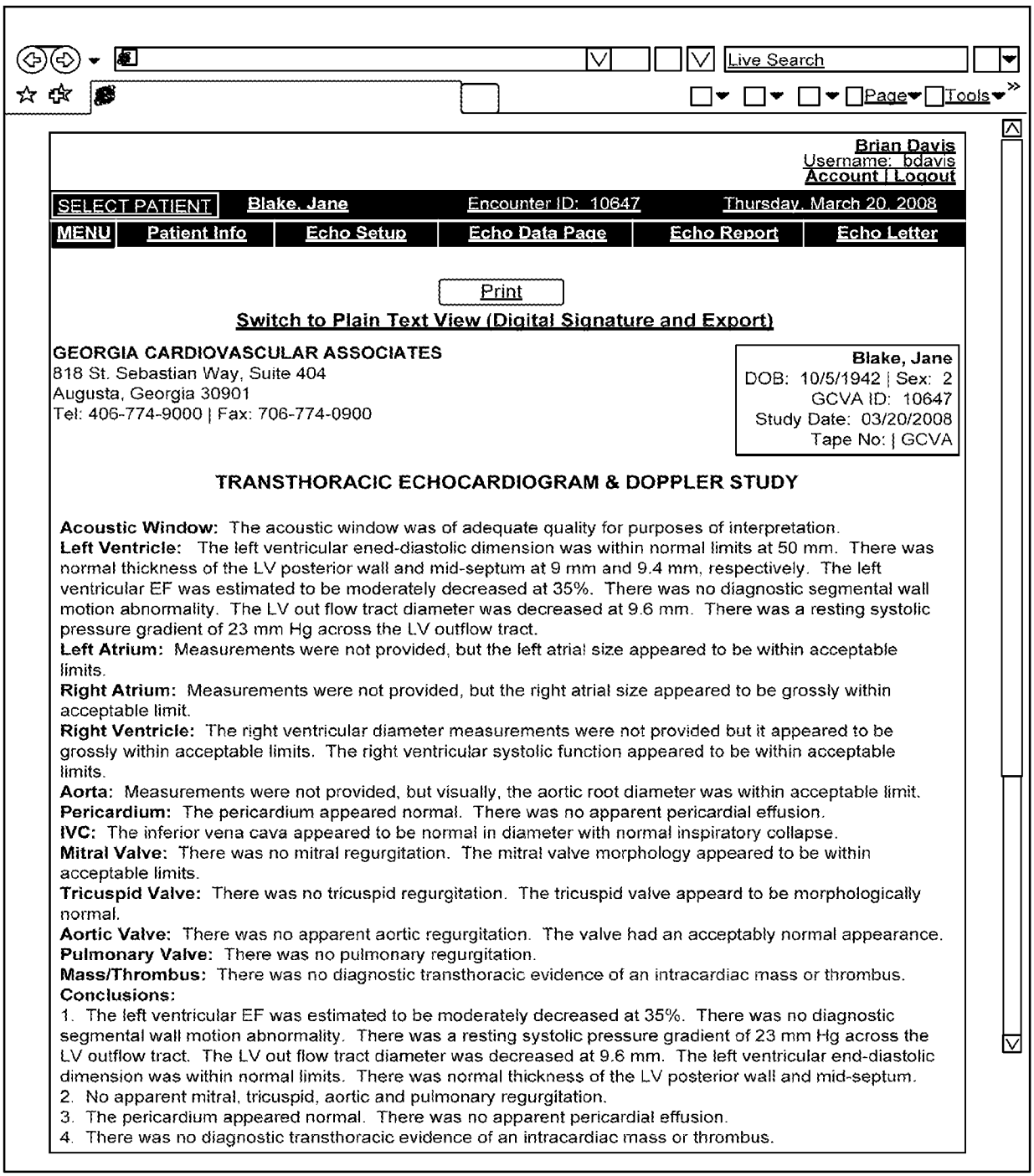
Tools
Brian Davis
Username: bdavis
Account | Logout
SELECT PATIENT
Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
MENU
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
General Information • Left Ventricle • Other Chambers
LEFT VENTRICLE
Accept defaults
Not available
MEASUREMENTS
CHARACTERISTICS & COMMENTS
SEGMENTAL WALL MOTION
"Mechanical" IVS pattern (Post-op) = yes
Paradoxical septal motion = yes
Anteroseptal
Septum
Anterior
Posterior
Inferior
Lateral
Apex
All
Mid
Basal
Apical
Select
Report Text
The left ventricular end-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm HG across the LV outflow tract.

Figure 1G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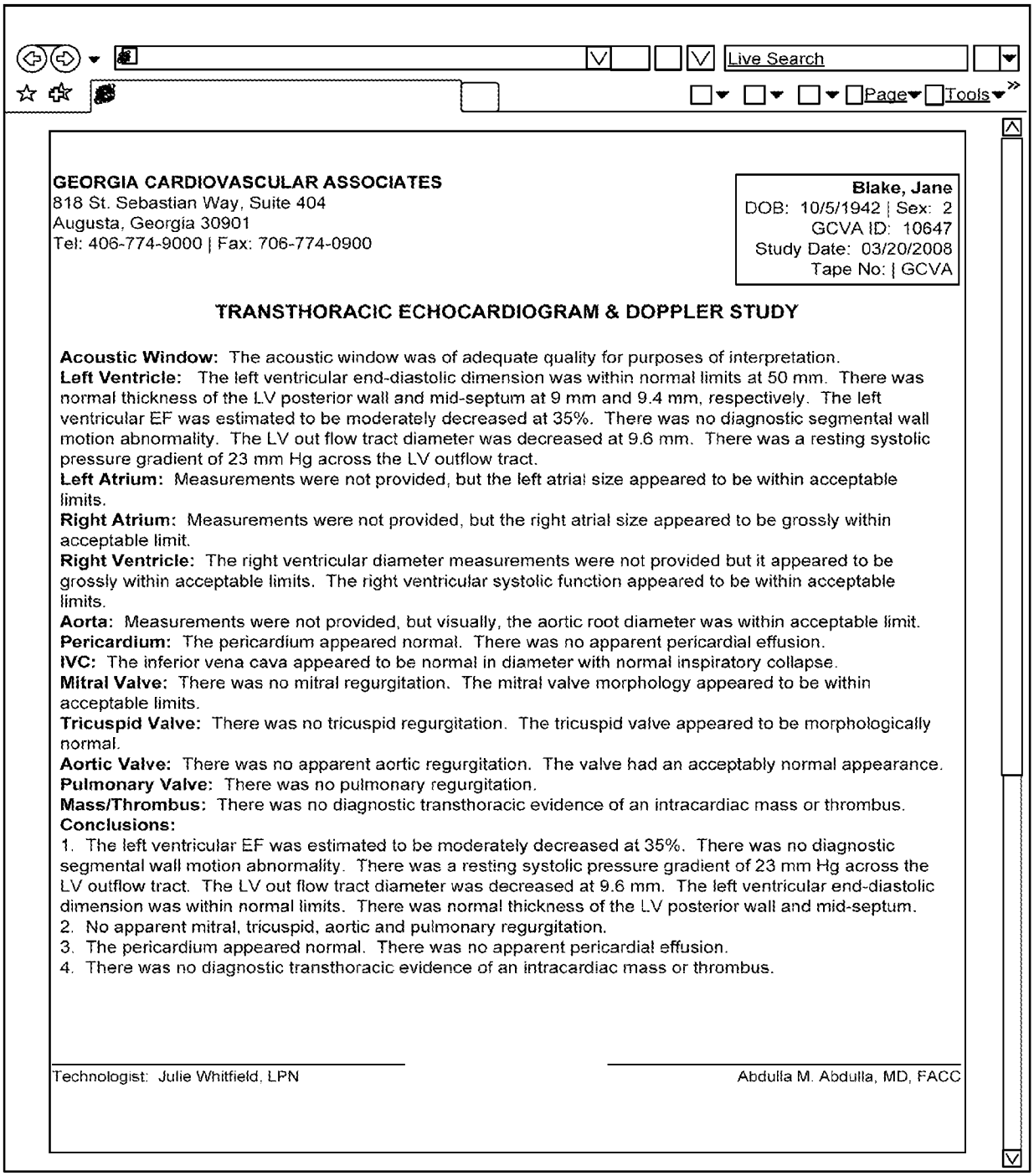
Brian Davis
Username: bdavis
Account | Logout
SELECT PATIENT
Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
MENU
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
Print
Switch to Plain Text View (Digital Signature and Export)
GEORGIA CARDIOVASCULAR ASSOCIATES
818 St. Sebastian Way, Suite 404
Augusta, Georgia 30901
Tel: 406-774-9000 | Fax: 706-774-0900
Blake, Jane
DOB: 10/5/1942 | Sex: 2
GCVA ID: 10647
Study Date: 03/20/2008
Tape No: | GCVA
TRANSTHORACIC ECHOCARDIOGRAM & DOPPLER STUDY
Acoustic Window: The acoustic window was of adequate quality for purposes of interpretation.
Left Ventricle: The left ventricular ened-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm Hg across the LV outflow tract.
Left Atrium: Measurements were not provided, but the left atrial size appeared to be within acceptable limits.
Right Atrium: Measurements were not provided, but the right atrial size appeared to be grossly within acceptable limit.
Right Ventricle: The right ventricular diameter measurements were not provided but it appeared to be grossly within acceptable limits. The right ventricular systolic function appeared to be within acceptable limits.
Aorta: Measurements were not provided, but visually, the aortic root diameter was within acceptable limit.
Pericardium: The pericardium appeared normal. There was no apparent pericardial effusion.
IVC: The inferior vena cava appeared to be normal in diameter with normal inspiratory collapse.
Mitral Valve: There was no mitral regurgitation. The mitral valve morphology appeared to be within acceptable limits.
Tricuspid Valve: There was no tricuspid regurgitation. The tricuspid valve appeard to be morphologically normal.
Aortic Valve: There was no apparent aortic regurgitation. The valve had an acceptably normal appearance.
Pulmonary Valve: There was no pulmonary regurgitation.
Mass/Thrombus: There was no diagnostic transthoracic evidence of an intracardiac mass or thrombus.
Conclusions:
1. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. There was a resting systolic pressure gradient of 23 mm Hg across the LV outflow tract. The LV out flow tract diameter was decreased at 9.6 mm. The left ventricular end-diastolic dimension was within normal limits. There was normal thickness of the LV posterior wall and mid-septum.
2. No apparent mitral, tricuspid, aortic and pulmonary regurgitation.
3. The pericardium appeared normal. There was no apparent pericardial effusion.
4. There was no diagnostic transthoracic evidence of an intracardiac mass or thrombus.

Figure 1H



GEORGIA CARDIOVASCULAR ASSOCIATES
818 St. Sebastian Way, Suite 404
Augusta, Georgia 30901
Tel: 406-774-9000 | Fax: 706-774-0900

Blake, Jane
DOB: 10/5/1942 | Sex: 2
GCVA ID: 10647
Study Date: 03/20/2008
Tape No: | GCVA

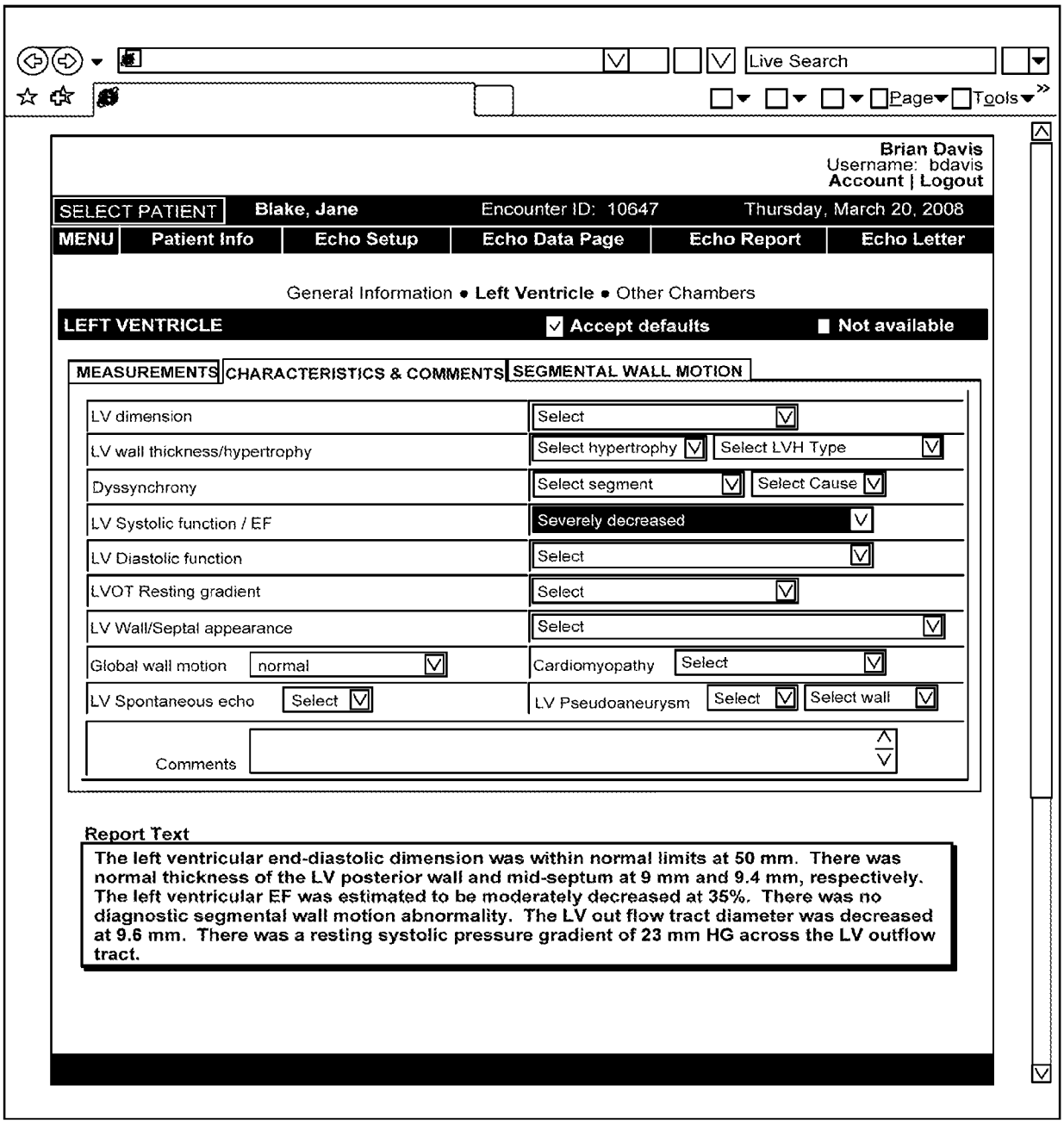
TRANSTHORACIC ECHOCARDIOGRAM & DOPPLER STUDY

Acoustic Window: The acoustic window was of adequate quality for purposes of interpretation.
Left Ventricle: The left ventricular end-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm Hg across the LV outflow tract.
Left Atrium: Measurements were not provided, but the left atrial size appeared to be within acceptable limits.
Right Atrium: Measurements were not provided, but the right atrial size appeared to be grossly within acceptable limit.
Right Ventricle: The right ventricular diameter measurements were not provided but it appeared to be grossly within acceptable limits. The right ventricular systolic function appeared to be within acceptable limits.
Aorta: Measurements were not provided, but visually, the aortic root diameter was within acceptable limit.
Pericardium: The pericardium appeared normal. There was no apparent pericardial effusion.
IVC: The inferior vena cava appeared to be normal in diameter with normal inspiratory collapse.
Mitral Valve: There was no mitral regurgitation. The mitral valve morphology appeared to be within acceptable limits.
Tricuspid Valve: There was no tricuspid regurgitation. The tricuspid valve appeared to be morphologically normal.
Aortic Valve: There was no apparent aortic regurgitation. The valve had an acceptably normal appearance.
Pulmonary Valve: There was no pulmonary regurgitation.
Mass/Thrombus: There was no diagnostic transthoracic evidence of an intracardiac mass or thrombus.
Conclusions:
1. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. There was a resting systolic pressure gradient of 23 mm Hg across the LV outflow tract. The LV out flow tract diameter was decreased at 9.6 mm. The left ventricular end-diastolic dimension was within normal limits. There was normal thickness of the LV posterior wall and mid-septum.
2. No apparent mitral, tricuspid, aortic and pulmonary regurgitation.
3. The pericardium appeared normal. There was no apparent pericardial effusion.
4. There was no diagnostic transthoracic evidence of an intracardiac mass or thrombus.

Technologist: Julie Whitfield, LPN

Abdulla M. Abdulla, MD, FACC

Figure 1I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Brian Davis
Username: bdavis
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Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
MENU
Patient Info
Echo Setup
Echo Data Page
Echo Report
Echo Letter
General Information • Left Ventricle • Other Chambers
LEFT VENTRICLE
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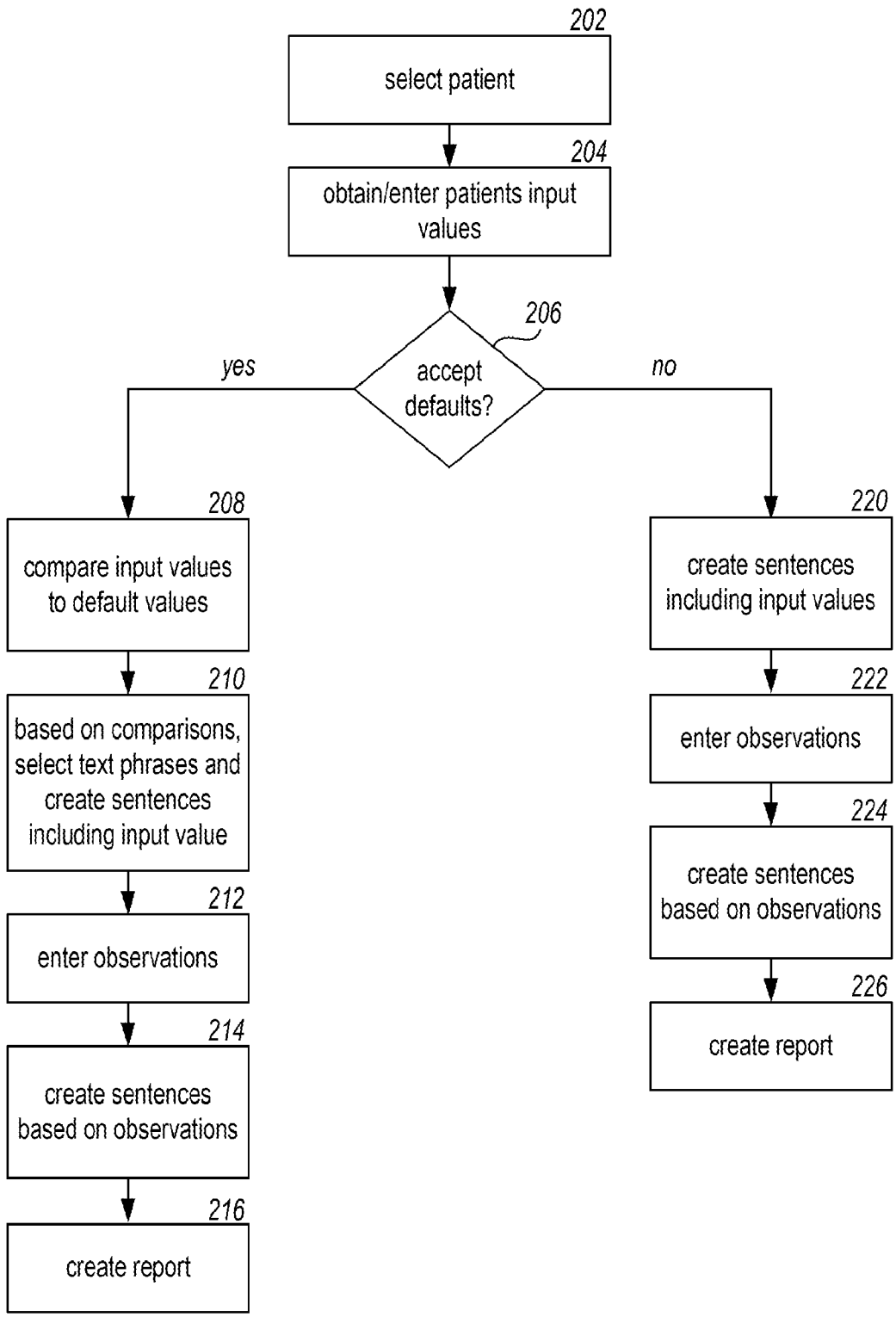
Not available
MEASUREMENTS
CHARACTERISTICS & COMMENTS
SEGMENTAL WALL MOTION
LV dimension
Select
LV wall thickness/hypertrophy
Select hypertrophy
Select LVH Type
Dyssynchrony
Select segment
Select Cause
LV Systolic function / EF
Severely decreased
LV Diastolic function
Select
LVOT Resting gradient
Select
LV Wall/Septal appearance
Select
Global wall motion
normal
Cardiomyopathy
Select
LV Spontaneous echo
Select
LV Pseudoaneurysm
Select
Select wall
Comments
Report Text
The left ventricular end-diastolic dimension was within normal limits at 50 mm. There was normal thickness of the LV posterior wall and mid-septum at 9 mm and 9.4 mm, respectively. The left ventricular EF was estimated to be moderately decreased at 35%. There was no diagnostic segmental wall motion abnormality. The LV out flow tract diameter was decreased at 9.6 mm. There was a resting systolic pressure gradient of 23 mm HG across the LV outflow tract.

Figure 1J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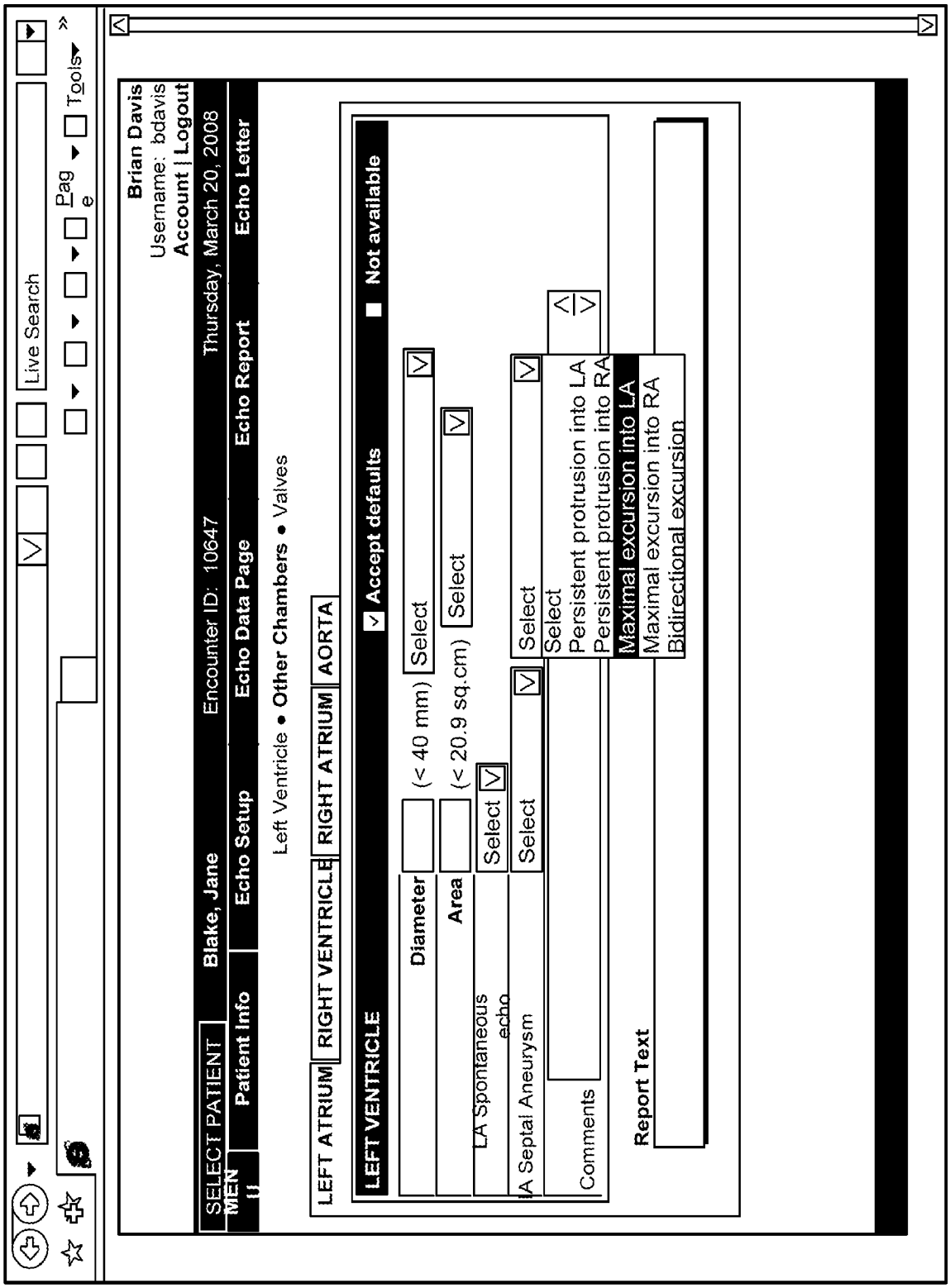
206
accept defaults?
yes
no
208
compare input values to default values
210
based on comparisons, select text phrases and create sentences including input value
212
enter observations
214
create sentences based on observations
216
create report
220
create sentences including input values
222
enter observations
224
create sentences based on observations
226
create report

Figure 2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Username: bdavis
Account | Logout
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Blake, Jane
Encounter ID: 10647
Thursday, March 20, 2008
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Echo Data Page
Echo Report
Echo Letter
Left Ventricle • Other Chambers • Valves
LEFT ATRIUM
RIGHT VENTRICLE
RIGHT ATRIUM
AORTA
LEFT VENTRICLE
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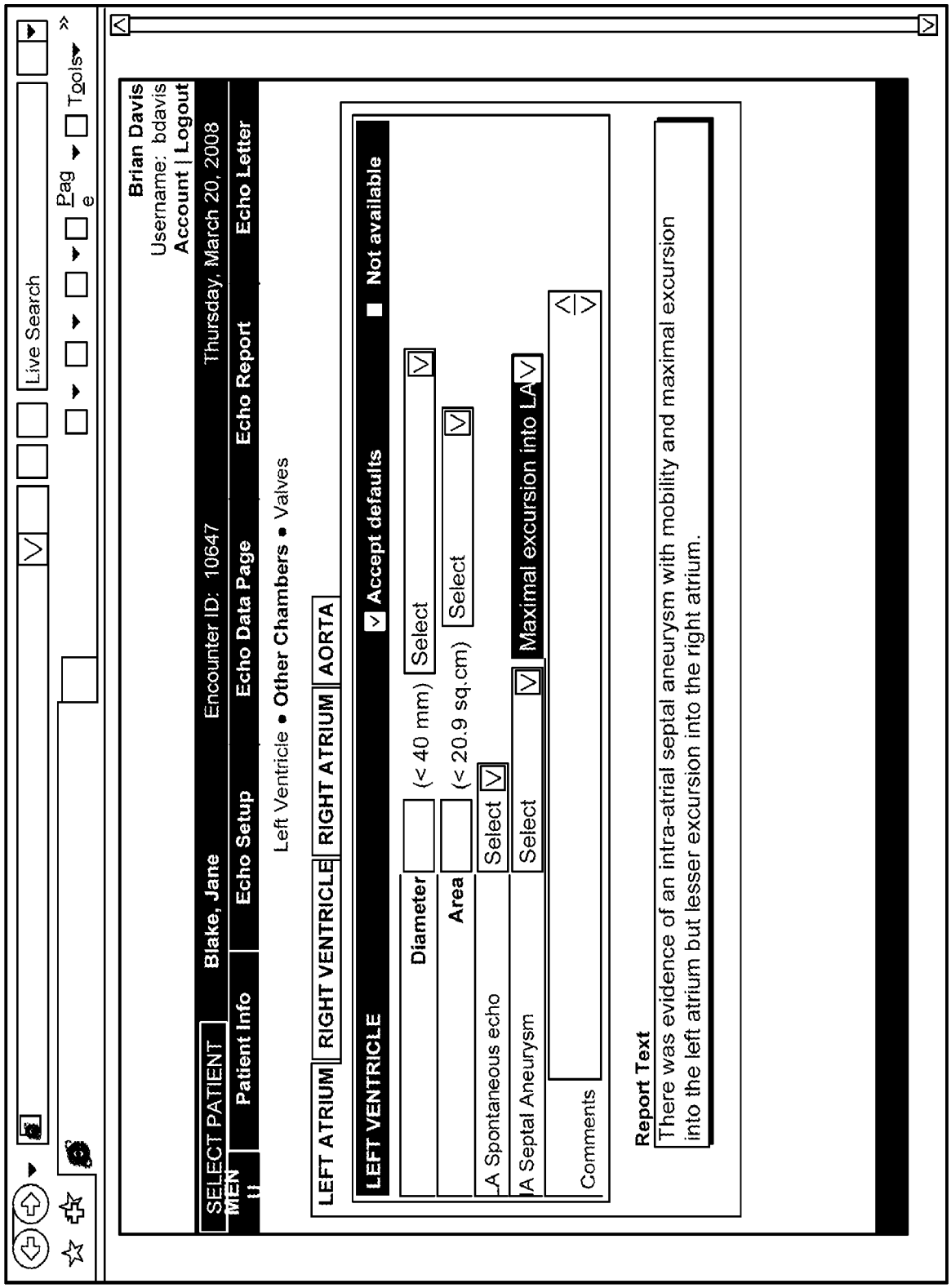
Diameter
(< 40 mm)
Select
Area
(< 20.9 sq.cm)
Select
LA Spontaneous echo
Select
IA Septal Aneurysm
Select
Select
Persistent protrusion into LA
Persistent protrusion into RA
Maximal excursion into LA
Maximal excursion into RA
Bidirectional excursion
Comments
Report Text

Figure 3A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Encounter ID: 10647
Thursday, March 20, 2008
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Echo Setup
Echo Data Page
Echo Report
Echo Letter
Left Ventricle • Other Chambers • Valves
LEFT ATRIUM
RIGHT VENTRICLE
RIGHT ATRIUM
AORTA
LEFT VENTRICLE
Accept defaults
Not available
Diameter
(< 40 mm)
Select
Area
(< 20.9 sq.cm)
Select
LA Spontaneous echo
Select
IA Septal Aneurysm
Select
Maximal excursion into LA
Comments
Report Text
There was evidence of an intra-atrial septal aneurysm with mobility and maximal excursion into the left atrium but lesser excursion into the right atrium.

Figure 3B

402 404

ATTRIBUTE LIST ITEM				
LIST	INDEX	VALUE	DISPLAY	TEXT
145	1	1	Select	
145	2	115	Persistent protrusion into LA	persistent protrusion into the left atrium throughout the cardiorespiratory cycle
145	3	116	Persistent protrusion into RA	persistent protrusion into the right atrium throughout the cardiorespiratory cycle
145	4	117	Maximal excursion into LA	mobility and maximal excursion into the left atrium but lesser excursion into the right atrium
145	5	118	Maximal excursion into RA	mobility and maximal excursion into the right atrium but lesser excursion into the left atrium
145	6	119	Bidirectional excursion	bidirectional and equidistant excursion to the right and left atria during the cardiorespiratory cycle

Figure 4

eSex	eLVEDd	Text
F	less than 39	reduced at {eLVEDd}
F	39-53	within normal limits at {eLVEDd}
F	53-57	mildly dilated at {eLVEDd}
F	57-61	moderately dilated at {eLVEDd}
F	more than 61	severely dilated at {eLVEDd}
M	less than 42	reduced at {eLVEDd}
M	42-59	within normal limits at {eLVEDd}
M	59-63	mildly dilated at {eLVEDd}
M	63-68	moderately dilated at {eLVEDd}
M	more than 68	severely dilated at {eLVEDd}

Figure 5

```
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dimension was">
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
({eLVEDd}!=) and ({eSex}=F) and ({eLVEDd}<39)]">
    <ElementValue>reduced at {eLVEDd}</ElementValue>
  </Conditional>
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    <ElementValue>within normal limits at {eLVEDd}</ElementValue>
  </Conditional>
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  </Conditional>
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    <ElementValue>moderately dilated at {eLVEDd}</ElementValue>
  </Conditional>
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
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    <ElementValue>severely dilated at {eLVEDd}</ElementValue>
  </Conditional>
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
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    <ElementValue>reduced at {eLVEDd}</ElementValue>
  </Conditional>
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
({eLVEDd}!=) and (({eSex}=M) or ({eSex}=)) and ({eLVEDd}>=42) and
({eLVEDd}<=59)]">
    <ElementValue>within normal limits at {eLVEDd}</ElementValue>
  </Conditional>
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
({eLVEDd}!=) and (({eSex}=M) or ({eSex}=)) and ({eLVEDd}>59) and
({eLVEDd}<=63)]">
    <ElementValue>mildly dilated at {eLVEDd}</ElementValue>
  </Conditional>
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({eLVEDd}!=) and (({eSex}=M) or ({eSex}=)) and ({eLVEDd}>63) and
({eLVEDd}<=68)]">
    <ElementValue>moderately dilated at {eLVEDd}</ElementValue>
  </Conditional>
  <Conditional var="ceval[({eLVEDd_type}=) and ({eCB_DefaultLV}!=) and
({eLVEDd}!=) and (({eSex}=M) or ({eSex}=)) and ({eLVEDd}>68)]">
    <ElementValue>severely dilated at {eLVEDd}</ElementValue>
  </Conditional>
</showlist>
```

Figure 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/058840

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F19/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, EMBASE, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/37389 A (SULLIVAN DANIEL JOSEPH [US]) 10 May 2002 (2002-05-10) page 33, line 1 - page 35, line 13 figures 20,21	1-19
X	WO 03/071391 A (LEXICOR MEDICAL TECHNOLOGY INC [US]; JOFFE DAVID [US]; COLWELL VINCIEN) 28 August 2003 (2003-08-28) the whole document	1-19
X	WO 03/065033 A (CONTROL DIABETES INC [US]) 7 August 2003 (2003-08-07) page 4, line 14 - page 14, line 16 figures 1-6	1,10,15

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 July 2008	07/08/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Itoafa, Alex

3

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/058840

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01/95214 A (QUALITY METRIC [US]) 13 December 2001 (2001-12-13) page 42, line 24 - page 43, line 4 page 44, line 13 - line 21 figures 7-10,8-27	1,10,15
A	WO 99/49775 A (ECHOVISION INC [US]; WEISMAN JEFFREY [US]; ZIETZ STANLEY [US]) 7 October 1999 (1999-10-07) page 25, line 2 - page 26, line 20 figures 5,6,9,10	1-19
A	US 2006/212317 A1 (HAHN JERAD J [US] ET AL) 21 September 2006 (2006-09-21) page 9, left-hand column, paragraph 104 - right-hand column, paragraph 109 figures 26-29	1,10,15

3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/058840

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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