US 20190295727A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2019/0295727 A1**

Xanthakis et al. (43) **Pub. Date: Sep. 26, 2019**

(54) **SYSTEM AND METHOD FOR ASSESSING HEART HEALTH AND COMMUNICATING THE ASSESSMENT TO A PATIENT**

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(21) Appl. No.: **16/360,747**

(22) Filed: **Mar. 21, 2019**

Related U.S. Application Data

(60) Provisional application No. 62/647,020, filed on Mar. 23, 2018.

Publication Classification

(51) **Int. Cl.**

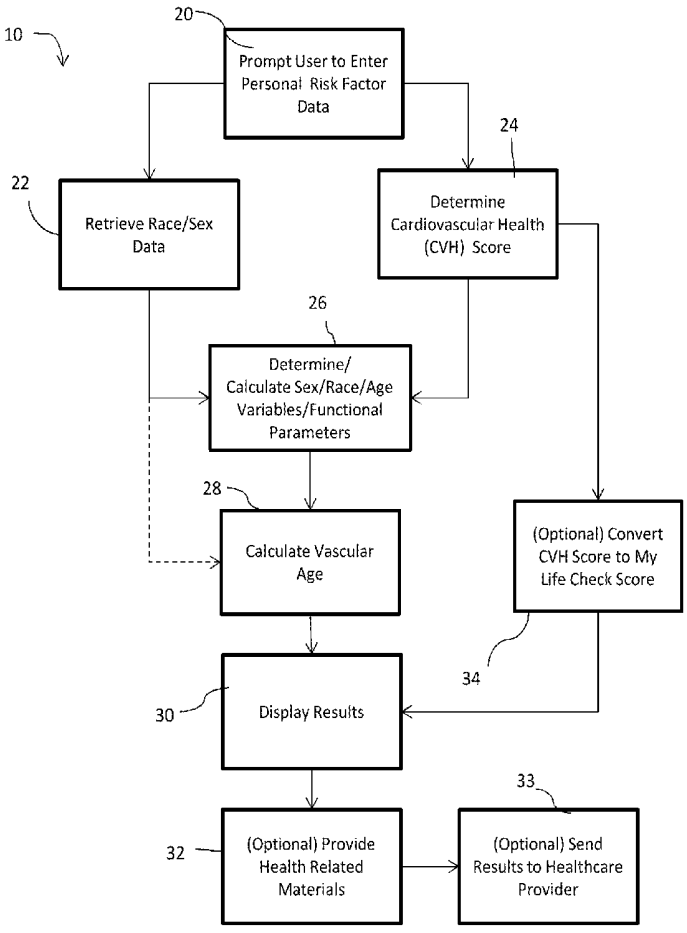
G16H 50/30	(2006.01)
G16H 80/00	(2006.01)
A61B 5/00	(2006.01)

(52) **U.S. Cl.**

CPC ***G16H 50/30*** (2018.01); *G16H 50/20* (2018.01); ***A61B 5/7275*** (2013.01); ***G16H 80/00*** (2018.01)

(57) **ABSTRACT**

A method and system for assessing a patient's heart health and communication that assessment to the patient in an understandable format. Various personal data and information regarding personal risk factors are used to calculate a CVH score. The CVH score, patient's actual age, and various predetermined functional parameters specific to the patient's race and sex are used to calculate a vascular age of the patient. The vascular age is this provided to the patient and may be older than the patient's actual age (indicating poor cardiovascular health), the same as the patient's actual age (indicating average cardiovascular health), or younger than the patient's actual age (indicating ideal cardiovascular health). Optionally health information may also be provided based on the personal risk factors, CVH score, vascular age, or comparisons to previous values or predetermined thresholds.



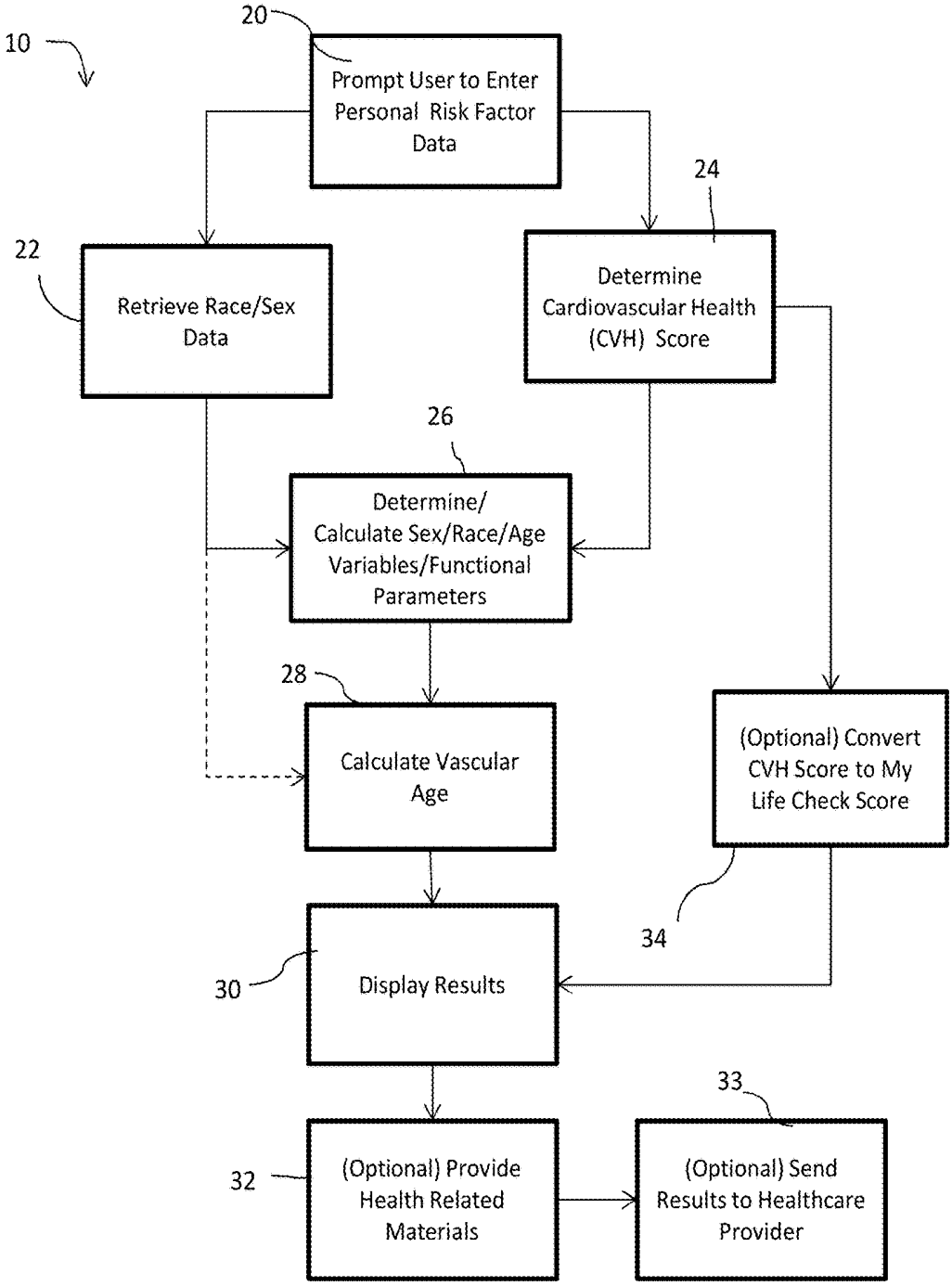

10
20
Prompt User to Enter Personal Risk Factor Data
22
Retrieve Race/Sex Data
24
Determine Cardiovascular Health (CVH) Score
26
Determine/ Calculate Sex/Race/Age Variables/Functional Parameters
28
Calculate Vascular Age
(Optional) Convert CVH Score to My Life Check Score
34
30
Display Results
33
32
(Optional) Provide Health Related Materials
(Optional) Send Results to Healthcare Provider

FIG. 1

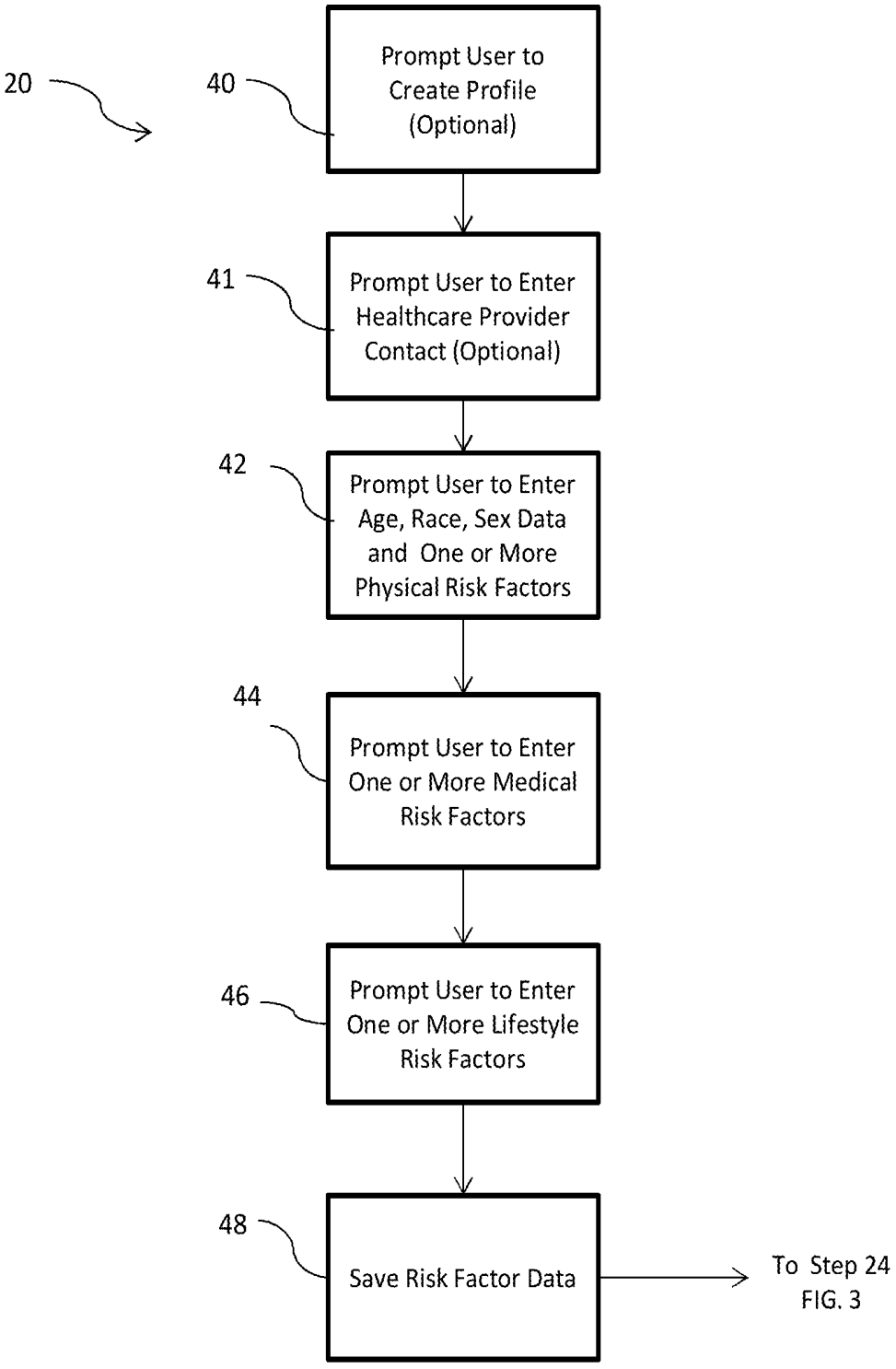

20
40
Prompt User to Create Profile (Optional)
41
Prompt User to Enter Healthcare Provider Contact (Optional)
42
Prompt User to Enter Age, Race, Sex Data and One or More Physical Risk Factors
44
Prompt User to Enter One or More Medical Risk Factors
46
Prompt User to Enter One or More Lifestyle Risk Factors
48
Save Risk Factor Data
To Step 24 FIG. 3

FIG. 2

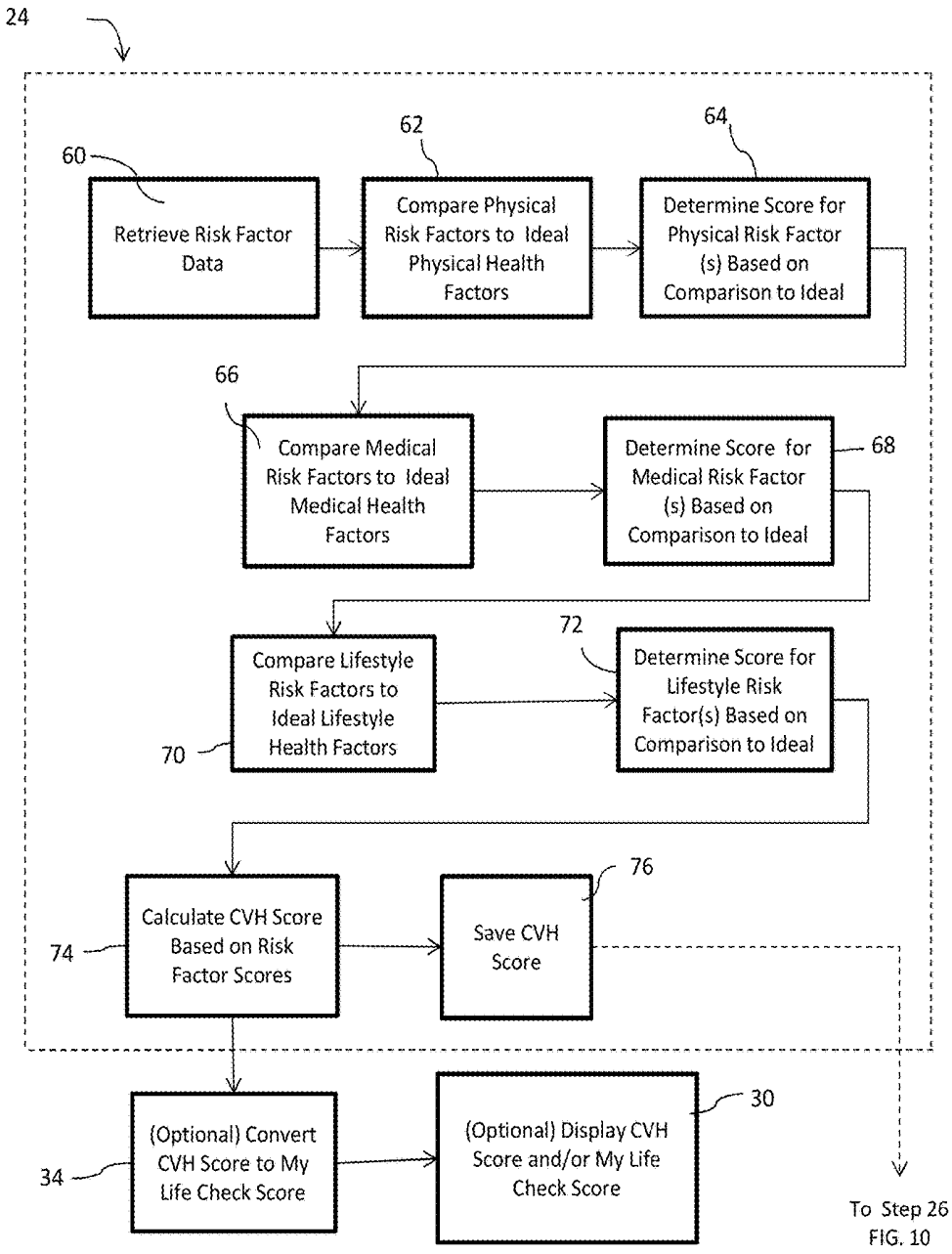

24
60
Retrieve Risk Factor Data
62
Compare Physical Risk Factors to Ideal Physical Health Factors
64
Determine Score for Physical Risk Factor (s) Based on Comparison to Ideal
66
Compare Medical Risk Factors to Ideal Medical Health Factors
Determine Score for Medical Risk Factor (s) Based on Comparison to Ideal
68
Compare Lifestyle Risk Factors to Ideal Lifestyle Health Factors
70
72
Determine Score for Lifestyle Risk Factor(s) Based on Comparison to Ideal
Calculate CVH Score Based on Risk Factor Scores
74
Save CVH Score
76
(Optional) Convert CVH Score to My Life Check Score
34
(Optional) Display CVH Score and/or My Life Check Score
30
To Step 26
FIG. 10

FIG. 3

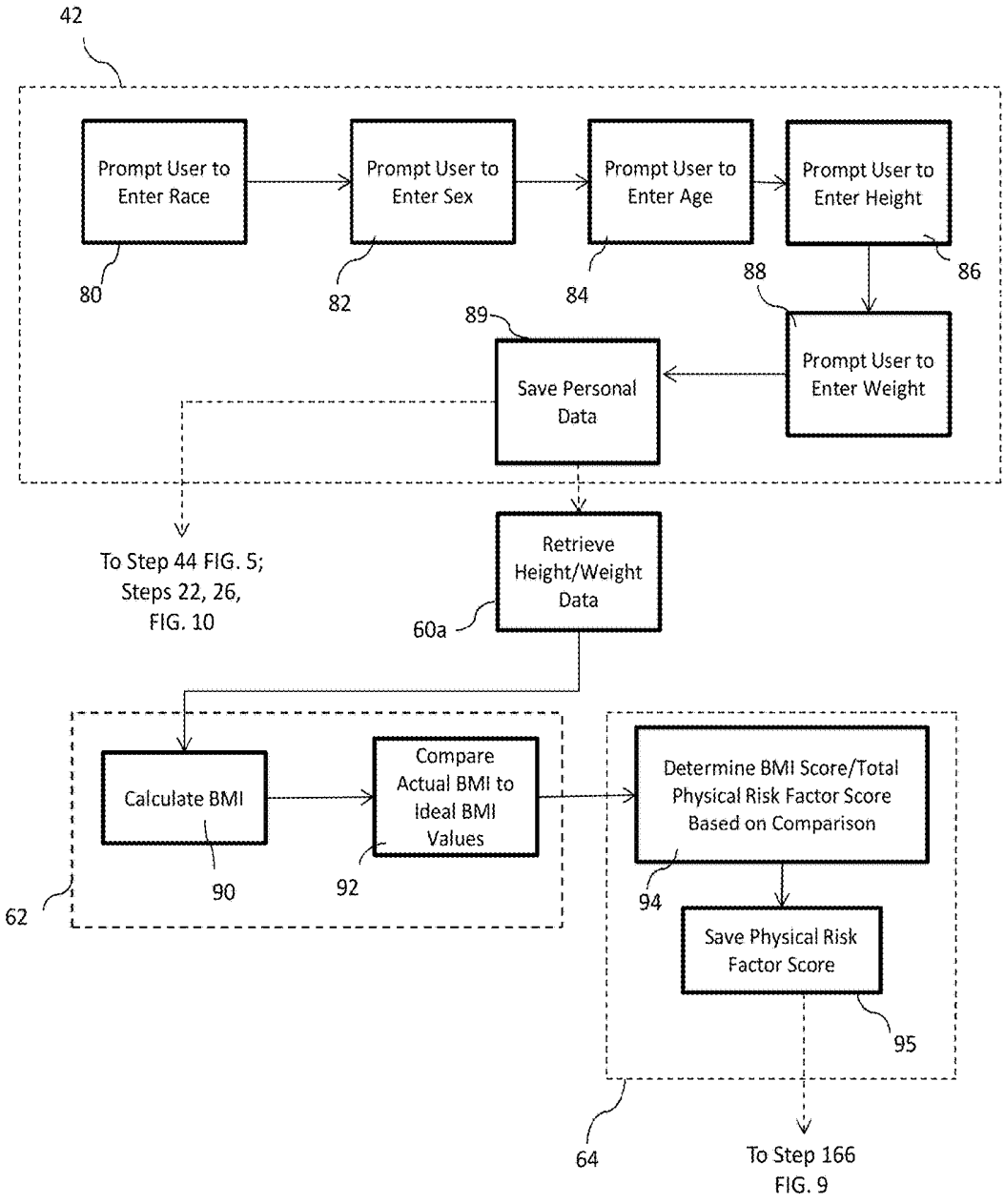

42
Prompt User to Enter Race
Prompt User to Enter Sex
Prompt User to Enter Age
Prompt User to Enter Height
80
82
84
86
88
89
Prompt User to Enter Weight
Save Personal Data
To Step 44 FIG. 5; Steps 22, 26, FIG. 10
Retrieve Height/Weight Data
60a
Calculate BMI
Compare Actual BMI to Ideal BMI Values
90
92
62
Determine BMI Score/Total Physical Risk Factor Score Based on Comparison
94
Save Physical Risk Factor Score
95
64
To Step 166 FIG. 9

FIG. 4

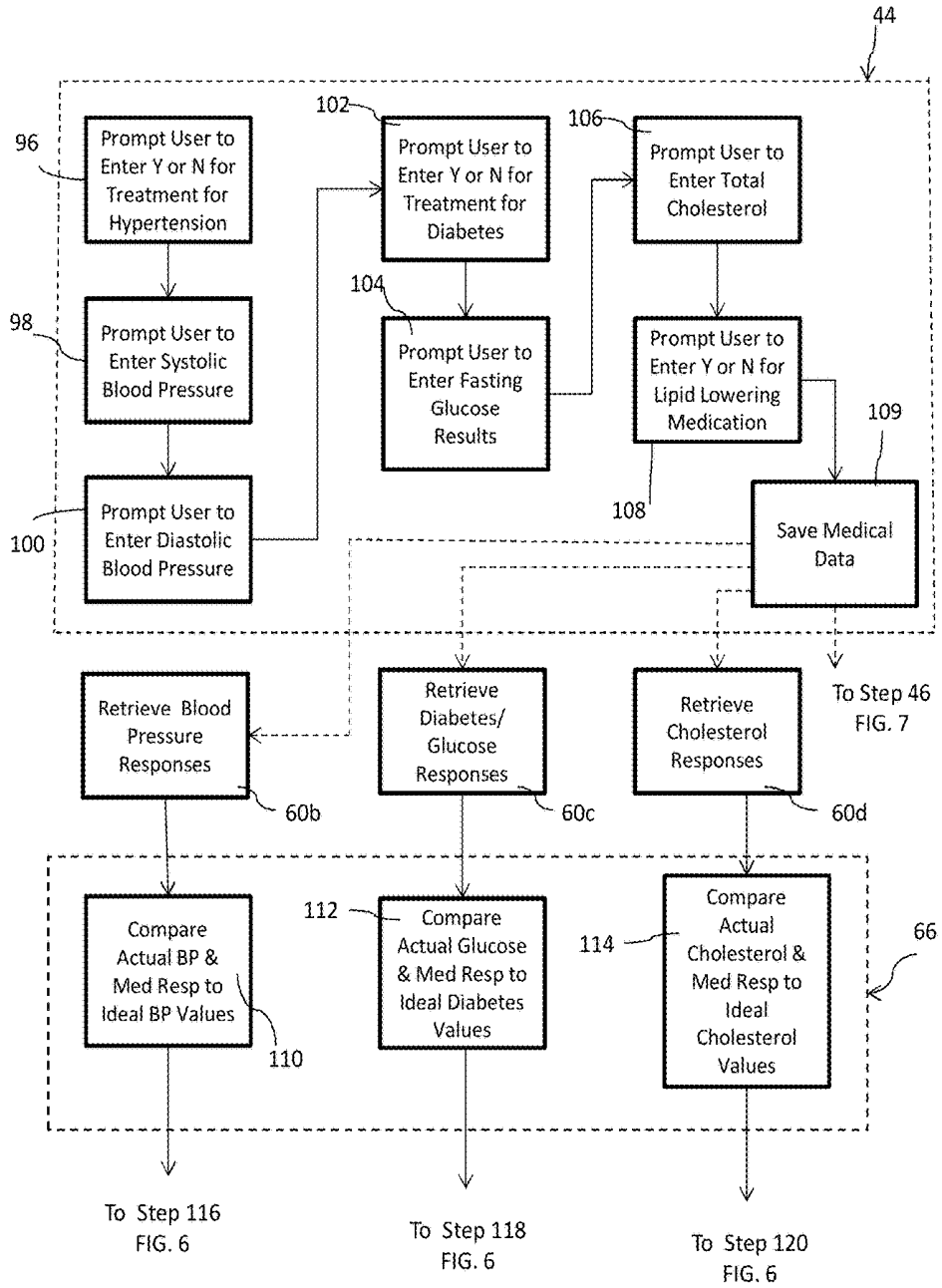

44
96
Prompt User to Enter Y or N for Treatment for Hypertension
102
Prompt User to Enter Y or N for Treatment for Diabetes
106
Prompt User to Enter Total Cholesterol
98
Prompt User to Enter Systolic Blood Pressure
104
Prompt User to Enter Fasting Glucose Results
Prompt User to Enter Y or N for Lipid Lowering Medication
109
100
Prompt User to Enter Diastolic Blood Pressure
108
Save Medical Data
To Step 46 FIG. 7
Retrieve Blood Pressure Responses
60b
Retrieve Diabetes/ Glucose Responses
60c
Retrieve Cholesterol Responses
60d
66
Compare Actual BP & Med Resp to Ideal BP Values
110
112
Compare Actual Glucose & Med Resp to Ideal Diabetes Values
114
Compare Actual Cholesterol & Med Resp to Ideal Cholesterol Values
To Step 116 FIG. 6
To Step 118 FIG. 6
To Step 120 FIG. 6

FIG. 5

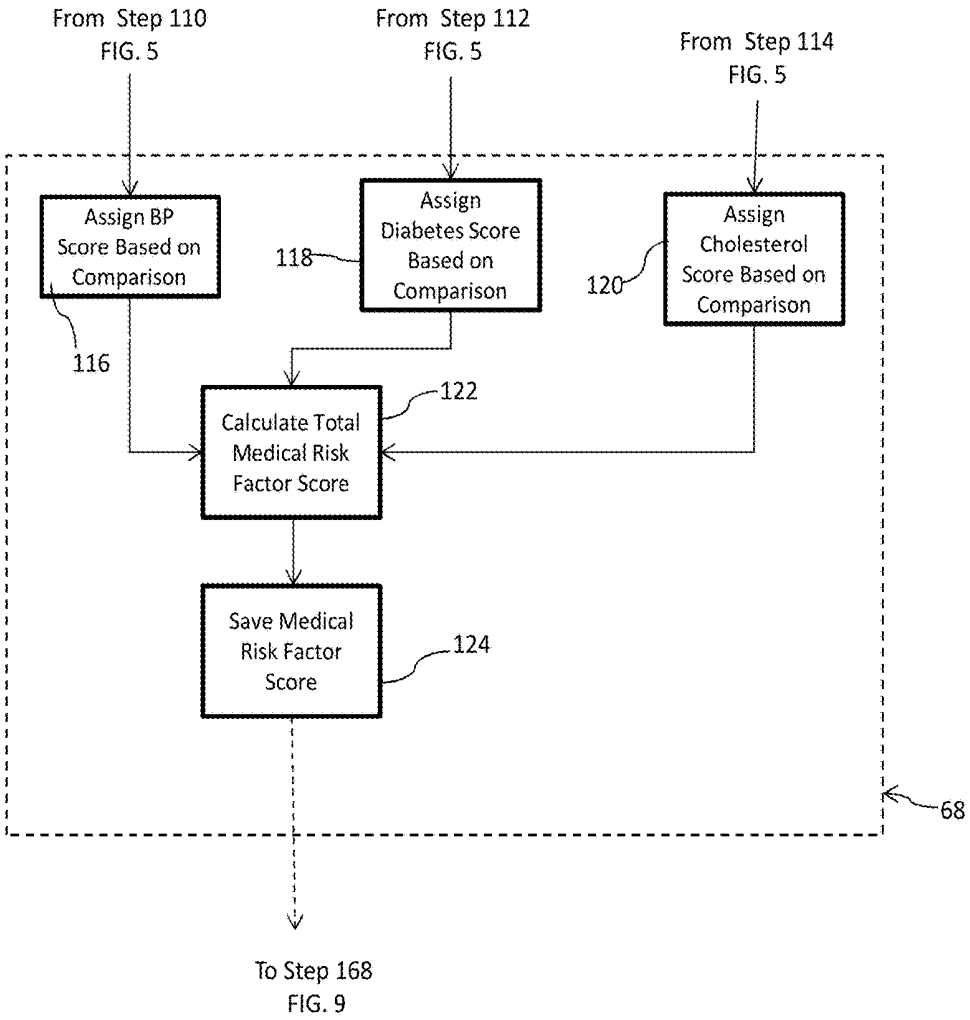

From Step 110
FIG. 5
From Step 112
FIG. 5
From Step 114
FIG. 5
Assign BP Score Based on Comparison
116
Assign Diabetes Score Based on Comparison
118
Assign Cholesterol Score Based on Comparison
120
Calculate Total Medical Risk Factor Score
122
Save Medical Risk Factor Score
124
68
To Step 168
FIG. 9

FIG. 6

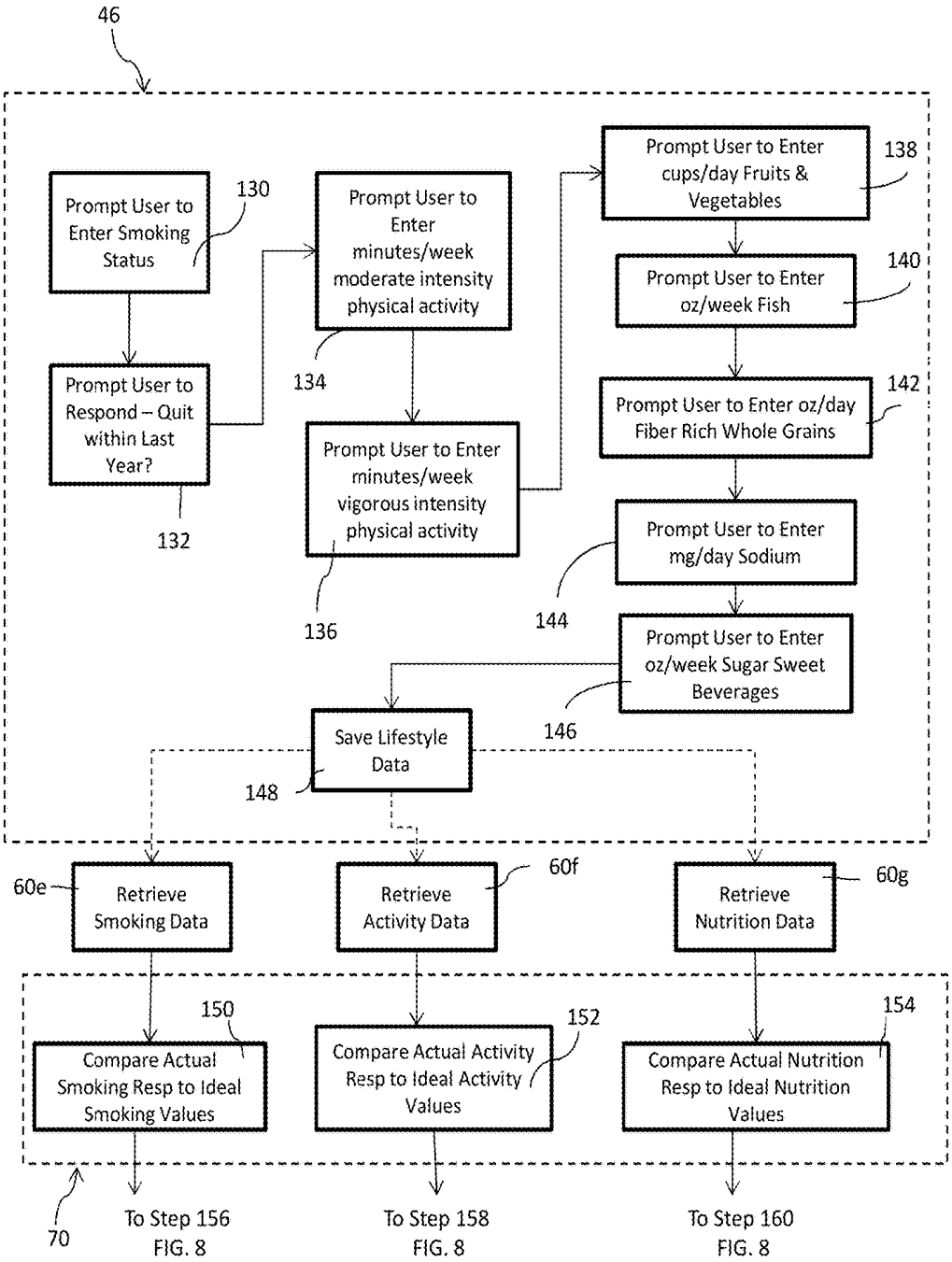

46
Prompt User to Enter Smoking Status
130
Prompt User to Respond – Quit within Last Year?
132
Prompt User to Enter minutes/week moderate intensity physical activity
134
Prompt User to Enter minutes/week vigorous intensity physical activity
136
Prompt User to Enter cups/day Fruits & Vegetables
138
Prompt User to Enter oz/week Fish
140
Prompt User to Enter oz/day Fiber Rich Whole Grains
142
Prompt User to Enter mg/day Sodium
144
Prompt User to Enter oz/week Sugar Sweet Beverages
146
Save Lifestyle Data
148
60e
Retrieve Smoking Data
60f
Retrieve Activity Data
60g
Retrieve Nutrition Data
150
Compare Actual Smoking Resp to Ideal Smoking Values
152
Compare Actual Activity Resp to Ideal Activity Values
154
Compare Actual Nutrition Resp to Ideal Nutrition Values
70
To Step 156 FIG. 8
To Step 158 FIG. 8
To Step 160 FIG. 8

FIG. 7

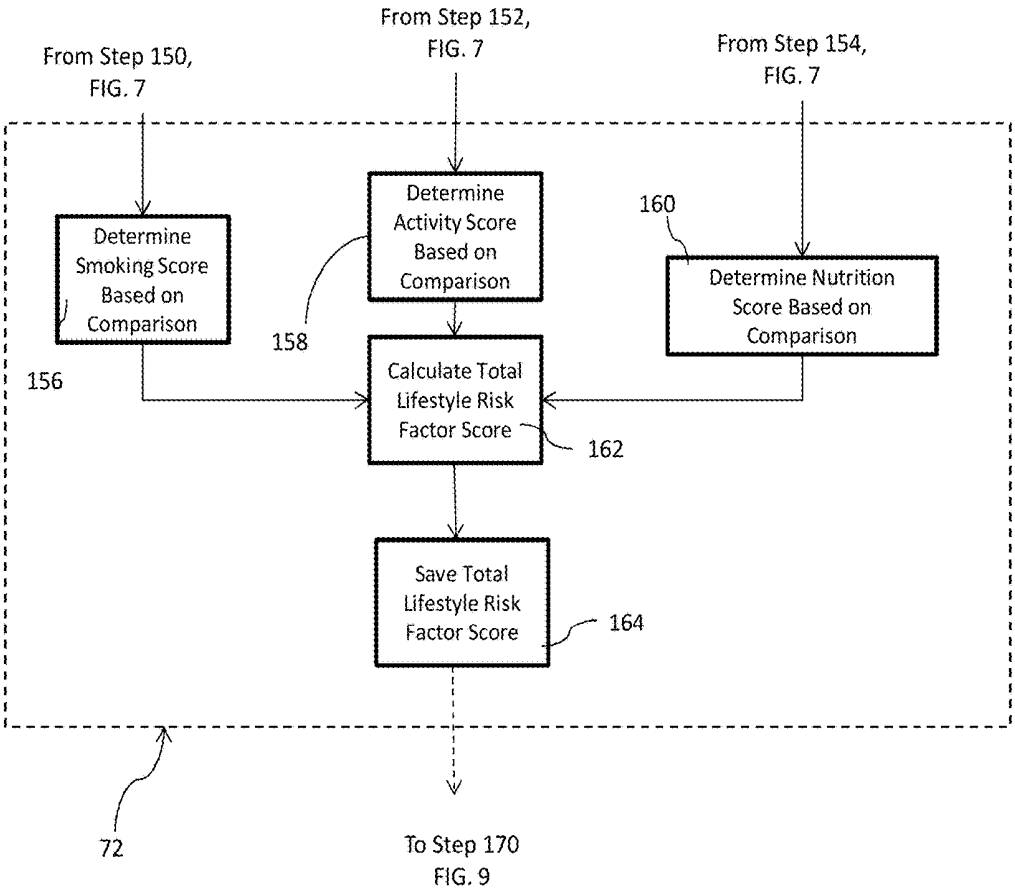

From Step 150, FIG. 7
From Step 152, FIG. 7
From Step 154, FIG. 7
Determine Smoking Score Based on Comparison
156
Determine Activity Score Based on Comparison
158
160
Determine Nutrition Score Based on Comparison
Calculate Total Lifestyle Risk Factor Score
162
Save Total Lifestyle Risk Factor Score
164
72
To Step 170 FIG. 9

FIG. 8

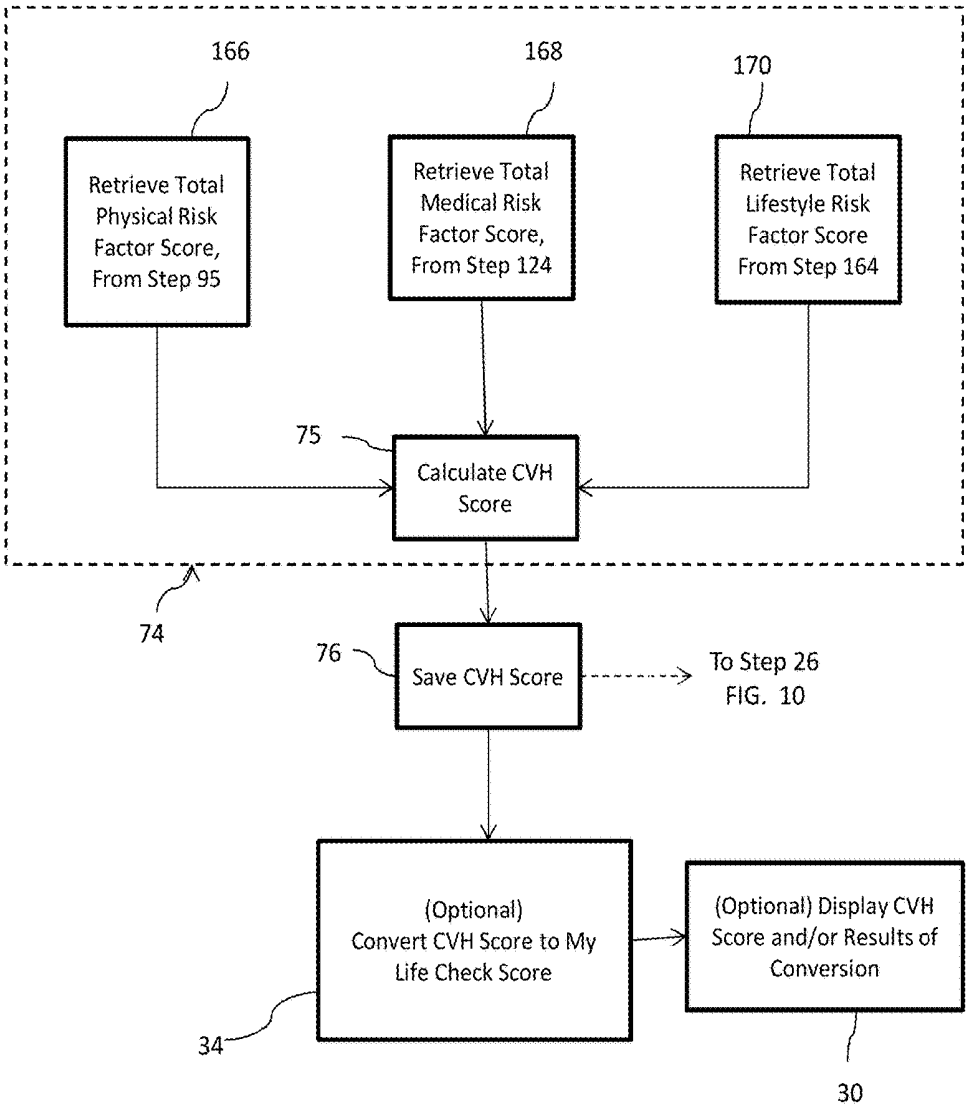

166
168
170
Retrieve Total Physical Risk Factor Score, From Step 95
Retrieve Total Medical Risk Factor Score, From Step 124
Retrieve Total Lifestyle Risk Factor Score From Step 164
75
Calculate CVH Score
74
76
Save CVH Score
To Step 26 FIG. 10
(Optional) Convert CVH Score to My Life Check Score
(Optional) Display CVH Score and/or Results of Conversion
34
30
152

FIG. 9

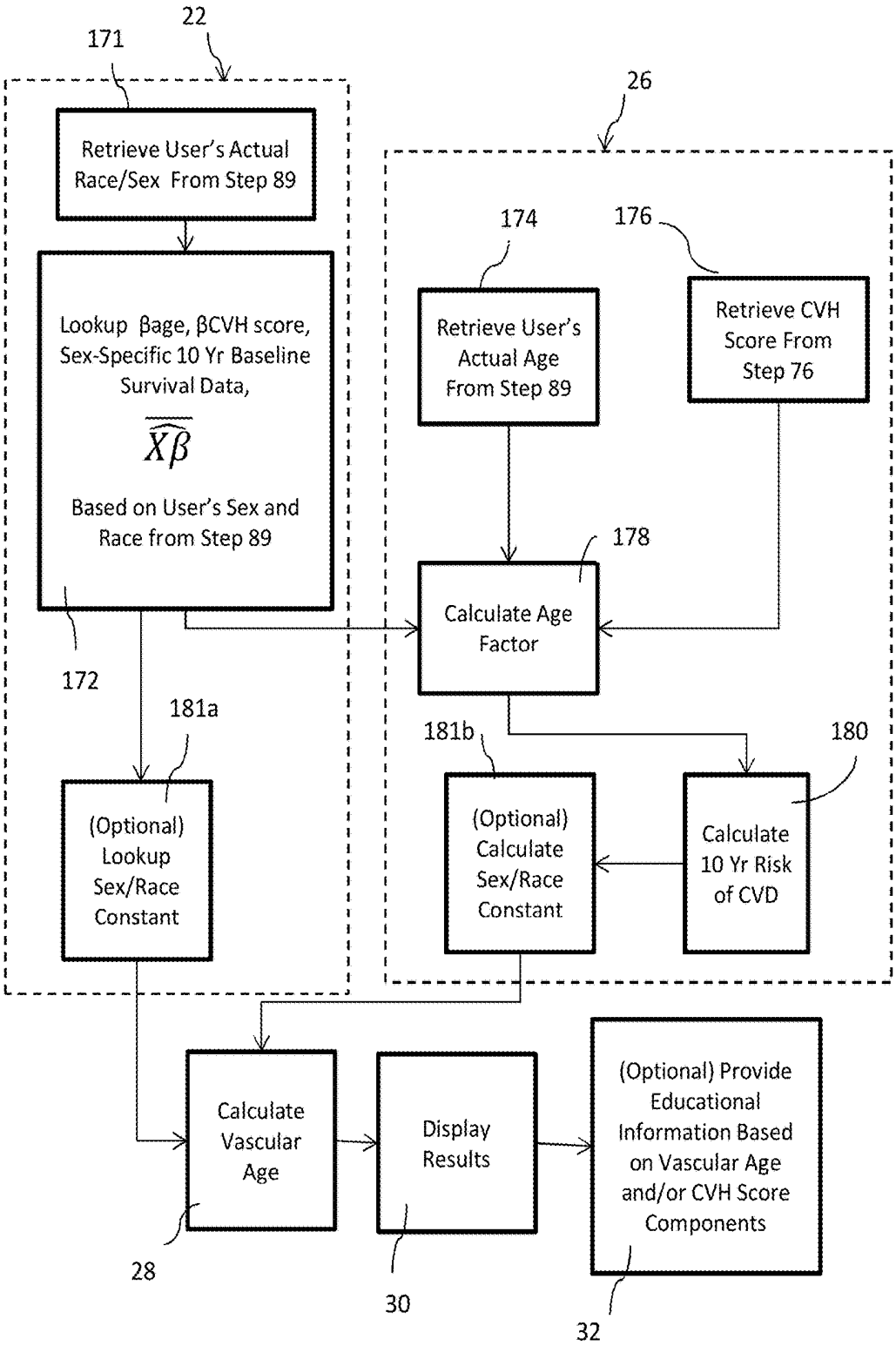

22
171
26
Retrieve User's Actual Race/Sex From Step 89
174
176
Retrieve User's Actual Age From Step 89
Retrieve CVH Score From Step 76
Lookup βage, βCVH score, Sex-Specific 10 Yr Baseline Survival Data,
$\overline{\widehat{X\beta}}$
Based on User's Sex and Race from Step 89
178
Calculate Age Factor
172
181a
181b
180
(Optional) Lookup Sex/Race Constant
(Optional) Calculate Sex/Race Constant
Calculate 10 Yr Risk of CVD
Calculate Vascular Age
Display Results
(Optional) Provide Educational Information Based on Vascular Age and/or CVH Score Components
28
30
32

FIG. 10

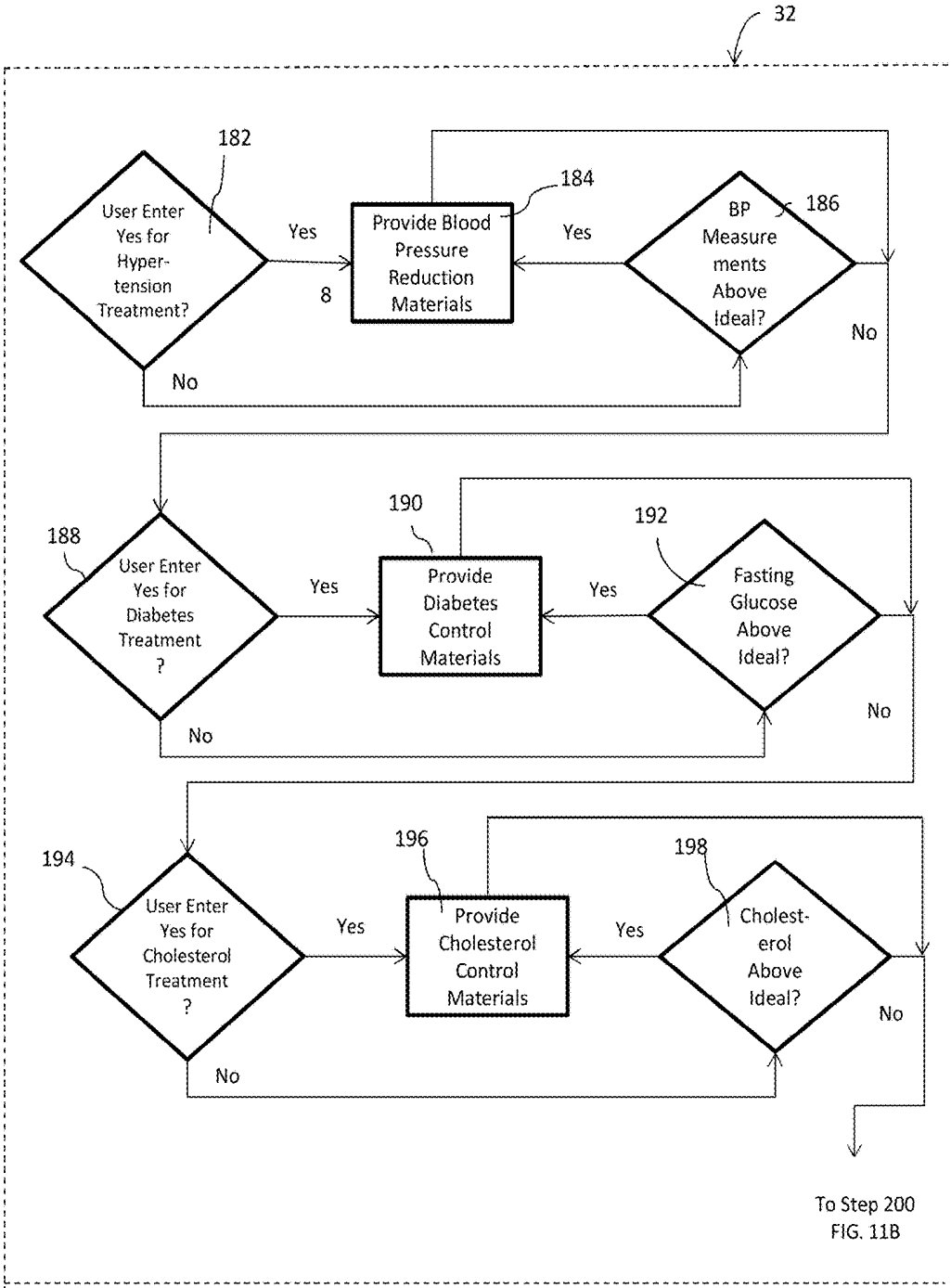

32
182
User Enter Yes for Hyper-tension Treatment?
Yes
8
Provide Blood Pressure Reduction Materials
184
Yes
BP Measure ments Above Ideal?
186
No
No
188
User Enter Yes for Diabetes Treatment ?
Yes
190
Provide Diabetes Control Materials
Yes
192
Fasting Glucose Above Ideal?
No
No
194
User Enter Yes for Cholesterol Treatment ?
Yes
196
Provide Cholesterol Control Materials
Yes
198
Cholest-erol Above Ideal?
No
No
To Step 200
FIG. 11B

FIG. 11A

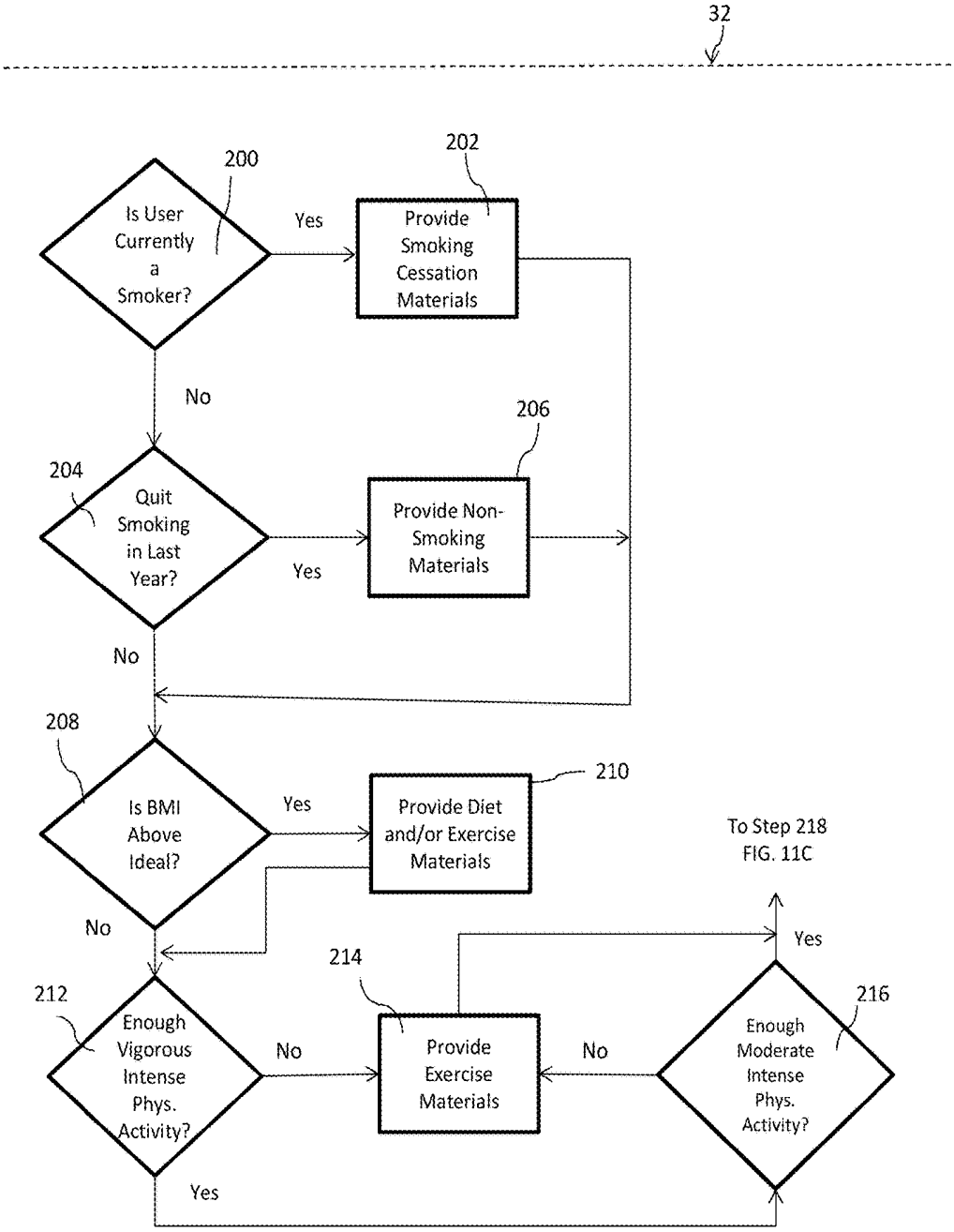

32
200
Is User Currently a Smoker?
Yes
202
Provide Smoking Cessation Materials
No
204
Quit Smoking in Last Year?
Yes
206
Provide Non-Smoking Materials
No
208
Is BMI Above Ideal?
Yes
210
Provide Diet and/or Exercise Materials
To Step 218 FIG. 11C
No
Yes
212
Enough Vigorous Intense Phys. Activity?
No
214
Provide Exercise Materials
No
216
Enough Moderate Intense Phys. Activity?
Yes

FIG. 11B

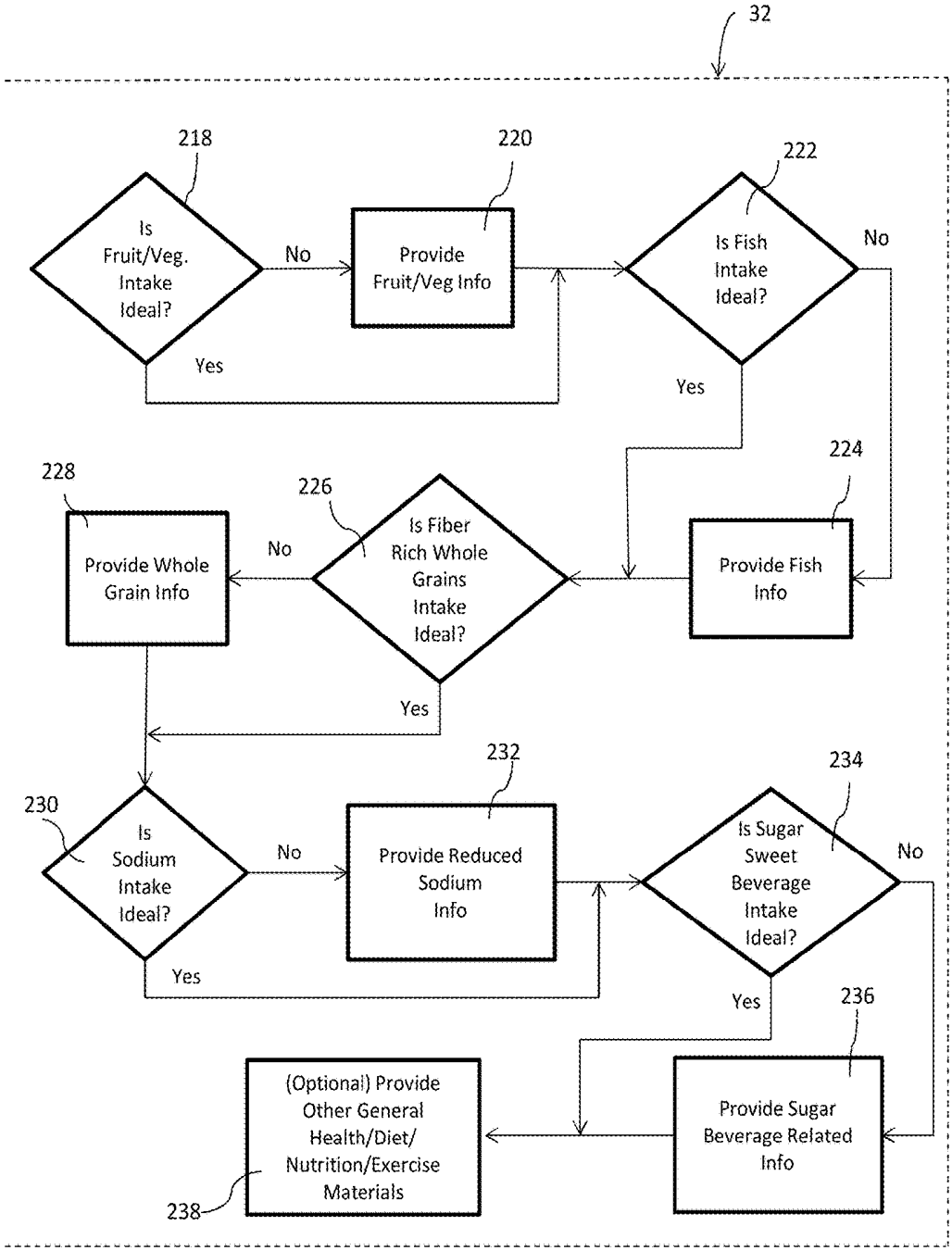

32
218
Is Fruit/Veg. Intake Ideal?
No
Yes
220
Provide Fruit/Veg Info
222
Is Fish Intake Ideal?
No
Yes
224
Provide Fish Info
226
Is Fiber Rich Whole Grains Intake Ideal?
No
Yes
228
Provide Whole Grain Info
230
Is Sodium Intake Ideal?
No
Yes
232
Provide Reduced Sodium Info
234
Is Sugar Sweet Beverage Intake Ideal?
No
Yes
236
Provide Sugar Beverage Related Info
238
(Optional) Provide Other General Health/Diet/ Nutrition/Exercise Materials

FIG. 11C

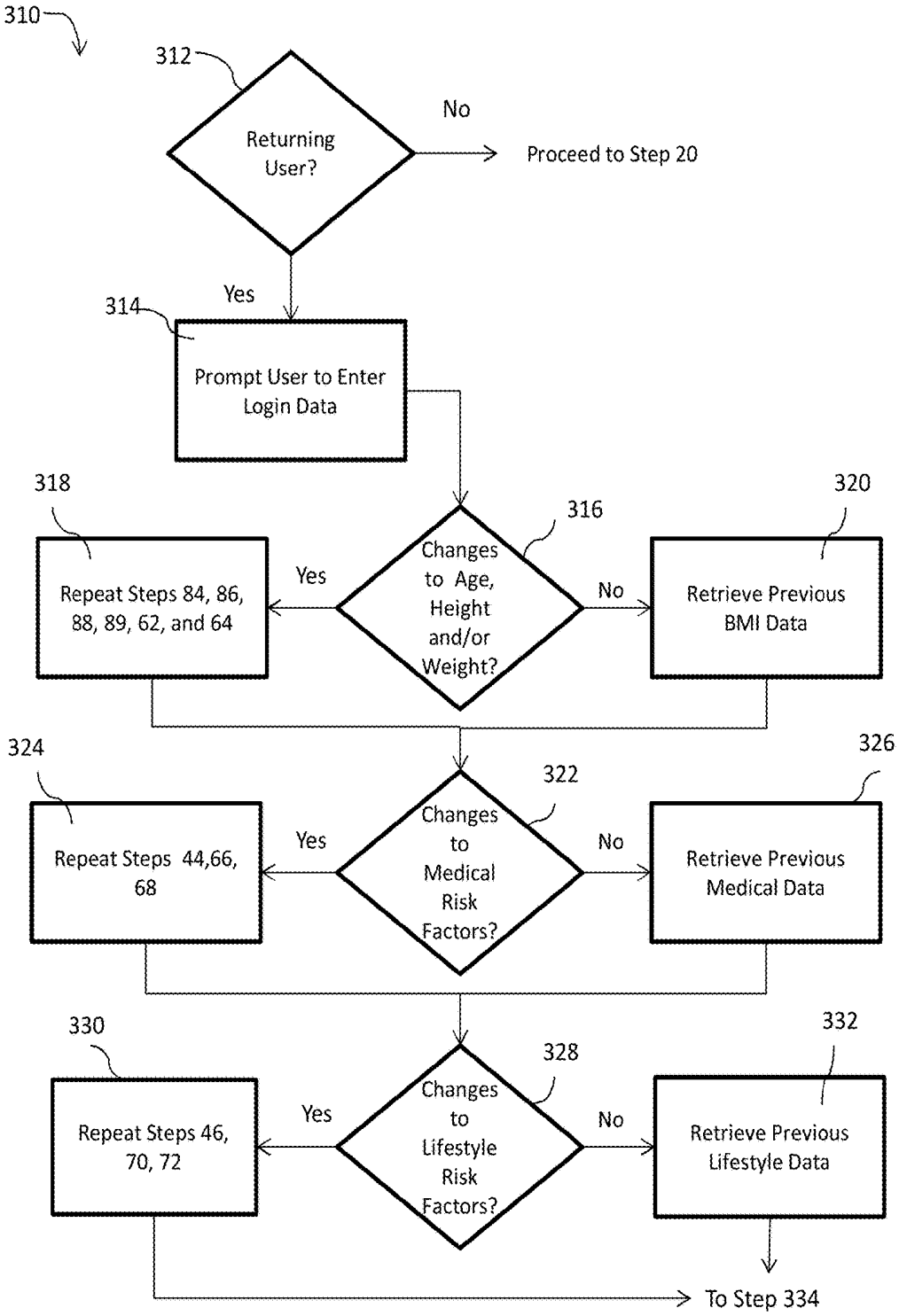

310
312
Returning User?
No
Proceed to Step 20
Yes
314
Prompt User to Enter Login Data
318
316
320
Repeat Steps 84, 86, 88, 89, 62, and 64
Yes
Changes to Age, Height and/or Weight?
No
Retrieve Previous BMI Data
324
322
326
Repeat Steps 44,66, 68
Yes
Changes to Medical Risk Factors?
No
Retrieve Previous Medical Data
330
328
332
Repeat Steps 46, 70, 72
Yes
Changes to Lifestyle Risk Factors?
No
Retrieve Previous Lifestyle Data
To Step 334

FIG. 12

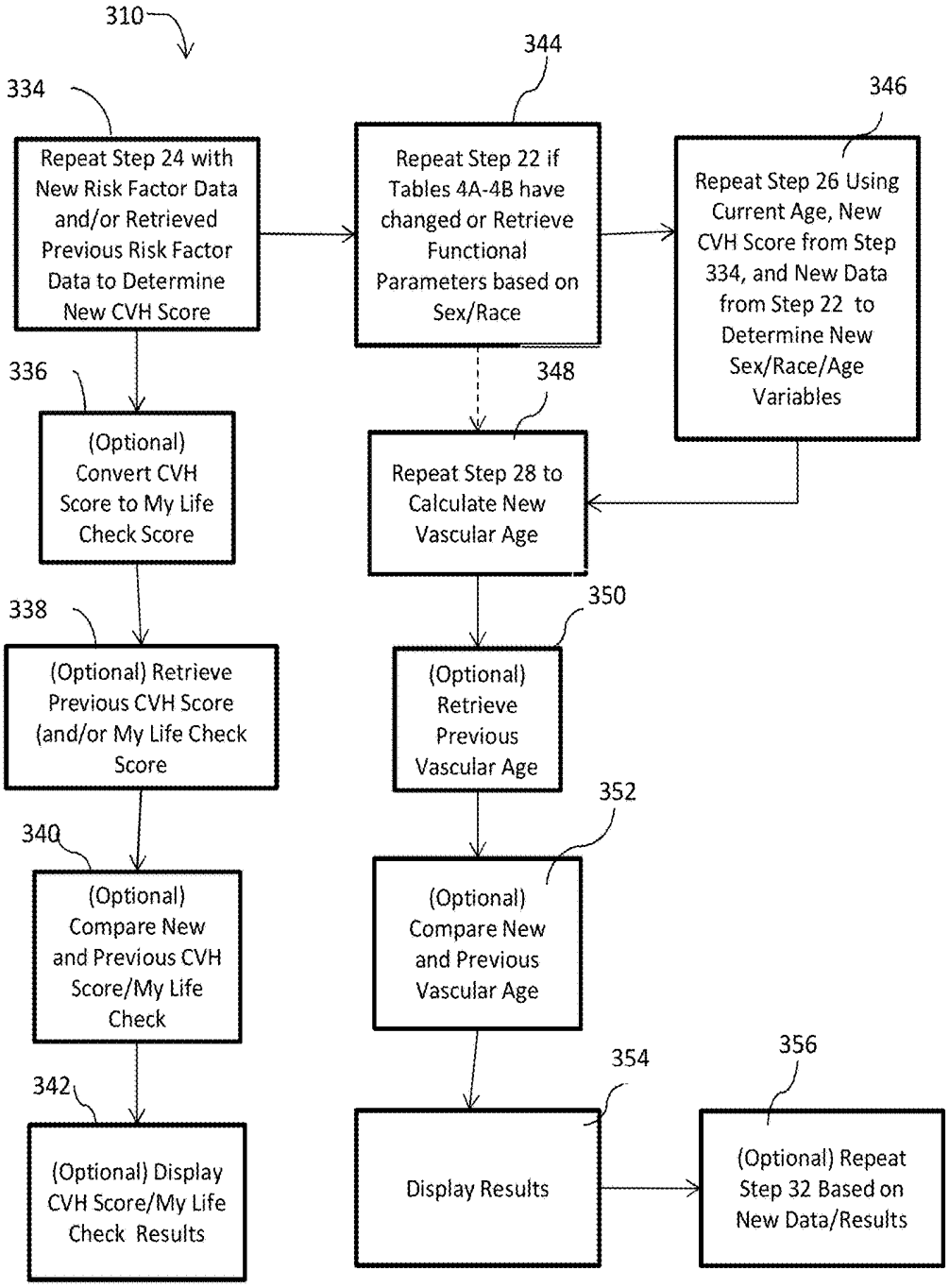

310
334
Repeat Step 24 with New Risk Factor Data and/or Retrieved Previous Risk Factor Data to Determine New CVH Score
336
(Optional) Convert CVH Score to My Life Check Score
338
(Optional) Retrieve Previous CVH Score (and/or My Life Check Score
340
(Optional) Compare New and Previous CVH Score/My Life Check
342
(Optional) Display CVH Score/My Life Check Results
344
Repeat Step 22 if Tables 4A-4B have changed or Retrieve Functional Parameters based on Sex/Race
346
Repeat Step 26 Using Current Age, New CVH Score from Step 334, and New Data from Step 22 to Determine New Sex/Race/Age Variables
348
Repeat Step 28 to Calculate New Vascular Age
350
(Optional) Retrieve Previous Vascular Age
352
(Optional) Compare New and Previous Vascular Age
354
Display Results
356
(Optional) Repeat Step 32 Based on New Data/Results

FIG. 13

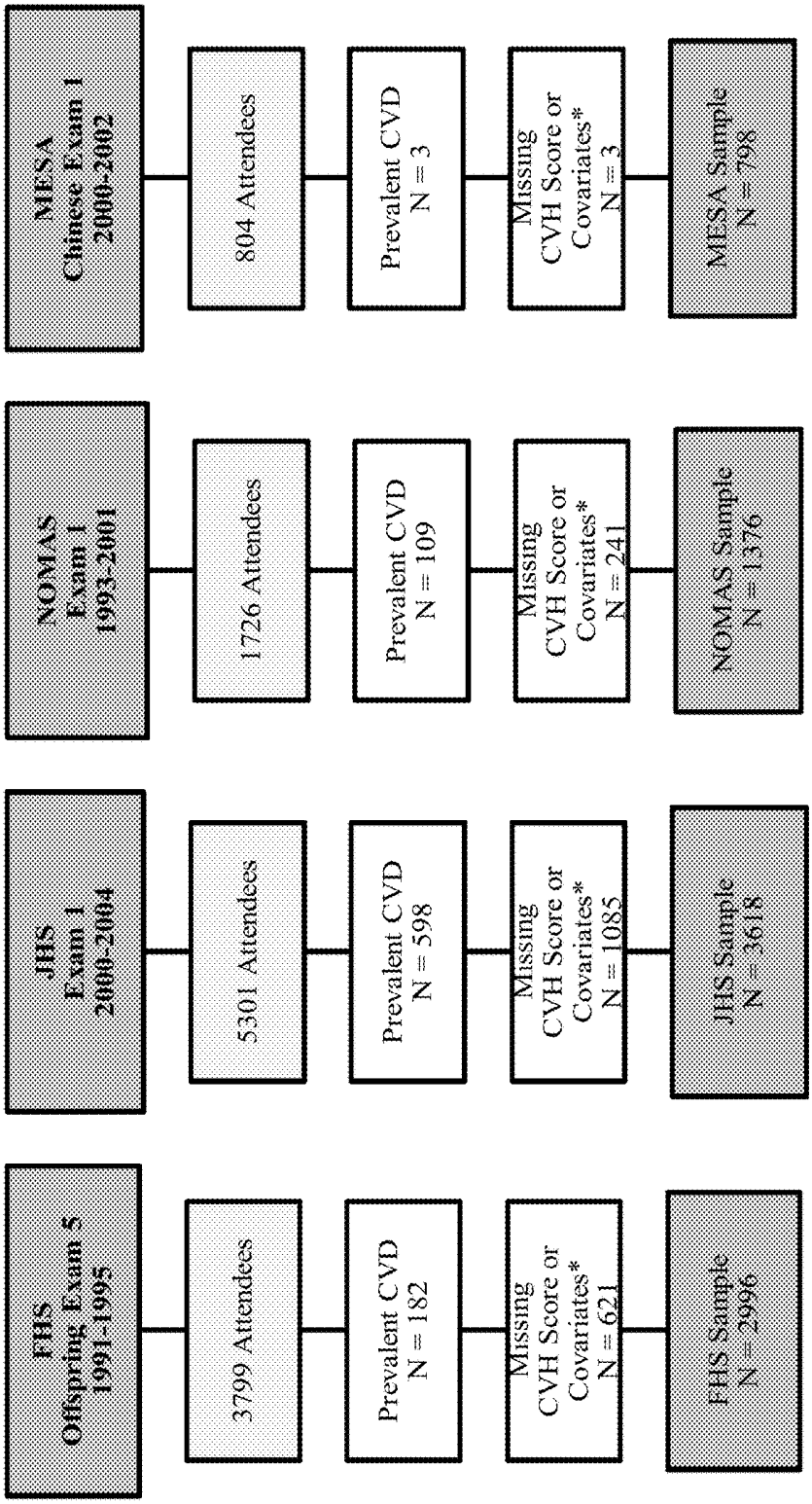

FHS
Offspring Exam 5
1991-1995
3799 Attendees
Prevalent CVD
N = 182
Missing
CVH Score or
Covariates*
N = 621
FHS Sample
N = 2996
JHS
Exam 1
2000-2004
5301 Attendees
Prevalent CVD
N = 598
Missing
CVH Score or
Covariates*
N = 1085
JHS Sample
N = 3618
NOMAS
Exam 1
1993-2001
1726 Attendees
Prevalent CVD
N = 109
Missing
CVH Score or
Covariates*
N = 241
NOMAS Sample
N = 1376
MESA
Chinese Exam 1
2000-2002
804 Attendees
Prevalent CVD
N = 3
Missing
CVH Score or
Covariates*
N = 3
MESA Sample
N = 798

FIG. 14

SYSTEM AND METHOD FOR ASSESSING HEART HEALTH AND COMMUNICATING THE ASSESSMENT TO A PATIENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application Ser. No. 62/647,020 filed on Mar. 23, 2018.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] This invention relates to a system and method for assessing a patient's heart health and communicating such assessment in an easily understandable format and optionally with heart health related information to aid the patient in improving his or her heart health.

2. Description of Related Art

[0003] A problem frequently encountered by healthcare providers is how to adequately convey to patients in an understandable form the status of the patients' health. Various tests may be performed that provide numerical results, such as blood pressure measurements and total cholesterol, but the significance of these numerical results may not be easily understood by the patient and therefore may not adequately convey to the patient as assessment of the patient's health. There are several known methods of assessing a patient's health that involve determining a health score that are intended to be more easily understood than raw test measurement data. For example, U.S. Pat. No. 9,378,335 discloses a system and method for determining a health score based on various health related information, comparing the health score to a threshold, and taking action based on the comparison, such as providing the user with a list of food items that if avoided would improve the health score. As another example, the American Heart Association's My Life Check determines a heart health score, on a scale up 10, based on various health related information. Although the My Life Check score is easy to calculate, patients do not necessarily understand the meaning of the score and healthcare providers and clinicians find it difficult to convey the meaning of the score to the lay person or patient, since the a numerical score is not inherently meaningful in conveying CVD. Most patients are able to understand that having a low My Life Check score translates to higher chance of developing CVD, but it is not easy for a patient to understand how much he/she needs to improve their My Life Check score to avoid developing CVD, and how such knowledge can motivate patients towards improved cardiovascular health. Additionally, the clinical significance of a My Life Check score in the intermediate range is not readily obvious either in terms of motivating lifestyle changes or the likelihood of developing CVD over the short-term.

[0004] Other known health assessment tools involve graphical representations of health, rather than numerical representations. For example, U.S. Pat. No. 9,101,261 discloses using health information regarding a patient to generate an avatar image designed to illustrate the patient's health status using different facial expressions and characteristics on the generated avatar. As another example, U.S. Pat. No. 9,241,677 discloses variations on smiley faces, stop light graphics, and graphical hearts of varying sizes to communicate a patient's health status.

[0005] Although these prior methods of communicating health assessments are beneficial, there is still a need for other alternatives and more easily understandable assessment methods. There is also a need to more accurately assess a patient's heart health based on race and sex specific parameters.

SUMMARY OF THE INVENTION

[0006] A method and system according to a preferred embodiment of the invention allows a user to input certain personal information regarding a patient, including race, sex, and age, and information regarding one or more personal risk factors for the patient, in order to obtain an assessment of the patient's heart health in an easily understandable format. Preferably, the personal risk factors include one or more from the following categories: physical risk factors, medical risk factors, and lifestyle risk factors. According to one preferred embodiment, the user's inputs are compared to ideal values to calculate a cardiovascular health (CVH) score for the patient, which may optionally be displayed or provided to the user or patient. According to another preferred embodiment, the system and method retrieve certain data from a pre-populated database to use in calculations, along with the patient's calculated CVH score, to assess the patient's overall heart health and to display or provide that assessment to the user or patient in an easily understandable format.

[0007] According to one preferred embodiment, an easily understandable format for the patient's heart health is a number that represents the patient's cardiovascular age, which may be around the same, younger, or older than the patient's actual age. A younger cardiovascular age indicates good or even ideal cardiovascular health. An older cardiovascular age indicates poor cardiovascular health. A cardiovascular age around the same as the patient's actual age indicates average cardiovascular health for the patient's age. According to another preferred embodiment, the easily understandable format is a score on a scale of 1 to 10 that corresponds to the American Heart Association's My Life Check® scale.

[0008] According to another preferred embodiment, a system and method of the invention provides the user with health related information, such as educational support materials, corresponding to physical, medical, and/or lifestyle risk factors. According to another preferred embodiment, such health related information is provided when one or more of the user's inputs indicate that the patient has a moderate to high risk in a given category or otherwise indicates that the patient's information is less than ideal or above or below of predetermined threshold. According to another preferred embodiment, a system and method of the invention provides the user with generalized health information.

[0009] According to another preferred embodiment of the invention, the patient's personal data, personal risk factor data, previous CVH score and/or previous vascular age are stored for future use. Comparisons to previous data or scores or vascular age may be used to provide information to the user regarding changes in the patient's heart health status.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The method of the invention is further described and explained in relation to the following drawings wherein:

[0011] FIG. **1** is a flow chart showing process stages for a preferred embodiment of the heart health assessment system and method of the invention;

[0012] FIG. **2** is a flow chart showing preferred process steps for one preferred stage of the embodiment according to FIG. **1**;

[0013] FIG. **3** is a flow chart showing preferred process steps for certain stages of the embodiment according to FIG. **1**;

[0014] FIG. **4** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIGS. **2-3**;

[0015] FIG. **5** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIGS. **2-3**;

[0016] FIG. **6** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIG. **3**;

[0017] FIG. **7** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIGS. **2-3**;

[0018] FIG. **8** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIG. **3**;

[0019] FIG. **9** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIG. **3**;

[0020] FIG. **10** is a flow chart showing preferred process steps for certain sub-stages of the embodiment according to FIG. **1**;

[0021] FIGS. **11**A-**11**C are continuing flow charts showing preferred process steps for a certain sub-stage of the embodiment according to FIG. **1**;

[0022] FIG. **12** is a flow chart showing process stages for another preferred embodiment of the heart health assessment system and method of the invention;

[0023] FIG. **13** is a flow chart showing additional process stages for the embodiment of FIG. **12**;

[0024] FIG. **14** is a table showing sample exclusion from the cohorts.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] A preferred embodiment of a method and system **10** for assessing and communicating a patient's cardiovascular health is shown in FIGS. **1-11**C. The method and system **10** includes several processing stages, including entry of the patient's personal data **20**, retrieval of race/sex data from database/table **22**, determining cardiovascular health (CVH) score **24**, determining or calculating sex/race/age variables or functional parameters **26**, calculating vascular age **28**, optionally converting CVH score to a My Life Check Score **34**, displaying the results **30**, optionally providing health related materials **32**, and optionally sending results to a healthcare provider **33**. Typically, the user will be the patient, but a third party (such as a family member or caretaker) or healthcare provider may also be the user to enter data on behalf of a patient.

[0026] As shown in FIG. **2**, a personal data entry stage **20** preferably comprises optionally prompting the user to create a profile **40**, optionally prompting the user to enter healthcare provider contact information **41** so that results of the calculations may be optionally shared with the healthcare provider at step **33**, prompting the user to enter age, race, sex information and data regarding one or more physical risk factors **42** (described in more detail in FIG. **4**), prompting the user to enter data regarding one or more medical risk factors **44** (described in more detail in FIG. **5**), prompting the user to enter data regarding one or more lifestyle risk factors **46** (described in more detail in FIG. **7**). Optionally, but preferably, a user will create a profile at step **40** by entering a user name and password. A user name should be unique to each user, so system **10** may compare and entered user name to existing user names to make sure there are no duplicates. If a user attempts to use a duplicate user name, he/she will be prompted to enter a different user name until a unique user name is entered. Criteria for user name and password may be pre-set to require a certain number of characters, numbers, or special characters, or to prohibit the use of certain characters, as is standard in user profile creation. A user may also be periodically required to change his/her password, if desired.

[0027] The data entered is preferably stored at step **48** so that it may be retrieved for use in making calculations and completing data lookup/retrieval tasks as part of steps **22**, **24**, **26**, **28**, and optional step **32**. All saved data or data storage in connection with system **10** described herein may be short term or temporary storage, for use only during the current session as need to make calculations and complete data lookup tasks to provide the user with the patient's vascular age results. If the patient has created a profile at step **40**, then such storage may be long term, to allow the patient to later retrieve the vascular age results and to repeat the calculations according to another preferred embodiment of a method and system **310** according to the invention, as shown in FIGS. **12-13**.

[0028] As shown in FIG. **3**, a CVH score determination stage **24** preferably comprises retrieving risk factor data at step **60** and comparing the retrieved data to ideal data steps **62** (described in more detail in FIG. **4**), **66** (described in more detail in FIG. **5**), and **70** (described in more detail in FIG. **7**) in order to determine scores at steps **64** (described in more detail in FIG. **4**), **68** (described in more detail in FIG. **6**), and **72** (described in more detail in FIG. **8**). The scores determined at steps **64**, **68**, and **72** are added together to calculate a CVH score at step **74**. Optionally, the CVH score may be converted to a My Life Check score at step **34** using a simple mathematical conversion from a 0-14 scale to a 0-10 scale (e.g. a CVH score of 14 equals a My Life Check Score of 10, a CVH score of 7 equals a My Life Check score of 5) and the CVH score and/or My Life Check Score may be displayed to the user at step **30**. The CVH score is also saved or stored at step **76** for later use.

[0029] Referring to FIG. **4**, a user is preferably prompted to enter basic physical information regarding the patient at step **42**. Such information includes personal data regarding the patient's race **80**, sex **82**, and age **84**, and physical risk factors relevant to cardiovascular health, such as height **86** and weight **88**. Other data that may be relevant to cardiovascular health, such as specific ethnic origin information, may also be included in step **42**. This data is preferably saved at step **89** for later use and retrieved at step **60***a*. At step **62**, the physical risk factor data (such as height and weight or a calculated BMI) is compared to ideal data. Most preferably, step **62** comprises calculating a BMI based on the patient's height and weight data retrieved at step **60***a*. The patient's actual BMI is compared to ideal BMI at step **92** and a score is determined at step **94** based on the comparison.

The preferred criteria for determining the BMI/total physical risk factor score is discussed further below. The physical risk factor score is saved at step **95** for later use in calculating the CVH score. BMI is the preferred physical risk factor for use in calculating CVH score, but other physical risk factors may also be used if desired.

[0030] Referring to FIGS. **5** and **6**, a user is preferably prompted to enter basic medical information regarding the patient at step **44**. Such information includes risk factors for cardiovascular health, such as whether the patient is taking medication to control blood pressure **96**, the patient's systolic blood pressure (SBP) **98**, the patient's diastolic blood pressure (DBP) **100**, whether the patient is taking medication to control diabetes **102**, the patient's fasting glucose results **104**, the patient's total cholesterol **106**, and whether the patient is taking medication to control cholesterol or lower lipids **108**. This data is preferably saved at step **109** for later use and retrieved at steps **60***b*-**60***d*. These particular medical risk factor categories are preferred, but other medical risk factors may also be used if desired. For example, instead of total cholesterol, separate amounts for LDL and HDL may be used. Additionally, triglycerides may be an added medical risk factor. The patient's blood pressure data/response is compared to ideal blood pressure data at step **110** and a score is determined at step **116** based on the comparison. The patient's diabetes/glucose data/response is compared to ideal glucose data at step **112** and a score is determined at step **118** based on the comparison. The patient's cholesterol data/response is compared to ideal cholesterol data at step **114** and a score is determined at step **120** based on the comparison. The preferred criteria for determining the blood pressure, cholesterol, and diabetes/glucose risk factor scores is discussed further below. The scores for each of these subcategories is added together at step **122** to calculate a total medical risk factor score, which is saved for later use at step **124**.

[0031] Referring to FIGS. **7** and **8**, a user is preferably prompted to enter basic lifestyle information regarding the patient at step **46**. Such information includes risk factors for cardiovascular health, such as whether the patient is a current smoker **130** or quit within the last 12 months **132**, the patient's minutes of moderate intensity physical activity per week **134**, the patient's minutes of vigorous intensity physical activity per week **136**, cups per day of fruits and vegetables eaten **138**, ounces per week of fish eaten **140**, ounces per day of fiber rich whole grains **142**, mg per day sodium **144**, and ounces per week of sugar sweet beverages **146**. This data is preferably saved at step **148** for later use and retrieved at steps **60***e*-**60***g*. These particular lifestyle risk factor categories are preferred, but other lifestyle risk factors may also be used if desired. For example, ounces of red meat eaten per week, grams of saturated fat per week, and similar subcategories may also be used or alternatively be used. Most preferably, the prompts for minutes of moderate intensity and vigorous intensity physical activity at steps **134**, **136** provide examples of the types of activity that are considered moderate and those that are considered vigorous to aid the user in entering accurate information. For example, walking, vacuuming, and mopping may be examples of moderate intensity activity. Running, swimming laps, and riding a bicycle may be examples of vigorous intensity activity. Additionally or as an alternative, heart rate ranges for a man and for a woman and/or for different age ranges may be provided as examples indicating whether an activity is moderate or vigorous and the user may compare the patient's actual heart rate during any given activity to the ranges to determine whether the activity is moderate or vigorous.

[0032] The patient's smoking data/response is compared to ideal smoking data at step **150** and a score is determined at step **156** based on the comparison. The patient's activity data is compared to ideal activity data at step **152** and a score is determined at step **158** based on the comparison. The patient's nutritional/dietary data is compared to ideal dietary data at step **154** and a score is determined at step **160** based on the comparison. The preferred criteria for determining the smoking, activity, and dietary risk factor scores is discussed further below. The scores for each of these subcategories is added together at step **162** to calculate a total lifestyle risk factor score, which is saved for later use at step **164**.

[0033] The physical risk factor score assigned at step **94**, the medical risk factor scores determined at steps **116**, **118**, and **120**, and the lifestyle risk factors scores determined at steps **156**, **158**, and **160** are preferably determined based on the data provided in Table 1 below. Most preferably, a CVH score is a scale of 0 to 14. Each risk factor sub-category (e.g. BMI risk factor, smoking risk factor, blood pressure risk factor), is scored a 0, 1, or a 2 based on the comparisons at steps **92**, **110**, **112**, **114**, **150**, **152**, and **154** to the corresponding data in Table 1. A score of zero for any subcategory indicates poor health in that subcategory; a score of 1 in any subcategory indicates intermediate health in that subcategory; and a score of 2 in any subcategory indicates ideal health in that subcategory.

TABLE 1

Scoring Criteria for CVH Subcategories

Goal/Metric	Poor Health (Score 0)	Intermediate Health (Score 1)	Ideal Health (Score 2)
Physical Risk Factor-Body mass index	≥30 kg/m^2	25-<30 kg/m^2	<25 kg/m^2
Lifestyle Risk Factor-Smoking	Current smoker	Quit ≤ 12 months	Never or quit ≥ 12 months
Lifestyle Risk Factor-Physical activity*	None	1-149 min/week moderate intensity or 1-74 min/week vigorous intensity or 1-149 min/week combined moderate/vigorous intensity	>150 min/week moderate intensity or >75 min/week vigorous intensity or >150 min/week combined moderate/vigorous intensity
Lifestyle Risk Factor-Healthy diet score (see Table 2)	0-1 components	2-3 components	4-5 components
Medical Risk Factor-Total cholesterol	≥240 mg/dL	200-<240 mg/dL or On lipid lowering treatment/ medication to treat to goal	<200 mg/dL and not on lipid-lowering treatment
Medical Risk Factor-Blood pressure	SBP ≥ 140 mmHg or DBP ≥ 90 mmHg	SBP 120-<140 mmHg or DBP 80-<90 mmHg or On hypertension treatment/ medication to treat to goal	SBP < 120 mmHg and DBP < 80 mmHg and not on hypertension treatment

TABLE 1-continued

Scoring Criteria for CVH Subcategories

Goal/Metric	Poor Health (Score 0)	Intermediate Health (Score 1)	Ideal Health (Score 2)
Medical Risk Factor-Fasting plasma glucose/ Diabetes	≥126 mg/dL	100-<126 mg/dL or On diabetes treatment/ medication to treat to goal	<100 mg/dL and not on diabetes treatment

[0034] Comparison step **154** preferably comprises several sub-steps **154***a*-**154***e* where the patient's information entered at steps **138**, **140**, **142**, **144**, and **146** are compared to the data in Table 2 below. If the data entered at step **138** indicates the patient consumes 4.5 cups or more fruits and vegetable per day, then comparison step **154***a* passes, equating to a 1 component sub-score for that dietary element. If the data entered at step **138** indicates the patient consumes fewer than 4.5 cups of fruits and vegetables per day, then the comparison step **154***a* fails, equating to a zero sub-score for that dietary element. Similar pass/fail comparisons **154***b*-**154***e* are made for each dietary element in table 2. At step **160** a nutrition score is preferably determined by adding up all of the component sub-scores from steps **154***a*-**154***e* and comparing the total actual components to the ideal data in Table 1 to assign a nutrition/dietary score of 0, 1, or 2.

TABLE 2

Components for Health Diet Score

Dietary Element	Amount for 1 Component
Fruits and vegetables (for step 138)	≥4.5 cups per day
Fish (preferably oily fish) (for step 140)	≥two 3.5 oz. servings per week
Fiber rich whole grains (for step 142)	≥1 oz. equivalent servings per day
Sodium (for step 144)	<1500 mg/day
Sugar sweetened beverages (for step 146)	≤450 kcal per week

[0035] Referring to FIG. **9**, the previously saved total physical risk factor, medical risk factor, and lifestyle risk factor scores are retrieved at steps **166**, **168**, and **170**. These scores are added together at step **75** to calculate a CVH score, preferably on a scale of 0 to 14. Other scoring criteria or modifications to the criteria indicated in Table 1 may be used, if desired. The CVH score is saved at step **76**.

[0036] Optionally, the CVH score may be converted to a My Life Check score, using a simple mathematical conversion from a 01-4 scale to a 0-10 scale, which estimates cardiovascular health on a scale of 1 (poor health) to 10 (ideal health) at step **34**. Optionally, the CVH score and/or My Life Check Score may be displayed or otherwise provided, such as by email or printout, to the user/patient at step **30**.

[0037] An example of the scoring for each category and CVH calculation based on hypothetical answers to the prompts in method and system **10** is provided below in Table 3.

TABLE 3

Example Scoring

Goal/Metric	User's Response	Calculation	Score
Physical Risk Factor-Body mass index	Height (step 86)-5'8" Weight (step 88)-180 lbs	BMI (Step 90)-27.4	1
Medical Risk Factor-Blood pressure	Blood Pressure Treatment (step 96)-No SBP (step 98)-145 DBP (step 100)-90	N/A	0
Medical Risk Factor-Fasting plasma glucose/Diabetes	Diabetes Treatment (step 102)-No Fasting Glucose (step 104)-80 mg/DL	N/A	2
Medical Risk Factor-Total cholesterol	Total Cholesterol (step 106)-220 mg/DL Treatment for Cholesterol (step 108)-No	N/A	1
Lifestyle Risk Factor-Smoking	Current Smoker (step 130)-No Quit within last 12 months (step 132)-No	N/A	2
Lifestyle Risk Factor-Physical activity*	Minutes per week moderate activity (step 134)-45 Minutes per week vigorous activity (step 136)-30	N/A	1
Lifestyle Risk Factor-Healthy diet score	Fruits and vegetables (step 138)-6 Fish (step 140)-3 Fiber Rich Whole Grains (step 142)-2 Sodium (step 144)-1000 Sugar Beverages (step 146)-0	(step 154a) 1 component (step 154b) 0 components (step 154c) 0 components (step 154d) 1 component (step 154e) 1 component	1
Total CVH score			8

[0038] As additional medical research is conducted, the data in Tables 1 and/or 2 may be modified to reflect more up-to-date research. Similarly, additional criteria may be added based on new medical research to alter the risk factors that are used to determine the CVH score, which may also result in a change in the CVH score scale described herein. Corresponding modifications to the method and system **10** (or **310**) based on such new research may be made as will be understood by those of ordinary skill in the art.

[0039] Referring to FIG. **10**, the patient's personal data regarding race, sex, and age are retrieved at step **171**. This data is used to lookup certain functional parameters or variables based on the patient's race and sex at step **172** that are used in calculating an age factor at step **178** and vascular age at step **28**. Most preferably, the functional parameters for step **172** are from Tables 4A-4B, which was created based on data from four epidemiological studies, capturing four different ethnic groups: a) Whites—the Framingham Heart Study (FHS); b) Blacks—the Jackson Heart Study (JHS); c) Hispanics—the Northern Manhattan Study (NOMAS); and d) Chinese—the Multi-Ethnic Study of Atherosclerosis (MESA). For the Framingham Heart Study, second generation participants attending examination cycle 5 were used. Below is a description of each study.

[0040] FHS: All events were classified using hospital and other medical records, death certificates, and health status updates. A panel of physicians reviewed and adjudicated each event. MI was defined using ECG, enzymes, previous history and autopsy evidence, and was ascertained when there were at least two (2) of three (3) findings: 1) symptoms

indicative of ischemia; 2) changes in biomarkers of myocardial necrosis; and 3) serial changes in the electrocardiograms. Stroke was defined as sudden or rapid onset of a focal neurologic deficit persisting for greater than 24 hours and is classified as hemorrhagic stroke, ischemic stroke, or atherothrombotic brain infarction. Vascular death was defined as death from MI, CHD, and intermittent claudication.

[0041] JHS: At JHS, hospital and physician's office records were reviewed and adjudicated continuously. MI was defined by presence of cardiac pain, change in enzymes, and electrocardiographic findings. Hospitalized MI was defined using ICD-9 codes 402, 410-414, 427, 428, and 518.4. Ischemic stroke was defined based on ICD-9 code 435 and ICD-10 code G45. The criteria for classifying vascular death are based on any combination of 1) chest pain; 2) history of MI, CHD, or angina; 3) the absence of evidence of other probable cause of death; and/or 4) the use of ICD-9 codes (i.e., 250, 401, 402, 410-414, 427-429, 440, 518.4, 798, 799) or ICD-10 codes (E10-14, 110-11, 121-25, 146-51, 170, 197, J81, J96, R96, R98-99).

[0042] MESA: Periodic follow-ups of the cohort every 6-12 months were used to ascertain outcomes between examinations. Determination of events is performed using public files (death certificates), medical records from hospitalizations, autopsy reports, and interviews/questionnaires from participants regarding treatments and lifestyle changes, and in some cases, interviews/questionnaires from their physicians, friends and relatives. Events were reviewed by designated reviewers who determined the occurrence of the event and cause of death, and also discussed any discrepancies in diagnoses. If reviewers are unable to agree, the case was referred to the Morbidity and Mortality Committee. Hard cardiovascular disease is a composite variable defined by the first event of any myocardial infarction, resuscitated cardiac arrest, fatal/nonfatal stroke (not including TIA), or death from any CHD. Death from coronary heart disease included death from MI, CHD, stroke, and other cardiovascular disease death. Information on hard cardiovascular disease events was collected via participant phone interviews every 6-9 months and medical records.

[0043] NOMAS: Subjects were annually screened by phone to determine lifestyle changes, changes in vital status, detect stroke occurrence, document hospitalizations, and review status of risk factors, and treatment changes. People with a positive screening were scheduled for in-person assessment, including examination by a neurologist and also a chart review. Ongoing hospital records, including ICD-9 codes, and medical records were reviewed by specially trained research assistants (and study cardiologists and neurologists, when available) to verify events. MI was defined using criteria adapted from the Cardiac Arrhythmia Suppression Trial and the Lipid Research Clinics Coronary Primary Prevention Trial, requiring at least 2 of the **3** following criteria: (a) ischemic cardiac pain determined to be typical angina; (b) cardiac enzyme abnormalities defined as abnormal CPK-MB fraction or Troponin values; and (c) EKG abnormalities. Stroke was defined using the WHO criteria: "rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin." Vascular death was defined using ICD-9 codes 390-459, medical records, death certificates and information from family.

[0044] Follow-up time was truncated to a maximum of 13 years for FHS and NOMAS, in order to make the follow-up time ranges more homogeneous among the four cohorts. Tables 5A-5B show the descriptive characteristics for each cohort, and sample exclusions are presented in FIG. **14**. A comparison of people included to those excluded (by cohort) is contained in Tables 6A-6B. MESA only excluded six subjects, so that cohort is not included in Tables 6A-6B.

TABLE 4A

Race/Sex-specific risk functions for a hard CVD event in 10-years and derivation of vascular age

	FHS (White)		JHS (Black)	
	Women N = 1619	Men N = 1377	Women N = 2421	Men N = 1197
CVD events, N (%)	76 (4.7)	138 (10.0)	127 (5.2)	67 (5.6)
MI	34 (44.7)	74 (53.6)	56 (44.1)	36 (53.7)
Stroke	35 (46.1)	47 (34.1)	64 (50.4)	28 (41.8)
CVD death	7 (9.2)	17 (12.3)	7 (5.5)	3 (4.5)
Follow-up time, yrs Median (Min, Max)	13.0 (0.4, 13.0)	13.0 (0.1, 13.0)	8.1 (0.1, 11.1)	8.5 (0.1, 11.1)
Function parameters				
$\hat{\beta}_{age}$ ± SE	0.070 ± 0.014	0.062 ± 0.009	0.069 ± 0.008	0.055 ± 0.010
$\hat{\beta}_{CVH\ score}$ ± SE	−0.354 ± 0.053	−0.187 ± 0.044	−0.267 ± 0.051	−0.126 ± 0.061
$S_0(10)$	0.983	0.939	0.964	0.949
$\overline{X\hat{\beta}}$	0.894	2.011	1.813	1.917
Constant term	73.332	68.196	72.633	62.116
C, (95% CI)	0.777 (0.717, 0.837)	0.720 (0.673, 0.768)	0.788 (0.754, 0.821)	0.731 (0.677, 0.786)
Calibration X^2 p-value	6.19 p =0.72	7.07 p =0.63	6.01 p =0.74	13.61 p =0.14

TABLE 4B

Race/Sex-specific risk functions for a hard CVD event in 10-years and derivation of vascular age

	NOMAS (Hispanic)		MESA (Chinese)	
	Women N = 864	Men N = 512	Women N = 412	Men N = 386
CVD events, N (%)	149 (17.2)	108 (21.1)	20 (4.9)	23 (6.0)
MI	44 (29.5)	37 (34.3)	6 (30.0)	11 (47.8)
Stroke	67 (45.0)	48 (44.4)	7 (35.0)	8 (34.8)
CVD death	38 (25.5)	23 (21.3)	7 (35.0)	4 (17.4)
Follow-up time, yrs Median (Min, Max)	13.0 (0.1, 13.0)	13.0 (0.1, 13.0)	12.1 (0.6, 13.4)	12.1 (0.2, 13.5)
Function parameters				
$\hat{\beta}_{age}$ ± SE	0.085 ± 0.009	0.072 ± 0.011	0.114 ± 0.029	0.065 ± 0.022
$\hat{\beta}_{CVH\ score}$ ± SE	−0.173 ± 0.045	−0.147 ± 0.049	−0.201 ± 0.114	−0.079 ± 0.122
$S_0(10)$	0.898	0.832	0.979	0.961
$\overline{X\hat{\beta}}$	4.408	3.621	5.132	3.298

TABLE 4B-continued

Race/Sex-specific risk functions for a hard CVD event in 10-years and derivation of vascular age

	NOMAS (Hispanic)		MESA (Chinese)	
	Women N = 864	Men N = 512	Women N = 412	Men N = 386
Constant term	76.280	74.8	66.179	57.569
C, (95% CI)	0.725 (0.686, 0.764)	0.669 (0.618, 0.720)	0.81 (0.74, 0.89)	0.68 (0.59, 0.77)
Calibration X^2	6.25	2.05	11.68	18.54
p-value	p = 0.71	p = 0.99	p = 0.23	P = 0.03

[0045] As additional medical research is conducted, the data in Tables 4A-4B may be modified to reflect more up-to-date research. Although the system and method of the invention are currently configured for the four identified races, the information may still be useful for patients of other races. For example, patients of other Asian races may use the data for calculations based on the MESA study even though they are not Chinese. Similarly, the NOMAS data includes more Hispanics from certain countries than others, such as more Dominicans than Mexicans, and may not be as accurate for all Hispanics. The calculations will not be as accurate for other races as they are for the specific races in the studies upon which the calculations are based; however, the calculations may still provide a useful tool for understanding a patient's overall heart health.

TABLE 5A

	FHS (White)		JHS (Black)	
	Women	Men	Women	Men
N (%)	1619 (54.0)	1377 (46.0)	2421 (66.9)	1197 (33.1)
Age, years	54.6 ± 9.6	55.0 ± 9.8	53.9 ± 12.8	51.2 ± 12.6
Body mass index, kg/m^2	26.7 ± 5.5	28.2 ± 4.2	32.8 ± 7.7	29.8 ± 6.2
Systolic blood pressure, mmHg	123 ± 20	129 ± 17	125 ± 19	127 ± 17
Diastolic blood pressure, mmHg	73 ± 10	77 ± 10	78 ± 10	82 ± 10
Hypertensive, N (%)	478 (29.5)	506 (36.7)	1423 (58.8)	629 (52.5)
Antihypertensive medication, N (%)	265 (16.4)	258 (18.7)	1199 (49.6)	417 (35.0)
Total cholesterol, mg/dL	207 ± 38	202 ± 35	200 ± 39	197 ± 40
HDL cholesterol, mg/dL	56 ± 15	43 ± 11	55 ± 14	46 ± 13
Lipid-lowering medication, N (%)	85(5.3)	105 (7.6)	223 (9.2)	84 (7.1)
Fasting glucose, mg/dL	97.1 ± 24.5	103.9 ± 29.8	98.1 ± 31.9	98.8 ± 31.5
Diabetes mellitus, N (%)	78 (4.8)	114 (8.3)	437 (18.1)	170 (14.3)
Diabetes medication, N (%)	34 (2.1)	52 (3.8)	308 (13.5)	108 (10.8)
Ever smokers, N (%)	1000 (61.8)	1038 (75.4)	268 (11.1)	260 (21.7)
Moderate activity, min/week*	1146 ± 841	1134 ± 848	42 ± 76	49 ± 84
Vigorous activity, min/week*	208 ± 410	492 ± 697	20 ± 61	34 ± 83
Diet score	1.7 ± 0.9	1.4 ± 0.9	1.3 ± 1.0	1.0 ± 1.0
CVH score	8.3 ± 2.2	7.6 ± 2.0	7.1 ± 2.0	7.2 ± 2.1
CVH score, N (%)				
0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1	2 (0.1)	1 (0.1)	1 (0.1)	4 (0.3)
2	7 (0.4)	6 (0.4)	11 (0.4)	11 (0.9)
3	26 (1.6)	19 (1.4)	58 (2.4)	27 (2.3)
4	54 (3.3)	58 (4.2)	157 (6.5)	82 (6.8)
5	90 (5.6)	119 (8.6)	329 (13.6)	133 (11.1)
6	175 (10.8)	184 (13.4)	408 (16.8)	170 (14.2)
7	225 (13.9)	275 (20.0)	437 (18.1)	228 (19.1)
8	257 (15.9)	263 (19.1)	392 (16.2)	229 (19.1)
9	276 (17.0)	232 (16.8)	293 (12.1)	132 (11.0)
10	231 (14.3)	114 (8.3)	206 (8.5)	117 (9.8)
11	165 (10.2)	74 (5.4)	82 (3.4)	51 (4.3)
12	92 (5.7)	30 (2.2)	42 (1.7)	12 (1.0)
13	18 (1.1)	2 (0.1)	5 (0.2)	1 (0.1)
14	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)

Values represent mean ± standard deviation unless otherwise noted.

*Activity min/week in FHS are inflated, as activity was collected as hours/day and converted to min/week for this analysis. For this reason, FHS activity was treated differently in the calculation of the CVH score. For FHS only, poor health defined as <median of min/week moderate/vigorous intensity, intermediate health defined as median-top quartile of min/week moderate/vigorous intensity, and ideal health defined as top quartile of min/week moderate/vigorous intensity. This definition is quantitatively similar to the AHA physical activity metric. Median = 840 min/week, 75th percentile = 1260 min/week.

TABLE 5B

	NOMAS (Hispanic)		MESA (Chinese)	
	Women	Men	Women	Men
N (%)	864 (62.8)	512 (37.2)	412 (51.6)	386 (48.4)
Age, years	65.9 ± 9.3	65.0 ± 8.5	62.3 ± 10.4	62.4 ± 10.3
Body mass index, kg/m^2	29.0 ± 5.2	27.3 ± 4.3	23.9 ± 3.4	24.1 ± 3.1
Systolic blood pressure, mmHg	143 ± 21	143 ± 22	125 ± 24	124 ± 19
Diastolic blood pressure, mmHg	84 ± 10	86 ± 11	69 ± 11	75 ± 9
Hypertensive, N (%)	630 (72.9)	353 (68.9)	163 (39.6)	135 (34.9)
Antihypertensive medication, N (%)	419 (48.5)	180 (35.2)	120 (29.1)	109 (28.2)
Total cholesterol, mg/dL	209 ± 40	193 ± 39	195 ± 32	190 ± 31
HDL cholesterol, mg/dL	47 ± 13	39 ± 12	53 ± 13	46 ± 11
Lipid-lowering medication, N (%)	132 (15.3)	47 (9.2)	66 (16.0)	50 (12.9)
Fasting glucose, mg/dL	107.9 ± 52.7	108.9 ± 52.7	95.9 ± 23.9	102.0 ± 31.8
Diabetes mellitus, N (%)	187 (21.6)	113 (22.1)	50 (12.1)	53 (13.7)
Diabetes medication, N (%)	141 (16.3)	83 (16.2)	38 (9.2)	38 (9.8)
Ever smokers, N (%)	332 (38.4)	344 (67.2)	16 (3.9)	181 (46.9)
Moderate activity, min/week*	93 ± 176	126 ± 235	245 ± 339	269 ± 351
Vigorous activity, min/week*	13 ± 82	19 ± 103	10 ± 52	33 ± 105

TABLE 5B-continued

	NOMAS (Hispanic)		MESA (Chinese)	
	Women	Men	Women	Men
Diet score	1.4 ± 1.0	1.0 ± 0.9	2.0 ± 0.7	1.7 ± 0.8
CVH score	6.9 ± 1.9	7.2 ± 1.9	9.8 ± 1.8	9.6 ± 1.8
CVH score, N (%)				
0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1	1 (0.1)	2 (0.4)	0 (0.0)	0 (0.0)
2	8 (0.9)	2 (0.4)	0 (0.0)	0 (0.0)
3	18 (2.1)	11 (2.1)	0 (0.0)	0 (0.0)
4	59 (6.8)	26 (5.1)	1 (0.3)	1 (0.3)
5	115 (13.3)	51 (10.0)	4 (1.0)	2 (0.5)
6	174 (20.1)	77 (15.0)	15 (3.7)	14 (3.6)
7	175 (20.3)	112 (21.9)	24 (5.8)	29 (7.5)
8	151 (17.5)	113 (22.1)	42 (10.2)	69 (17.9)
9	97 (11.2)	61 (11.9)	82 (19.9)	62 (16.1)
10	43 (5.0)	35 (6.8)	92 (22.3)	77 (19.9)
11	18 (2.1)	17 (3.3)	78 (18.9)	72 (18.6)
12	5 (0.6)	5 (1.0)	52 (12.6)	42 (10.9)
13	0 (0.0)	0 (0.0)	22 (5.3)	18 (4.7)
14	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Values represent mean ± standard deviation unless otherwise noted.

TABLE 6A-1

Descriptive Characteristics of Included vs. Excluded Subjects by Cohort-FHS (White)

	Included N = 2996	Excluded N = 803		
	Mean ± std or n (%)	Mean ± std or n (%)	N†	p-value
Female sex	1619 (54.0)	388 (48.3)	803	0.004
Age, years	54.7 ± 9.7	58.2 ± 10.4	803	<0.001
BMI, kg/m^2	27.4 ± 5.0	27.7 ± 4.8	786	0.06
SBP, mmHg	126 ± 19	128 ± 19	802	<0.001
DBP, mmHg	75 ± 10	75 ± 10	802	0.90
Hypertensive	984 (32.8)	323 (40.3)	802	<0.001
Antihypertensive RX	523 (17.5)	208 (26.4)	789	<0.001
Total cholesterol, mg/dL	205 ± 37	205 ± 38	774	0.62
HDL cholesterol, mg/dL	50 ± 15	48 ± 16	772	<0.001
Lipid-lowering RX	190 (6.3)	105 (13.1)	801	<0.001
Fasting glucose, mg/dL	100.2 ± 27.3	106.1 ± 37.6	772	<0.001
Diabetes mellitus	192 (6.4)	93 (12.0)	773	<0.001
Diabetes RX	86 (2.9)	54 (6.7)	801	<0.001
Ever smokers	2038 (68.0)	595 (74.4)	800	<0.001
Moderate activity, min/week	1140 ± 844	1070 ± 820	686	0.05
Vigorous activity, min/week	339 ± 578	292 ± 596	685	0.06
Diet score	1.6 ± 0.9	1.6 ± 0.9	233	0.95
CVH score	8.0 ± 2.2	6.7 ± 2.0	125	<0.001

N† = number of excluded subjects with available data

TABLE 6A-2

Descriptive Characteristics of Included vs. Excluded Subjects by Cohort-JHS (Black)

	Included N = 3618	Excluded N = 1683		
	Mean ± std or n (%)	Mean ± std or n (%)	N†	p-value
Female sex	2421 (66.9)	946 (56.2)	1683	<0.001
Age, years	53.0 ± 12.8	60.5 ± 11.4	1683	<0.001
BMI, kg/m^2	31.8 ± 7.3	31.7 ± 7.0	1677	0.76
SBP, mmHg	126 ± 18	130 ± 19	1674	<0.001
DBP, mmHg	79 ± 10	78 ± 11	1674	<0.001
Hypertensive	2052 (56.7)	1260 (75.3)	1674	<0.001
Antihypertensive RX	1616 (44.8)	1096 (66.3)	1652	<0.001
Total cholesterol, mg/dL	199 ± 40	198 ± 41	1374	0.31
HDL cholesterol, mg/dL	52 ± 14	51 ± 15	1311	0.12
Lipid-lowering RX	307 (8.5)	322 (19.5)	1652	<0.001
Fasting glucose, mg/dL	98.3 ± 31.8	109.8 ± 47.9	1640	<0.001
Diabetes mellitus	607 (16.9)	545 (33.2)	1561	<0.001
Diabetes RX	416 (12.7)	422 (27.0)	1672	<0.001
Ever smokers	528 (14.6)	1188 (71.1)	1678	<0.001
Moderate activity, min/week	44 ± 79	43 ± 78	1678	0.63
Vigorous activity, min/week	25 ± 69	16 ± 49	1683	<0.001
Diet score	1.2 ± 0.9	1.3 ± 1.0	1506	<0.001
CVH score	7.2 ± 2.1	6.1 ± 2.0	355	<0.001

N† = number of excluded subjects with available data

TABLE 6B

Descriptive Characteristics of Included vs. Excluded Subjects by Cohort-NOMAS (Hispanic)

	Included N = 1376	Excluded N = 350		
	Mean ± std or n (%)	Mean ± std or n (%)	N†	p-value
Female sex	864 (62.8)	217 (62.0)	350	0.78
Age, years	65.5 ± 9.0	69.3 ± 10.4	350	<0.001
BMI, kg/m^2	28.4 ± 5.0	28.3 ± 5.3	341	0.66
SBP, mmHg	143 ± 21	146 ± 21	344	0.06
DBP, mmHg	84 ± 11	84 ± 11	344	0.49
Hypertensive	983 (71.4)	281 (80.3)	350	<0.001
Antihypertensive RX	599 (43.5)	190 (54.4)	349	<0.001
Total cholesterol, mg/dL	203 ± 41	199 ± 43	289	0.14
HDL cholesterol, mg/dL	44 ± 13	43 ± 13	288	0.44
Lipid-lowering RX	179 (13.0)	70 (20.1)	349	<0.001
Fasting glucose, mg/dL	108.3 ± 52.7	109.8 ± 54.2	269	0.67
Diabetes mellitus	300 (21.8)	79 (22.6)	350	0.76

TABLE 6B-continued

Descriptive Characteristics of Included vs. Excluded Subjects by Cohort-NOMAS (Hispanic)

	Included N = 1376	Excluded N = 350		
	Mean ± std or n (%)	Mean ± std or n (%)	N†	p-value
Diabetes RX	224 (16.3)	61 (17.5)	349	0.6
Ever smokers	676 (49.1)	174 (49.7)	350	0.84
Moderate activity, min/week	105 ± 200	174 ± 211	222	<0.001
Vigorous activity, min/week	15 ± 91	69 ± 272	99	0.05
Diet score	1.2 ± 1.0	1.3 ± 1.1	174	0.36
CVH score	7.0 ± 1.9	6.6 ± 2.1	85	0.08

N† = number of excluded subjects with available data

[0046] The patient's age is also retrieved from step **89** at step **174**, and the patient's CVH score is retrieved from step **76** at step **176**. This information, along with the functional parameters based on race and sex from step **172**, are used to calculate an age factor $\overline{\hat{X}\hat{\beta}}$ at step **178**. Most preferably, the age factor is calculated as follows:

$$\overline{\hat{X}\hat{\beta}} = \hat{\beta}_{age} \cdot X_{age} + \hat{\beta}_{CVH\ score} \cdot X_{CVH\ score} - \overline{\overline{\hat{X}\hat{\beta}}}$$

where X_{age} is the patient's actual age retrieved from step **89**, and $X_{CVH\ score}$ is the patient's actual CVH score as determined at step **75**. The other variables are the functional parameters retrieved from the data in Tables 4A-4B, based on the patient's sex and race, at step **172**.

[0047] The age factor from step **178** is then used to calculate a 10 year risk of CVD (defined as myocardial infarction, stroke, or vascular death), $\hat{p}$, at step **180**. Most preferably, the 10 year risk of CVD is calculated as follows:

$$\hat{p} = 1 - S_0(10)^{\exp(\overline{\hat{X}\hat{\beta}})}$$

where $S_0(10)$ indicates the sex-specific 10-year baseline survival, which is retrieved from the data in Tables 4A-4B based on the patient's race and sex, at step **172** and $\overline{\hat{X}\hat{\beta}}$ is the age factor calculated at step **178**. Next, the sex/race constant term is either looked-up from Tables 4A-4B at step **181***a* or is calculated at step **181***b*. If calculated, the constant term is preferably calculated as follows:

$$\text{constant term} = \frac{\overline{\overline{\hat{X}\hat{\beta}}} - (\hat{\beta}_{CVH\ score} \cdot 12)}{\hat{\beta}_{Age}}$$

where all variables are functional parameters based on race and sex retrieved from the data in Tables 4A-4B at step **172**.

[0048] Next, the patient's vascular age is calculated at step **28**, using the constant term from step **181***a* or **181***b*, the 10 year risk of CVD calculated at step **180**, and data retrieved from Tables 4A-4B, based on the patient's sex and race, at step **172**. Most preferably, the patient's vascular age is calculated as follows:

$$\text{Vascular Age} = \ln\left[\left(\frac{\ln(1-\hat{p})}{\ln(S_0(10))}\right)^{\frac{1}{\hat{\beta}_{Age}}}\right] + \text{constant term}$$

[0049] The results of the vascular age calculation are displayed at step **30** as a rounded number in years, representing the cardiovascular health age of the patient, which may be less than, greater than, or the same as the patient's actual age. An individual's vascular age (or heart age) is defined as the age of a hypothetical person with the same predicted risk of an incident CVD event in 10 years but with an ideal CVH score of 12. Although CVH score may go as high as 14, there were few subjects in the examined cohorts with scores higher than 12, so 12 is preferably used as indicating an ideal score. Additionally, using 12 as an ideal score (instead of 14) allows for individuals with very high CVH scores (13 and 14) to have vascular ages lower than their actual chronological age, which aids in creating a more understandable and relatable vascular age estimate.

[0050] As an example of the method **10**, a patient with the following characteristics and risk factors will have a vascular age of 50 years.

TABLE 7

Example Patient

Step	Characteristic/Risk Factor	Patient Data
80	Race	White
82	Sex	Female
84	Actual Age	60
86	Height	5-8
88	Weight	150
90	Calculated BMI	22.8
94	BMI Score	2
96	Treatment for Hypertension	No
98	Systolic BP	115
100	Diastolic BP	70
102	Treatment for Diabetes	No
104	Fasting Glucose	90
106	Total Cholesterol	180
108	Lipid Lowering Medication	No
110	BP Score	2
112	Glucose/Diabetes Score	2
114	Cholesterol Score	2
130	Smoking Status	No
132	Quit in last 12 months	No
134	Minutes moderate intensity activity	160
136	Minutes vigorous intensity activity	80
138	Cups fruits/vegetables per day	5
140	Fish per week	10
142	Fiber rich whole grains per day	5
144	Sodium per day	1200
146	Sweetened beverages per week	0
150	Smoking Score	2
152	Activity Score	2
154	Diet/nutrition score	2
74	CVH score	14
172	$\hat{\beta}_{age}$	0.070
172	$\hat{\beta}_{CVH\ score}$	−0.354
172	$\overline{\hat{X}\hat{\beta}}$	0.894
172	$S_0(10)$	0.983
181a	Constant term	73.332
28	Vascular Age	50 years

[0051] A test version of a vascular age calculator (using an Excel spreadsheet) demonstrated at an American Heart Association EPI Lifestyle Conference in March 2017 used 14 as the CVH score ideal value for making the calculations. With that ideal value, a hypothetical patient with the same health risk factors, race, sex, and age as indicated in Table 7 would have a vascular age of 60, equal to the patient's actual age. This was determined to not accurately reflect the excellent health of such a hypothetical patient, making the

test version of the calculator less helpful in conveying cardiovascular health to a patient. The calculation method, including the functional parameters in Tables 4A-4B, was modified to lower the CVH ideal to 12 to allow the calculated vascular age according to the invention to be lower than the patient's actual age. Similarly, a lower ideal CVH score alters the vascular age calculation for patients across the majority of the CVH score scale. For example, a 60 year-old white woman with a CVH score of 12 (considered a high score) would have a vascular age of 70 years with a 14 point-score based ideal, but would have a vascular age of 60 (equal to actual age) with a 12 point-score based ideal. A 60 year-old white female with a CVH score of 6 would have a vascular age of 100 years using a 14 point-score based ideal, but would have a vascular age of 90 years using a 12 point-score based ideal. The following are the variables used in these example calculations:

[0052] 14 point scale: Bage=0.070; Bcvh_score=−0.354; XB=0.894; S0(10)=0.983; Constant term=83.429

[0053] 12 point scale: Bage=0.070; Bcvh_score=−0.354; XB=0.894; S0(10)=0.983; Constant term=73.332

[0054] The change in the constant term used make the calculation more accurate and meaningful in conveying a picture of a patient's cardiovascular health.

[0055] System and method **10** also preferably include step **32**, at which the patient is provided with information based on the calculated vascular age and/or CVH score. Such information may be educational (such as information on ways to reduce blood pressure or cholesterol, smoking cessation materials, recipes, meal planning, diet tips, and/or exercise instruction), inspirational (words of encouragement or success stories from other patients who have improved their CVH score and/or vascular age), and/or medical (such as information pertaining to prescription drugs that may aid in reducing blood pressure, glucose levels, or cholesterol or information regarding clinical trials that a patient may be interested in following or becoming a participant). Most preferably, the information provided at step **32** is customized for a particular patient, based on responses to various inputs from step **20**, the patient's CVH score, and/or the patient's vascular age; however, general health related information may also be provided, or a combination of general and customized information may be provided.

[0056] A preferred embodiment of step **32** for providing customized materials is show in FIGS. **11**A-**11**C, wherein step **32** preferably comprises providing specific types of information based on the patient's data input. For example, at step **182**, system **10** determines whether the user entered "yes" for hypertension treatment at step **96**. If so, then the patient is optionally provided with blood pressure reduction materials at step **184**, such as tips for reducing blood pressure. If not, then at step **186** system **10** determines whether the patient's blood pressure measurements (entered at steps **98** and **100**) are above ideal. If so, then the patient is optionally provided with blood pressure reduction materials at step **184**, such as tips for reducing blood pressure. If the patient is provided with blood pressure related materials at step **184**, or the answers to both steps **182** and **186** are negative, then system **10** determines whether the user entered "yes" for diabetes treatment (entered at step **102**) at step **188**. If so, then the patient is optionally provided with diabetes related materials at step **190**, such as recipes to help control blood glucose levels. If not, then at step **192** system **10** determines whether the patient's blood glucose measurement (entered at step **104**) is above ideal. If so, then the patient is optionally provided with diabetes related materials at step **190**, such as recipes to help control blood glucose levels.

[0057] If the patient is provided with diabetes related materials at step **190** or the answers to both steps **188** and **192** are negative, then system **10** determines whether the user entered "yes" for cholesterol treatment (entered at step **108**) at step **194**. If so, then the patient is optionally provided with cholesterol related materials at step **196**, such as recipes to help reduce cholesterol levels. If not, then at step **198**, system **10** determines whether the patient's total cholesterol measurement (entered at step **106**) is above ideal. If so, then the patient is optionally provided with cholesterol related materials at step **196**.

[0058] If the patient is provided with cholesterol related materials at step **196**, or the answers to both steps **194** and **198** are negative, then system **10** determines whether the user entered "yes" for being a current smoker (entered at step **130**) at step **200**. If so, then the patient is optionally provided with smoking cessation related materials at step **202**, such as tips on how to stop smoking and information regarding the dangers of smoking. If not, then at step **204** system **10** determines whether the patient stopped smoking in the last twelve months at step **204** (entered at step **132**). If so, then the patient is optionally provided with smoking related materials at step **206**, such as success stories of health improvement in persons who have stopped smoking or other support materials to help prevent the patient from returning to smoking.

[0059] If the patient is provided with smoking related materials at step **202** or **206**, or the answers to both steps **200** and **204** are negative, then system **10** determines whether the patient's BMI (calculated at step **90**) is above ideal at step **208**. If so, then the patient is optionally provided with weight reduction or diet or exercise related materials at step **210**, such as low calorie recipes or an exercise plan. If not, or if the patient is provided with materials at step **210**, then at step **212**, system **10** determines whether the patient's weekly vigorous activity level (entered at step **136**) is ideal. If not, then the patient is optionally provided with exercise related materials at step **214**, such as an exercise plan or success stories of health improvement in persons who have adopted exercise routines. If yes, then at step **216**, system **10** determines whether the patient's weekly moderate activity level is ideal. If not, then the patient is optionally provided with exercise related materials at step **214**. If yes, or if the patient is provided with materials at step **214**, then system **10** determines at step **218** whether the patient's fruit and vegetable intake (entered at step **138**) is ideal. If not, then the patient is optionally provided with fruit and vegetable related materials at step **220**, such tips for incorporating more vegetables into the patient's diet or recipes, and proceeds to step **222**. If yes, then system **10** determines at step **222** whether the patient's fish intake (entered at step **140**) is ideal. If not, then the patient is optionally provided with fish related materials at step **224**, such as tips for incorporating more fish into the patient's diet or information regarding supplements, and proceeds to step **226**. If yes, then then system **10** determines at step **226** whether the patient's fiber rich whole grain intake (entered at step **142**) is ideal. If not, then the patient is optionally provided with whole grain related materials at step **228**, such as tips for incorporating more fiber rich whole grains into the patient's diet or recipes,

and proceeds to step **230**. If yes, then system **10** determines at step **230** whether the patient's sodium intake (entered at step **144**) is ideal. If not, then the patient is optionally provided with sodium related materials at step **232**, such as reduced sodium recipes, and proceeds to step **234**. If yes, then system **10** determines at step **234** whether the patient's sugar sweet beverage intake (entered at step **146**) is ideal. If not, then the patient is optionally provided with sugar sweetened beverage related materials at step **236**, such as alternatives to sugar sweetened drinks, and proceeds to step **238**. If yes, then system **10** optionally provides at step **238** other general health or diet or nutrition or exercise related materials to the patient.

[0060] Materials or information provided in step **32** may include any type of health and lifestyle related materials, including nutrition information, exercise information, recipes, diet information, grocery lists, meal planning information, smoking cessation information, tips for reducing sodium intake, cholesterol control information, diabetes control information, blood pressure control information, weight management information, weight loss information, stress reduction information, and information regarding prescription medications. Materials or information provided in step **32** may be provided to the patient in any form, such as displayed on a screen, printouts, sent by email, download, uploaded to a file sharing site, text, or other electronic means, or may be sent by postal mail. They may also optionally be sent to a healthcare provider to give to and/or review with the patient at the patient's next appointment with the provider. The comparison to ideal steps shown in FIGS. **11**A-**11**B need not be separate steps, but may be incorporated into the comparison steps used in determining CVH score. For example, step **152** may be used to determine whether a patient should receive exercise related materials at step **214**, instead of using separate steps **212** and **216**.

[0061] According to another preferred embodiment, step **32** comprises using the CVH sub-score for one or more risk factors to determine whether a patient should receive materials. If any given sub-score is below a predetermined threshold, then the patient will receive materials related to that particular risk factor. Most preferably, the predetermined threshold is a "2," the highest possible sub-score, but a sub-score below 1 may also be used to trigger providing materials related to that risk factor. For example, if the CVH sub-score for cholesterol at step **120** is less than ideal (less than 2), then the patient should receive cholesterol related materials at step **196**, without having to repeat the comparison steps **194** and **198** that were used to determine the sub-score at step **120**.

[0062] According to another preferred embodiment, step **32** comprises providing generalized health information when the patient's calculated vascular age is more than a predetermined amount over the patient's actual age. For example, if the vascular age is more than 5 years over the patient's actual age or is 5% or 10% higher than the patients' actual age, then the patient will be provided with health information to aid the patient in improving overall health and lowering his/her vascular age for future calculations. Other predetermined parameters may also be used to trigger step **32** based on calculated vascular age. According to another preferred embodiment, step **32** comprises providing generalized health information when the patient's CVH score, or optional My Life Check score, is below a predetermined threshold. For example, if the CVH score is 9 or below or the My Life Check score is 7 or below, then the patient will be provided with health information to aid the patient in improving overall health and lowering his/her CVH score or My Life Check score for future calculations.

[0063] Referring to FIGS. **12**-**13**, another preferred embodiment of a method and system **310** is shown. In this preferred embodiment, a patient may create a login profile and the system may store the patient's data and calculations for future reference. At step **312**, the user is prompted to enter whether the patient is a returning user. If not, the user is sent to step **20** and proceeds through the previously described steps, including optionally creating a profile to save the patient's data for future use, to determine the patient's vascular age. If yes, the user is prompted to enter his/her login information. The user is then prompted at step **316** to enter whether there have been any changes to the patient's age, height, and/or weight since the last time data for the patient was entered. Any change in age may also be calculated by system **310** based on the current date and the patient's age entered the last time data for the patient was entered, or based on the current date and the patient's date of birth (if included as part of step **84**). If there have not been any changes, then at step **320** the patient's previous BMI data is retrieved. If there have been changes, then at step **318** steps **84**, **86**, **88**, **89**, **62**, and **64** are repeated. At step **322**, the user is prompted to indicate whether there have been any changes to the patient's medical risk factors. If there have not been any changes, then the previous medical data is retrieved at step **326**. If there have been changes, then steps **44**, **66**, and **68** are repeated. At step **328**, the user is prompted to indicate whether there have been any changes to the patient's lifestyle risk factors. If there have not been any changes, then the previous lifestyle data is retrieved at step **332**. If there have been changes, then steps **46**, **70** and **72** are repeated.

[0064] With the retrieved previous data and new risk factor data, step **24** is repeated at step **334** to determine a new CVH score. The CVH score may optionally be converted to a My Life Check Score at step **336**. If the data in Tables 4A-4B has been changed since the last vascular age calculation, step **22** is repeated at step **344** based on the new data. If not, the previously looked-up functional parameters may be retrieved if previously stored for this particular patient. Step **26** is repeated at step **346** using current age, new CVH score from step **334**, and functional parameter data from step **344** to determine a new age factor and new 10 year risk of CVD. This data is then used at step **348** to calculate a new vascular age by repeating step **28** using the equations indicated above. The new vascular age is displayed or otherwise provided at step **354**. Optionally, informational materials are provided at step **356** by repeating step **32** based on the new data and results.

[0065] Optionally, the previous (or one or more previous) CVH scores (or My Life Check scores) and/or vascular ages may be retrieved at steps **338** and **350** and compared to the new CVH score (and new My Life Check Score) and vascular age at steps **340** and **352**. The new CVH score, and optional My Life Check Score, and/or results of a comparison to previous scores may optionally be displayed or otherwise provided to the user at step **342**. Similarly, the results of a comparison of current vascular age to one or more previously determined vascular age results may also be displayed or otherwise provided at step **354**. Any comparison to previous scores is preferably displayed or provided as

a percentage of change, a line or bar graph showing current and previous results, or a single number indicating the changed amount (e.g. new vascular age is 5 years younger than previous vascular age or new CVH score is 3 points higher than previous score). Most preferably, if a patient creates a login profile, the patient's data is saved for future use and comparison to aid in the patient's understanding of how changes in risk factors impact CVH score and vascular age.

[0066] Each of steps **316**, **322**, and **328** may be grouped to prompt the user to indicate a change in more than one type of information. For example, step **322** could prompt the user to indicate yes or no to whether there have been changes to blood pressure, cholesterol, or glucose measurements or medications. If the user enters "yes," then all of steps **44**, **66**, and **68** have to be repeated. According to another preferred embodiment, the user is separately prompted to indicate whether there is a change for each type of information in steps **316**, **322**, and **328**. For example, a user would be separately prompted for change in height, change in weight, changes in blood pressure measurements and medication status, changes in cholesterol measurement and medication status, etc. Having separate prompts would reduce the number of steps that may have to be repeated. For example, if the user indicates no change in blood pressure measurement or medications, but that there have been changes in cholesterol measurement or medications, then steps **106**, **108**, **114**, and **120** related to cholesterol would be repeated, but it would not be necessary to repeat steps **96**, **98**, **100**, **110**, or **116** related to blood pressure.

[0067] According to one preferred embodiment, a system for carrying out the preferred method of heart health assessment and communication according to the invention comprises:

[0068] one or more computers or terminals or other computing devices, with or without a server, accessible by a user/patient/healthcare provider, to allow data entry in response to prompts regarding personal information and risk factors; to provide or display a CVH score and/or vascular age to the user/patient/healthcare provide; optionally to receive or allow for printing or download of risk factor specific and/or generalized health information; and/or optionally to allow communication via the internet with one or more external sites (an external computer, terminal, or computing device, an external database, an externally hosted software site, file sharing site, and/or a healthcare provider computer, terminal, or computing device);

[0069] a software component at the user/patient/healthcare provider's computer, terminal, computing device, or server or remotely accessible from such (hosted at the software provider's or other third party's site) for managing, initiating, and carrying out the method steps of the personal data and risk factor data entry, calculations, and optional provision of information;

[0070] a database system or similar data storage capability for storing data used to determine CVH score and the race/sex data used to make other calculations, including the data contained in Tables 1, 2, and 4A-4B, the database system accessible by the software component or integrated into the software component;

[0071] if the software component is hosted externally from the user/patient/healthcare provider's device, a computerized server connected to a network to host the software, preferably containing the database system and optional database systems, and to allow communication with and between one or more user computers, terminals, or other computing devices; one or more users/patients, including by email; and optionally one or more external sites (an external database, file sharing site, or a remote healthcare provider or patient computer or terminal) via the internet;

[0072] an optional database system or similar data storage capability for storing files containing historic or previously entered personal information and risk factor data, previous calculations of CVH score, optionally My Life Check Score, and vascular age, the database system accessible by the software component; and

[0073] an optional database system or similar data storage capability for storing risk factor related information and/or generalized health information, the database system accessible by the software component to send, display, or otherwise provide such information to the user/patient/healthcare provider, preferably through the user/patient/healthcare provider's computer, terminal, computing device, or server.

[0074] Computer, terminals, and computing devices preferably have a processor and memory storage capability to allow execution of the software component to carry out the steps of the methods according to the invention. Methods and systems **10** and **310** may also be incorporated into a number of medical related devices, such as devices to measure a medical parameter of the patient. For example, an automated blood pressure measuring machine (similar to those found at pharmacies) or a weight scale or a home blood glucose testing device, may incorporate various components or embodiments of a method and system **10** according to the invention. When incorporated into such devices, certain patient inputs may be skipped. For example, if part of an automated blood pressure measuring device, the patient's blood pressure would be actually measured and those measurements used in place of prompting the user to enter those measurements at steps **98** and **100**. Various embodiments of a method according to the invention may also be carried out on a computer, tablet, smart phone, stand-alone kiosk, or similar device having a user interface to allow input of a patient's data, a processor for making calculations, and the ability to store data (such as Tables 4A and 4B and, optionally, a patient's particular data for a given date).

[0075] The basic operation and calculations made in methods and systems **10** and **310** may also be incorporated into a pre-existing medical database or patient health record system, which already includes basic information regarding the patient's race, sex, age, height, weight, and medical history, which may be periodically updated with new physical exams or data entry. Systems **10** and **310** may be modified to retrieve such pre-existing information directly from such medical database or patient health record system without requiring separate data entry, as will be understood by those of ordinary skill in the art.

[0076] One or more components or steps described with one preferred embodiment of a system or method according to the invention may be used with another embodiment of the system or method, even if not specifically described in connection with the embodiment. References to servers, computers, terminals, and other computing devices are intended to include all such devices that permit the data

entry, communication, storage, and access to data and information, and/or that are capable of carrying out steps defined in a software program. Steps described herein as a prompt to a user may alternatively be a tab, drop-down box, or other option to be selected by the user or recipient. Unless a specific format is indicated (e.g. display on a screen), references herein to displaying or providing results or information include any manner of display or providing the results or information, such as displayed on a screen, printouts, postal mail, courier, sent by email, download, uploaded to a file sharing site, text, or other electronic means. Any combination of optional stages or steps may be used in connection with the preferred methods and system of the invention. Those of ordinary skill in the art will also appreciate upon reading this specification, that modifications and alterations to the methodology and system for calculation of a vascular age may be made within the scope of the invention and it is intended that the scope of the invention disclosed herein be limited only by the broadest interpretation of the appended claims to which the inventors are legally entitled.

What is claimed is:

1. A method for assessing a patient's heart health, the method comprising:

obtaining information regarding the patient's race, sex, and age and regarding a plurality of personal risk factors for the patient;

determining a CVH score for the patient;

retrieving functional parameters based on the patient's race and sex;

determining a vascular age for the patient based on the patient's CVH score and the retrieved functional parameters;

providing the vascular age to the patient; and

providing health information to the patient based on the information regarding one or more of the plurality of personal risk factors, CVH score, vascular age, or a combination thereof.

2. The method of claim **1** wherein the determining the CVH score step comprises:

comparing the information regarding the plurality of personal risk factors to a set of ideal values for each risk factor;

assigning a point value for each of the plurality of personal risk factors based on the comparison; and

adding the point values together to calculate the patient's CVH score.

3. The method of claim **2** wherein the personal risk factors comprise at least one risk factor from each of the following categories: physical risk factors, medical risk factors, and lifestyle risk factors; and

wherein the ideal values for each risk factor are those listed in Tables 1 and 2.

4. The method of claim **3** wherein the physical risk factors comprise height and weight or BMI;

wherein the medical risk factors comprises one or more of the following: whether the patient is on medication for treatment of high blood pressure, lipids, or diabetes, systolic blood pressure measurement, diastolic blood pressure measurement, total cholesterol measurement, and fasting blood glucose measurement; and

wherein the lifestyle risk factors comprise one or more of the following: whether the patient is a current smoker, whether the patient quit smoking in the last twelve months, amount of physical activity per predetermined time period, amount of fruits and vegetables consumed per predetermined time period, amount of fish consumed per predetermined time period, amount of fiber rich whole grains consumed per predetermined time period, amount of sodium consumed per predetermined time period, and amount of sugar sweet beverages consumed per predetermined time period.

5. The method of claim **1** wherein the functional parameters based on sex and race are listed in Tables 4A-4B.

6. The method of claim **5** wherein the determining a vascular age step comprises:

calculating an age factor for the patient using the equation:

$$\vec{X}\vec{\hat{\beta}}=\hat{\beta}_{age}\cdot X_{age}+\hat{\beta}_{CVH\ score}\cdot X_{CVH\ score}-\overline{\vec{X}\vec{\hat{\beta}}}$$

calculating a 10 year risk of CVD for the patient using the equation:

$$\hat{p}=1-S_0(10)^{\exp(\vec{X}\vec{\hat{\beta}})}; \text{ and}$$

calculating the patient's vascular age using the equation:

$$\text{Vascular Age} = \ln\left[\left(\frac{\ln(1-\hat{p})}{\ln(S_0(10))}\right)^{\frac{1}{\hat{\beta}_{Age}}}\right] + \text{constant term}$$

wherein X_{age} is the patient's actual age, $X_{CVH\ score}$ is the determined CVH score for the patient, and all other variables are functional parameters based on the patient's race and sex.

7. The method of claim **6** wherein the information regarding personal risk factors comprises three or more of: height, weight, measured blood pressure, measured cholesterol, and measured fasting blood glucose; and

wherein the obtaining step comprises data entry, retrieving information from a patient health record system, or a combination thereof.

8. The method of claim **6** further comprising:

identifying one or more personal risk factors where the assigned point value is below a predetermined threshold; and

wherein the providing health information step comprises providing health information specific to the identified personal risk factor.

9. The method of claim **8** wherein the health information comprises one or more of nutrition information, exercise information, recipes, diet information, grocery lists, meal planning information, smoking cessation information, tips for reducing sodium intake, cholesterol control information, diabetes control information, blood pressure control information, weight management information, weight loss information, stress reduction information and information regarding prescription medications.

10. The method of claim **6** further comprising determining whether the patient's calculated vascular age is over the patient's actual age by a predetermined amount or whether the patient's CVH score is under a predetermined threshold or both; and

wherein the providing health information step is carried out when the patient's calculated vascular age is over the patient's actual age by a predetermined amount or whether the patient's CVH score is under a predetermined threshold or both.

11. A method for assessing a patient's heart health, the method comprising:

obtaining information regarding the patient's race, sex, and age and regarding a plurality of personal risk factors for the patient;

determining a CVH score for the patient;

retrieving functional parameters based on the patient's race and sex as listed in Tables 4A-4B;

determining a vascular age for the patient based on the patient's CVH score and the retrieved functional parameters; and

providing the vascular age to the patient.

12. The method of claim **11** wherein the information regarding the plurality of risk factors comprises BMI, cholesterol information, diabetes information, blood pressure information, smoking information, activity level information, and diet information;

wherein the determining the CVH score step comprises:

comparing the risk factor information to an ideal value or set of ideal values for each risk factor;

assigning a point value for each of the personal risk factors based on the comparison; and

adding the point values together to calculate the patient's CVH score on a scale of 0 to 14.

13. The method of claim **12** wherein the determining a vascular age step comprises:

calculating an age factor for the patient using the equation:

$$\widehat{X\beta} = \hat{\beta}_{age} \cdot X_{age} + \hat{\beta}_{CVH\ score} \cdot X_{CVH\ score} - \overline{\widehat{X\beta}}$$

calculating a 10 year risk of CVD for the patient using the equation:

$$\hat{p} = 1 - S_0(10^{\exp(\widehat{X\beta})}); \text{ and}$$

calculating the patient's vascular age using the equation:

$$\text{Vascular Age} = \ln\left[\left(\frac{\ln(1-\hat{p})}{\ln(S_0(10))}\right)^{\frac{1}{\hat{\beta}_{Age}}}\right] + \text{constant term}$$

wherein X_{age} is the patient's actual age, $X_{CVH\ score}$ is the determined CVH score for the patient, and all other variables are functional parameters based on the patient's race and sex.

14. The method of claim **13** further comprising:

identifying one or more personal risk factors where the assigned point value is below a predetermined threshold; and

providing health information specific to any personal risk factor identified.

15. The method of claim **14** wherein the health information comprises one or more of nutrition information, exercise information, recipes, diet information, grocery lists, meal planning information, smoking cessation information, tips for reducing sodium intake, cholesterol control information, diabetes control information, blood pressure control information, weight management information, weight loss information, stress reduction information and information regarding prescription medications.

16. The method of claim **13** further comprising determining whether the patient's calculated vascular age is over the patient's actual age by a predetermined amount or whether the patient's CVH score is under a predetermined threshold or both; and

providing health information if the patient's calculated vascular age is over the patient's actual age by the predetermined amount or if the patient's CVH score is under the predetermined threshold or both.

17. A system for assessing a patient's heart health, the system comprising:

a computer, terminal, or other computing device accessible by a user or patient;

a software component on or accessible from the computer, terminal or other computing device configured to (1) obtain information regarding the patient's race, sex, and age; (2) obtain information regarding a plurality of personal risk factors for the patient; (3) determine a CVH score for the patient; (4) retrieve functional parameters based on the patient's race and sex; (5) determine a vascular age for the patient based on the patient's CVH score and the retrieved functional parameters; (6) provide the vascular age to the patient; and (7) optionally provide health information to the user or patient;

one or more database systems or data storage systems for storing ideal values for each risk factor, functional parameters based on race and sex as listed in Tables 4A-4B, optionally previously obtained information regarding the personal risk factors for the patient, optionally previously determined CVH score, optionally previously determined vascular age, optionally health information, or a combination thereof.

18. The system according to claim **17** wherein the software component is configured to determine a CVH score by comparing the risk factor information to an ideal value or set of ideal values for each risk factor;

assigning a point value for each of the personal risk factors based on the comparison; and

adding the point values together to calculate the patient's CVH score on a scale of 0 to 14; and

wherein the software component is configured to determine a vascular age by L calculating an age factor for the patient using the equation:

$$\widehat{X\beta} = \hat{\beta}_{age} \cdot X_{age} + \hat{\beta}_{CVH\ score} \cdot X_{CVH\ score} - \overline{\widehat{X\beta}}$$

calculating a 10 year risk of CVD for the patient using the equation:

$$\hat{p} = 1 - S_0(10^{\exp(\widehat{X\beta})}); \text{ and}$$

calculating the patient's vascular age using the equation:

$$\text{Vascular Age} = \ln\left[\left(\frac{\ln(1-\hat{p})}{\ln(S_0(10))}\right)^{\frac{1}{\hat{\beta}_{Age}}}\right] + \text{constant term}$$

wherein X_{age} is the patient's actual age, $X_{CVH\ score}$ is the determined CVH score for the patient, and all other variables are functional parameters based on the patient's race and sex.

19. The system of claim **18** wherein the computer, terminal, or other computing device or the software component is integrated into a device to measure a medical parameter of the patient or integrated into a patient health record system.

* * * * *

专利名称(译)	评估心脏健康并将评估传达给患者的系统和方法		
公开(公告)号	US20190295727A1	公开(公告)日	2019-09-26
申请号	US16/360747	申请日	2019-03-21
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IPC分类号	G16H50/30 G16H80/00 A61B5/00		
CPC分类号	G16H50/20 G16H50/30 G16H80/00 G16H10/20 A61B5/7264 A61B5/7275 G16H50/70 A61B5/02007 A61B5/0402 A61B5/1118 A61B5/14532		
优先权	62/647020 2018-03-23 US		
外部链接	Espacenet USPTO		

摘要(译)

一种用于评估患者的心脏健康并以可理解的格式与患者进行评估的沟通的方法和系统。有关个人危险因素的各种个人数据和信息用于计算CVH分数。 CVH分数，患者的实际年龄以及特定于患者种族和性别的各种预定功能参数用于计算患者的血管年龄。血管年龄是提供给患者的，可能比患者的实际年龄大（表明心血管健康状况不佳），与患者的实际年龄相同（表明平均心血管健康状况），或者比患者的实际年龄年轻（表明理想的心血管疾病）健康）。可选地，还可以基于个人危险因素，CVH评分，血管年龄或与先前值或预定阈值的比较来提供健康信息。