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(54) HEALTHCARE MANAGEMENT SYSTEM AND METHOD OF PREDICTING HIGH UTILIZERS OF HEALTHCARE SERVICES

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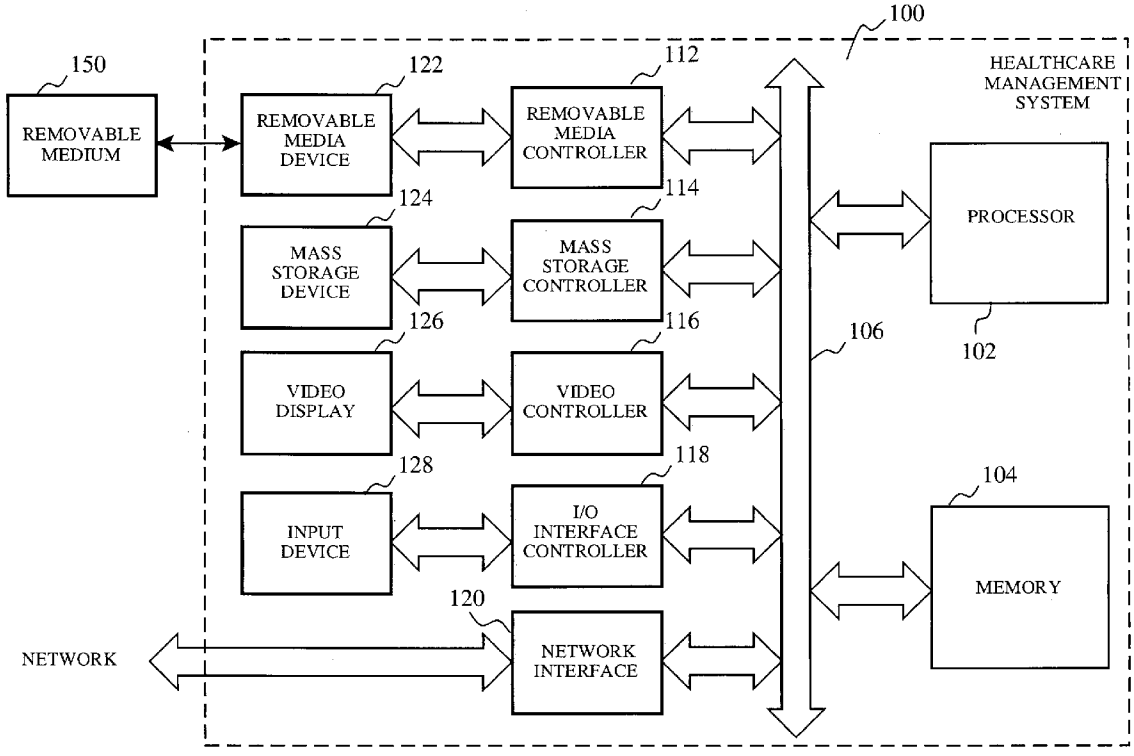
(57) **ABSTRACT**

A healthcare management system and method identify individuals at risk of high near-term healthcare use. On step of the method includes collecting information from an individual for a predetermined set of predictive factors. Another step of the method includes assigning, based upon the information from the individual, a separate value to each predictive factor of the predetermined set of predictive factors. The method further includes the step of generating, based upon a predetermined predictive model and the separate values assigned to the predetermined set of predictive factors, a risk level of the individual utilizing healthcare services at a predetermined level within a prospective time span.



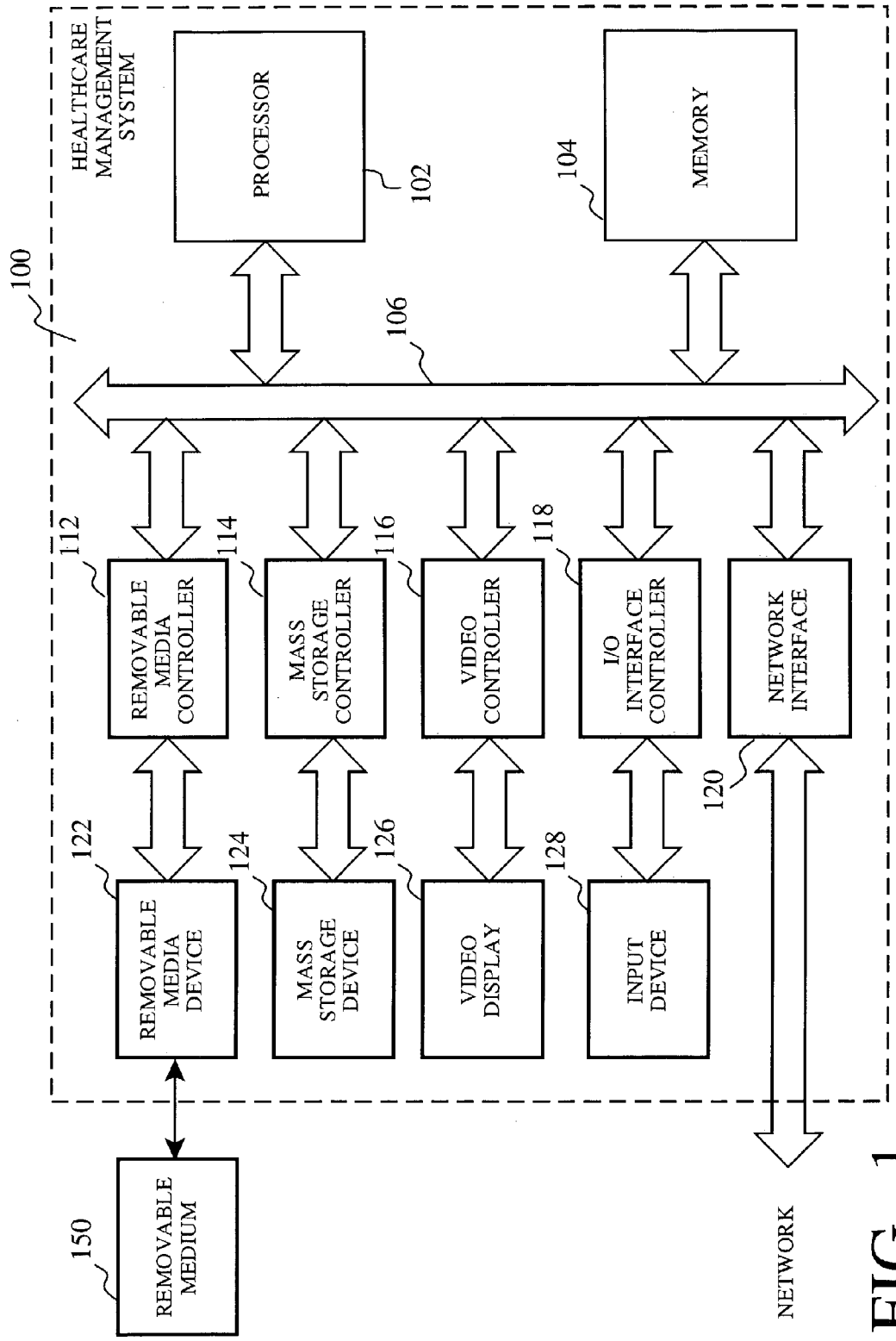

HEALTHCARE MANAGEMENT SYSTEM
100
PROCESSOR
102
MEMORY
104
106
REMOVABLE MEDIA CONTROLLER
112
MASS STORAGE CONTROLLER
114
VIDEO CONTROLLER
116
I/O INTERFACE CONTROLLER
118
NETWORK INTERFACE
120
REMOVABLE MEDIA DEVICE
122
MASS STORAGE DEVICE
124
VIDEO DISPLAY
126
INPUT DEVICE
128
REMOVABLE MEDIUM
150
NETWORK

FIG. 1

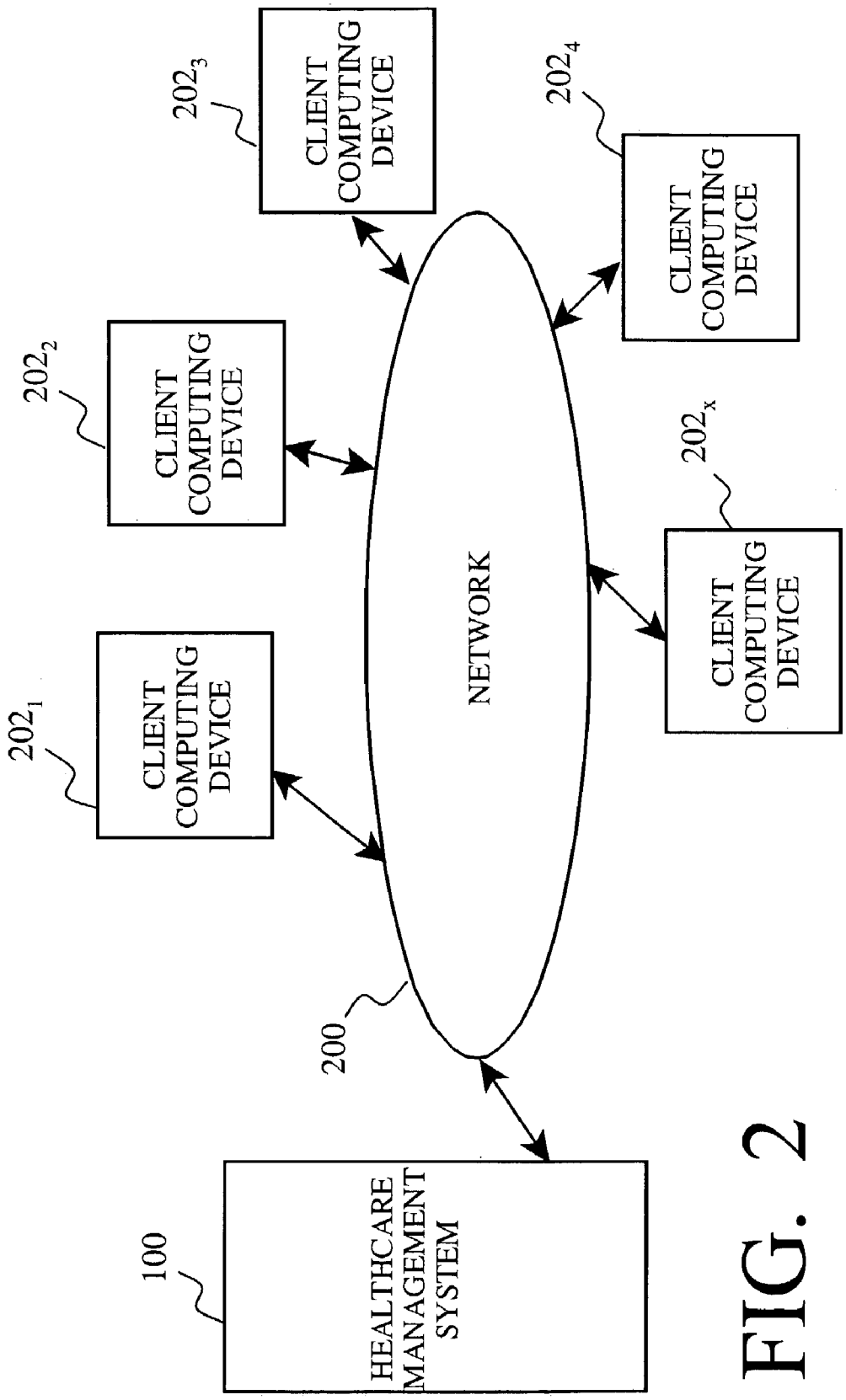

CLIENT COMPUTING DEVICE
202_1
CLIENT COMPUTING DEVICE
202_2
CLIENT COMPUTING DEVICE
202_3
CLIENT COMPUTING DEVICE
202_4
CLIENT COMPUTING DEVICE
202_x
NETWORK
200
HEALTHCARE MANAGEMENT SYSTEM
100

FIG. 2

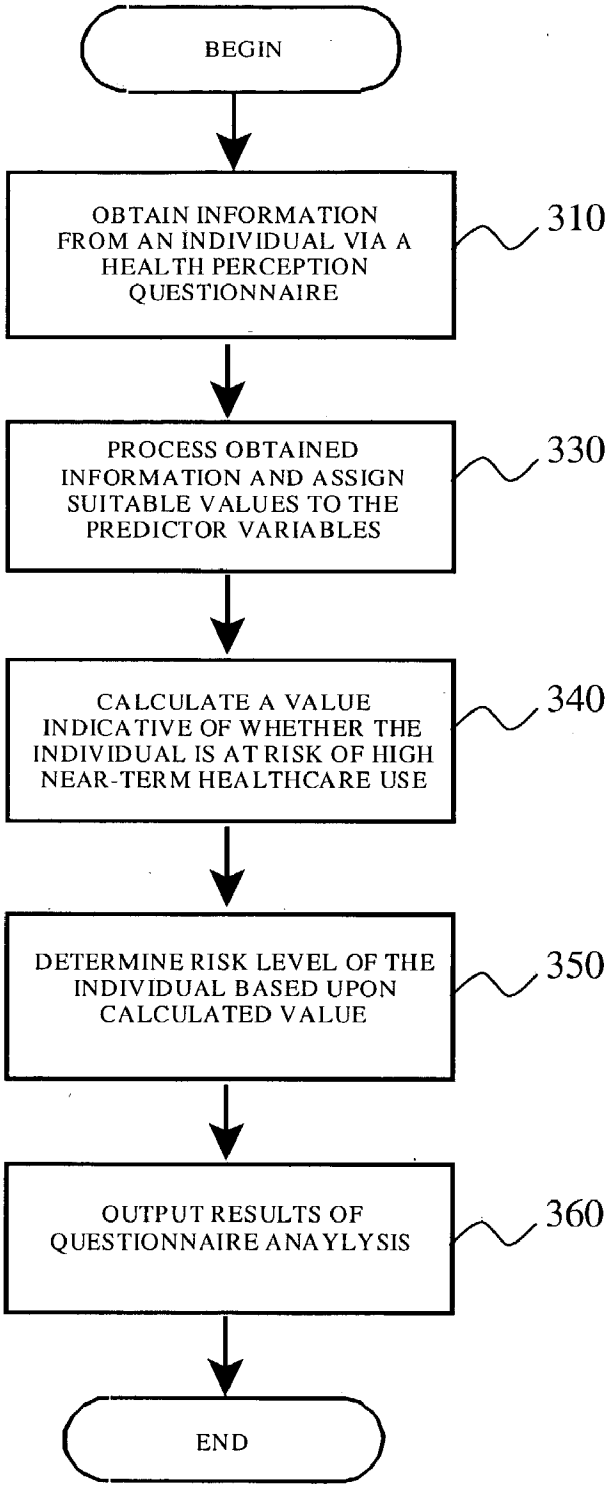

BEGIN
OBTAIN INFORMATION FROM AN INDIVIDUAL VIA A HEALTH PERCEPTION QUESTIONNAIRE
310
PROCESS OBTAINED INFORMATION AND ASSIGN SUITABLE VALUES TO THE PREDICTOR VARIABLES
330
CALCULATE A VALUE INDICATIVE OF WHETHER THE INDIVIDUAL IS AT RISK OF HIGH NEAR-TERM HEALTHCARE USE
340
DETERMINE RISK LEVEL OF THE INDIVIDUAL BASED UPON CALCULATED VALUE
350
OUTPUT RESULTS OF QUESTIONNAIRE ANAYLYSIS
360
END

FIG. 3

HEALTHCARE MANAGEMENT SYSTEM AND METHOD OF PREDICTING HIGH UTILIZERS OF HEALTHCARE SERVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 09/520,419, filed Mar. 8, 2000, which is expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates generally to healthcare management systems, and more particularly to a healthcare management system and method for identifying individuals at risk for high near-term healthcare use.

BACKGROUND OF THE INVENTION

[0003] In commercial adult managed care populations, typically 10-20% of the population will incur 80-90% of the risk exposure for the risk-bearing payer. A major challenge in today's managed care environment is prospectively predicting which members are at risk for high utilization to enable appropriate targeting of proactive case management and intervention programs. These members could enjoy better health and incur fewer health-related expenses if they could be identified early and managed proactively.

[0004] Historically over the last 30 years, health assessment tools for adult populations (18-65 years of age) have been built upon clinical risk/chronic disease models to guide clinical decision making, to serve as outcome measures, or to automate aspects of care such as automated problem lists, laboratory results, and healthcare reminders. The emphasis has been on practical clinical issues, resulting in limited predictive power in terms of targeting those at risk for higher levels of healthcare-seeking behavior.

[0005] Increasingly, the ability of risk-bearing payers to approach population health management in a cost and quality-effective manner, will be dependent upon sound predictive models which guide care toward members who have a higher probability of becoming a high care user in the near-term. Adding momentum to the efforts, technological advances such as ASP and dynamic HTML Web tools, widespread connectivity to the Internet, and digital, variable-data print technologies have only recently become available to make population-based care management a real option versus a rhetorical question.

[0006] Theoretically and empirically, evidence suggests that near-term healthcare utilization may not be as strongly tied to traditional disease and clinical risk models as once thought. Indeed, 40-60% of office visits are often tied to non-disease based concerns. Also, from a practical perspective, risk/disease models often miss key prescriptive data which may guide the health counseling process (i.e., areas of readiness to change, stress levels, levels of perceived self-management, etc.) and key outcome measures (i.e., improvements in functional ability, levels of stress emotions, disease and medication compliance, etc.). In a practical sense, claims-based stratification methods are limited by the inherent inadequacies of the claims data itself, including the lack of claims history from new enrollees and the several month time lags often required to access and process the predictive information.

[0007] Therefore, a need exists for a healthcare management system and method that identify, based upon easily ascertained self-reported information, those members of a managed healthcare group who are at risk for high near-term healthcare use

SUMMARY OF THE INVENTION

[0008] The present invention addresses the above-identified need, as well as others, with a method of managing healthcare services. On step of the method includes collecting information from an individual for a predetermined set of predictive factors. Another step of the method includes assigning, based upon the information from the individual, a separate value to each predictive factor of the predetermined set of predictive factors. The method further includes the step of generating, based upon a predetermined predictive model and the separate values assigned to the predetermined set of predictive factors, a risk level of the individual utilizing healthcare services at a predetermined level within a prospective time span.

[0009] Pursuant to another embodiment of the present invention, there is provided a healthcare management system including a processor, and a memory operably coupled to the processor. The memory includes instructions that, when executed by the processor, cause the processor to assign, based upon information from an individual, a separate value to each predictive factor of a set of predictive factors. The instructions of the memory, when executed by the processor, further cause the processor to generate, based upon a predetermined predictive model and the separate values assigned to the predetermined set of predictive factors, a risk level of the individual utilizing healthcare services at a predetermined level within a prospective time span.

[0010] Pursuant to a further embodiment of the present invention, there is provided a computer readable medium for a healthcare management system. The computer readable medium including instructions that, when executed by the healthcare management system, cause the healthcare management system to assign, based upon information from an individual, a separate value to each predictive factor of a set of predictive factors. The instructions, when executed by the healthcare management system, further cause the healthcare management system to generate, based upon a predetermined predictive model and the separate values assigned to the predetermined set of predictive factors, a risk level of the individual utilizing healthcare services at a predetermined level within a prospective time span.

[0011] It is an object of the present invention to provide an improved healthcare management system and method.

[0012] It is also an object of the present invention to provide a new and useful healthcare management system and method.

[0013] It is another object of the present invention to provide a healthcare management system and method for identifying high risk individual users of healthcare services.

[0014] It is yet another object of the present invention to provide a computer readable medium for configuring a healthcare management system to identify individuals at risk of high near-term healthcare use.

[0015] It is yet another object of the present invention to provide a healthcare management system and method for identifying members of a managed care group who are at risk to utilize healthcare services at a predetermined usage rate within prospective time span.

[0016] The above and other objects, features, and advantages of the present invention will become apparent from the following description and the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] **FIG. 1** is a simplified block diagram of an exemplary healthcare management system which incorporates various features of the present invention;

[0018] **FIG. 2** illustrates an exemplary operating environment in which the healthcare management system of **FIG. 1** may be utilized; and

[0019] **FIG. 3** is a flowchart depicting the general operation of the healthcare management system of **FIG. 1**.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0020] While the invention is susceptible to various modifications and alternative forms, exemplary embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

[0021] Referring now to **FIG. 1, a** simplified block diagram of an exemplary healthcare management system ("HMS") **100** is shown which incorporates various features of the present invention. As will be explained in more detail, the exemplary HMS **100** is generally operable to identify members (i.e. individuals), based upon perceived health information, who are at risk of high near-term healthcare use. Besides identifying members of the managed care group who are at risk for high near-term healthcare use, the HMS **100** enables proactive case management of the identified members. For example, the HMS **100** enables healthcare managers identify individuals who are at risk of incurring significant healthcare expenses in the near-term so that intervention programs may be targeted to these identified individuals in order to help these individuals to enjoy better health and to incur fewer health-related expenses.

[0022] To this end, the exemplary HMS **100** includes a processor **102**, memory **104**, a system bus **106**, controllers **112**, **114**, **116**, **118**, network interface **120**, and devices **122**, **124**, **126**, **128**. The hardware architecture of the exemplary HMS **100** is generally illustrative of general purpose computing systems such as personal computers, workstations, and servers currently manufactured by Gateway, Dell, Macintosh, Sun Microsystems, and IBM. While the hardware architecture of the exemplary HMS **100** is generally illustrative of general purpose computing systems, the HMS **100** may also be implemented as a special purpose computing device that is generally operable to perform a limited set of tasks associated with healthcare management.

[0023] Returning to the description of the exemplary HMS **100**, the processor **102** includes one or more processing units such as the central processing units of Intel, AMD, IBM, National Semiconductor, and Transmeta. The processor **102** is generally operable to execute software and/or firmware routines stored in the memory **104**. As a result of executing the software and/or firmware routines of the memory **104**, the processor **102** controls the general operation of the HMS **100** and the devices **122**, **124**, **126**, **128** via the respective controllers **112**, **114**, **116**, **118**. Moreover, the processor **102** as a result of executing software and/or firmware routines of the memory **104** is generally operable to implement a predictive model that identifies, based upon perceived health, members of a managed care group who are at risk of high near-term healthcare use.

[0024] The memory **104** of the exemplary HMS **100** is operable to store data and code used by the processor **102**. To this end, the memory **104**, in an exemplary embodiment, includes standard random access memory for storing the data and software code needed by the processor **102**. However, the memory **104** may alternatively include other volatile memory types such as DRAM, SDRAM, and SRAM for storing data and software code and/or non-volatile memory such as ROMs, PROMs, EEPROMs, and flash memory for storing data and firmware code.

[0025] The system bus **106** is generally operable to interconnect the processor **102**, the memory **104**, and the controllers **112**, **114**, **116**, **118**. To this end, the system bus **106** in the exemplary embodiment includes an address bus and data bus which enable the various components of the exemplary HMS **100** to communicate with one another.

[0026] The removable media drive **122** is generally operable to read information from and write information to the removable storage medium **150**, and the removable storage media controller **112** is generally operable to provide the processor **102** with an interface to the removable media drive **122**. The removable media drive **122** may include various computer readable and/or writeable storage media devices such as floppy disk drives, DVD drives, tape drives, DAT drives, and ZIP drives in order to access corresponding types of removable storage media. The removable media drive **122** may also include non-volatile memory interfaces for accessing non-volatile memory devices such as PROMS, EEPROMS, and Flash Memory.

[0027] The mass storage device **124** is generally operable to store data and/or software code of the exemplary HMS **100**, and the mass storage controller **114** is generally operable to provide the processor **102** with an interface to the data and/or software code stored by the mass storage device **118**. To this end, the mass storage device **118** may include various computer readable and/or writeable media devices such as hard disk drives, floppy disk drives, CD-ROM drives, DVD-RAM drives, RAID devices, and/or Disk-On Chip devices to name a few. The HMS **100** may alternatively be implemented without a mass storage device **122** and mass storage controller **112**. For example, the exemplary HMS **100** may be implemented with data and firmware code stored in a non-volatile manner in the memory **104**.

[0028] The video display device **126** is operable to provide a visual display to a user of the exemplary HMS **100**, and the video controller **116** is operable to provide the processor **102** with an interface to the video display device **126**. To this end, the video display device **126** may include CRT displays, LCD displays, and/or standard television displays. The HMS

100 may alternatively be implemented without a video display device **126**, and video controller **116**. For example, the HMS **100** may be implemented to output results to an attached printer (not shown), the removable storage media **150**, and/or another computing device attached to the HMS **100** via the network interface **120**, a USB port (not shown), parallel port (not shown), or FireWire interface (not shown).

[**0029**] The input device **128** is operable to provide a user of the exemplary HMS **100** with an interface to control the operation of the exemplary FMS **100** and/or to provide the exemplary HMS **100** with information. Moreover, the I/O interface controller **118** is operable to provide the processor **102** with an interface to the input device **128**. To this end, the input device may include a mouse, keyboard, touch pad, push buttons, touch screen, and/or digital scanner.

[**0030**] The network interface **120** is generally operable to couple the exemplary HMS **100** to a network such as the Internet, an intranet, and/or an extranet. The network interface **120** generally enables the exemplary HMS **100** to send and receive information to and from other computing devices coupled to the network. To this end, the network interface **120** may be implemented with a network interface card such as an Ethernet card or Token Ring card. The network interface **120** may also be implemented with an analog modem for use over POTS telephone lines such as a 28.8K or 56K modem. The network interface **120** may also be implemented with a digital modem such as a cable modem for use over a cable distribution network, an ISDN modem for use over an ISDN telephone line, or a DSL modem for use over a POTS telephone lines that support DSL.

[**0031**] An exemplary operating environment is illustrated in **FIG. 2**. As illustrated, the HMS **100** is operably coupled to client computing devices $\mathbf{202}_1$, $\mathbf{202}_2$ . . . $\mathbf{202}_X$ via a network **200**. The network **200** may include multiple public or private LANs and/or WANs that are operably coupled to one another via routers, switches, hubs, gateways, proxies, and/or firewalls. In an exemplary embodiment, the network interface **120** of the HMS **100** is operably coupled to a LAN that provides a gateway to the Internet. As a result, the exemplary HMS **100** is accessible to client computing devices $\mathbf{202}_1$, $\mathbf{202}_2$ . . . $\mathbf{202}_X$ that are either coupled to the LAN or the Internet, thus providing the services of the HMS **100** to people located locally and throughout the world.

[**0032**] In an exemplary embodiment, the HMS **100** communicates with client computing devices $\mathbf{202}_1$, $\mathbf{202}_2$ . . . $\mathbf{202}_x$ in accordance with the Hyper Text Transport Protocol (HTTP) and other Internet Protocols (IP). Accordingly, the services of the HMS **100** are generally available to any client computing device that supports the appropriate IP protocols. Most personal computers such as those manufactured by Dell and MacIntosh include web browsing software that provide an interface to services delivered via the IP protocols. However, besides personal computers, many other devices are being developed that include web browsing capabilities. For example, set-top boxes such as Microsoft's WebTV and certain digital mobile phones include web browsing capabilities and could be used to access the services of the HMS **100**.

[**0033**] As stated above, the HMS **100** identifies individuals who are at risk of high near-term healthcare use based upon perceived health information and other information. Perceived health is defined as a person's composite evaluation of how he or she is feeling and doing. People experience health as either some level of wellness or illness. If a person is experiencing unpleasant or uncomfortable physical sensations and/or emotions in addition to not functioning up to their perceived capability level, the person perceives some level of illness. Some degree of wellness, on the other hand, is perceived when the person experiences pleasant/comfortable physical sensations and emotions combined with an acceptable level of self-evaluated functioning.

[**0034**] The difference between the perceived health and disease/risk models is that a person can experience wellness in the presence or absence of disease. For example, a person who has diabetes can experience wellness in that from the person's perspective the person is feeling and doing well. Conversely, a person can experience illness in the absence of discernable disease in that from the person's perspective the person is not feeling nor doing well. From a practical viewpoint, people seek care when their sense of feeling and doing is below their perceived threshold of tolerance.

[**0035**] Evidence also shows a correlation between (i) an individual's beliefs and preferences regarding the healthcare system and (ii) particular types of healthcare-seeking behavior. In particular, individuals who place high levels of faith in the healthcare system or desire the input of health professionals to make health decisions tend to use the healthcare system more often.

[**0036**] As a result of the above observed correlations, the exemplary HMS **100** attempts to identify individuals at risk of high near-term healthcare use based upon information about an individual's perceived health, beliefs and preferences regarding the healthcare system, past levels of healthcare use, and demographics. To this end, the HMS **100** in step **310** of **FIG. 3** obtains such information from an individual via a health perception questionnaire. An exemplary questionnaire is provided in Appendix A and includes questions that elicit information for a predetermined set of predictive factors which include past healthcare use factors, demographic factors, perceived health factors, disease factors, healthcare compliance factors, healthcare belief factors, and healthcare preference factors.

[**0037**] The exemplary HMS **100** is operable to display the health perception questionnaire on the video display **126** and receives responses to the questions of the questionnaire via the input device **128**. Moreover, the exemplary HMS **100** is further operable to transmit the questionnaire to client computing devices $\mathbf{202}_1$, $\mathbf{202}_2$ . . . $\mathbf{202}_X$ via the network **200**, and receives responses to the questions of the questionnaire from client computing devices $\mathbf{202}_1$, $\mathbf{202}_2$ . . . $\mathbf{202}_X$ via the network **200**. The HMS **100** may also include various other mechanisms for receiving responses to the health perception questionnaire. For example, the HMS **100** may include a digital scanner that is operable to read from a printed questionnaire an individual's responses to the questions of the questionnaire. The HMS **100** may also obtain responses to the questionnaire from archived information stored on a removable medium **150**, the mass storage device **124**, or a database accessible via the network **200**. Further yet, them HMS **100** may obtain responses to the questionnaire via telephone (e.g. an interactive voice response telephone system).

[**0038**] After obtaining information from an individual, the exemplary HMS **100** analyzes the information based upon a

predictive model developed from similar information collected from other individuals and their prospective use of healthcare services. As will be explained in more detail below, the exemplary HMS **100** analyzes the information based upon a logistic regression predictive model represented by the following equations:

$$z=\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4 \ldots \beta_{38}X_{38}+\beta_{39}X_1X_2+C,$$

$$P_{high_use}=e^z/(1+e^z)$$

[**0039**] where $\beta_1, \beta_2, \beta_3, \beta_4 \ldots \beta_{39}$ represent the regression coefficient shown in Table 2 of Appendix B; $X_1, X_2, X_3, X_4 \ldots X_{38}$ represent the predictor variables shown in the questionnaire of Appendix A and Table **2** of Appendix B; and C represents the regression constant shown in Table 2 of Appendix B. Those skilled in the art should appreciate that predictor variables X_1 and X_2 are interaction variables. Moreover, other analysis tools such as neural networks, genetic algorithms, and fuzzy logic could also be used to develop the predictive model.

[**0040**] In order to utilize the above logistic regression predictive model, the exemplary HMS **100** in step **330** processes an individual's responses to the health perception questionnaire in order to obtain suitable values for the predictor variables $X_1, X_2, X_3, X_4 \ldots X_{38}$. More specifically, the predictor variables $X_1, X_2, X_3, X_4 \ldots X_{38}$ of the logistic regression are converted to dichotomous variables (i.e. variables that can have one of only two values such as 0 or 1). Accordingly, the exemplary HMS **100** assigns an appropriate dichotomous value to each of the predictor variables $X_1, X_2, X_3, X_4 \ldots X_{38}$ based upon the responses to the health perception questionnaire. In the exemplary embodiment, the HMS **100** generally assigns a first dichotomous value of "0" to each variable $X_1, X_2, X_3, X_4 \ldots X_{38}$ that the responses suggest are not indicative of the individual being at risk of high near-term healthcare use, and assigns a second dichotomous value of "1" to each variable $X_1, X_2, X_3, X_4 \ldots X_{38}$ that the responses suggest are indicative of the individual being at risk of high near-term healthcare use. Table 2 of Appendix B illustrates the possible responses to the questionnaire for each predictive variable and corresponding dichotomous value assigned to the predictive variable $X_1, X_2, X_3, X_4 \ldots X_{38}$. Moreover, for each variable each variable $X_1, X_2, X_3, X_4 \ldots X_{38}$ corresponding to an answered or an inappropriately answered question, the exemplary HMS **100** assigns the variable a value of "0" in order to be conservative in identifying individuals as high near-term users of healthcare services.

[**0041**] After assigning a dichotomous value to each of the predictor variables $X_1, X_2, X_3, X_4 \ldots X_{38}$, the HMS **100** in step **340** calculates, based upon the above logistic regression equations, a value indicative of whether the individual is at risk of high near-term healthcare use. Essentially, the exemplary HMS **100** in step **340** obtains for the individual a probability value, ranging between 0 and 1, that is indicative of the probability that the individual is a high-risk for high near-term healthcare use.

[**0042**] The HMS **100** then in step **350** determines based upon the probability value obtained for the individual in step **340** whether the individual should be identified as a high-risk or a low-risk person. In particular, the exemplary HMS **100** makes such a determination by comparing the obtained probability value to a predetermined threshold value. The threshold value is preselected to strike a balance between sensitivity and specificity of the measurement. Sensitivity is defined as the percent of people who become high care users and are so identified prospectively by the predictive formula. Specificity is defined as the percent of people who do not become high care users and are so identified by the formula. From a practical viewpoint, the threshold value may also be selected dependent upon the sponsoring plan's objectives, intervention capacity, financial parameters, and expectations. The exemplary HMS **100** utilizes a threshold value of 0.47 and identifies any individual with a probability value greater than the threshold value as a high-risk of high near-term healthcare use. Furthermore, besides identifying an individual as a high-risk if their associated probability value P_{high_user} exceeds the threshold value, the exemplary HMS **100** also marks an individual as a high risk if the individual fails to answer or incorrectly answers more than a predetermined number of questions.

[**0043**] The HMS **100** in step **360** outputs the results of the analysis. In particular, the exemplary HMS **100** is operable to display output results on video display **126** or transmit the output results to a client computing device $\mathbf{202}_1$, $\mathbf{202}_2 \ldots \mathbf{202}_x$ for display. In the exemplary embodiment, the HMS $\mathbf{100}_x$ is operable to generate several types of reports and restrict the generation of certain reports to authorized personnel. For example, a member of the managed care group (i.e. an individual responding to the health perception questionnaire) may cause the HMS **100** to generate reports which (i) provide a general health report, (ii) advise as to how the individual may improve their overall health, (iii) provide information about appropriate intervention programs, and (iv) provide follow-up coaching reports from care providers. On the other hand, personnel of a managed care group may cause the HMS **100** to later generate similar reports about the above identified member and additional reports that (i) summarize the wellness of the managed care group, (ii) list individuals identified as high risk, and (iii) identify intervention programs which address wellness needs of the managed care group.

[**0044**] Development and Validation of the Exemplary Predictive Model

[**0045**] The predictive model of the exemplary HMS **100** was developed from an initial member population of 20,000 members ages 18-65 with claims data showing more than **6** primary care visits within the last year. A health perception questionnaire containing **70** question/**126** response was mailed to the 20,000 members. Subsequently, for the 5,285 members who responded, claims data were obtained from the health plan for the next six months yielding 4,271 members who responded to the health perception questionnaire and were also continuously enrolled during the entire study time period. Those members who completed an intervention program targeted to high utilizers (N=61) were removed from subsequent analyses, leaving 4,210 for the final sample. The sample included 3 female respondents for every male respondent. To assure that the predictive model was developed for a gender-representative population, cases were weighted (3:1) to approximate the normal gender distribution of 51.2% female to 48.8% male. Both the original and weighted sample descriptives are listed in Table 1 of Appendix B.

[**0046**] As indicated above, logistic regression was selected for developing the predictive model; however, other

analysis tools such as neural networks, genetic algorithms, and fuzzy logic could also be used to develop the predictive model. Logistic regression is especially suited for highly skewed data such as the six-month claims encounter data. For this reason, members confirmed as outliers in terms of six-month total dollars or encounters were left in the data set, because the conversion to a dichotomous variable mitigates the outlier effect.

[0047] To prepare all questionnaire information for logistic analysis, each survey item of the questionnaire was converted to a dichotomous variable with a value of "0" indicating low-risk and a value of "1" indicating high-risk responses for each item. In cases where item responses could not be conceptually categorized as high-risk versus low-risk, analyses were run comparing responses with subsequent care use to determine the final coding. All missing survey item data (<10% on each variable) was coded as "0" to be conservative.

[0048] "Total encounters" over the subsequent six-month period was chosen as the dependent variable. An encounter was defined as a unique person with a unique provider on a unique date. Thus for example, if a person went to their physician, was subsequently sent to a lab and finally to pick up a prescription, the total encounters would equal three. With the impact of DRG's on hospital stays and the increasing movement of services to the outpatient and office settings, this definition of encounters was felt to more accurately represent total healthcare use with accompanying total dollars.

[0049] The decision to dichotomize the dependent variable, essentially deciding where to mark the cut-off for a high (1) versus low (0) care user, was a more difficult challenge. A practical rule was used that compares the percent of the population with the percent of premium dollar used. What seems to occur with regularity across adult commercial populations is that the top 2% of care users utilize 40% of the premium, the next 18% of high care users utilize the next 40% of the premium; the next 65% of the members will use the remaining 20% of the premium and 15% of the population will have no care use within the given year. The total member population for the health plan at that time was 36,354 people.

[0050] The sample population was ranked from highest to lowest based upon total claims dollars, and each segment of the above identified segments were then weighted until the population reached 36,354. Subsequently, the resulting data set was checked to assure that the percentage of the population coincided with the percent of premium dollar used. Using this method, 3.6% of the extrapolated population used the first 40% of the premium and 22.3% used the next 40% of the premium. By observing the mean, median and range of encounters for this combined 25.9% group versus all others in the population, the dependent variable cut-off was determined to be 6 or greater encounters in a six month period as the high-risk group coded as "1".

[0051] After the dependent variable and all of the potential predictor variables were coded with dichotomous values, logistic regression was applied using all perceived health, risk, disease, compliance, belief/preference and demographic variables. A split-half technique was used where the predictive model is developed on a randomly selected first half of the data set (N=2,067) and then tested for its stability on the second half of the population (N=2,143). Using standard logistic regression on the first split-half of the weighted sample, 50 variables were found to have significance levels at 0.25 or less including 3 interaction variables in the initial analysis. Subsequent to this initial analysis, a forward stepwise regression was run using these 50 variables on the first split-half, with 39 variables entering the equation. The results of the forward stepwise logistic regression of the probability of becoming a high encounter member using the 39 final predictor variables on the first split-half are shown in Table 2 of Appendix B. The obtained logistic model correctly predicted 68.08% of the observed high care use group and 61.93% of the observed low care use group.

[0052] Next, the predictive model was converted to a formula, which could be used to test the first and second split-halves. First, the formula calculates each person's probability (P_{high_use}) of becoming a high care user by inserting his or her responses to the 39-predictor variables into the logistic formula:

$$z=\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4 \ldots \beta_{38}X_{38}+\beta_{39}X_1X_2+C,$$

$$P_{high_use}=e^z/(1+e^z)$$

[0053] where $\beta_1, \beta_2, \beta_3, \beta_4 \ldots \beta_{39}$ represent the regression coefficient shown in Table 2 of Appendix B; X_1, X_2, X_3, X_4 . . . X_{38} represent the predictor variables shown in the questionnaire of Appendix A and Table 2 of Appendix B; and C represents the regression constant shown in Table 2 of Appendix B.

[0054] Next, the member is predicted to be high-risk or low-risk according to whether his or her resulting probability value P_{high_use} exceeds a threshold value that is determined a priori. The threshold value was selected to strike the optimal balance between the sensitivity and specificity of the measure. The probability values for the entire weighted respondent population ranged from 0.06 to 0.99 with a mean of 0.53, median of 0.52 and a standard deviation of 0.18. Various threshold values were evaluated for their efficacy using these parameters resulting in a selection of 0.47 as the final probability threshold value. This resulted in 59.9% of the entire weighted respondent population classified as high-risk, which when extrapolated to the entire population equaled approximately 6.9% of the total member population. This confirms, as stated previously, that the study sample had a disproportionate number of past and subsequent high care utilizers.

[0055] To test the predictive validity of the predictive model and the HMS **100**, the formula was tested on both halves of the population with the Chi Square test using predicted (0,1) vs. observed (0,1) care use groups. In the first split-half (see Table 3 of Appendix B), the formula resulted in 72.5% (sensitivity) of the high-risk group predicted correctly and 52.7% (specificity) of the low-risk group. Positive predictive value was 63.5% and negative predictive value was 62.9%. In the second split-half, the formula resulted in 64.2% (sensitivity) of the high-risk group predicted correctly and 46.7% (specificity) of the low-risk group. Positive predictive value was 57.3% and negative predictive value was 53.9%.

[0056] For the total weighted population, the predicted high-risk members have significantly higher encounters and dollars than the low-risk group as detailed in Table 4.

High-risk group average encounters exceeded the low-risk group by nearly 3 encounters as well as an average of $301 more in average care use dollars. Reduction in these dollars by even a net 25% through proactive intervention would have netted this health plan conservatively a half million dollars annually.

[**0057**] Moreover, the selection of 0.47 for the probability threshold value resulted in approximately 7% of the study population potentially needing prospective health advocacy. Accordingly, the health perception questionnaire and the HMS **100** are effective in identifying individuals at high risk for future high near-term care use without placing an exorbitant burden upon proactive case managers.

[**0058**] To test the health perception model of the exemplary HMS **100** against more traditional stratification methods, a logistic model was developed which used merely traditional predictor variables. The predictor variables used were previous hospitalization in the last six months, age, and presence of a chronic disease. At a probability threshold value of 0.56, sensitivity was 60.1% and specificity was 51.1%. Results showed that compared to the traditional method of identifying high-risk members, the health perception model of the exemplary HMS **100** added 12.4% to the sensitivity and 1.6% to the specificity in the first split-half, thus contributing considerable predictive power. In addition, because the exemplary HMS **100** uses self-reported information versus claims data, the time lag from assessment to intervention is shortened from several months to less than 24 hours from the initiation of data collection. Care providers also are not subsequently required to complete an additional health assessment, because the exemplary HMS **100** provides prescriptive as well as predictive information to guide health-counseling efforts.

[**0059**] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description is to be considered as exemplary and not restrictive in character, it being understood that only exemplary embodiments have been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

Appendix A

HEALTH PERCEPTION QUESTIONNAIRE

Part One: Tell us how you're feeling and doing

Please complete each section.
We want to ask you:

How you are feeling and doing–compared with how you *expect to be* feeling and doing. Health is experienced as some level of illness or wellness. For example, a person can feel "well", that is be feeling good and doing what they are usually able to do, even though he or she may have a disease like diabetes or heart disease. At other time, a person who does not have a disease can feel "ill".

Tell us how you're doing

1) Think about your normal ability to do things. **How have you been able to do things IN THE PAST MONTH?** (Your "normal" ability is what you are usually able to do.)

Response box: 1,2,3,4, and 5
1 = A lot less than my normal ability
2 = A little less than my normal ability
3 = At my normal ability
4 = A little above my normal ability
5 = Quite a bit better than my normal ability

X_{38} a) Physical ability (for example, walk, walk up stairs, vacuum, care for self, lift objects, mow lawn)
b) Mental ability (for example, think, learn new things, solve problems, make decisions)
c) Social ability (for example, get along with others, enjoy social activities, talk with others, meet your role responsibilities)
d) Spiritual ability (for example, have a sense of meaning or purpose in life, have a sense of inner peace)
X_7 e) Personal needs ability (for example, spend time with family, sleep/rest, and leisure/free time activities)

2) To what extent has "feeling stressed" affected your ability to function overall in the areas listed above?

0 = Have not felt stressed
X_8 1 = Have felt stressed, but has not limited my ability
2 = Have felt stressed, and has slightly limited my ability
3 = Have felt stressed, and has moderately limited my ability
4 = Have felt stressed, and has greatly limited my ability

Tell us how you're feeling

Your physical symptoms

1) This question is about whether you are feeling any of the physical symptoms listed below. First, review the list below and if you have *not felt* any of the symptoms DURING THE PAST MONTH, mark the response below and move on to Question 1 on the next page.

○ I have *not felt* any of the symptoms listed below DURING THE PAST MONTH.

Next, for every symptom you have felt DURING THE PAST MONTH, please mark: 1) How often you have had each symptom, and 2) How much discomfort you have had from each symptom.

It is only necessary to mark those symptoms you are feeling - LEAVE ALL OTHER SYMPTOMS BLANK.

		A	multiplied by	B
	Symptom	How often have you felt this discomfort? 1 = Rarely felt 2 = Sometimes felt 3 = Frequently felt 4 = Constantly felt		How much discomfort have you had? 1 = Slight discomfort 2 = Mild discomfort 3 = Moderate discomfort 4 = Extreme discomfort
	a) Change in urination habits			
	b) Chest pain/chest discomfort			
	c) Dizziness/light headedness			
X_{17}	d) Drowsiness			
	e) Frequent back pain			
	f) Frequent coughing/wheezing			
	g) Headache			
X_{15}	h) Indigestion			
	i) Nausea/vomiting			
	j) Obvious change in a mole			
	k) Pain other than chest or back paid (including cramping, aching)			
	l) Passing blood in stool			
	m) Persistent constipation			
X_{16}	n) Persistent diarrhea			
	o) Shortness of breath/difficulty breathing			
	p) Skin sore that doesn't heal			
	q) Thickening or lump in breast			
X_{14}	r) Tired/fatigued/weakness			
	s) Trouble with vision (even while wearing glasses or contacts)			
	t) Unexplained weight loss of more than 10 lbs.			
	u) Unusual bleeding or discharge			

Your medical conditions and how you care for yourself

1) This question is about whether you currently have any of the medical conditions listed below. First, review the list below and if you do not have any of the medical conditions listed, mark the response below and move on to Question 2 on this page. (unmarked=0, marked=1)

X_{19} ❍ I *do not have* any of the medical conditions listed below.

It is only necessary to mark those medical conditions you currently have – please mark ALL that apply - LEAVE ALL OTHERS BLANK.

❍ a) Allergies
X_{21} ❍ b) Arthritis
❍ c) Asthma
❍ d) Cancer
❍ e) Cataracts
❍ f) Chronic back problems
X_{23} ❍ g) Chronic lung disease
❍ h) Coronary heart disease, congestive heart failure, angina, heart attack, or heart surgery
❍ i) Deafness
❍ j) Depression
X_{20} ❍ k) Diabetes or high blood sugar
❍ l) High blood cholesterol of 240 or higher
X_{22} ❍ m) High blood pressure of 140/90 or higher
❍ n) Kidney disease
❍ o) Osteoporosis
❍ p) Psychiatric illness other than depression
❍ q) Seizures or epilepsy
❍ r) Stroke
❍ s) Ulcer or bowel/stomach bleeding
X_{24} ❍ t) Other _____ (please print clearly)

2) Overall, how adequately do you feel you are managing your medical condition(s)? (Managing your medical condition(s) adequately means that you understand your condition and participate in your care.) Choose only one.
0 = I do not currently have a medical condition(s), so this question does not apply to me.
1 = More than adequately
2 = Adequately
3 = Somewhat adequately
4 = Not at all adequately

X_{25} 3) When given long-term medication, which statement is most like you? Choose only one.
0 = I have never been given long-term medication, so this question does not apply to me.
1 = I give myself reminders so I remember to take the medicine
2 = I usually remember on my own
3 = I don't pay much attention unless I get worse
4 = I often forget to take my medicine
5 = I sometimes stop taking my medicine on my own
6 = I usually don't take the medicine at all.

4) How adequately do you feel you are currently managing your long-term medication(s)? (Managing your medication(s) adequately means that you understand how to take your medicine and you report how you're doing to your doctor.) Choose only one.

0 = I am not currently on any long-term medication(s), so this question does not apply to me
1 = More than adequately
2 = Adequately
3 = Somewhat adequately
4 = Not at all adequately

Your emotions

1) DURING THE PAST MONTH, how much have you felt each of the following?

0 = Not felt
1 = slightly
2 = Somewhat
3 = Quite a bit
4 = Greatly

X_{12} a) Afraid
b) Angry
c) Calm
X_{11} d) Depressed
e) Frustrated
X_{13} f) Guilty
X_{10} g) Happy
X_9 h) Sad

Part Two: Tell us about your health care visits and preferences

Please complete each section.

Your health care visits

X_2 1) How many visits to a family doctor or specialist have you made IN THE PAST 6 MONTHS? (0-99)

X_3 1a) Think about those visits–how many did you initiate because of concerns you had or because you didn't feel well? (0-99)

2) How many visits have you made to the emergency room IN THE PAST 6 MONTHS? (0-99)

X_1 3) How many days have you been in the hospital due to sickness or injury IN THE PAST 6 MONTHS? (0-999)

X_6 4) How many days have you missed work or stayed home because you didn't feel well IN THE PAST 6 MONTHS? (0-999)

Your health care beliefs and preferences

X_{26} 1) Which statement best describes your faith in doctors in general when you are dealing with a medical problem that you aren't sure about? Choose only one.

1 = I don't believe what doctors tell me at all.
2 = I believe what doctors tell me is often wrong.
3 = I'm not sure if doctors are more often right or wrong.
4 = I believe what doctors tell me is usually right.
5 = I believe all of what doctors tell me.

X_{27} 2) Which statement best describes your opinion of the effectiveness and safety of medicine in general? Choose only one.

1 = Most medical treatments have not been proven and might be harmful.
2 = Many medical treatments may have harmful effects we don't know about.
3 = Some medical treatments haven't been proven, but most are safe.
4 = Most medical treatments have been proven to be effective and safe.

3) When facing an important medical issue, how often do you seek information from the following sources?

0 = Never
1 = Occasionally
2 = Sometimes
3 = Always

a) Alternative Provider (for example, chiropractor, nutritionist, acupuncturist, etc.)
b) Computer or Internet-based services
c) Co-workers
d) Doctor
e) Family
f) Friends
g) Nurse
X_{28} h) Printed materials
X_{29} i) Telephone information services
X_{30} j)Videos

4) Please rate your feelings about the following statements:

1 = Strongly agree
2 = Agree
3 = Disagree
4 = Strongly disagree

X_{31} a) As you become sicker, you should be told more about your illness.
X_{32} b) Even if the news is bad, you should be well informed
X_{33} c) When you are caring for a family member, it is important to understand everything about their illness and treatment.

X_{35} 5) When you talk to your doctor about a health problem, how much information do you usually receive? Choose only one.

1 = Less than I would like
2 = The right amount
3 = More than I would like

X_{36} 6) For a minor illness, who should be making decisions about your care? Choose only one.

1 = The doctor alone
2 = Mostly your doctor
3 = You and your doctor equally
4 = Mostly you
5 = You alone

X_{37} 7) When making a significant decision about health, which statement best describes you. Choose only one.

1 = I have not yet had to make an important medical care decision.
2 = I take as much time as I need to get as many opinions as I can and consider all my options carefully before I move ahead.
3 = I get a few opinions from key people, choose an action and then move ahead.
4 = I take action as quickly as possible based upon all the information I have at the time

X_{34} 8) How much information would you like to receive about a serious medical problem? Choose only one.

1 = None
2 = Very little
3 = A fair amount
4 = Quite a lot
5 = All there is to know

Part Three: Tell us about your health practices and interests.

1) For each statement below, please tell us whether you *already* do or *intend* to do the following health practices. For each statement, please also tell us if you are interested in more information on that topic.

1 = Yes, I have for 5 or more years.
2 = Yes, I have for more than 6 months, but less than 5 years
3 = Yes, I have, but for less than 6 months
4 = No, but I intend to improve in the next 30 days
5 = No, but I intend to improve in the next 6 months
6 = No, and I do not intend to improve in the next 6 months
Check box: I am interested in more information on this topic

With respect to your overall lifestyle, do you...

a) Wear seat belts whenever you are in a motor vehicle?
X_{18} b) Have your blood pressure checked regularly?
c) Have your blood cholesterol checked regularly?
d) Get regular health exams appropriate for your gender and age? (Examples are: mammograms, pap smears, prostate, rectal exams)
e) Use self-care information to avoid unnecessary doctor visits?
f) Watch your body for the seven warning signs of cancer?
g) Avoid eating high-fat foods?
h) Avoid being overweight for your height and frame size?
i) Exercise moderately at least three times a week for 30 minutes?
j) Avoid smoking or tobacco use? (If you have never smoked, mark 1)
k) Get 7 to 8 hours of sleep most days?
l) Use measures to protect your back when lifting heavy objects?
m) Have a working smoke detector near your sleeping area?
n) Have not more than 15 drinks per week if a man or 12 drinks per week if a woman? (If you have never consumed alcohol, mark 1.)
o) Avoid driving after having to much to drink, or riding with such a person?
p) Avoid using drugs to relieve stress or to alter sleep or for recreational use? (If you have never used drugs for these reasons, mark 1.)

-22-

q) Have people in your life you can call upon to share problems with or to get help if needed?
r) Cope well with stress on a regular basis?
s) Deal well with emotions such as anxiety, fear, guilt, frustration or anger?
t) Generally find meaning in your life?

Part Four: Tell us about yourself

It is very important that you accurately complete this section.

1) Name (Last Name, First Name, MI.)

2) Personal ID/SS No.

3) Group ID number (if applicable)

4) Today's Date

5) Age (years)

6) Gender
0=male
X_4 1=female

X_5 7) Race (Optional)
1 = White
2 = Black, African American, Negro
3 = Asian
4 = Hispanic
5 = American Indian or native American
6 = Pacific Islander
7 = Other, please print _____

8) Education in Years (Optional)
For example, high school = 12 years; trade school = 13 years; bachelor's degree = 16 years

9) Income (Optional)
1 = Under $20,000
2 = $20,000-$39,999
3 = $40,000-$59,999
4 = $60,000-$79,999
5 = $80,000 or more

Appendix B

Table 1. Sample Descriptives: Unweighted and Weighted for Gender

Characteristics:	Unweighted		Weighted	
	N	Percent	N	Percent
Total Population:	20,000	100.0%		
Total Respondents:	4,210	21.1%	6,312	
Gender				
• Male	1,043	24.8%	3,129	49.6%
• Female	3,159	75.0%	3,159	50.0%
• Missing	8	.2%	24	.4%
Age				
• Mean age	45.3		46.4	
• Median age	46.1		47.3	
• Std. Deviation	10.4		10.3	
• Age range	18.8 – 65.2		18.8-65.2	
• Missing	8		24	
Ethnicity				
• White	3,499	83.1%	5,239	83.0%
• Black, African American, or Negro	273	6.5%	401	6.4%
• Asian				
• Hispanic	22	.5%	38	.6%
• American Indian or Native American	146	3.5%	228	3.6%
• Other	18	.4%	36	.6%
• Missing				
	38	.9%	56	.9%
	214	5.1%	314	5.0%
Education				
• Mean years of education	14.4		14.4	
• Median years of education	14.0		14.0	
• Std. Deviation	2.7		2.8	
• Education range	0-30		0-30	
Percentiles				
25th	12.0		12.0	
50th	14.0		14.0	
75th	16.0		16.0	
• Missing	257		383	
Subsequent 6 month Total Encounters				
• Mean	8.5		8.4	
• Median	6.0		6.0	
• Std. Deviation	8.7		8.9	
• Range	1-128		1-128	
Percentiles				
25th	3.0		3.0	
50th	6.0		6.0	
75th	11.0		10.0	
Subsequent 6 month Total Claims Dollars				
• Mean	$832		$858	
• Median	$237		$230	
• Std. Deviation	$2,329		$2,495	
• Range	$0-$56,821		$0-$56,821	
Percentiles				
25th	$102		$98	
50th	$237		$230	
75th	$630		$631	

Table 2. Logistic Model of Predictors of the Probability Of Becoming a High Encounter User within Six Months

Predictors:	Original Range	Predictor Variable Assignment			Regression Coefficient	Coefficient Value
		Variable	Assign 1	Assign 0		
Past care use predictors:						
• Hospitalized in the past 6 months	0-999	X_1	2-999	0-1	β_1	.4665
• Visits to physician in the past 6 months	0-99	X_2	6-99	0-5	β_2	.8483
• Visits to physician initiated by member because of concerns	0-99	X_3	5-99	0-4	β_3	-.2624
Demographic predictors:						
• Age	0-199	X_4	0-199			
60.0001 or more years					β_4	0
50.0001-60 years					β_4	-.2986
40.0001-50 years					β_4	-.4798
30.0001-40 years					β_4	-.7207
30 or less years					β_4	-.6724
• Gender	0-1	X_5	1	0	β_5	.4115
• Absence from work in past 6 months	0-999	X_6	2-999	0-1	β_6	.2326
Perceived Health predictors:						
• Level of personal functioning	1-5	X_7	1	2-5	β_7	-.3915
• Feeling stressed	0-4	X_8	0-2	3-4	β_8	.4262
• Feeling Sad	0-4	X_9	2-4	0-1	β_9	-.2154
• Feeling Happy	0-4	X_{10}	0-1	2-4	β_{10}	.2038
• Feeling Depressed	0-4	X_{11}	2-4	0-1	β_{11}	-.3643
• Feeling Afraid	0-4	X_{12}	2-4	0-1	β_{12}	.2681
• Feeling Guilty	0-4	X_{13}	2-4	0-1	β_{13}	-.3581
• Tiredness	0-16	X_{14}	0-8	9-16	β_{14}	.6502
• Indigestion	0-16	X_{15}	0-8	9-16	β_{15}	.4265
• Diarrhea	0-16	X_{16}	0-8	9-16	β_{16}	.5226
• Drowsiness	0-16	X_{17}	0-8	9-16	β_{17}	-.7959
Disease/compliance predictors:						
• Regular blood pressure checks	1-6	X_{18}	4-6	1-3	β_{18}	-.4244
• No disease conditions	0-1	X_{19}	0	1	β_{19}	-.4186
• Diabetes	0-1	X_{20}	1	0	β_{20}	.8025
• Arthritis	0-1	X_{21}	1	0	β_{21}	-.1828
• Hypertension	0-1	X_{22}	1	0	β_{22}	-.2132
• Chronic lung disease	0-1	X_{23}	1	0	β_{23}	.4641
• Other diseases	0-1	X_{24}	1	0	β_{24}	.2071
• Medication compliance	0-6	X_{25}	0-2	3-6	β_{25}	-.5362
Belief/Preference predictors:						
• Faith in the care system	1-5	X_{26}	1-3	4-5	β_{26}	.3306
• Effectiveness and safety of care	1-4	X_{27}	1-2	3-4	β_{27}	.2235
• Seek information from printed material	0-3	X_{28}	0-1	2-3	β_{28}	.1441
• Seek information from phone information services	0-3	X_{29}	0-1	2-3	β_{29}	-.3793
• Seek information from videos	0-3	X_{30}	0-1	2-3	β_{30}	-.6228
• Told more as you become sicker	1-4	X_{31}	3-4	1-2	β_{31}	.3322
• Well informed even if bad news	1-4	X_{32}	3-4	1-2	β_{32}	1.9274
• Should have treatment information when caring for family member	1-4	X_{33}	3-4	1-2	β_{33}	-1.0287
• Preference for amount of information for serious medical problem	1-5	X_{34}	1-3	4-5	β_{34}	1.8249

Table 2. Logistic Model of Predictors of the Probability Of Becoming a High Encounter User within Six Months

Predictors:	Original Range	Predictor Variable Assignment: Variable	Assign 1	Assign 0	Regression Coefficient	Coefficient Value
• Preference for amount of information received from doctor	1-3	X_{35}	1,3	2	β_{35}	-.1790
• Who should make care decisions with minor illness	1-5	X_{36}	1,5	2-4	β_{36}	-.4005
• Time to make significant health decision	1-4	X_{37}	2-4	1	β_{37}	-.2932
Interaction predictors:						
• Age by level of physical functioning	1-5	X_{38}	1	2-5		
60.0001 or more years					β_{38}	0
50.0001-60 years					β_{38}	.7472
40.0001-50 years					β_{38}	.4277
30.0001-40 years					β_{38}	1.3903
30 or less years					β_{38}	.0424
• Hospitalization by visits to physician					β_{39}	-1.5563
Constant					C	1.1724

Table 3. Results of Chi Square for Predicted vs. Observed Care Use Groups for Split-Half-1

		Predicted care use groups		Total
Observed care use groups		**Low (0)**	**High (1)**	
Low (0)	Count	769	689	1458
	% Within observed group	52.7%	47.3%	100.0%
	% Within predicted group	62.9%	36.5%	46.9%
	% Of Total	24.7%	22.2%	46.9%
High (1)	Count	454	1197	1651
	% Within observed group	27.5%	72.5%	100.0%
	% Within predicted group	37.1%	63.5%	53.1%
	% Of Total	14.6%	38.5%	53.1%
Total	Count	1223	1886	3109
	% Within observed group	39.3%	60.7%	100.0%
	% Within predicted group	100.0%	100.0%	100.0%
	% Of Total	39.3%	60.7%	100.0%

Table 4. ANOVA: Differences in Care Use between Predicted High vs. Low Risk Groups

		Sum of Squares	df	Mean Square	F	Sig.
Encounters	**Between groups**	**10047.02**	**1**	**10047.02**	**130.024**	**.000**
	Within groups	**487578.09**	**6310**	**77.271**		
	Total	**497625.11**	**6311**			
Dollars	**Between groups**	**1.38E+08**	**1**	**137655738.62**	**22.179**	**.000**
	Within groups	**3.92E+10**	**6310**	**6206462.045**		
	Total	**3.93E+10**	**6311**			

	High-Risk Group (Weighted) (N=3,778)	Low-Risk Group (Weighted) (N=2,534)
• Encounters over six months (mean)	9.41	6.83
• Dollars over six months (mean)	$979.29	$678.03

What is claimed is:

1. A method of managing healthcare services, comprising the steps of:

collecting information describing an individual's perceived health relative to their subjective expectation of health; and

generating, based upon a predictive model, an output suggestive of future healthcare service use by the individual.

2. The method of claim 1, wherein the output is a risk value indicative of the likelihood of the individual utilizing healthcare services at a predetermined level within a prospective time span.

3. The method of claim 1, further including the step of assigning, based upon the information, a separate value to each of a plurality of predetermined factors in a set of predictive factors.

4. The method of claim 1, wherein the information collected comprises at least one data point for each of a plurality of predetermined predictive factors.

5. The method of claim 4, further including the step of comparing one collected data point to a set value for the respective predictive factor to determine if the collected data point is indicative of either a high risk or a low risk of future healthcare service use, and assigning, based upon the comparing step, a value to the predetermined predictive factor.

6. The method of claim 5, wherein each of the predictive factors is inserted into the predictive model to generate the output.

7. A method of managing healthcare services, comprising the steps of:

collecting information directly from an individual for a predetermined set of predictive factors;

assigning, based upon the information from the individual, a separate value to each predictive factor of the set of predictive factors; and

generating, based upon a predetermined predictive model and the separate values assigned to the predetermined set of predictive factors, a risk level of the individual utilizing healthcare service at a predetermined level.

8. A method of managing healthcare services, comprising the steps of:

providing a survey including a plurality of questions;

receiving response information from an individual for each of said plurality of questions of the survey;

determining, from the information of each question, whether the response is indicative of one of a high or a low future use of healthcare services;

assigning values to a plurality of predictive factors based upon the determining step; and

generating, based upon the assigned values, an output suggestive of future use of healthcare services.

9. The method of claim 8, wherein the survey is presented by a computer.

10. The method of claim 9, further including the step of providing the individual with at least one intervention program in response to the generating step generating an output suggestive of a high risk of future use of healthcare services.

11. The method of claim 10, wherein the intervention program is provided substantially contemporaneously with the receiving of responses from the individual.

12. The method of claim 8, wherein the plurality of questions includes a question regarding the individual's perceived health.

13. The method of claim 8, wherein the output is a risk value indicative of the likelihood of the individual utilizing healthcare services at a predetermined level.

14. A method of managing healthcare service including the steps of:

collecting information about an individual including a plurality of data points corresponding to a plurality of factors in a set of predictive factors;

determining, for each data point, what the data point indicates about use of healthcare services by the individual; and

generating, based on a predictive model, an output suggestive of future use of healthcare services by the individual.

15. The method of claim 14, further including the step of assigning a value to each factor in the set of predictive factors, each assignment being based upon the determining step for each of the corresponding data points, wherein the generating step is performed by inserting into the predictive model the assigned values for the set of predictive factors.

16. The method of claim 14, wherein the determining step categorizes the data points as either indicative of a high use of healthcare services or a low use of healthcare services.

17. The method of claim 14, wherein the determining step includes the step of assigning to each predictive factor one of two dichotomous values.

18. The method of claim 14, wherein the output is a risk value indicative of the likelihood of the individual utilizing healthcare services at a predetermined level.

19. A method of managing healthcare service including the steps of:

analyzing healthcare information utilizing a predictive model represented by the equations $z=\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4 \ldots \beta_{n-1}X_{n-1}+\beta_nX_1X_2+C$, and $P_{high_use}=e^z/(1+e^z)$, wherein β_1, β_2, β_3, β_4, . . . β_n represent regression coefficients, X_1, X_2, X_3, X_4, . . . X_{n-1} represent predictor variables, the predictor variables are dichotomous variables, and the values of the dichotomous predictor variables are determined based upon the healthcare information.

20. The method of claim 19, wherein individuals with a P_{high_use} value greater than a threshold value are identified as individuals with a high-risk of high near-term healthcare use.

21. The method of claim 19, wherein the analyzing step causes the generation of reports.

22. The method of claim 21, wherein the reports are one or more reports selected from the group including: a general health report, advice as to how the individual may improve

their overall health, information about appropriate intervention programs, and follow-up coaching reports from care providers.

23. The method of claim 21, wherein the reports are one or more reports selected from the group including: a summary of the wellness of a managed care group, a list of individuals identified as high risk, and a report identifying intervention programs which address wellness needs of a managed care group.

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