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(54) CHRONIC PAIN PATIENT DIAGNOSTIC SYSTEM

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Publication Classification

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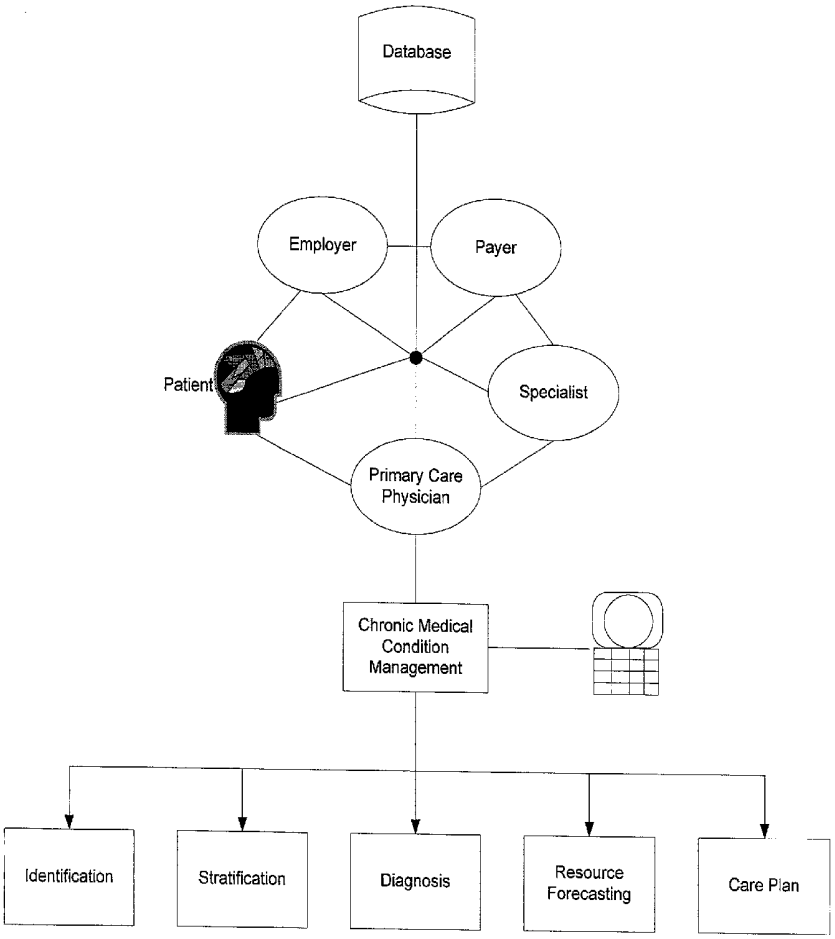
(52) **U.S. Cl.** **600/300**; 128/923

(57) **ABSTRACT**

Potential chronic pain patients are identified in a population such as an employer or medical care payer database using a method or computer software product to improve accuracy in identifying potential chronic pain patients, decrease the time required to identify potential chronic pain patient increasing opportunities for early intervention, identify selected potential chronic pain patients based upon preference of stakeholders, and many other benefits. Desired patient indicia including direct medical indicia, indirect medical indicia, and non-medical indicia are selected to serve as independent variables. At least one chronic pain indication is selected to serve as a dependent variable. A chronic pain model is created using the patient indicia and the chronic pain indication. The chronic pain model is applied to the population and potential chronic pain patients are identified by selecting individuals from the population that conform to the chronic pain model. Many different embodiments of the chronic pain patient identification system method and software product are possible.



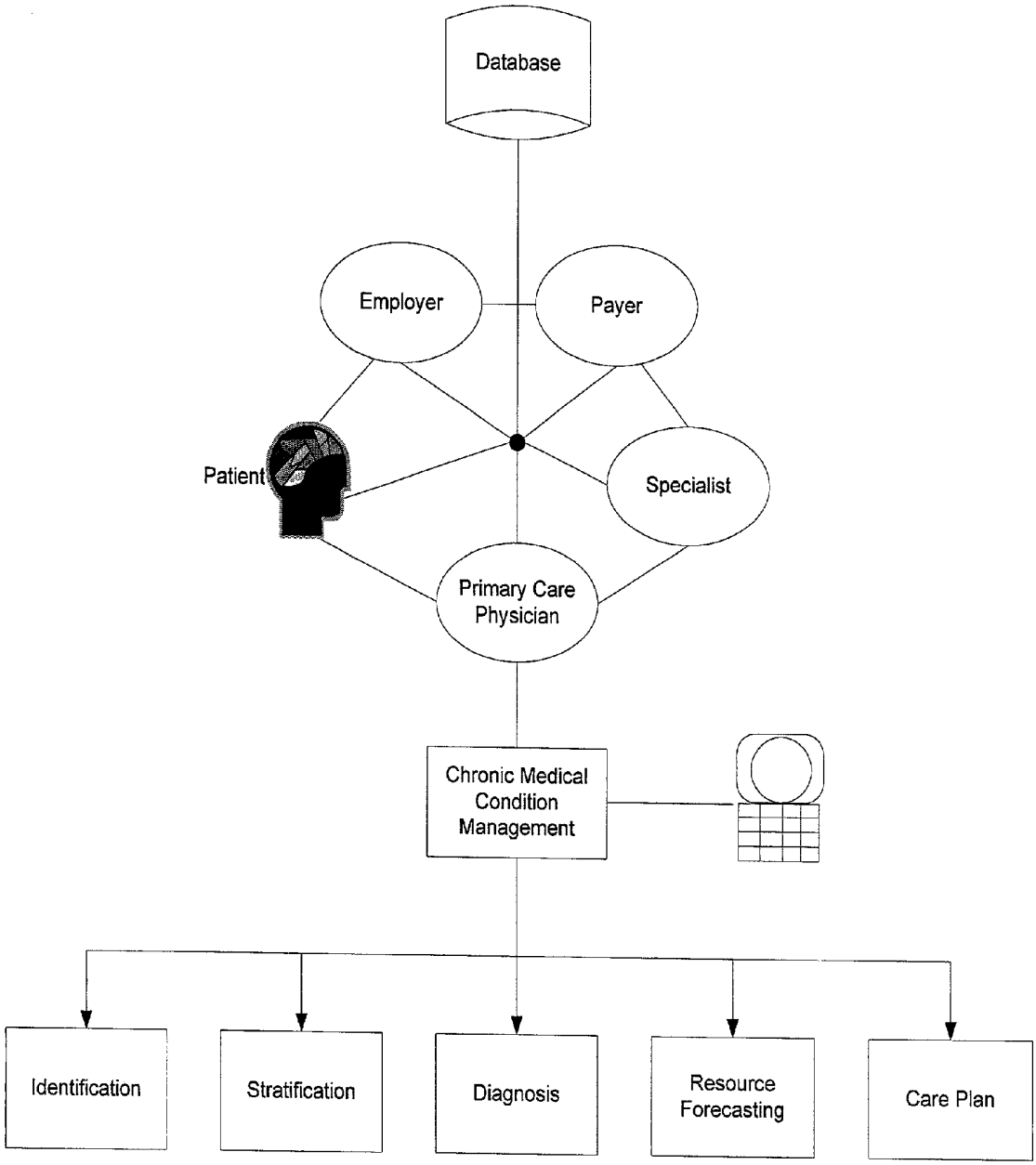

Database
Employer
Payer
Patient
Specialist
Primary Care Physician
Chronic Medical Condition Management
Identification
Stratification
Diagnosis
Resource Forecasting
Care Plan

FIG. 1

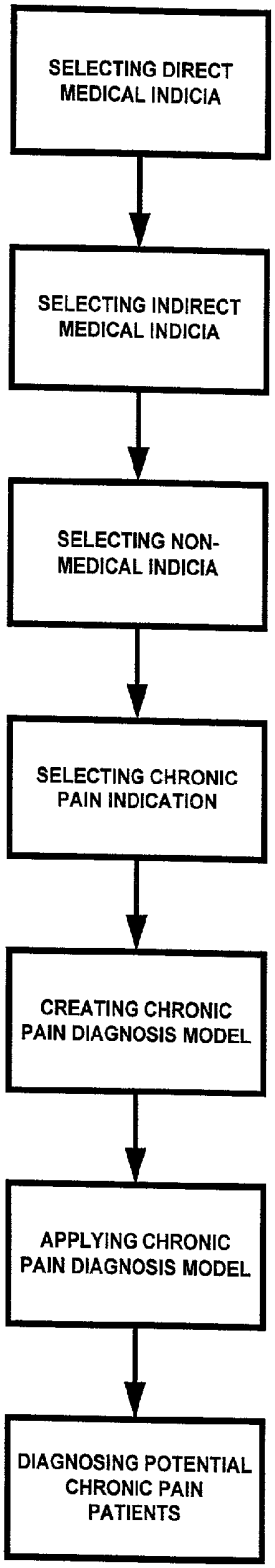

SELECTING DIRECT MEDICAL INDICIA
SELECTING INDIRECT MEDICAL INDICIA
SELECTING NON-MEDICAL INDICIA
SELECTING CHRONIC PAIN INDICATION
CREATING CHRONIC PAIN DIAGNOSIS MODEL
APPLYING CHRONIC PAIN DIAGNOSIS MODEL
DIAGNOSING POTENTIAL CHRONIC PAIN PATIENTS

FIG. 2

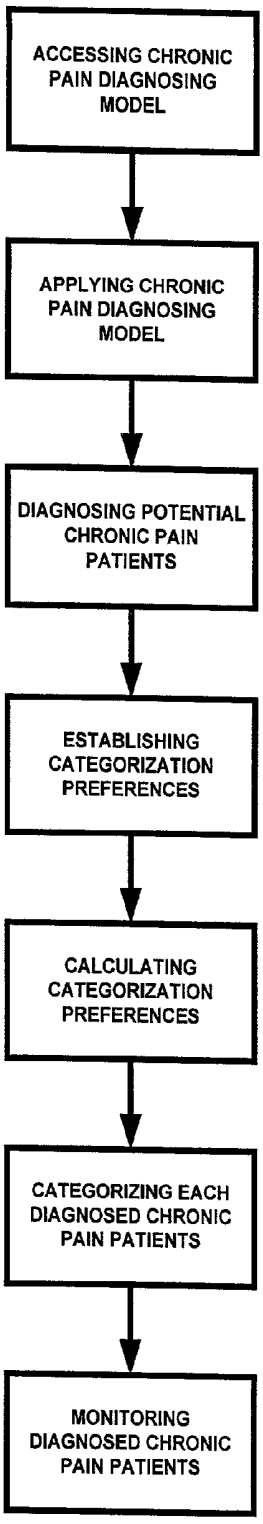

ACCESSING CHRONIC PAIN DIAGNOSING MODEL
APPLYING CHRONIC PAIN DIAGNOSING MODEL
DIAGNOSING POTENTIAL CHRONIC PAIN PATIENTS
ESTABLISHING CATEGORIZATION PREFERENCES
CALCULATING CATEGORIZATION PREFERENCES
CATEGORIZING EACH DIAGNOSED CHRONIC PAIN PATIENTS
MONITORING DIAGNOSED CHRONIC PAIN PATIENTS

FIG. 3

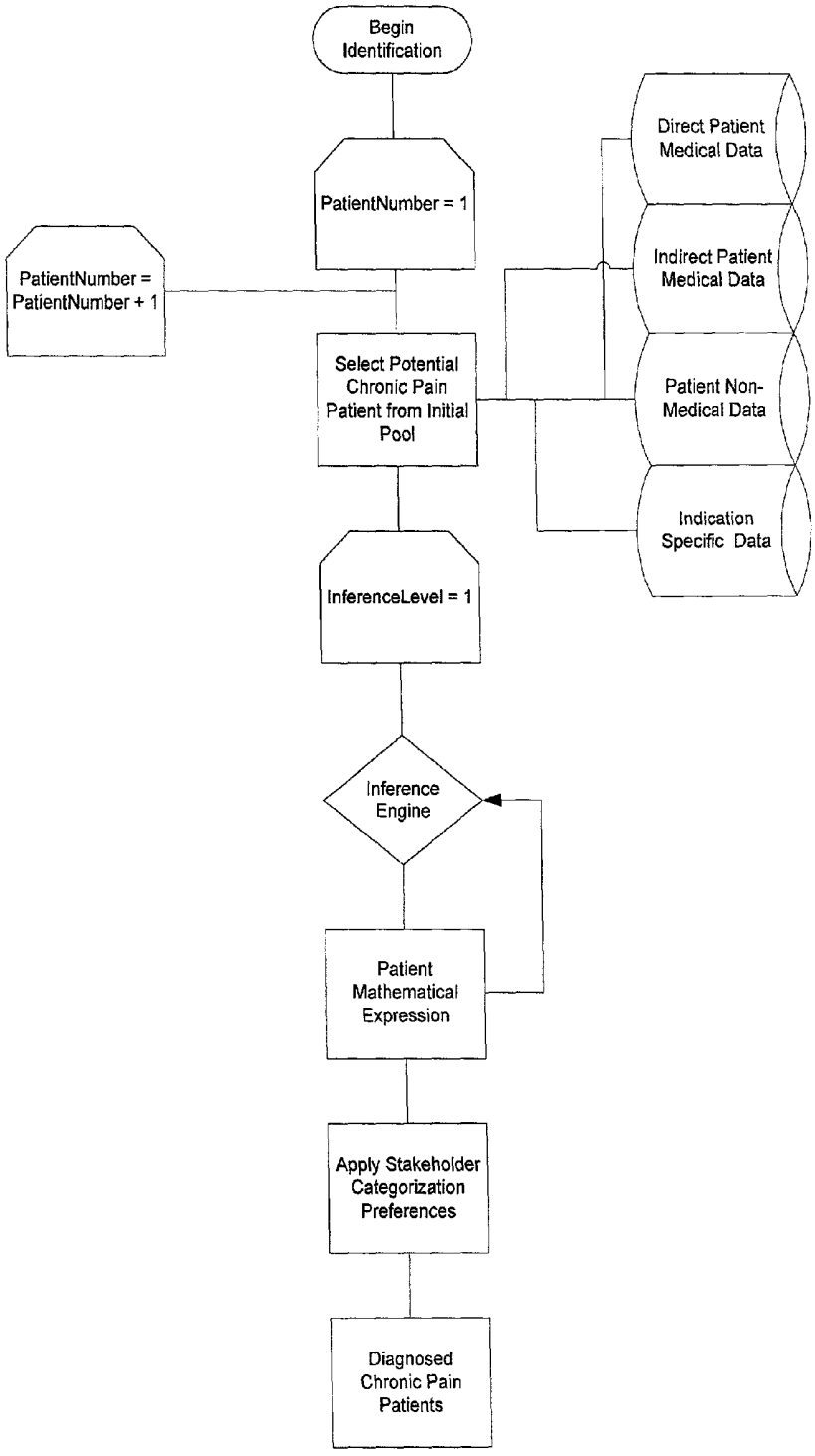

Begin Identification
PatientNumber = 1
PatientNumber = PatientNumber + 1
Select Potential Chronic Pain Patient from Initial Pool
InferenceLevel = 1
Inference Engine
Patient Mathematical Expression
Apply Stakeholder Categorization Preferences
Diagnosed Chronic Pain Patients
Direct Patient Medical Data
Indirect Patient Medical Data
Patient Non-Medical Data
Indication Specific Data

FIG. 4

Direct Medical Indicia	Remarks
1. ICD-9-CM "Specific" Lumbar Spine Diagnoses Code.	The Direct Medical Indicia example used in this document relates to the lumbar spine pain indication. For this example there is a specific ICD-9-CM diagnostic code relating to the underlying injury. The presence of this (and similar codes for other pain indications) is a significant indicator for the presence of pain.
2. ICD-9-CM "Non-specific" Generalized Pain Syndrome Diagnoses Codes.	It is common for pain to be characterized in a "non-specific" manner by providers who are not pain treatment specialists. However, this code indicates the presence of pain, and is an important indicator.
3. ICD-9-CM Diagnosis Code Identifying a Co-morbidity Commonly Associated with Lumbar Spine Injury.	Chronic pain patients typically have an assortment of health problems. Patterns or clusters of these other health issues can be identified in the data, and more will be learned from the inductive learning capabilities of the chronic condition management system.
4. ICD-9-CM "Other" Medical Condition Diagnostic Code Clearly Attributing the Condition to a Diagnosis Commonly Associated with Chronic Pain.	There are numerous known medical conditions for which pain is an associated symptom. Often, these conditions are reflected in the medical data, while the pain condition is not specifically coded. Identifying the presence of these codes is a significant indicator for the presence of a pain condition.
5. ICD-9-CM Procedure Codes Indicating the Condition is Related to a Known Acute Pain Condition (e.g. post-operative surgical pain).	There is a commonly accepted list of known ICD-9-CM procedure codes associated with the treatment of acute pain. The presence of one or more of these codes is a significant indicator for the presence of acute pain.
6. CPT Codes Indicating the Condition is Related to a Known Acute Pain Condition (e.g. post-operative surgical pain).	There is a commonly accepted list of known physician services (CPT) codes associated with the treatment of acute pain. The presence of one or more of these codes is a significant indicator for the presence of acute pain.
7. ICD-9-CM Procedure Codes Relating to Lumbar Spine Care.	There is a commonly accepted list of known ICD-9-CM procedure codes associated with lumbar spine care. It is commonly accepted that pain is often concomitantly associated with lumbar spine care. The presence of one or more of these codes is an indicator for the potential presence of lumbar spine pain.
8. ICD-9-CM Procedure Codes Relating to Lumbar Spine Pain.	There is a commonly accepted list of known ICD-9-CM procedure codes associated with the treatment of lumbar spine pain. The presence of one or more of these codes is a significant indicator for the presence of lumbar spine pain.
9. ICD-9-CM Procedure Codes Relating to Lumbar Spine Pain Establishing a Pattern of Chronicity (time and homogeneity).	It is assumed that a pattern of specific treatment occurring continuously over the course of $\geq$91 days tends to indicate a pattern of chronicity.

FIG. 5a

Direct Medical Indicia	Remarks
10. CPT Codes Identifying Lumbar Spine Care-related Procedures.	There is a commonly accepted list of known physician service (CPT) codes associated with lumbar spine care. It is commonly accepted that pain is often concomitantly associated with lumbar spine care. The presence of one or more of these codes is an indicator for the potential presence of lumbar spine pain.
11. CPT Codes Identifying Lumbar Spine Pain-related Procedures.	There is a commonly accepted list of known physician service (CPT) codes associated with the treatment of lumbar spine pain. The presence of one or more of these codes is a significant indicator for the presence of lumbar spine pain.
12. CPT Codes Identifying Lumbar Spine Pain-related Procedures Establishing a Pattern of Chronicity.	It is assumed that a pattern of specific treatment occurring continuously over the course of $\geq$91 days tends to indicate a pattern of chronicity.
13. Drug Prescription Codes for opioid, non-steriodal or muscle relaxant indicating dosage, frequency, length of time, combinations consistent with spine pain treatment.	There is a commonly accepted list of nationally recognized drug codes associated with the treatment of lumbar spine pain. The presence of one or more of these codes is an indicator for the presence of lumbar spine pain. The predictive power of prescription drug codes significantly increases as such drug codes are found in combination with one another.
14. Drug Prescription Codes for opioid, non-steriodal or muscle relaxant indicating dosage, frequency, length of time, combinations identifying patient as being at risk of developing a chronic lumbar pain condition.	A patient's drug treatment regiment is significantly related to their propensity to later develop a chronic pain condition.
15. Drug Prescription Codes for opioid, non-steriodal or muscle relaxant indicating dosage, frequency, length of time, combinations consistent with chronic spine pain treatment.	It is assumed that a pattern of specific treatment occurring continuously over the course of $\geq$91 days tends to indicate a pattern of chronicity.
16. Emergency Room Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Condition	A patient's frequent use of emergency room services is an indicator of an uncontrolled or "spiking" medical condition. It is common for lumbar spine patients who are experiencing associated severe pain, to make use of emergency room services, particularly those associated with pain control. This is a significant indicator of the presence of uncontrolled pain.

FIG. 5b

Direct Medical Indicia	Remarks
17. Emergency Room Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Pain Condition	A patient's frequent use of emergency room services is an indicator of an uncontrolled or "spiking" medical condition. It is common for lumbar spine patients who are experiencing associated severe pain, to make use of emergency room services, particularly those associated with pain control. This is a significant indicator of the presence of uncontrolled pain.
18. Emergency Room Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Establishing the Chronicity of a Lumbar Spine Pain Condition (time and pattern or homogeneity)	It is assumed that a pattern of specific treatment occurring continuously over the course of $\geq$91 days tends to indicate a pattern of chronicity.
19. Hospitalizations Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Condition	"Days in hospital" is an indicator of a patient's uncontrolled or "spiking" medical condition, and can relate to severity level of that patient's medical condition. Lumbar spine patients who are experiencing associated severe pain, are sometimes hospitalized for that condition. This is a significant indicator of the presence of uncontrolled pain.
20. Hospitalizations Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Pain Condition	"Days in hospital" is an indicator of a patient's uncontrolled or "spiking" medical condition, and can relate to severity level of that patient's medical condition. Lumbar spine patients who are experiencing associated severe pain, are sometimes hospitalized for that condition. This is a significant indicator of the presence of uncontrolled pain.
21. Hospitalizations Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Establishing the Chronicity of Lumbar Spine Pain Condition (time and pattern or homogeneity)	It is assumed that a pattern of specific treatment occurring continuously over the course of $\geq$91 days tends to indicate a pattern of chronicity.
22. Physician Office Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Condition	Frequency of "physician office visits" is an indicator of a patient's uncontrolled or "spiking" medical condition, and can relate to severity level of that patient's medical condition. Lumbar spine patients who are experiencing associated severe pain often seek in-office physician care for that condition. This is a significant indicator of the presence of uncontrolled pain.

FIG. 5c

Direct Medical Indicia	Remarks
23. Physician Office Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Indicating a Lumbar Spine Pain Condition.	Frequency of "physician office visits" is an indicator of a patient's uncontrolled or "spiking" medical condition, and can relate to severity level of that patient's medical condition. Lumbar spine patients who are experiencing associated severe pain often seek in-office physician care for that condition. This is a significant indicator of the presence of uncontrolled pain.
24. Physician Office Visits (with ICD-9-CM, CPT or Drug Codes, or test results) Establishing the Chronicity of a Lumbar Spine Pain Condition (time and pattern or homogeneity of complaint).	Frequency of "physician office visits" is an indicator of a patient's uncontrolled or "spiking" medical condition. Lumbar spine patients who are experiencing associated severe pain often seek in-office physician care for that condition. This is a significant indicator of the presence of uncontrolled pain.
25. Rehabilitation or Palliative Care ICD-9-CM Procedure Codes.	Pain patients often receive rehabilitation or palliative care services as a part of their proscribed treatment regimen.
26. Telephone Consultation (with documentation relating to lumbar spine pain condition)	Frequency of "telephone consultations" with a care provider is an indicator of a patient's uncontrolled or "spiking" medical condition. Lumbar spine patients who are experiencing associated severe pain often contact their care for that condition. This is an indicator of the presence of uncontrolled pain.
27. Coded Trauma (related test result, procedure, etc.).	Trauma is a precipitating factor for certain pain indications.

FIG. 5d

Direct Medical Indicia Drug Product	Maximum Recommended Daily Dose (Adult)	Chronic Pain Indicators
Over The Counter Non-Narcotic Analgesic Agents		
Acetaminophen (Tylenol)	12 tabs	12 tabs ≥91 days
Aspirin 325mg	18 tabs	18 tabs ≥91 days
bIbuprofen 200mg (Motrin)	16 tabs	16 tabs ≥91 days
Salicylate Agents		
Salsalate 500mg (Disalcid)	6 tabs	6 tabs ≥91 days
Diflunisal 500mg (Dolobid)	3 tabs	3 tabs ≥91 days
Opioid and Related Analgesic Agents		
APAP/Propoxyphene Napsylate 100 (Darvocet-N 100)	6 tabs	6 tabs ≥91 days
APAP/Oxycodone 5/325 (Percocet)	12 tabs	12 tabs ≥91 days
ASA/Oxycodone 5/325 (Percodan)	18 tabs	18 tabs ≥91 days
APAP/Oxycodone 5/500 (Tylox)	8 tabs	8 tabs ≥91 days
APAP/Hydrocodone 5/500 (Vicodin)	8 tabs	8 tabs ≥91 days
APAP/Hydrocodone 10/650 (Lorcet)	6 tabs	6 tabs ≥91 days
APAP/Hydrocodone 2.5/500 (Lortab)	8 tabs	8 tabs ≥91 days

FIG. 6a

Direct Medical Indicia Drug Product	Maximum Recommended Daily Dose (Adult)h	Chronic Pain Indicators
APAP/Codeine 30/300 (Tylenol-3)	12 tabs	12 tabs ≥91 days
Non-Steroidal Anti-inflammatory Drugs (NSAIDs)		
Celecoxib (Celebrex)	4 caps	4 caps ≥91 days
Diclofenac 100mg ER (Voltaren XR)	2 tabs	2 tabs ≥91 days
Etodolac Extended Release 400mg (Lodine XL)	3 tabs	3 tabs ≥91 days
Naproxen Controlled Release 500mg (Naprelan)	2 tabs	2 tabs ≥91 days
Nabumeton 500mg (Relafen)	4 tabs	4 tabs ≥91 days
Muscle Relaxants		
Carisoprodol (Soma)	4 tabs	4 tabs ≥91 days
Chlorzoxazone (Paraflex)	12 tabs	12 tabs ≥91 days
Cylobenzaprine (Flexeril)	6 tabs	6 tabs ≥91 days
Diazepam 5mg (Valium)	8 tabs	8 tabs ≥91 days
Metaxalone (Skelaxin)	8 tabs	8 tabs ≥91 days
Methocarbamol 500 (Robaxin)	8 tabs	8 tabs ≥91 days
Orphenadrine Citrate (Norflex)	2 tabs	2 tabs ≥91 days

FIG. 6b

Indirect Medical Indicia	Measure	Remarks
1. Physician Office Visits a. Documented reason for visit b. Physician specialty associated with visit c. Time period establishing chronicity	a. Associated ICD-9-CM or CPT code. b. Medical record notation. c. Associated time period, either multiple visits within an associated period of time; or pattern of visits showing elapsed period of time (e.g. ≥91 days).	Chronic pain patients frequently visit the physician office, for pain related reasons as well as for complaints of non-specific origin.
2. Emergency Room Visits a. Reason for visit b. Time period establishing chronicity	a. Associated ICD-9-CM or CPT code. b. Associated time period, either multiple visits within an associated period of time; or pattern of visits showing elapsed period of time (e.g. ≥91 days months).	Chronic pain patients frequently present to the ER for pain related reasons as well as for complaints non-specific in origin.
3. Drug Therapy a. Drug prescription b. Drug combinations c. Dosing levels d. Prescription patterns e. Time period establishing chronicity f. Pattern of substance abuse	a. Drug code for drugs (e.g. anti-inflammatory, anti-depressant, muscle relaxant, opioid) associated with pain symptom treatment. b. Drug codes, when used in combination, tend to indicate presence of pain. c. Dosing level consistently high. d. Multiple prescribers. e. Associated time period establishing elapsed period of time (≥91 days). f. Evidence of drug over use or use of illegal drugs.	Prescription and non-prescription drug use is a common indicator of chronic pain. Such drugs are often provided to patients from a variety of sources in an uncoordinated manner, or without the development of a patient plan of care.
4. Telephone Consults a. Documented reason for call b. Frequency of calls c. Pattern of calls d. Time period establishing chronicity	a. Notation in medical record, associated code if possible. b. Calls outside the defined range of frequency for a typical patient. c. Clustered calls with a defined time period. e. Associated time period establishing elapsed period of time (≥91 days).	Chronic pain patients often demand more attention from their caregivers than the general population, for symptom – specific as well as for non-symptom specific reasons.

FIG. 7a

Indirect Medical Indicia	Measure	Remarks
5. Primary Diagnosis	ICD-9-CM diagnostic code associated with pain condition or trauma, or with a disease known to have associated pain condition.	Chronic pain can be identified through diagnostic codes two ways: the pain can be a condition associated with a disease state such as diabetes (indirect), or it can be the primary reason for the pain condition such as low back pain (direct).
6. Co-Morbidities	ICD-9-CM diagnostic code associated with conditions known to occur with chronic pain.	Certain co-morbidities are known to be associated with chronic pain.
7. Hospitalizations a. Time period establishing chronicity b. Admitting diagnosis c. Procedures performed	a. Associated time period either multiple visits within an associated period of time, or pattern of visits showing elapsed period of time (e.g. $\geq$91 days). b. Associated ICD-9-CM diagnostic code. c. Pattern of ICD-9-CM and CPT procedure codes.	Certain chronic pain patients are frequently hospitalized, either to treat spikes in pain, or to receive back-related procedures.
8. Evidence of trauma a. Diagnostic test associated with trauma	a. Test results such as x-ray, contained in medical record.	Numerous chronic pain indications are trauma-related in origin (e.g. CRPS).
9. Evidence of palliative or rehabilitation care a. Documented procedure b. Pattern of care c. Time interval establishing chronicity	a. ICD-9-CM procedure codes associated with palliative or rehabilitation care. b. Evidence of care seeking behavior relating to combination of providers. c. Associated time period, either multiple visits within an associated period of time; or pattern of visits showing elapsed period of time (e.g. $\geq$91 days).	Chronic pain patients receive a variety of physical therapy, chiropractic services, acupuncture therapy and other similar types of services to treat their condition.

FIG. 7b

Non-Medical Indicia	Remarks
1. Patient Self-Assessment - Pain Significantly Interferes with Life Activities	Patient self-assessment is one important and relevant perspective to measure the patient's perceptions relative to the impact the pain is having upon the quality of their life. This data is critical in stratifying patients; for example, a high score could trigger "a high need for treatment immediacy" category.
2. Patient Self-Assessment - High Pain Intensity Rating	This data is critical in stratifying patients; for example, a high score could trigger "a high need for treatment immediacy" category.
3. Patient Self-Assessment - Intense and Multiple Pain Descriptors	This data is critical in stratifying patients; for example, a high score could trigger "a high need for treatment immediacy" category.
4. Patient Self-Assessment - High Impact of Pain on Mood	This data point is also a quality of life indicator, measuring patient's perception of how pain alters personality.
5. Patient Self-Assessment - Low Family Support	Family support is a key indicator of treatment success. It also has an impact on the type of treatment that a provider will proscribe (For example, certain treatments are enhanced through the encouragement of family.)
6. Patient Self-Assessment - High Impact of Pain on Ability to Work	This is a data point that will be of particular interest to the payer and employer. It also can be relevant in determining the type and intensity of treatment.
7. Patient Self-Assessment - High Impact of Pain on Health Status	This data point is an important quality of life indicator.
8. Patient Self-Assessment - Downward Health Trend	This data point is an important quality of life indicator.
9. Patient Self Assessment - Depression	Many chronic pain patients suffer from depression (accounting for up to 40% of overall health care costs associated with the treatment of low back.) It is a key chronic pain indicator, and will be a determining factor in course of treatment.
10. Patient Self-Assessment - Low Life Satisfaction Score	This data point is an important quality of life indicator.
11. Patient Self-Assessment, or Family Assessment - Poor Community Support Structure	Community support is a key indicator of treatment success.
12. Patient Self-Assessment - Low Job Satisfaction Score	This data point is an important quality of life indicator.

FIG. 8a

Non-Medical Indicia	Remarks
13. Patient Self-Assessment, or Family Assessment - Lack of Daytime Distractions	This data point is a predictor of treatment success.
14. Patient is a Smoker	Smoking complicates the delivery of health care services, has a direct relationship to health outcomes, and is a significant driver of health care costs.
15. Other Behavior Characteristics • Current • Past*	This is relevant to predict treatment success, to determine course of treatment, and as a stratification indicator.
16. Patient Matches Personality/Psychological Risk Profile	Personality characteristics are strong indicators of treatment success, and also provide guidance in determining choice of treatment.
17. Pending Litigation Relating to Injury	The existence of a pending lawsuit has a measurable relationship to treatment outcome, particularly as it relates to length of treatment.
18. Patient is Overweight by more than 25% of Normal Weight	Weight relates to treatment choice, treatment outcome and to health care complications (which relate to overall health care treatment costs.)
19. Patient's Job is in a High Work Risk Category	Patients in certain high-risk work categories, such as trucking and heavy industry, have a much higher incidence of low back injuries and other chronic pain indications.
20. Patient Involved in Recent or Pending Divorce	A patient's marital status relates to state of being, which is related to how well a patient will respond to treatment. It also relates to stress, which increases a patient's overall risk for an adverse health event.
21. Other Demographic Indicators: * Age * Race/ethnicity * Religion * Economic status * Gender	Certain demographic factors, such as those listed, have a direct relationship to treatment choice, treatment outcome and health care complications (which relate to overall health care treatment costs.)
22. Open Workers' Compensation Claim	The existence an open workers' compensation claim is a significant predictor of treatment outcome, particularly as it relates to length of treatment. It is also a variable an employer is interested in tracking.
23. Patient has Hired an Attorney for Representation on a Work-related Injury	The existence of an attorney has a measurable relationship to treatment success.

FIG. 8b

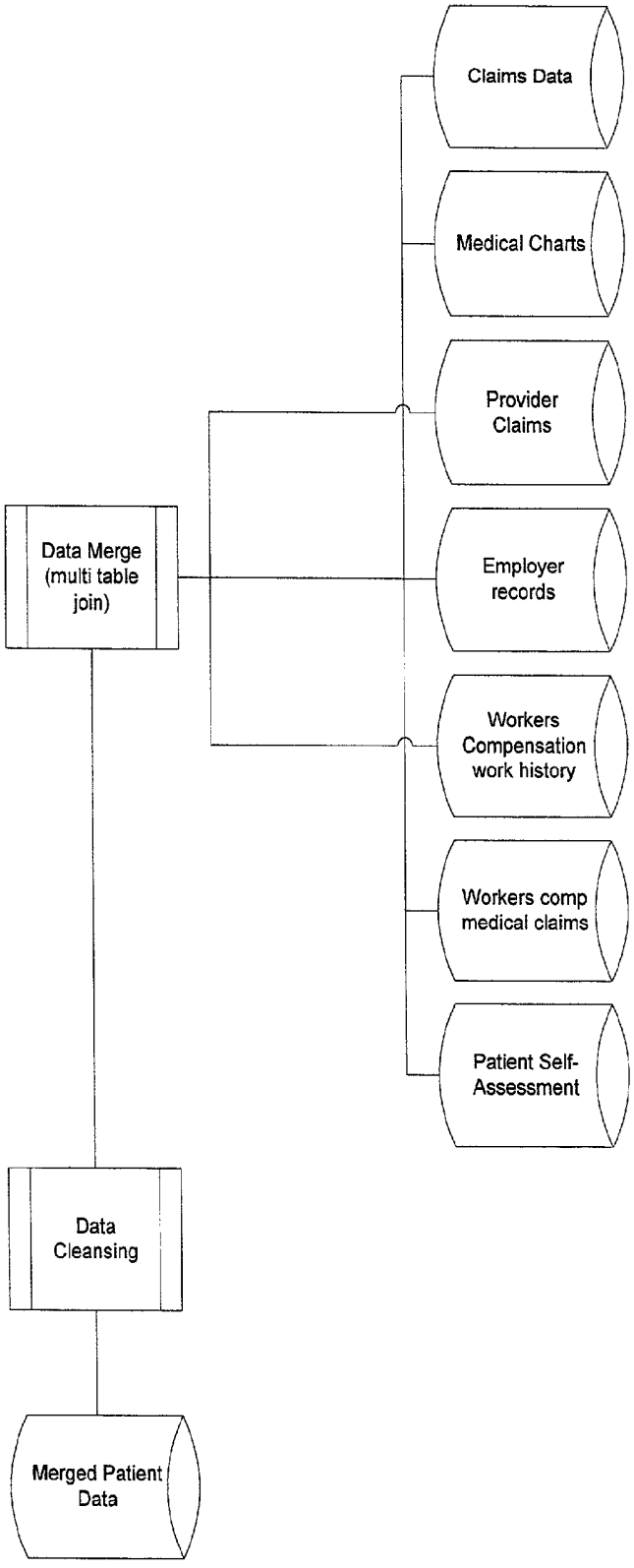

Claims Data
Medical Charts
Provider Claims
Employer records
Workers Compensation work history
Workers comp medical claims
Patient Self-Assessment
Data Merge (multi table join)
Data Cleansing
Merged Patient Data

FIG. 9

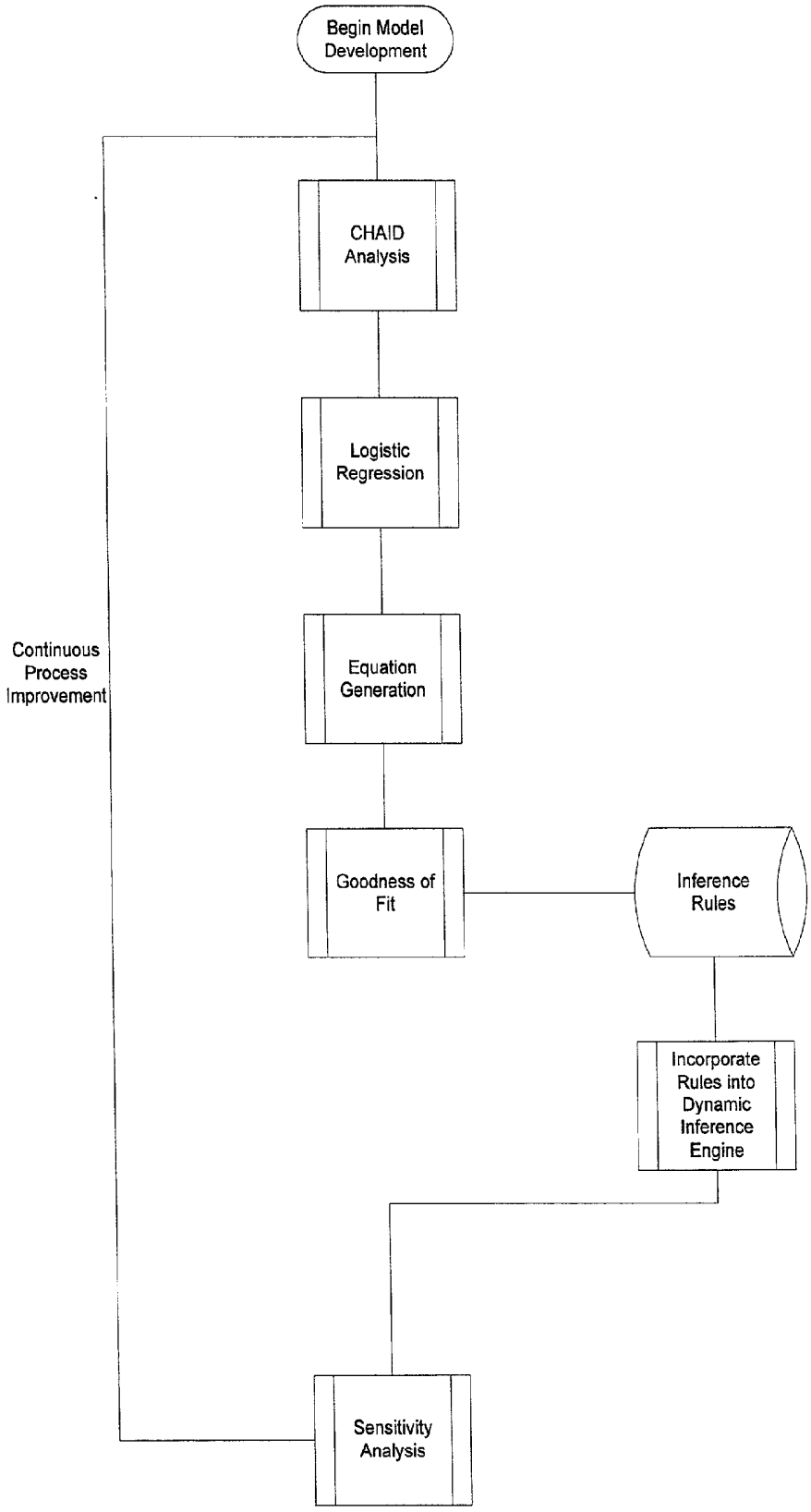

Begin Model Development
CHAID Analysis
Logistic Regression
Equation Generation
Goodness of Fit
Inference Rules
Incorporate Rules into Dynamic Inference Engine
Sensitivity Analysis
Continuous Process Improvement

FIG. 10

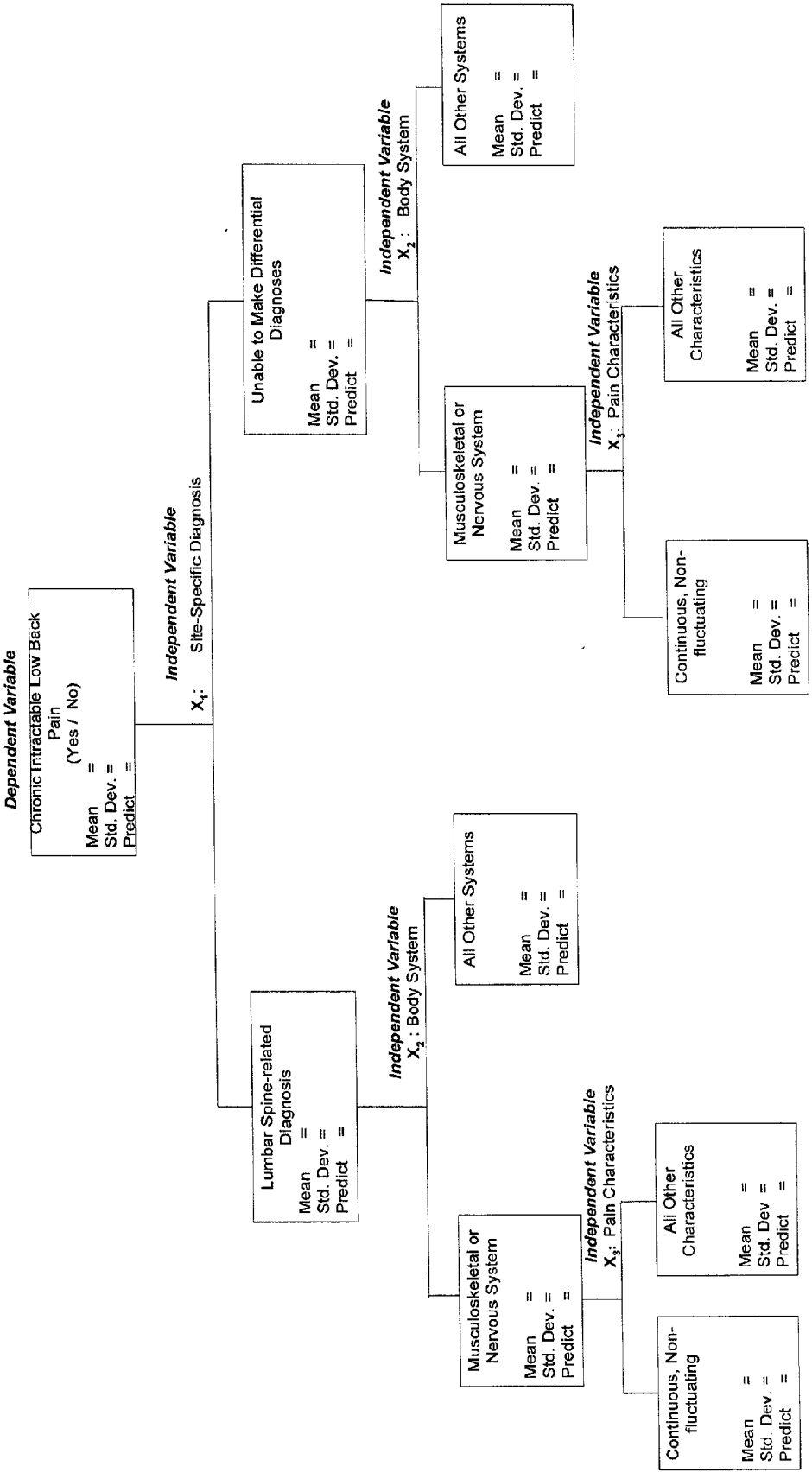

Dependent Variable
Chronic Intractable Low Back Pain (Yes / No)
Mean =
Std. Dev. =
Predict =
Independent Variable
X1: Site-Specific Diagnosis
Unable to Make Differential Diagnoses
Mean =
Std. Dev. =
Predict =
Independent Variable
X2: Body System
All Other Systems
Mean =
Std. Dev. =
Predict =
Musculoskeletal or Nervous System
Mean =
Std. Dev. =
Predict =
Independent Variable
X3: Pain Characteristics
All Other Characteristics
Mean =
Std. Dev. =
Predict =
Continuous, Non-fluctuating
Mean =
Std. Dev. =
Predict =
Lumbar Spine-related Diagnosis
Mean =
Std. Dev. =
Predict =
Independent Variable
X2: Body System
All Other Systems
Mean =
Std. Dev. =
Predict =
Musculoskeletal or Nervous System
Mean =
Std. Dev. =
Predict =
Independent Variable
X3: Pain Characteristics
All Other Characteristics
Mean =
Std. Dev =
Predict =
Continuous, Non-fluctuating
Mean =
Std. Dev. =
Predict =

FIG. 11

Logistics Output Independent Variable	Variable Parameter	Odds Ratio	P-Value
Constant	(+)		
Number of Back Surgeries (X_1)	(+)	3.1	P<0.05
Mental Health (≥ 40 years) (X_2)	(+)	2.1	P<0.05
Job Type (X3)	(+)	1.9	P<0.05
(X_4)			
(X_5)			

FIG. 12

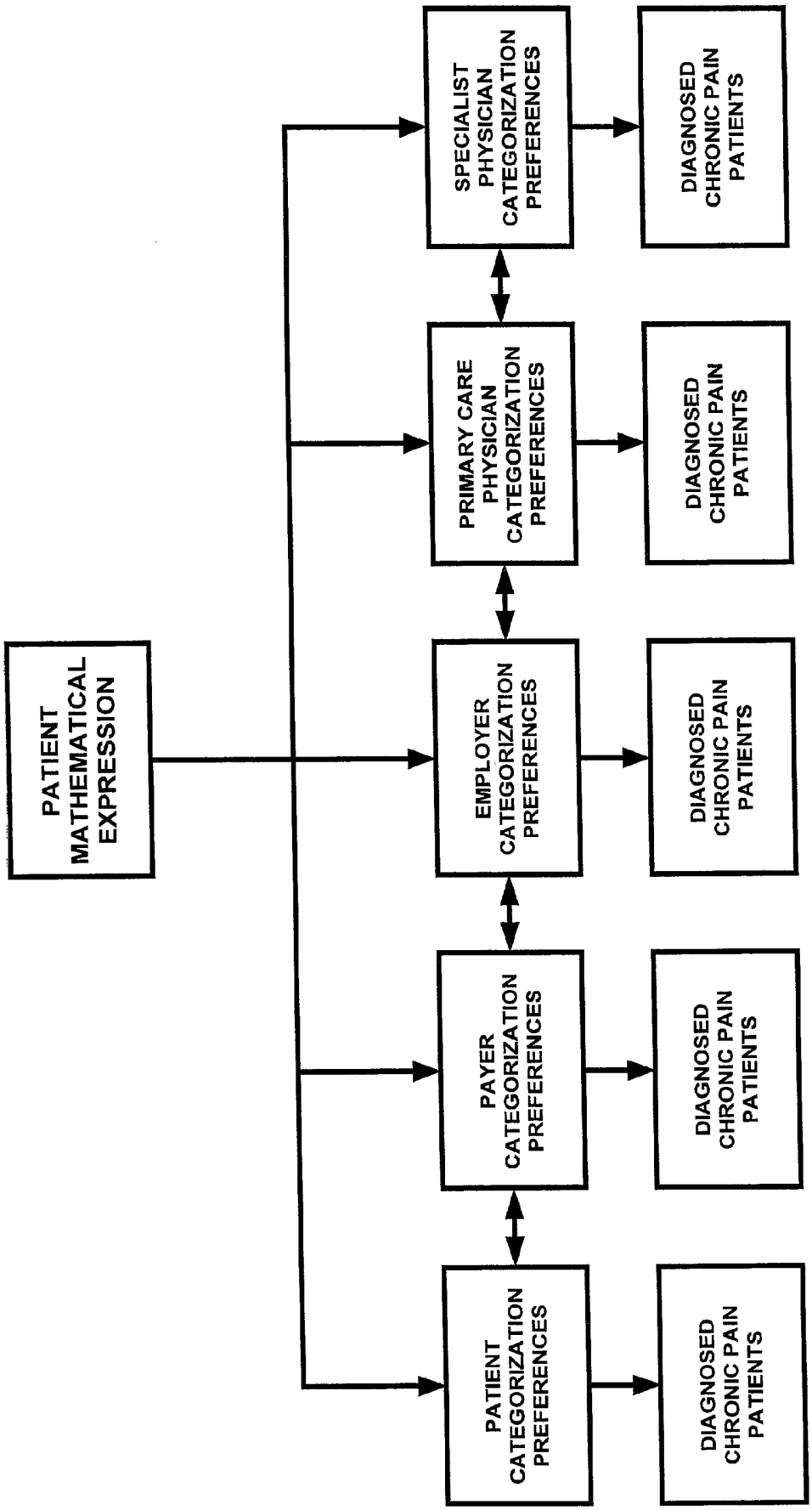

PATIENT MATHEMATICAL EXPRESSION
SPECIALIST PHYSICIAN CATEGORIZATION PREFERENCES
PRIMARY CARE PHYSICIAN CATEGORIZATION PREFERENCES
EMPLOYER CATEGORIZATION PREFERENCES
PAYER CATEGORIZATION PREFERENCES
PATIENT CATEGORIZATION PREFERENCES
DIAGNOSED CHRONIC PAIN PATIENTS
DIAGNOSED CHRONIC PAIN PATIENTS
DIAGNOSED CHRONIC PAIN PATIENTS
DIAGNOSED CHRONIC PAIN PATIENTS
DIAGNOSED CHRONIC PAIN PATIENTS

FIG. 13

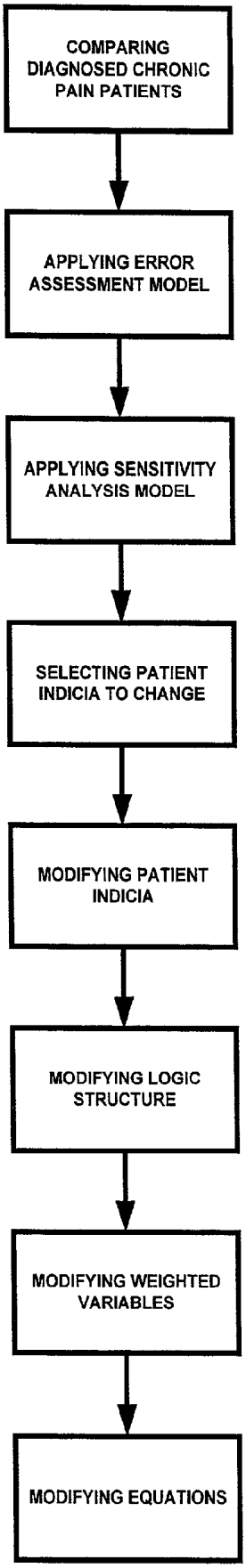

COMPARING DIAGNOSED CHRONIC PAIN PATIENTS
APPLYING ERROR ASSESSMENT MODEL
APPLYING SENSITIVITY ANALYSIS MODEL
SELECTING PATIENT INDICIA TO CHANGE
MODIFYING PATIENT INDICIA
MODIFYING LOGIC STRUCTURE
MODIFYING WEIGHTED VARIABLES
MODIFYING EQUATIONS

FIG. 14

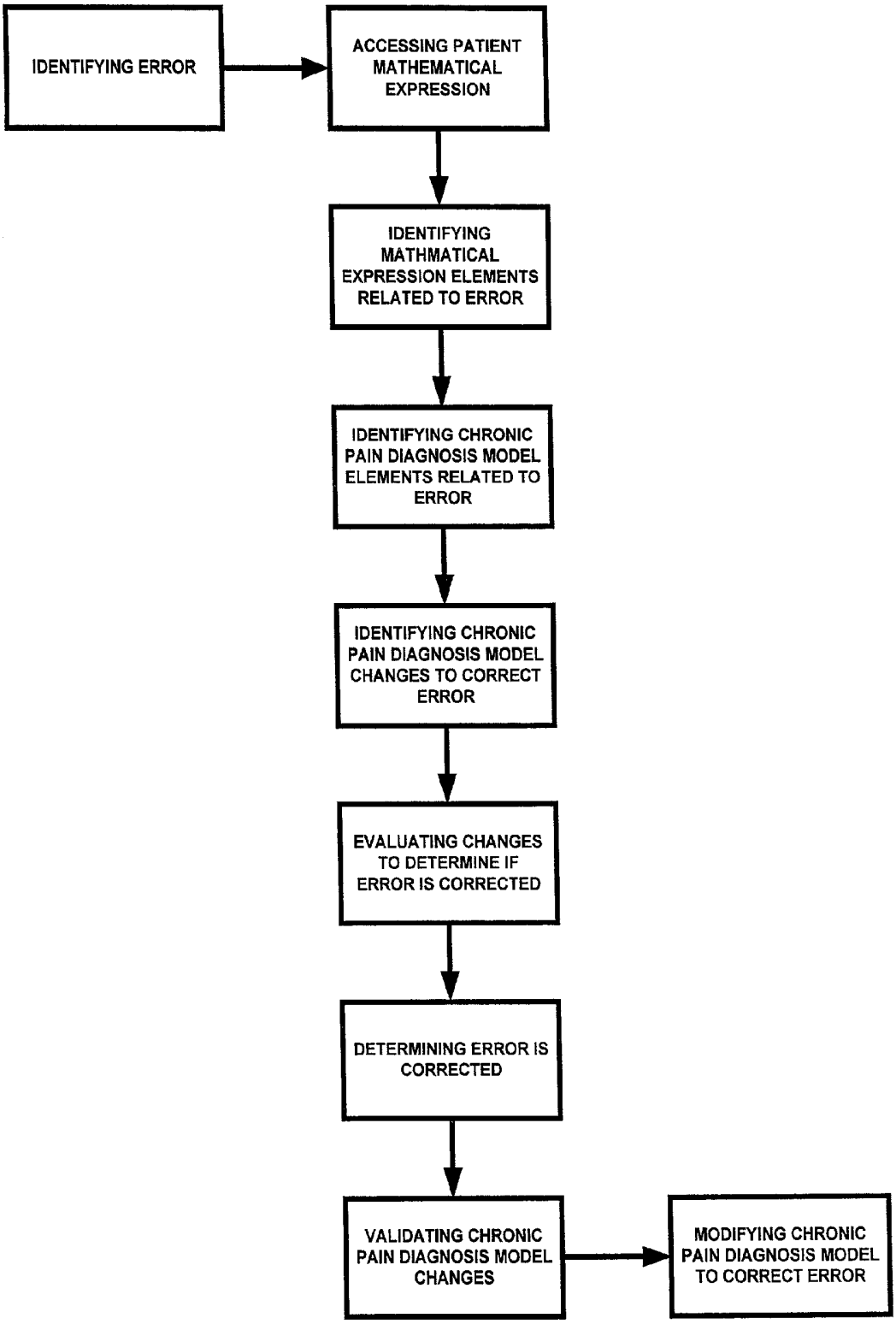

IDENTIFYING ERROR
ACCESSING PATIENT MATHEMATICAL EXPRESSION
IDENTIFYING MATHMATICAL EXPRESSION ELEMENTS RELATED TO ERROR
IDENTIFYING CHRONIC PAIN DIAGNOSIS MODEL ELEMENTS RELATED TO ERROR
IDENTIFYING CHRONIC PAIN DIAGNOSIS MODEL CHANGES TO CORRECT ERROR
EVALUATING CHANGES TO DETERMINE IF ERROR IS CORRECTED
DETERMINING ERROR IS CORRECTED
VALIDATING CHRONIC PAIN DIAGNOSIS MODEL CHANGES
MODIFYING CHRONIC PAIN DIAGNOSIS MODEL TO CORRECT ERROR

FIG. 15

CHRONIC PAIN PATIENT DIAGNOSTIC SYSTEM

[0001] This application claims the benefit of provisional application U.S. Serial No. 60/258,556 filed on Dec. 29, 2000 entitled "Disease Management System And Methods" by Goetzke et al. This application is also related to the following co-pending applications entitled "Chronic Pain Patient Risk Stratification System" by inventors Goetzke et al. (attorney docket number P9640.00); "Chronic Pain Patient Identification System" by inventors Goetzke et al. (attorney docket number P9581.00); "Chronic Pain Patient Medical Resources Forecaster" by inventors Goetzke et al. (attorney docket number P9642.00); "Chronic Pain Patient Care Plan" by inventors Goetzke et al. (attorney docket number P9643.00) which are not admitted as prior art with respect to the present invention by its mention in this cross reference section.

BACKGROUND OF THE INVENTION

[0002] This disclosure relates to a medical information system and more specifically to a chronic pain patient diagnostic computer program and method.

[0003] Although medical treatment of acute injuries and illnesses have improved significantly over the past few decades, chronic disease remains by far the greatest cause of mortality, diminished quality of life, and increased healthcare expenditures. Approximately 80% of healthcare costs are spent on the treatment of chronic disease, much of it on unnecessary hospitalizations, inappropriate medical interventions, and poor overall coordination of care. This is true because chronic diseases are commonly treated but quite frequently not appropriately managed. The bulk of these expenses are spent on cardiovascular disease, cancer, diabetes, AIDS, orthopedic and spinal disease, arthritis, and the full range of neurological diseases. In countries with an aging population, the prevalence of chronic disease will increase dramatically, further accentuating the need for better chronic care.

[0004] Historically chronic disease has often been considered part of normal aging with little attention given to prevention, precise diagnosis and fully coordinated, long-term treatment. This view of chronic disease manifests itself with relatively late-stage treatments conducted as a series of acute interventions after a critical episode. Treatments after a critical episode are typically more invasive, expensive, and less effective at restoring an individual to a full health than treatments that could be given prior to episode if only the chronic disease risk or symptoms had been more accurately diagnosed. The medical profession's focus on late-stage treatment of chronic disease after a series of acute interventions has been influenced by the compartmentalization of medical specialties around acute diseases that often do not provide optimal treatment for chronic diseases. The medical profession's lack of attention to chronic disease has also been slow to change because of the largely passive role payers, employers, health care policy makers and patients have played in the past.

[0005] The medical profession's perspective on chronic disease is changing through increased knowledge and access to better data and more meaningful information that are changing historical views. Adding momentum to the medical profession's understanding of chronic disease is the empowerment of payers and patients. Payers are pressuring the medical profession to control the high cost of chronic disease treatment. Payers understand that chronic disease costs can often be substantially reduces through a better understanding of chronic disease risks, early and accurate diagnosis, appropriate intervention, and fully coordinated, long-term care. Patients are empowered with informational technologies to ask questions, understand disease risks and symptoms, understand alternatives including complimentary therapies, and seek treatments that improve both length and quality of life.

[0006] With the change in focus on chronic disease, there is recognition that the following chronic diseases that are not effectively managed: cancer, cardiovascular diseases, neurological diseases, musculo-skeletal diseases, diabetes, gastro-intestinal diseases, and chronic pain. The chronic pain population is among the most difficult to identify, to accurately diagnose, and to manage.

[0007] Many primary care physicians have limited knowledge of the broad spectrum and varied etiologies of chronic pain. Primary care physicians also have a limited understanding of the medical and non-medical risks associated with later onset of chronic pain. Chronic pain is expressed in a wide variety of conditions, also known as indications. (The International Association for the Study of Pain recognized over 450 separate indications.) Due to the complex nature of chronic pain it is often difficult for non-specialists to accurately diagnosis the specific pain condition. The complexity of chronic pain disease is described in texts such as Merskey et al., "Classification Of Chronic Pain, 2nd Ed.", International Association For The Study of Pain, IASP Press (1994).

[0008] Previous clinical efforts have not effectively identified patients who are at risk for chronic disease, who have undetected chronic disease, or who have been misdiagnosed for a condition other than their actual chronic disease.

[0009] Previous clinical efforts have been particularly ineffective in accurately diagnosing those patients so they are effectively treated in a manner that corresponds to their specific disease condition.

[0010] For the foregoing reasons, there is a need for a chronic disease patient diagnostic system that permits earlier and more targeted intervention to treat chronic disease to improve patient health, reduce costs, and provide additional benefits.

SUMMARY OF THE INVENTION

[0011] The chronic pain patient diagnosis system can be a method or computer software product that identifies individuals at risk for a chronic pain indication in a population. Desired patient indicia including direct medical indicia, indirect medical indicia, and non-medical indicia are selected to serve as independent variables. At least one chronic pain indication is selected to serve as a dependent variable. A chronic pain diagnosis model is created using the patient indicia and the chronic pain indication. The chronic pain diagnosis model is applied to the population and potential chronic pain patients are identified by selecting individuals from the population that conform to the chronic pain model. Some embodiments can include establishing selection preferences that specify patient characteristics desired to be selected by a stakeholder such as a patient,

primary care physician, specialist physician, employer, or payer. The selection preferences are calculated with each potential chronic pain patient's mathematical expression to identify relationships between the selection preferences and each potential chronic pain patient's mathematical expression. Each potential chronic pain patient is categorized based upon the relationships between the selection preferences and each potential chronic pain patient's mathematical expression. Some embodiments can include sensitivity analysis to improve accuracy of the chronic pain patient diagnosis system. The sensitivity analysis includes comparing the identified chronic pain patients with outside patient indicia to create a patient error list. An error assessment model is applied to the patient error list to identify the non-corresponding patient indicia that contributed to the errors. A sensitivity analysis model is applied to the non-corresponding to the non-corresponding patient indicia to identify potential patient indicia changes to reduce errors in identifying chronic pain patients. At least one patient indicia change is selected from the potential patient indicia changes to apply to the patient indicia to modify the patient indicia. Many different embodiments of the chronic pain patient diagnosis system method and software product are possible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** shows a block diagram of a chronic pain patient management system embodiment;

[0013] **FIG. 2** shows a block diagram of a chronic pain patient identification system embodiment;

[0014] **FIG. 3** shows another block diagram of a chronic pain patient identification system embodiment;

[0015] **FIG. 4** shows a more detailed block diagram of a chronic pain patient identification system embodiment;

[0016] **FIGS. 5***a*-**5***b* show a table of direct medical indicia prophetic example embodiment;

[0017] **FIGS. 6***a*-**6***b* show a table of direct medical indicia therapeutic agents prophetic example embodiment;

[0018] **FIGS. 7***a*-**7***b* show a table of indirect medical indicia prophetic example embodiment;

[0019] **FIGS. 8***a*-**8***b* show a table of non-medical indicia prophetic example embodiment;

[0020] **FIG. 9** shows a block diagram of a chronic pain patient data preparation embodiment;

[0021] **FIG. 10** shows a block diagram of a chronic pain model development embodiment;

[0022] **FIG. 11** shows a Chi-Square Automatic Interaction Detection (CHAID) analysis prophetic example embodiment;

[0023] **FIG. 12** shows a logistics table prophetic example embodiment;

[0024] **FIG. 13** shows a block diagram of applying preferences to a patient mathematical expression;

[0025] **FIG. 14** shows a block diagram of a sensitivity analysis chronic pain patient identification system embodiment; and,

[0026] **FIG. 15** shows a more detailed block diagram of a sensitivity analysis chronic pain patient identification system embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] **FIG. 1** shows a block diagram of a chronic medical condition management system embodiment and some elements of its operating environment. The chronic medical condition management system integrates the requirements and interests of at least five stakeholders include the patient, employer, payer, medical specialist, primary care physician, and the like. Other parties can also be added such as federal government, state government, allied health care professionals such as chiropractors, physical therapists, occupational therapists, and the like. The chronic medical condition management system can operate on data controlled by each stakeholder and on data contained in a common database. The management system can be operated on a variety of computer systems depending upon the complexity of the management system such as a personal computer, minicomputer, mainframe computer, super computer, and the like. The management system can contain one or more components such as a chronic pain patient identification system, chronic pain patient risk stratification system, chronic pain patient diagnosis system, chronic pain patient medical resource forecaster, and chronic pain patient care plan. All the stakeholders typically desire a health care delivery process that provides appropriate and efficacious care in a cost effective manner, but this desire takes on different meanings depending upon the perspective of the stakeholder. These perspectives are built into the software in the form of categorization preferences, which will later be taken into consideration when making software-driven choices. Since each stakeholder can use system-generated data for different purposes, each stakeholder can have a customized view and access to the data. The system also profiles these data needs as data preferences, and data is provided in accordance with customized data requirement profiles. Following is a brief discussion of each stakeholder's interest.

[0028] Employers are typically interested in resource stewardship, maintaining a safe work environment for their workers, enhancing work force productivity, and the like. From an employer's perspective, a safe, healthy, and happy work force translates into improved worker productivity. For this reason many employers strive to understand and meet the basic health care needs of their work force but seek to do so in a cost effective manner. Employers are more engaged than ever in designing benefit packages for their employees. They will typically endorse efficacious, lowest cost treatments and particularly those designed to promptly return an injured employee to work. To make such benefit decisions, employers need data. Information relating cost benefit analysis and similar data that will allow them to compare therapies based upon clinical effectiveness and cost is very useful. Return to work data is also of critical importance. There is a host of other data points that employers would find useful, but which is data that is not typically collected or well understood. For example, employers would find it helpful to better understand the cost of patient compliance vs. non-compliance with specific treatment options. Information that could profile an employee to predict patient compliance, could be crucial to the decision making process. Also, work environment data, such as knowing whether

injury patterns can be identified among a work force, could allow employers to develop targeted strategies to reduce or eliminate work place injuries.

[0029] Payers are typically interested in ensuring that clinically effective care is provided to health care members in a cost effective manner that provides a high level of reported patient satisfaction. The role of the payer is evolving with time, and in the future, payers will become more involved in population management for specific disease states. For this reason, payers will require epidemiological data. Payers desire to be more involved in educating their members on specific disease states, personalizing responses to match the specific needs of their members. Additionally, payers require clinical and economic data in a format that business leaders are accustomed to using in the decision making process. In short, payers are evolving their data collection practices to become more practical partners with employers, as both parties strive to tailor benefits to meet the needs of a defined population of employees.

[0030] Specialist are typically interested in having patients referred that are appropriate for the specialist scope of practice. Health care payers increasingly demand more rigorous proof of therapy value. The evidence is requested in the form of clinical, quality of life and economic outcome studies, claims-based retrospective studies, or economic models. Physicians are becoming more involved in the data collection, interpretation and reporting process, and it is quite common for them to develop their own data bank of information on patient outcomes. In addition, the specialist is typically a part of a care team, and the primary care physician usually acts as the gatekeeper of care. Depending upon the primary care physician's approach toward care delivery, the care team is either loosely coordinated or more actively coordinated, or sometime not at all coordinated. However, care coordination is becoming more and more a valued process, as payers and providers are realizing that a seamless and more efficient care process has a direct impact on therapy outcome and cost. For this reason, it is important for the entire team to communicate with each other and to adopt uniform processes for care delivery and outcome reporting. As patients become more actively engaged in the care delivery process, the specialist is also striving to evolve the communication relationship with their patients. Patients are becoming informed consumers of health care services, and specialists are responding by creating new means of communicating with patients. For example, it is quite common for specialists to have their own patient-focused website.

[0031] Primary care physicians are typically interested in making a proper diagnosis of their patients and making a proper decision on when a patient should be referred to a specialist. The data and communication needs of the primary care physician are similar to those of a specialist. Additionally, the primary care physician is finding it of practical value to have disease specific information readily available across a broad array of topics. Patients are asking questions that are more detailed about their condition, and often approach physicians with information they pulled from the web relating to a potential therapy or new drug that might be of potential treatment benefit. Being a generalist by training, the primary care physician often finds it useful to easily access clinical summaries, suggested treatment standards or other similar information that helps them decide how to initiate the management of a condition.

[0032] Patients are typically interested in participating in their health care, proper diagnosis of their medical condition, and effective treatment of their medical condition. They are seeking to better understand their medical condition, and to become more actively informed in health care decision-making and more active participants in the treatment process. As more of the payment burden is shifted onto the patient, they also are becoming "care shoppers", and therapy-specific economic data is more relevant to making an informed choice. Patients are also beginning to leverage web technology, using the web to get general disease information as well as to obtained more tailored information, programs or services that are personalized to their medical condition. The web is also being more frequently used as a means of communication between patients and their care providers, and is beginning to take the place of the telephone call and the physician office visit in the care delivery process. One component of the chronic pain patient management system is the chronic pain patient identification system.

[0033] **FIGS. 2 and 3** show block diagrams of chronic pain patient identification system embodiments, and **FIG. 4** shows more detailed block diagram of a chronic pain patient identification system embodiment. The chronic pain patient identification system comprises the general elements of selecting patient indicia to evaluate, selecting a chronic pain indication, creating a chronic pain model using the patient indicia and the chronic pain indication, applying the chronic pain model to a population, and identifying patients at risk for chronic pain. Additionally, some embodiments can include accessing the chronic pain model, applying the chronic pain model, establishing categorization preferences for desired categories of potential chronic pain patients, calculating the categorization preferences with each potential chronic pain patient's mathematical expression to establish relationships, categorizing each potential chronic pain patient based upon these relationships, and monitoring the potential chronic pain patient. The patient indicia are selected from sources such as claims records, medical records, workers' compensation records, and employer records. The chronic pain model is applied to a population such as a payer database, employer database, primary care physician database, and the like.

[0034] The chronic pain patient diagnostic system is predicated upon the logic of a differential diagnostic process. An Inference Engine asks a series of questions of the patient data to either include or exclude the patient from a branch of the decision tree. Diagnostic "options" or "branches" of the tree are eliminated as they are excluded. The algorithm continues to draw inferences until a) there is a positive inclusion, meaning a diagnosis with a high level of predictive confidence; or b) there is no more data or inference rules upon which to complete an accurate diagnosis. When alternative (b) occurs, the model will identify the missing independent variable(s), in order of predictive value, and specify the type(s) of diagnostic tests or observations that are most likely to provide the user with a statistically reliable result. Conversely, the user will be able to specify which diagnostic tests or observations are unlikely or less likely to result in a statistically reliable conclusion (diagnosis).

[0035] The system is designed to allow users to enter at any point during the logic process, if the user has adequate information that allows them to bypass earlier process steps and navigate the system to a successful conclusion from that point of entry. The user is also able to skip steps in the process that may not be required to arrive at an accurate (significantly reliable) diagnosis.

[0036] **FIGS. 5***a*-**5***b* show a prophetic table of some direct medical indicia related to chronic pain, and **FIGS. 6***a*-**6***b* show a prophetic table of some direct medical indicia in the form drug products. Although the indicia in **FIGS. 5***a*-**6***b* are labeled direct medical indicia, under some circumstance certain of these direct indicia could also be classified as indirect indicia. The columns in **FIGS. 5***a*-**6***b* and **8***a*-**8***b* labeled Positive-In, Positive-Out, Probable-In, and Probable-Out are a gross simplification used to show how the chronic pain model could evaluate each indicium with Positive-In meaning selection as a potential chronic pain patient, Positive-Out meaning exclusion as a potential chronic pain patient, Probable-In as possible selection as a potential chronic pain patient depending upon other patient indicia, and Probable-Out as possible exclusion as a potential chronic pain patient depending upon other patient indicia. Patient indicia would actually be included in the chronic pain model and applied to a population.

[0037] Direct medical indicia associated with chronic pain are selected to serve as independent variables for the chronic pain model. Direct medical indicia include information, recorded by a clinician, relating to a chronic pain indication of a patient. In addition to the direct medical indicia shown in **FIGS. 5***a*-**6***b*, direct medical indicia can also include indicia such as primary diagnosis, associated secondary diagnosis, co-morbidities, drug treatment regimen, telephone consultations with a clinician, trauma episodes, palliative care, rehabilitative care, clinician office visits, emergency room visits, hospitalizations, and the like. Some direct medical indicia can be expressed as codes derived from nationally recognized coding systems such as International Classification of Diseases (ICD), American Medical Association Administrative Current Procedural Terminology (CPT); Healthcare Financing HCPCS), and National Drug Codes (NDC) shown in **FIGS. 5***a*-**5***b*. Direct medical indicia are available from sources such as claims records, medical records, workers' compensation records, employer records, and the like. The importance of each of direct medical indicia is typically supported by the current body of chronic pain clinical literature, and can also be bolstered by expert medical opinion.

[0038] **FIGS. 6***a*-**6***b* show a prophetic table of some of the drug products that can be direct medical indicia. A patient's history of prescription and over the counter drug use can be a primary medical indicator of the existence of chronic pain, and in many cases provides adequate predictive evidence to cause a patient to receive a "positive in" classification. The type of drug, as well as the dosing level, and the length of time the patient has been using the drug, are all relevant characteristics in establishing a utilization pattern to support such a classification. Additionally, when certain drugs are used in combination with one another, the predictive power of the drug treatment regimen indicia becomes even more significant. For example, the medical literature indicates that muscle relaxants, anti-inflammatory drugs, anti-depressants, and opioid drugs are commonly prescribed to treat pain patients.

[0039] **FIGS. 7***a*-**7***b* show a prophetic table of some indirect medical indicia. Indirect medical indicia associated with chronic pain are selected to serve as independent variables for the chronic pain model. Under some circumstances, the indirect medical indicia could be considered direct medical indicia. Indirect medical indicia include information recorded by a clinician relating to a patient's health condition but non-specific to the disease of chronic pain. Studies support the link between direct and non-medical indicia in predicting the presence of chronic pain. Relevant indicia include such criteria as the patient's mental health status as indicated by a mental health ICD-9-CM diagnosis, as well patient's history of acute respiratory episodes requiring hospitalization or emergency room visits. It is believed that as much as 40% of a back pain patient's overall health care costs can be attributed to mental health treatment, and there is a link between smoking and all chronic disease.

[0040] **FIGS. 8***a*-**8***b* show a prophetic table of some non-medical indicia. Non-medical indicia associated with chronic pain are selected to serve as independent variables for the chronic pain model. Non-medical indicia include all indicia related to determining or predicting a person's health care status that is not medical indicia. Less is known in the clinical literature about non-medical indicia as markers for the existence of chronic pain, than is known about medical indicia. Currently known non-medical indicia include socio-demographic factors such as: life style behaviors including alcohol consumption, smoking, weight gain, pain perception factors, life satisfaction measures, patient support structure from the family and the community at large, day time distractions, quality of their marital relationship, and personality and psychological profiles. Additional non-medical indicia include demographic factors such as age, gender, economic status, and race/ethnicity, the existence of an open workers' compensation claim, and the presence of an attorney hired by the patient to adjudicate a workers' compensation claim. Non-medical risk indicia are mined from such sources as medical records; patient self-report documents; patient self-assessment surveys; employer databases; workers' compensation records; medical chart reviews; telephone interviews with patients, treating clinicians, and family members.

[0041] A chronic pain indication, also known as a chronic pain condition, is selected to serves as a dependent variable for the chronic pain model. Chronic pain indications are published by professional organizations such as the International Association for the Study of Pain (IASP) and include the following indications Peripheral Neuropathy; Stump Pain; Phantom Pain; Complex Regional Pain Syndrome Type I (Reflex Sympathetic Dystrophy); Complex Regional Pain Syndrome Type II (Causalgia); Central Pain; Rheumatoid Arthritis; Osteoarthritis; Sickle Cell Arthropathy; Stiff Man Syndrome; Osteoporosis; Guillain-Barre Syndrome; Superior Pulmonary Sulcus Syndrome (Pancoast Tumor); Pain of Skeletal Metastatic Disease of the Neck, Arm, or Shoulder Girdle; Carcinoma of Thyroid; Post Herpetic Neuralgia; Syphilis (Tabes Dorsalis and Hypertrophic Pachymeningitis); Primary Tumor of a Vertebral Body; Radicular Pain Attributable to a Prolapsed Cervical Disk; Traumatic Avulsion of Nerve Roots; Primary Tumor of a

Vertegral Body; Radicular Pain Attributable to a Thoracic Disk; Chemical Irritation of the Brachial Plexus; Traumatic Avulsion of the Brachial Plexus; Postradiation Pain of the Brachial Plexus; Painful Arms and Moving Fingers; Brachial Neuritis (Brachial Neuropathy, Neuralgic Amyotrophy, Parsonage-Turner Syndrome); Raynaud's Disease; Raynaud's Phenomenon; Frostbite and Cold Injury; Brythema Pernio (Chilblains); Acrocyanosis; Livedo Reticularis; Volkmann's Ischemic Contracture; Thromboangiitis; Intermittent Claudication; Rest Pain; Gangrene Due to Arterial Insufficiency; Other Postinfectious and Segmental Peripheral Neuralgia; Angina Pectoris; Postmastectomy Pain Syndrome (Chronic Nonmalignant); Late Postmastectomy Pain or Regional Carcinoma; Segmental or Intercostal Neuralgia; Chronic Pelvic Pain Without Obvious Pathology; Pain from Urinary Tract; Carcinoma of the Bladder; Lumbar Spinal or Radicular Pain after Failed Spinal Surgery; Spinal Stenosis (Cauda Equina Lesion); Pain referred from Abdominal or Pelvic Viscera or Vessels Perceived as Sacral Spinal Pain; Femoral Neuralgia; and, Sciatica Neuralgia. Although the chronic pain model typically considers only one chronic pain indication dependent variable at a time, there can be chronic pain model embodiments that would consider at least one and up to many chronic pain indication simultaneously.

[0042] **FIG. 9** shows a method for cleansing data such as patient indicia from potential data sources before the data is used in creating the chronic pain model. Often it is desirable to clean the data before the data is operated upon because data from various sources can have incompatible formats and data can contain errors. Data cleansing improves the reliability, accuracy and robustness of the chronic pain patient identification system.

[0043] **FIG. 10** shows a block diagram for creation of the chronic pain model in the form of a chronic pain inference engine embodiment. The chronic pain model comprises a logic structure, weighted variables, and equations. Some embodiments of the chronic pain model can include Hosmer-Lemeshow Goodness of Fit Analysis to evaluate the appropriateness of patient indicia, and monitoring patient indicia for changes that can be used to update the patient mathematical expression. The chronic pain inference engine can operate on at least fifty dependent variables, at least thirty independent variables, and at least fifty equations. The chronic pain model can be mathematically represented as follows: $f(x)=b_0+b_1(X_1)+b_2(X_2)+b_3(X_3) \ldots b_i(X_i)$ where b_0 is a beta weight constant; b_1–b_i are the beta weights for each corresponding variable; X_1–X_i are the significant variables identified from the model; and f(x) is the resultant measure of the characteristic of interest, i.e., chronic pain score. This chronic pain model equation creates a line that represents the minimized average for the dataset that is the line of prediction for the dataset.

[0044] **FIG. 11** shows a Chi-Square Automatic Interaction Detection (CHAID) analysis prophetic example embodiment, and **FIG. 12** shows an analysis flow per indication prophetic example embodiment that was established by CHAID analysis. The logic structure used to establish relationships between a dependent variable and the independent variable can be developed using a statistical technique such as Chi-Square Automatic Interaction Detection (CHAID) analysis, CART analysis, and the like. The logic structure defines a logical decision process to progressively reach greater certainty about potential chronic pain patients. The logic structure can be evaluated using a statistical technique such as Hosmer-Lemeshow Goodness of Fit Analysis, and the like. CHAID is well known in the art, is an exploratory analysis executed to examine relationships that may exist between a dependent variable and multiple categorical variables that may interact with one another. It is predicated upon the supposition the necessary data is available, and that it is possible to distinguish, within a given data set, between two or more variables known to exist and known to be important.

[0045] CHAID is applied to the chronic pain construct in the following manner. Existing relevant information believed to be related to pain are culled from the clinical literature and bolstered by expert medical opinion, and a set of independent variables is identified based on current knowledge. As new clinical literature becomes available, the logic structure can be modified to include the new information. When the CHAID analysis is properly executed in a sequential fashion, the independent variables most clearly associated with the chronic pain measure will emerge.

[0046] The independent variables (predictors) are assessed to determine if splitting the sample based on these variables leads to statistically significant discrimination on the dependent measure. The most significant relationship defines the first split on the sample (called a branch or node). Then, for each group formed by the split, the remaining independent variables are assessed to determine which, if any, can further significantly discriminate on the subgroup. The end result (referred to as a terminal nodes) is a series of groups that are maximally different from one another on the dependent variable. At each step a statistical assessment is made to determine if a significant split into further subgroups can be made.

[0047] The length of the tree is the number of branches allowed to reach a terminal node. Tree length is set by the researcher and statistician based on decision rules. Based on the experience of the researcher, it has been determined that the model will continue branching until the variables found significant in differentiating the included population subsets establish nodes of $N<15$ individuals. This analysis will identify variables for inclusion only if they are determined to be significant at the $p<0.05$ level. It is assumed that incorporating several different sources of non-medical risk data (Patient Survey, Employer records, etc.) will provide the necessary precision. An alternative to CHAID is Classification Adjusted Regression Tree (CART) analysis. However, CART does not have the same efficiency in creating the buckets of patients.

[0048] The CHAID technique presents certain advantages for this analysis. It provides a means of detecting patterns in what is a complicated set of data. The maximum amount of data is used because missing values can be incorporated into the analysis. The analysis allows for a nominal level of measurement on the dependent variable and the independent variables. Finally, the resultant model will emphasize strong results without over-capitalizing on chance occurrences because the many variables are considered at once in a step-wise fashion. Thus, CHAID is extremely useful in detecting data trends. In addition, it will allow formation of meaningful interaction terms, which will inform the estimation of probability in subsequent logistic regression analyses.

[0049] **FIG. 13** shows a table with a prophetic logistic regression example. The weighted variables reflect greater relevance of certain direct medical indicia, indirect medical indicia, and non-medical indicia to the chronic pain indication. The weighted variables can be developed using a statistical technique to establish relationships between the dependent variable and independent variables such as logistic regression, discriminant analysis, and the like. Logistic regression is a form of statistical modeling appropriate for categorical outcome variables. The method examines the relationship between a categorical response, or dependent variable, and a set of explanatory, or independent variables. The results of logistic regression provide regression coefficients. The coefficients can be as simple as a single numerical value or as complex as an equation including known independent variables. After transformation, the regression coefficients can be interpreted as odds ratios describing the influence of various factors and the dependent variables. The logistic regression procedure provides odds ratios for independent variables as well as the significance level for each odds ratio. For example, the process could provide that employees with job types where heavy lifting is characterized as a major function of the job, are three times more likely to be chronic low back pain sufferers than employees with other job types. As with CHAID analysis, the many independent variables will be considered in a stepwise fashion, which allows for detection of the most explanatory of the variables. To be included in the logistic model variables must achieve a significance level of $p<0.05$.

[0050] Because the dependent variable has only two possible values (either chronic pain is present or it is not), it is not correct to assume that the variable would be normally distributed in a sample of individuals. By transforming the variable using a logistic function, the variable is made to appear closer to a normal distribution than would otherwise be the case (the assumption of a normal distribution being essential to the use of a linear statistical procedure). Taking into account the logistic transformation, the mathematical equation (or logistic function) that results from analysis takes the form:

$$\text{Log } p/1-p=b_0+b_1(X_1)+b_2(X_2)+b_3(X_3)+b_4(X_4)\ldots b_i(X_i)$$

[0051] where p is probability; b_0 is a beta weight constant b_1–b_i is the beta weight for each corresponding variable; and X_1–X_i are the significant variables identified from the model, e.g., X_1 can be job type, X_2 can be gender and job satisfaction, and X_3 can be Drug Therapy, Number of Children and Gender. This logistic regression equation is further complicated by the potential interactions, described mathematically as follows: $b(X_1 \cdot X_2)$. An alternative to Logistic Regression is Discriminant Analysis. Discriminant Analysis requires looking at extreme groups of patients. In order to find the most efficient group, the process requires a mix of extremes. Once logistic regression has been complete, equations can be generated.

[0052] Equations are generated to represent relationships between or among weighted variables to build a chronic pain inference engine. The chronic pain inference engine can operates on at east fifty dependent variables; at least thirty independent variables; and, at least fifty equations. The potential chronic pain patients are identified with a patient mathematical expression generated by the chronic pain inference engine operating on the patient indicia and the chronic pain indication. The patient mathematical expression can be used to administratively categorize the potential chronic pain patient into a category such as Positively-In, Positively-Out, Probably-In, Probably-Out, and the like. After a potential chronic pain patient is identified with a mathematical expression, that potential chronic pain patient's patient indicia can be monitored for relevant changes and the potential chronic pain patient's mathematical expression can be updated to reflect those changes. The computer will generate odds ratios and related significance levels as an output. Interpretation of results is a simple exercise of examining the sign (the direction of the parameter estimate), the value of the odds ratio, and it's significance level.

[0053] The number of equations generated can become quite large such as thousand and millions or equations associated with each chronic pain indication dependent variable, and currently there are 456 separate chronic pain indications. Due to the complexity and large number of equations, a computer is typically required to calculate the equations to produce a patient mathematical expression. A prophetic example of the number and complexity of equation generation follows. It is known that there are at least 456 different indications for chronic pain. Assume a predictive model that accounts for each of these 456 dependent variables. Further assume that there are currently a total of 32 identified indicia for chronic pain, adding the medical and non-medical indicia together (this number will grow as more is learned about chronic pain). If the model is developed out to the fourth level of independent variable (X_4) the calculation is as follows:

Step	Equation Possibilities
1	Each indicia is considered individually: 32 total possibilities.
2	Each indicia is crossed with every other indicia for a two-way interaction calculation: 32 × 31 = 992 total possibilities.
3	Each indicia is combined in a three-way interaction calculation: 32 × 31 × 30 = 29,763 total possibilities.
4	Each indicia is combined in a four-way interaction calculation: 32 × 31 × 30 × 29 = 863,040 total possibilities.
5	Total possibilities are added together: 893,827 total possibilities.
6	The model is run 456 different times with 893,827 possibilities for each of these 456 indications.

* If a fifth independent variable is presented, the possibilities increase to: 25,058,947 total possibilities.

[0054] In addition to the complexity introduced by interaction terms, each time a new variable is identified and introduced into a model the logistic function must be regenerated. Any newly identified variable can dramatically affect the resultant model (the number of variables found to be significant, the value of the odds ratios found, and the directional relationship of the variables). New variables can be found to have significance when compared with previously tested variables and new variables can change the significance level of previously significant and non-significant variables or can change the way previous variables interact with either the new variable or previously identified variables. Thus as our knowledge of chronic pain expands, model generation must be revised, creating a dynamic knowledge opportunity limited only by our ability to iden-

tify and appropriately measure (both validly and reliably) additional variables and our ability to refine measurement of previously identified variables.

[0055] The potential complexity of chronic pain model can be seen from the following prophetic example. In the applied CHAID example, X_1 is "Job Type". If it is discovered that X_1 is "Injured Employee Retains an Attorney", every other independent variable is potentially altered. This alteration includes order of importance, clusters of importance, and even relevance in terms of predictability. If X_1 becomes "Injured Employee Retains an Attorney", X_2 could likely become "Unresolved Workers Compensation Claim". The weighted value of the cluster of these 2 indicia could be significantly higher than the cluster of the previous 2 indicia of "Job Type" and "Gender or Job Satisfaction". The potential patient indicia, their importance and weight, alone and in combination with others can be immense.

[0056] The Hosmer-Lemeshow Goodness of Fit tests the models and determines whether the variables chosen for the model were the best possible. Once the logistic model is determined, the Hosmer-Lemenshow Chi-Square statistic is calculated to assess the goodness of fit of the model. A non-significant value indicates an adequate goodness of fit. If the Hosmer-Lemeshow analysis indicates that there is not a good fit, then the conclusion drawn is that there are variables other than those identified for model inclusion that might better explain the concept being investigated. This is an indication that further identification of variables and data sources for those variables must be determined.

[0057] **FIG. 14** shows a block diagram of applying categorization preferences to a patient mathematical expression embodiment. Potential chronic pain patient's can be categorized by first establishing categorization preferences that specify characteristics of patients desired to be categorized. The categorization preferences include patient categorization preferences, payer categorization preferences, employer categorization preferences, primary care physician categorization preferences, and specialist physician categorization preferences. The different stakeholder categorization preferences can be interrelated. For example, a payer categorization preference can include a potential chronic patient preference that might indicate whether the potential chronic pain patient would be compliance with a physical therapy regimen. Some examples of categorization preferences for a patient can include a desire to be notified of being a potential chronic pain patient even though the other stakeholders categorization preferences do not identify the patient as a potential chronic pain patient, a desire to not be notified of being a unless the other stakeholders would support treatment, a desire to not be notified under any circumstance of being a potential chronic pain patient. Some examples of categorization preferences for a payer include a desire to know if potential chronic pain patient reimbursement criteria are met and a desire to know whether the potential chronic pain patient special care program criteria are met. Some examples of categorization preferences for an employer can include a desire to know potential chronic pain patients who's job performance may be affected and potential chronic pain patients that can be efficiently treated. Some examples of categorization preferences for a primary care physician can include potential chronic pain patients that are suitable for treatment by the primary care physician and potential chronic pain patients that should be considered for referral to a specialist. Some examples of categorization preferences for a specialist physician can include potential chronic pain patients that are suitable for treatment by the specialist physician and potential chronic pain patients that should be considered for referral to a primary care physician.

[0058] The categorization preferences are calculated against each potential chronic pain patient's mathematical expression to identify relationships between the categorization preferences and each potential chronic pain patient's mathematical expression. Calculation of categorization preference can range from simple search and find algorithms to complex statistical models such a modified chronic pain model.

[0059] The software assigns an alphanumeric score for each patient identified under the rules of the inference engine. The number score, based upon a 0-100% rating, relates to the level of predictive confidence that an appropriate candidate has been identified. Patients with a confidence rating of $\geqq$85% will be considered as potential chronic pain patients, and their names will be passed along to a primary care physician for an initial determination of program inclusion or exclusion. Patients with a lower than 35% rating will be excluded from further consideration. Patients with a score in the range of 35%-85% will be held in the system for up to one year, and the receipt of new information could alter their score upward or downward—triggering program inclusion or exclusion.

[0060] Letter designations represent pain type, site, or etiology, as coded or described in the data, as well as any other rules-based, identifying characteristics or profiles of pain. For this reason, patients can receive more than one letter designation. For example, a patient suffering from chronic peripheral neuropathy would receive an "E" designation. (See Figure). If the patient were also diabetic, he or she would also be designated as a "V". It should be noted that a patient's letter designation is subject to change, based upon the receipt of additional relevant data. If no such feature can be identified from the data query, the letter Z is assigned.

[0061] The following table lists the letter designations and explains the meaning of each designation. As system knowledge increases, this list will change through addition, deletion or modification.

Patient Rating System Table

Designation	Definition
A	Cardiac (Anginal Pain)
B	Low Back
C	Cancer
D	Failed Back Surgery Syndrome
E	Peripheral Neuropathy
F	Head, Face or Mouth
G	Repetitive Motion Injury
H	Urinary Tract
I	Stump Pain
J	Central Pain
K	Complex Regional Pain Syndrome
L	Causalgia
M	Chronic Pelvic Pain
N	Arthritis
O	Post Herpetic Neurology

-continued

Patient Rating System Table

Designation	Definition
P	Osteoporis
Q	Spinal Cord Injury
R	Sickle Cell Arthropathy
S	Heavy Smoker
T	Trauma
U	Heart Failure
V	Diabetic
W	Work-related Injury
X	Psychological Profile
Y	Addications
Z	No Identified Characteristics

[0062] Once potential chronic pain patients are selected, the potential chronic pain patient's patient indicia can be monitored to detect changes that can affect whether the potential chronic pain patients remain potential chronic pain patients or are no longer potential chronic pain patients. The selected potential chronic pain patient's direct medical indicia, indirect medical indicia, and non-medical indicia are monitored for changes and the patient's mathematical expression is updated based upon changes to the potential chronic pain patient's direct medical indicia, indirect medical indicia, and non-medical indicia.

[0063] **FIG. 15** shows a block diagram of a method of sensitivity analysis of a chronic pain model embodiment, and **FIG. 16** shows a block diagram of applying a sensitivity analysis model. The method can begin by comparing the identified potential chronic pain patients with outside diagnosed chronic pain patient data to create a patient error list. The outside diagnosed chronic pain patient data would typically include diagnosis information such as laboratory test results, patient survey data, physiologic measures, the specific chronic pain indication, and the like. Sources for outside diagnosed chronic pain patient data include medical claim data, medical charts, employer records, worker compensation records, and the like. The patient error list has an error assessment model applied to the patient error list to identify non-corresponding patient indicia that contributed to the errors. The non-corresponding patient indicia are typically the absence of one or more patient indicia or the inclusion of one or more extraneous patient indicia. The non-corresponding patient indicia has a sensitivity analysis model applied to the non-corresponding patient indicia to identify potential patient indicia changes to reduce errors in identifying chronic pain patients. Examples of potential patient indicia changes include the addition of one or more relevant indicia or the exclusion of one or more extraneous patient indicia. At least one patient indicia change is selected from the potential patient indicia changes for changing. Finally, the patient indicia are modified with at least one selected patient indicia change. The modified patient indicia typically improve accuracy of the method for new patients entered into the system because new patient indicia may be required. The modified patient can improve the accuracy of the method for patients currently entered into the system particularly if patient indicia are excluded.

[0064] The chronic pain model weighted variables can also be modified in a manner similar to the patient indicia. The sensitivity analysis model is applied to the weighted variables to identify potential weighted variable changes to reduce errors in identifying chronic pain patients. At least one weighted variable change is selected from the potential weighted variable changes to apply to the weighted variables. The weighed variables are modified to reflect greater or lesser relevance of patient indicia to reduce errors in identifying chronic pain patients.

Prophetic Patient Examples

[0065] The prophetic examples are used to illustrate just one of the many application of the chronic pain patient identification system and should not be read to limit application of the identification system.

Prophetic Patient Examples

[0066] The following examples describe four individuals who, due to their unique combination of attendant direct medical, indirect medical and non-medical risk indicia, have been identified as potential chronic patients. The examples illustrate how the chronic pain patient diagnostic model can be used to systematically diagnose patients who have been identified by the chronic pain patient identification model as potential chronic pain patients.

[0067] Patient A is a 42-year-old male with a lumbar spine injury (ICD-9-CM 724.8) diagnosis, and a history of two failed back surgeries. Patient A has never been diagnosed as having chronic intractable pain, although his primary care physician has been treating his pain as an associated symptom of the lumbar spine injury. The record indicates Patient A's physician having observed and described his pain as axial in nature and relating to the muskuloskeletal system. In addition, Patient A has verbally and in his Patient Diary described his pain as a dull, throbbing pain, the intensity of which "spikes" in time of stress.

[0068] The combination of the lumbar diagnosis, the axial nature of the pain, the impact of the pain on the muskuloskeletal system, and the description of the pain as dull and throbbing in nature, leads to a low back diagnosis. In addition, a review of the pharmaceutical claims data establishing that Patient A received a prescription for an Opiate (Percocet, 8 per day) and a Nonsteroidal (Celecoxib, 4 caps per day), both for ≧91 days, establishes the chronicity of the back pain.

[0069] Patient B is a 45-year-old male who received at least one lumbar spine procedure within the past 3 month. Patient B has an "Other" non-specific medical diagnosis, and no further diagnosis could be extracted from the medical record. His status triggered a call to the primary care physician's office nurse who identified a positive lab test for meningitis. The primary care physician added a notation in the medical record documenting a diagnosis of meningitis (to which the spinal procedure was related) and Patient B was therefore excluded from further diagnostic evaluation.

[0070] Patient C is a 46-year-old laborer who has been disabled after an apparent slip and fall. Medical records indicate that he has had generalized complaints of low back pain for approximately 5 months. The primary diagnosis listed in the medical record is lumbar spine-related (ICD-9-CM, 722.6). However, it has not been documented in the medical record for ≧91 days. Patient C's pain has been described and documented in his pain diary as para-spinal, bilateral pain radiating to his buttocks (but not down his legs). Patient C has further described the pain intensity is high and unbearable at times.

[0071] The diagnosis model identifies several missing variables. First, the model directs the practitioner to articu-

late the body system impacted and the model generates a list of suggested queries intended to identify body system impact. After further observation, Patient C's primary care physician identifies the impact as being upon the central nervous system.

[0072] The model also identifies the lack of sufficient data upon which to establish a pattern of chronicity. Although Patient C has been to the Emergency Room twice in the past 5 months, both times related to extreme, unbearable pain, the criteria for a diagnosis of chronic low back pain has not yet been adequately met. Patient C receives a diagnosis of low back pain, a diagnosis which is likely to be impacted in the future, as the inference engine receives additional indicia upon which to make an established conclusion of chronicity.

[0073] Patient D is a 38-year-old female who recently gave birth to her second child. While she was pregnant, she was diagnosed by her primary care physician as having lumbar sprain (ICD-9-CM 724). She self-reported a significant pain intensity (6 out of 10) in her Patient Diary, and described her pain as intense and throbbing. Body system impact was not noted in the medical record. The record indicates that the pain appears to coincide with movement of the involved muscle.

[0074] The medical record also indicates that within the past 120 days from the last day of service patient received a trigger point injection. The record does not establish a pattern ($\geqq$91 days) of chronic use of trigger point injections. The pharmaceutical claims data indicates that Patient D received a prescription for a short acting opiate (Tylenol 3), and Dantrium (a muscle relaxant) both for less than 91 days within the past 120 days from the last day of service.

[0075] The model requests the provider to identify the body system impacted, and the physician identifies the impacted system as muskuloskeletal, applying the list of queries generated by the model.

[0076] The diagnosis of acute low back pain was generated by the system. The inference engine will continue to monitor the indicia to determine whether Patient D experiences health care status changes or utilizes health care services in a manner that could trigger a change in diagnostic status.

[0077] Thus, embodiments of a method and computer software product for identifying individual at risk for chronic pain indication in a population are disclosed to improve the accuracy of identifying potential chronic pain patients, decrease the time required to identify potential chronic pain patient so early intervention can be considered, identify potential chronic pain patients that meet the preference of stakeholders, and many other benefits. One skilled in the art will appreciate that the present invention can be practiced with embodiments other than those disclosed. The disclosed embodiments are presented for purposes of illustration and not limitation, and the present invention is limited only by the claims that follow.

What is claimed is:

1. A method for diagnosing potential chronic pain patients, comprising:

selecting direct medical indicia associated with chronic pain that serve as independent variables;

selecting indirect medical indicia associated with chronic pain that serve as independent variables;

selecting non-medical indicia associated with chronic pain that serve as independent variables;

selecting a chronic pain indication that serves as a dependent variable;

creating a chronic pain diagnostic model using direct medical indicia, indirect medical indicia, non-medical indicia, and the chronic pain indication;

applying the chronic pain diagnostic model to a potential chronic pain patient to create a patient mathematical expression for each potential chronic pain patient; and,

diagnosing potential chronic pain patients by comparing each patient's mathematical expression to selection objectives.

2. The method as in claim 1 wherein the chronic pain model comprises,

a logic structure to define a logical decision process to operate on the independent variables and to progressively reach greater certainty about diagnosis of chronic pain patients;

weighted variables to reflect greater relevance of certain direct medical indicia, indirect medical indicia, and non-medical indicia to the chronic pain indication; and,

equations that represent relationships between or among weighted variables to form a chronic pain diagnosis inference engine.

3. The method as in claim 2 wherein the chronic pain diagnostic inference engine comprises,

at least fifty dependent variables;

at least thirty independent variables; and,

at least fifty equations.

4. The method as in claim 2 wherein the logic structure is developed using Chi-Square Automatic Interaction Detection (CHAID) analysis to establish relationships between a dependent variable and independent variables.

5. The method as in claim 2 wherein the logic structure is developed using Classification Adjusted Regression Tree (CART) analysis to establish relationships between the dependent variable and the independent variables.

6. The method as in claim 2 wherein the weighted variables are developed using logistical regression to establish relationships between the dependent variable and independent variables.

7. The method as in claim 2 wherein the weighted variables are developed using discriminate analysis to establish relationships between the dependent variable and independent variables.

8. The method as in claim 2 wherein appropriateness of patient indicia is evaluated using the Hosmer-Lemeshow Goodness of Fit Analysis.

9. The method as in claim 1 wherein the potential chronic pain patients are diagnosed with a patient mathematical expression generated by the chronic pain diagnosis inference engine operating on the patient indicia and the chronic pain indication.

10. The method as in claim 9 wherein the patient indicia are monitored and for changes and the patient mathematical expression is updated when patient indicia change.

11. The method as in claim 1 further comprising,

establishing categorization preferences that specify patient characteristics that are desired to be selected;

calculating the categorization preferences with each diagnosed chronic pain patient's mathematical expression to identify relationships between the categorization preferences and each potential chronic pain patient's mathematical expression; and,

categorizing each diagnosed chronic pain patient based upon the relationships between the categorization preferences and each potential chronic pain patient's mathematical expression.

12. The method as in claim 1 wherein the selection objectives are selected from the group consisting of potential chronic pain patients with pain attributable to their work environment, potential chronic pain patients unlikely to be compliant with treatment therapy, potential chronic pain patients unlikely to return to work, potential chronic pain patient suitable for low cost therapy, and potential chronic pain patient treatable by a primary care clinician.

13. The method as in claim 1 wherein the direct medical indicia are related to chronic pain in a known medical manner and recorded by a clinician.

14. The method as in claim 13 wherein the direct medical indicia are independent variables selected from the group consisting of primary diagnosis, associated secondary diagnosis, co-morbidities, drug treatment regimen, telephone consultations with a clinician, trauma episodes, palliative care, rehabilitative care, clinician office visits, emergency room visits, and hospitalizations.

15. The method as in claim 13 wherein the sources for direct medical indicia are selected from the group consisting of claims records, medical records, workers' compensation records, and employer records.

16. The method as in claim 1 wherein indirect medical indicia are a chronic pain co-morbidity that is recorded by a clinician.

17. The method as in claim 16 wherein the indirect medical indicia are independent variables selected from the group consisting of mental health condition, acute respiratory episodes, diabetes, and heart failure.

18. The method as in claim 16 wherein the sources for indirect medical indicia are selected from the group consisting of claims records, medical records, workers' compensation records, employer records, and patient surveys.

19. The method as in claim 1 wherein the non-medical indicia are independent variables selected from the group consisting of alcohol consumption, smoking status, weight gain, pain perception factors, life satisfaction measures, patient support structure, day-time distractions, marital relationship quality, personality profile, and psychological profile.

20. The method as in claim 19 wherein the sources for non-medical indicia are selected from the group consisting of medical records, patient surveys, patient self-reports, employer databases, workers' compensation records, medical chart reviews, patient interviews, treating clinician interviews, and family member interviews.

21. The method as in claim 19 wherein the chronic pain indication is selected from the group consisting of Peripheral Neuropathy; Stump Pain; Phantom Pain; Complex Regional Pain Syndrome Type I (Reflex Sympathetic Dystrophy); Complex Regional Pain Syndrome Type II (Causalgia); Central Pain; Rheumatoid Arthritis; Osteoarthritis; Sickle Cell Arthropathy; Stiff Man Syndrome; Osteoporosis; Guillain-Barre Syndrome; Superior Pulmonary Sulcus Syndrome (Pancoast Tumor); Pain of Skeletal Metastatic Disease of the Neck, Arm, or Shoulder Girdle; Carcinoma of Thyroid; Post Herpetic Neuralgia; Syphilis (Tabes Dorsalis and Hypertrophic Pachymeningitis); Primary Tumor of a Vertebral Body; Radicular Pain Attributable to a Prolapsed Cervical Disk; Traumatic Avulsion of Nerve Roots; Primary Tumor of a Vertegral Body; Radicular Pain Attributable to a Thoracic Disk; Chemical Irritation of the Brachial Plexus; Traumatic Avulsion of the Brachial Plexus; Postradiation Pain of the Brachial Plexus; Painful Arms and Moving Fingers; Brachial Neuritis (Brachial Neuropathy, Neuralgic Amyotrophy, Parsonage-Turner Syndrome); Raynaud's Disease; Raynaud's Phenomenon; Frostbite and Cold Injury; Brythema Pernio (Chilblains); Acrocyanosis; Livedo Reticularis; Volkmann's Ischemic Contracture; Thromboangiitis; Intermittent Claudication; Rest Pain; Gangrene Due to Arterial Insufficiency; Other Postinfectious and Segmental Peripheral Neuralgia; Angina Pectoris; Postmastectomy Pain Syndrome (Chronic Nonmalignant); Late Postmastectomy Pain or Regional Carcinoma; Segmental or Intercostal Neuralgia; Chronic Pelvic Pain Without Obvious Pathology; Pain from Urinary Tract; Carcinoma of the Bladder; Lumbar Spinal or Radicular Pain after Failed Spinal Surgery; Spinal Stenosis (Cauda Equina Lesion); Pain referred from Abdominal or Pelvic Viscera or Vessels Perceived as Sacral Spinal Pain; Femoral Neuralgia; and, Sciatica Neuralgia.

22. The method as in claim 21 wherein the source for chronic pain indications is the International Association for the Study of Pain (IASP) chronic pain guidelines.

23. The method as in claim 1 wherein the patient population is selected from the group consisting of payer database, employer database, clinician database, and workers' compensation database.

24. A method for diagnosing and categorizing potential chronic pain patients, comprising:

accessing a chronic pain diagnosis model having direct medical indicia, indirect medical indicia, non-medical indicia, and a chronic pain indication that are arranged logic structure, with weighted variables, and equations representing relationship between or among the variables;

applying the chronic pain diagnosis model to potential chronic pain patients to create a patient mathematical expression for each member of the population;

diagnosing potential chronic pain patients by comparing each patient mathematical expression to selection objectives;

establishing categorization preferences that specify characteristics of patents that are desired to be categorized;

calculating the categorization preferences with each potential chronic pain patient's mathematical expression to identify relationships between the categorization preferences and each potential chronic pain patient's mathematical expression;

categorizing each potential chronic pain patient based upon the relationships between the categorization preferences and each potential chronic pain patient's mathematical expression; and,

monitoring the potential chronic pain patient's direct medical indicia, indirect medical indicia, and non-medical indicia for changes and updating the patient's mathematical expression based upon changes to the potential chronic pain patient's direct medical indicia, indirect medical indicia, and non-medical indicia.

25. A computer software product that includes a medium readable by a computer, the medium having stored thereon instructions for diagnosing patients in a population having a chronic pain condition, comprising:

a first set of instructions when executed by the computer, causes the computer access a chronic pain diagnosis model having direct medical indicia, indirect medical indicia, non-medical indicia, and a chronic pain indication that are arranged logic structure, with weighted variables, and equations representing relationship between or among the variables;

a second set of instructions when executed by the computer, causes the computer to applying the chronic pain diagnosis model to a potential chronic pain patient to create a patient mathematical expression for each potential chronic pain patient; and,

a third set of instructions when executed by the computer, cause the computer to diagnosis potential chronic pain patients by comparing each patient mathematical expression to selection objectives.

26. The computer software product as in claim 25, further comprising,

a fourth set of instruction when executed by the computer, cause the computer to establish categorization preferences that specify characteristic of patients that are desired to be categorized;

a fifth set of instruction when executed by the computer, cause the computer to calculate the categorization preferences with each diagnosed chronic pain patient's mathematical expression to identify relationships between the categorization preferences and each diagnosed chronic pain patient's mathematical expression; and,

a sixth set of instruction when executed by the computer, cause the computer to categorize each diagnosed chronic pain patient based upon the relationships between the categorization preferences and each potential chronic pain patient's mathematical expression.

27. A method for sensitivity analysis of a chronic pain patient model, comprising:

comparing the diagnosed chronic pain patients with outside diagnosed chronic pain patient data to create a patient error list;

applying an error assessment model to the patient error list to identify the non-corresponding patient indicia that contributed to the errors;

applying a sensitivity analysis model to the non-corresponding patient indicia to identify potential patient indicia changes to reduce errors in diagnosing chronic pain patients;

selecting at least one patient indicia change from the potential patient indicia changes to apply to the patient indicia; and,

modifying the patient indicia with the at least one selected patient indicia change.

28. The method as in claim 27, further comprising

applying a sensitivity analysis model to the weighted variables to identify potential weighted variable changes to reduce errors in diagnosing potential chronic pain patients;

selecting at least weighted variable change from the potential weighted variable changes to apply to the weighted variables; and,

modifying weighed variables to reflect greater or lesser relevance of patient indicia to reduce errors in diagnosing potential chronic pain patients.

* * * * *

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摘要(译)

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