

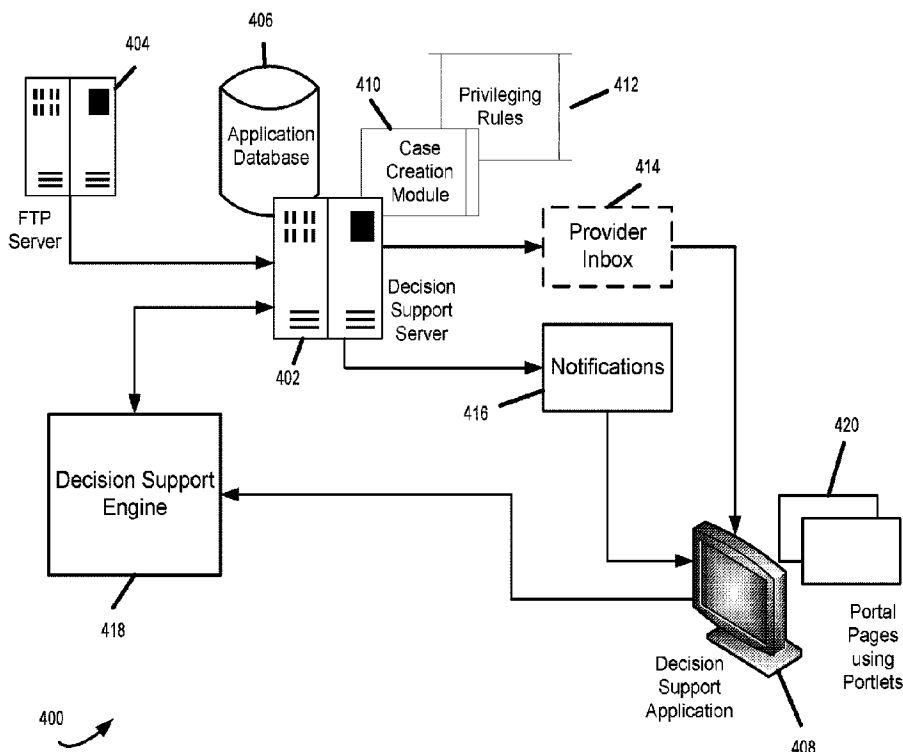


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(54) Title: DATA MANAGEMENT FOR GENETIC LABORATORY TESTING



(57) Abrégé/Abstract:

Aspects and features described herein can present a healthcare provider with information to support a decision, for example, a decision relating to one or more genetic tests for a patient. A processing device in a system can receive an order request from an electronic device associated with a provider, where the order request corresponds to a genetic laboratory test requested by a healthcare provider. The processing device can create and store a decision report request file corresponding to the genetic laboratory test and determine if the provider patient electronic health record is compatible with the decision report request file. The processing device can also populate a decision support application programming interface (API) corresponding to the provider if the provider patient electronic health record is compatible with the decision report request file.

Abstract

Aspects and features described herein can present a healthcare provider with information to support a decision, for example, a decision relating to one or more genetic tests for a patient. A processing device in a system can receive an order request from an electronic device associated with a provider, where the order request corresponds to a genetic laboratory test requested by a healthcare provider. The processing device can create and store a decision report request file corresponding to the genetic laboratory test and determine if the provider patient electronic health record is compatible with the decision report request file. The processing device can also populate a decision support application programming interface (API) corresponding to the provider if the provider patient electronic health record is compatible with the decision report request file.

DATA MANAGEMENT FOR GENETIC LABORATORY TESTING

FIELD

[0002] The present application generally relates to healthcare information and more specifically relates to systems and methods and media that provide enhanced test data management to healthcare providers. This disclosure further relates to systems, methods and media that facilitate exchange of data between systems, including those of genetic counselors, health insurers/insurance plans, laboratories, and/or patients.

BACKGROUND

[0003] Health care providers desire to provide the best care to their patients and, in doing so, often need to select laboratory tests. It is advantageous for health care providers to select the optimal test, or tests, for their patient, to know the proper timing of selected tests, to be able to differentiate the labs that have the expertise to perform the selected tests, and to understand insurance coverage relating to laboratory tests. In the case of molecular or genetic testing it is important to be able to deliver test results to providers and patients in a timely and efficient manner, with enough information about the test results to facilitate appropriate use and understanding of the test results.

SUMMARY

[0004] Various examples of systems and methods for genetic test data management are disclosed herein. In some examples a system includes a processing device, and a non-transitory computer-readable medium communicatively coupled to the processing device, wherein the non-transitory computer-readable medium includes computer program code executable by the processing device to cause the processing device to perform operations. The operations include receiving an order request from an electronic device associated with a provider, where the order

request corresponds to a genetic laboratory test requested by the provider. The operations also include creating and storing a decision report request file corresponding to the genetic laboratory test and determining if the healthcare provider patient electronic health record is compatible with the decision report request file. The operations further include populating a decision support application programming interface (API) corresponding to the provider if the provider patient electronic health record is compatible with the decision report request file.

[0005] In some examples, the processing device sends a batch file including the decision report request file to a stored inbox when the patient electronic health record is not compatible with the decision report request file. In some examples, the processing device sends a notification of the existence of the batch file to the electronic device associated with the provider. In some examples, the processing device identifies the provider using a national provider identifier (NPI). In some examples, the processing device checks for errors using fuzzy logic, common-service data access object pattern recognition, or both. In examples, the processing device generates a web portal in a number of portal pages provided to the electronic device associated with the provider in a number of portal pages presented by the use of portlets.

[0005a] In a broad aspect, moreover, the present invention relates to a system comprising: a processing device; and a non-transitory computer-readable medium communicatively coupled to the processing device, wherein the non-transitory computer-readable medium includes computer program code executable by the processing device to cause the processing device to perform operations comprising: receiving an order request and patient information in a clustered server environment from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider; producing index information using a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test; storing the index information in a cache; generating, using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processing device to prompt a review by a genetic counselor; producing, using the index information from the cache, a decision report request file corresponding to the genetic laboratory test; determining whether a healthcare provider patient electronic health record is compatible with the decision report request file; populating a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on

determining whether the healthcare provider patient electronic health record is compatible with the decision report request file; receiving a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API; dynamically generating a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties; formatting at least one test report of the plurality of test reports for SMS or an automated phone call; and selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

[0005b] In another broad aspect, the present invention relates to a method comprising: receiving, in a clustered server environment, by a processing device, an order request and patient information from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider; producing index information using the processing device and a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test; storing by the processing device, the index information in a cache; generating, by the processing device using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processing device to prompt a review by a genetic counselor; producing, by the processing device using the index information from the cache, a decision report request file corresponding to the genetic laboratory test; determining, by the processing device, whether a healthcare provider patient electronic health record is compatible with the decision report request file; and populating, by the processing device, a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file; receiving, by the processing device, a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API; dynamically generating, by the processing device, a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties; formatting at least one test report of the plurality of test reports for SMS or an automated phone

call; and selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

[0005c] In another broad aspect, the present invention relates to a non-transitory computer-readable medium storing program code executable by a processor to perform operations, the operations comprising: receiving an order request and patient information in a clustered server environment from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider; producing index information using a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test; storing the index information in a cache; generating, using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processor to prompt a review by a genetic counselor; producing, using the index information from the cache, a decision report request file corresponding to the genetic laboratory test; determining whether a healthcare provider patient electronic health record is compatible with the decision report request file; populating a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file; receiving a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API; dynamically generating a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties; formatting at least one test report of the plurality of test reports for SMS or an automated phone call; and selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

[0006] These illustrative examples are mentioned not to limit or define the scope of this disclosure, but rather to provide examples to aid understanding thereof. Illustrative examples are discussed in the Detailed Description, which provides further description. Advantages offered by various examples may be further understood by examining this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The accompanying drawings, which are incorporated into and constitute a part of this specification, illustrate one or more certain examples and, together with the description of the example, serve to explain the principles and implementations of the certain examples.

[0008] FIG. 1 shows a system for managing genetic test information and according to an example.

[0009] FIG. 2 shows a system for managing genetic test data according to an example.

[0010] FIG. 3 is a flowchart illustrating an example of a method 300 for providing enhanced decision support for genetic testing.

[0011] FIG. 4 shows a system for managing genetic test data according to an additional example.

[0012] FIG. 5 is a flowchart illustrating an example of a process for delivery and display of decision support request files, which may include genetic test information.

DETAILED DESCRIPTION

[0013] Examples are described herein in the context of systems and methods for managing genetic testing data. The following description is illustrative only and is not intended to be in any way limiting. Reference will now be made in detail to implementations of examples as illustrated in the accompanying drawings. The same reference indicators will be used throughout the drawings and the following description to refer to the same or like items.

[0014] In some aspects, systems, methods and media that, present a health care provider with information to support a decision, for example, a decision relating to one or more genetic tests for a patient. In additional aspects, systems, methods and media that advantageously allow interaction between and/or among a health care provider, a laboratory and/or a health plan.

[0015] As used herein health care provider refers to an individual or an institution that provides preventive, curative, promotional, or rehabilitative health care services to individuals, families or communities. An example of a health care provider includes, but is not limited to, a physicians, a physician's assistant, a nurse, a nurse's aide, a pharmacist, a pharmacist's assistant, a dentist, a dentist's assistant, a dental hygienist, a laboratory technician, a physical therapist, an occupational therapist, a genetic counselor, and the like. As used in the present application, health care provider also includes administrative and other staff who may work with a health care provider.

[0016] As used herein, patient information may comprise medical information and refer to information relating to a patient's individual and/or family medical history, including but not limited to, physical characteristics such as height, weight, eye color, hair color, tattoo's, birthmarks; genetic information; test information such as temperature, blood pressure, resting pulse, clinical test results; disease states past or present; pregnancy information; and similar information generally found in a health care record maintained by a health care provider and/or an insurer, and/or an electronic medical record.

[0017] As used herein, health plan, health insurance and/or health insurance plan, are used interchangeably to refer to a type of insurance coverage that pays for medical, surgical and/or laboratory expenses incurred by the insured. Examples of health plans in the US include

government plans such as Medicare; Medicaid; Veterans Health Benefits; Active Duty Service Personnel Health Benefits; Federal Employees Health Benefits; and private, or semi-private, plans offered by companies such as UnitedHealth Group; Wellpoint, Inc. Group; Kaiser Foundation Group; Humana Group; HCSC Group; Coventry Corp. Group; Highmark Group; Blue Cross Blue Shield Group, and others. As used herein, health insurance and/or health insurance plan also includes employer self-insured plans.

[0018] As used herein Laboratory includes, for example, a diagnostic laboratory that provides diagnostic testing, information and services that patients and health care providers use to improve health care related decision-making by examining materials derived from the human body for the purpose of providing information on diagnosis, prognosis, prevention, or treatment of disease. Examples of diagnostic tests are set forth below and include, but are not limited to, molecular and/or genetic testing, that aid in the screening for, detection of and/or prognosis for and/or recovery from disease states. The terms molecular and genetic when used to refer to a type of medical test are used herein synonymously. Genetic testing is testing aimed at providing information about a subject's genetic makeup. Since a subject's genes take the physical form of organic molecules, genetic testing can sometimes be referred to as molecular testing. As will be appreciated from the description herein, the foregoing definition is meant to provide a non-limiting general understanding of the nature and types of laboratories and laboratory tests that may be encompassed in examples of the present invention.

[0019] Suitable electronic devices include, but are not limited to, computer terminals, personal computers, tablets, smart phones and/or similar devices capable of providing information in a human readable format and receiving input from a human.

[0020] Patient information may comprise at least one datum from the data typically found on a patient's paper and/or electronic medical record, and/or a patient's paper and/or electronic health record relating to the patient's identification, physical characteristics, test results, medical conditions, medical history and/or care over time, and/or at least one datum related to a patient's current medical status or condition, including, but not limited to: a vital sign, including, but not limited to, body temperature, pulse rate (heart rate), blood pressure, respiratory rate, hemoglobin oxygen saturation and the like; intake: medication, fluid, nutrition, water and blood, etc.; output: blood, urine, excrement, vomitus, sweat, etc.; observation of pupil size; and/or capability of four limbs of body.

[0021] As understood by those of ordinary skill in the art, a patient's medical history may comprise a longitudinal record of what has happened to the patient since birth. For example, a patient's medical history may comprise information relating to diseases, major and minor illnesses, as well as growth landmarks. Medical history may include, but is not limited to, surgical history (a chronicle of surgery performed for the patient, dates of operations, operative reports, and/or the detailed narrative of what a surgeon did); obstetric history (prior pregnancies and their outcomes. It also includes any complications of these pregnancies); medications and medical allergies (a summary of the patient's current and previous medications as well as any medical allergies); family history (the health status of immediate family members as well as their causes of death (if known) and/or a list diseases common in the family or found only in one sex or the other and/or a pedigree chart); social history (a chronicle of human interactions, the relationships of the patient, his/her careers and trainings, schooling and religious training); habits (for example habits which impact health, such as tobacco use, alcohol intake, exercise and diet, and possibly sexual habits and sexual orientation); immunization history (history of vaccination and/or any blood tests proving immunity); growth chart and developmental history; medical encounters (discrete summations of a patient's medical history by a health care provider, e.g. a physician, nurse practitioner, or physician assistant using, for example a so-called SOAP (subjective, objective, assessment, and plan) including, for example, the chief complaint, history of the present illness, physical examination; assessment and plan); orders and prescriptions (orders by medical providers, including instructions given to other members of the health care team by a primary provider); progress notes (daily updates are entered into the medical record documenting clinical changes, new information, etc. often in the form of a SOAP note); laboratory test information (dates and results of testing, such as blood tests (e.g., complete blood count) radiology examinations (e.g., X-rays), pathology (e.g., biopsy results), or specialized testing (e.g., pulmonary function testing)); other information (including, but not limited to digital images of the patient, flowsheets from operations/intensive care units, informed consent forms, EKG tracings, outputs from medical devices (such as pacemakers), chemotherapy protocols, and the like).

[0022] Laboratory information may comprise at least one datum from data relating to a laboratory, for example a laboratory offering diagnostic testing, information and services that patients and health care providers use to improve health care related decision-making by

examining materials derived from the human body for the purpose of providing information on diagnosis, prognosis, prevention, or treatment of disease. The data relating to a laboratory may include, but is not limited to, data relating to: test offerings, expertise, location, contact information, processing time, sample collection, insurance reimbursement, insurance network coverage, as well as detailed information relating to specific tests and the relationship between published medical and/or scientific literature and a test or tests, and/or specific medical conditions.

[0023] Health plan information may comprise at least one datum from data relating to a health plan and/or a health insurance plan including, but not limited to, benefit information, coverage information, co-pay information, reimbursement information, claim information, claim processing time, test approval information, frequently asked questions, contact information and/or similar information relating to patient coverage.

[0024] A network comprises a plurality of computing devices, including, but not limited to, computers, personal computers, mini-computers, mainframes, tablets, smart phones, storage devices (e.g. RAID devices), and similar hardware, interconnected by communication channels that allow sharing of resources and information. The communication channels may be wired or wireless. Communication protocols define the rules and data formats for exchanging information in a computer network and provide the basis for network programming. Typical communications protocols include two Ethernet, a hardware and link layer standard that is ubiquitous in networks, and the Internet protocol suite, which defines a set of protocols for internetworking, i.e. for data communication between multiple networks, as well as host-to-host data transfer, and application-specific data transmission formats. In an example of the present invention, a network may: facilitate communication; permit sharing of files, data and other types of information; allow a user, e.g. a health care provider, employee of a healthcare provider, or a similar individual who is using the system, to access information stored on other computers on the network; allow a user, e.g. a health care provider to share computing resources; and/or provide other features.

[0025] In some aspects, a database, or a plurality of databases, can comprise patient information data, laboratory information data and/or health plan information data. The database, or plurality of databases, may be located on a single computing device or a plurality of computing devices. A laboratory computing device can comprise laboratory information data

and/or health plan information data. A health plan computing device can comprise health plan information data, patient information data and/or laboratory information. A health care provider computing device can include patient information data, health plan information data and/or laboratory information data. A service provider computing device can aggregate, and/or provide links to health care provider, health plan and/or laboratory computing devices, comprising patient information data, laboratory information data and/or health plan information data.

[0026] The process of receiving input from a health care provider may include a health care provider providing data relating to a relatively current patient condition. The input may be provided directly by the health care provider, and/or the input may be made to a patient medical record and comprise patient information.

[0027] In some examples, output may comprise laboratory information and/or health plan information and may further comprise options for patient care. By way of a non-limiting example, output may present a health care provider with an option and/or options for a diagnostic test, including a molecular or genetic test, a laboratory qualified to perform the diagnostic test and/or plan coverage information from a patient's health plan relating to coverage for the diagnostic test. Output may advantageously assist and/or support a health care provider's decision making

[0028] Reference will now be made in detail to implementations of example examples as illustrated in the accompanying drawings. The same reference indicators will be used throughout the drawings and the following description to refer to the same or like items.

[0029] In the interest of clarity, not all of the routine features of the implementations described herein are shown and described. It will, of course, be appreciated that in the development of any such actual implementation, numerous implementation-specific decisions must be made in order to achieve the developer's specific goals, such as compliance with application- and business-related constraints, and that these specific goals will vary from one implementation to another and from one developer to another.

[0030] In some examples, a health care provider uses an electronic device to access a website for to access patient information, laboratory information and/or health plan information. The health care provider can use the electronic device to determine one or more possible laboratory tests through the website. For example, the health care provider can use the electronic device to select or send medical information — such as one or more medical classification codes,

symptoms, diseases, historical medical information for a patient, etc. — to a server. In response to receiving the medical information, the server can determine one or more possible molecular or genetic laboratory tests. For example, the server may use the received medical information to query a data store comprising a plurality of molecular or genetic laboratory tests to determine one or more possible laboratory tests. The determined one or more possible laboratory tests can be based at least in part on the received medical information. At least one of the determined possible laboratory tests can be sent to the electronic device by the server.

[0031] In some examples, a patient's electronic health record may not be sufficiently compatible with examples of laboratory test ordering and/or reporting systems to directly populate the patient electronic health record as displayed in the API of the decision support application with laboratory test results. By way of an illustrative example, in this type of situation, patient and test information for a health care provider's practice may be sent as a batch file to the health care provider's system, e.g. a system of the present invention. The health care provider may receive notification of the existence and transmittal of the batch file, for example, via an Email communication.

[0032] If the health care provider's system supports decision support, upon a user logging in to the system, the user may receive notification of existence of the batch file, and upon the user's direction, a case in the decision support system may be populated with patient and test information from the batch file.

[0033] As will be recognized, implementation of molecular or genetic test data management may be accomplished using the features and aspects described herein. Among the advantages of this example are that the system allows decision support in an environment where complete integration of features relative to genetic testing and results may not be possible thereby increasing the ability of users to receive decision support; and that decision support may be implemented in such an environment while minimizing the need for laboratories to populate a decision support system with manual intervention.

[0034] FIG. 1 is a system 100 diagram depicting exemplary computing devices in an exemplary computing environment according to one example. The system 100 shown in FIG. 1 includes a network 105 in communication with various devices associated with health care providers, e.g. doctor offices 110, hospitals 120, patients 140, customer representatives 150, which may comprise health care provider customer representatives, laboratory customer

representatives, and/or health plan customer representatives, health plan providers 160, internal labs 170, and external labs 180. The various devices that network 105 is in communication with include, but are not limited to, a desktop computer (e.g. 155), a tablet computer (e.g. 130), or a mobile phone (e.g. 145). The network 105 in FIG. 1 is also in communication with a server 190 and the server 190 is in communication with a data store 195. The network 105 may be in communication with other networks such as, for example, network 125 which associated with the hospital 120. In examples, the various devices can send and receive messages with other devices associated with network 105. Thus, a desktop computer 115 in the doctor's office 110 is to communicate with server 190 through the network 105. As another example, a desktop computer 175 associated with an internal laboratory 170 may be able to receive information from data store 195 or store information to data store 195, or both, through the network 105 and the server 190.

[0035] Various devices including, but not limited to, desktop computer 115, tablet computer 130, and mobile phone 145, may be any device capable of communicating with a network, such as network 105, and capable of sending and receiving information to and from another device. For example, in FIG. 1, one device may be a tablet computer 130. The tablet computer 130 includes a touch-sensitive display and capability of communicating with network 105 through network 125 for example through the use of a wireless network interface card. Another device shown in FIG. 1 is a desktop computer 115. The desktop computer 115 has a display and is connected to network 105 through a wired network connection. The desktop computer 115 may be in communication with any number of input devices such as a keyboard or a mouse. In various examples, tablets, desktop computers, or other suitable computing devices may be associated with one or more health care providers, patients, customer representatives, health plan providers, internal labs, external labs, or other users.

[0036] In examples, network 105 shown in FIG. 1 facilitates communications between the various devices (i.e. 145, 155, 175, 185, etc.) and server 190. The network 105 may be any suitable number or type of networks or links, including, but not limited to, a dial-in network, a local area network (LAN), wide area network (WAN), public switched telephone network (PSTN), the Internet, an intranet or any combination of wired and/or wireless communication links. In one example, the network 105 may be a single network. In other examples, the network 105 may comprise two or more networks. For example, the various devices may be

connected to a first network, such as network 125, and the server 190 may be connected to a second network, such as network 105, and the first and the second network may be connected. Numerous other network configurations would be obvious to a person of ordinary skill in the art.

[0037] In examples, network 125 shown in FIG. 1 facilitates communications between the various devices (i.e. 130, 135, 145 etc.) and server 190. The network 125 may also be any suitable number or type of networks or links, including, but not limited to, a dial-in network, a local area network (LAN), wide area network (WAN), public switched telephone network (PSTN), the Internet, an intranet or any combination of wired and/or wireless communication links. In one example, the network 105 may be a single network. In other examples, the network 105 may comprise two or more networks. For example, various devices may be connected to a first network, such as network 125, and the server 190 may be connected to a second network, such as network 105, and the first and the second network may be connected.

[0038] In FIG. 1, network 125 is associated with hospital 120. In examples, any number of entities may be associated with one or more networks. For example, a network associated with customer representative 150 may be in communication with network 105. Likewise, a network associated with an external laboratory 180 may be associated with network 105. Numerous other networks associated with entities — such as a doctor's office 110, a health plan provider 160, patient 140, or internal laboratory 170 — and connected with network 105 may be present in various examples. Other network configurations would be obvious to a person of ordinary skill in the art.

[0039] In some examples, communication between devices, networks, or entities, or some combination thereof, may be facilitated by the Internet. For example, network 105 may be in communication with network 125 through the Internet. In some examples, such communication may be secure. For example, a hypertext transfer protocol secure (HTTPS) may be used to provide encrypted communication between various devices, networks, or entities, or some combination thereof. In another example, a virtual private connection (VPN) may be used to provide communication. For example, a gateway associated with network 125 can be in communication with a gateway associated with network 105 through a VPN connection. In one example, a VPN connection may contain a single tunnel connection. To at least provide redundancy, however, a VPN connection may comprise two or more tunnel connections. Thus,

if one tunnel connection in the VPN connection fails, communication may still be successful through the other tunnel connection.

[0040] The server 190 shown in FIG. 1 may be any device capable of communicating with a network, such as network 105, and capable of sending and receiving information to and from another device. For example, in the example shown in FIG. 1, the server 190 may receive a request from various devices such as tablet computer 130, desktop computer 155, or other devices. In this example, the server 190 may respond to the request by sending information back to the requesting device through the network 105. Thus, if server 190 receives a request from desktop computer 115 associated with doctor office 110 through network 105, then the server 190 may process the request including performing any necessary communication with any other device and respond to the request by sending a response back to the desktop computer 115 through the network 105. In an example, the server 190 can communicate with a gateway associated with the server and network 105. The server 190 may be in communication with one or more data stores, such as data store 195. Server 190 and other servers may implement a decision support server and a decision support engine as described later with respect to FIG. 4.

[0041] In examples, server 190 may be in communication with one or more additional devices, such as additional servers. In some examples, server 190 may communicate with one or more additional devices to process a request received from another device. For example, the server 190 in FIG. 1 may be in communication with a plurality of additional servers, at least one of which may be used to process at least a portion of a request received from another device, such as tablet computer 130, or desktop computer 175. In other examples, the server 190 may send a request to one or more devices and process any response received from the device or devices. For example, server 190 may send a request to desktop computer 135 associated with hospital 120. In this example, the server 190 may receive a response from the desktop computer 135 and process the response. For example, the server 190 may store information related to the response in data store 195.

[0042] Server 190 in this example includes a processing device 198 and computer program code instructions 199 installed in a non-transitory memory device such as a storage medium or electronic, non-volatile memory. The computer program code instructions can include a utility for receiving a directory file from a laboratory such as internal laboratory 170 or external laboratory 180, for example, through an FTP server. The computer program instructions

are executed by the server to parse the directory file to identify test data elements corresponding to the test identifier for each test and compare the test data elements for each test identifier to data elements for decision support tests used by for laboratory management. Computer program code instructions 199 can include a mapping engine with auto-mapping rules that compare each laboratory's tests to the rules to determine how to map the laboratory's test to a decision support test and to ultimately generate one or more decision support maps, which is used when tests are selected by health care providers. Computer program code instructions 199 can further include instructions for creating decision report request file in a required format, such as a format where one request file can include multiple or all genetic tests ordered or where there is one decision report request file for each genetic test ordered. The computer program code instructions 199 can include instructions to implement the function of a decision support server and/or a decision support engine as discussed below with respect to FIG. 4 and FIG. 5.

[0043] The system 100 shown in FIG. 1 includes a data store 195. The data store 195 can include numerous separate data stores, data tables, databases, or other data storage mechanisms and media for storing data relating to particular aspects of one or more of the examples disclosed herein. The architecture depicted in FIG. 1 is merely illustrative, and examples may be implemented using various different architectures.

[0044] A processing device such as processing device 198 of FIG. 1 can include a microprocessor, embedded controller, digital signal processor, or specifically-configured hardware, such as field-programmable gate array (FPGA) specifically to execute the various methods. For example, examples can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in a combination thereof. In one example, a device may include a processor or processors. The processor includes a computer-readable medium, such as a random access memory (RAM) coupled to the processor. The processor executes computer-executable program instructions stored in memory. Such processors may comprise a microprocessor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), field programmable gate arrays (FPGAs), and state machines. Such processors may further comprise programmable computing devices such as PLCs, programmable interrupt controllers (PICs), programmable logic devices (PLDs), programmable read-only memories (PROMs), electronically programmable read-only memories (EPROMs or EEPROMs), or other similar devices.

[0045] Such processors may include, or may be in communication with, media, for example, a non-transitory computer-readable storage medium, that may store instructions that, when executed by the processing device, can cause the processing to perform the operations described herein as carried out, or assisted, by the processing device. Examples of computer-readable media may include, but are not limited to, an electronic, optical, magnetic, or other storage device capable of providing a processor with computer-readable instructions. Other examples of media comprise, but are not limited to, a floppy disk, CD-ROM, magnetic disk, memory chip, ROM, RAM, ASIC, configured processor, all optical media, all magnetic tape or other magnetic media, or any other medium from which a computer processor can read. The processor, and the processing, described may be in one or more structures, and may be dispersed through one or more structures.

[0046] FIG. 2 is a diagram illustrating an example of a system 200 comprising various data stores 205, 280-290 that can store information. In the system 200 shown in FIG. 2, a laboratory management data store 205, a health care provider data store 280, a health plan provider data store 285, and a laboratory data store 290 are in communication with each other through network 275. Information stored in a data store may be accessed by one or more other data stores. For example, information stored in the health plan provider data store 285 may be accessed by the laboratory management data store 205. In examples, information stored in the laboratory management data store 205 may be accessed by the health plan provider data store 285. Information may be sent to or saved by, or both, one or more data stores from another data store. For example, information regarding a laboratory testing order may be sent by the health care provider data store 280 through network 275 the laboratory management data store 205. In this example, the laboratory management data store 205 may store laboratory testing order data to the orders database 245. In another example, information regarding the results of a laboratory test may be sent from laboratory management data store 205 to health care provider data store 280. In various examples, information stored in data stores 205, 280, 285, and 290 may contain information stored in data store 195 shown in FIG. 1 according to various examples.

[0047] In examples, network 275 shown in FIG. 2 facilitates communications between the various data stores 205, 280, 285, and 290. The network 105 may be any suitable number or type of networks or links, including, but not limited to, a dial-in network, a local area network (LAN), wide area network (WAN), public switched telephone network (PSTN), the Internet, an

intranet or any combination of wired and/or wireless communication links. In one example, the network 105 may be a single network. In other examples, the network 105 may comprise two or more networks. For example, the various devices may be connected to a first network, such as network 125, and the server 190 may be connected to a second network, such as network 105, and the first and the second network may be connected. Numerous other network configurations would be obvious to a person of ordinary skill in the art.

[0048] In the example shown in FIG. 2, the laboratory management data store 205 comprises information related to various aspects of a laboratory management system. The laboratory management data store 205 in FIG. 2 comprises information related to health care providers 210. For example, information related to health care providers 210 can include names, addresses, phone numbers, personnel, usernames, passwords, other security information, access levels, and other information associated with one or more providers. The laboratory management data store 205 in FIG. 2 contains information related to patients 215. Information related to patients 215 may include patient names, addresses, telephone numbers, providers to which the patients are associated, medical history, medications, relatives, health care provider plans, account balances, access information, or other information related to one or more patients.

[0049] In FIG. 2, the laboratory management data store 205 includes information related to health plan providers 220. For example, information related to health plan providers can include insurance companies, various insurance plans, payment information for laboratory tests, information related to one or more patients, deductible information, testing notification data, or other information associated with one or more health plan providers. The laboratory management data store 205 in FIG. 2 comprises information related to medical codes 230. Such information may include medical classifications for diseases, signs, symptoms, potential causes of injury, potential causes of one or more diseases, testing procedures, laboratory tests, other coding information, or a combination thereof. For example, in one example, information related to medical codes 230 can include data from the International Statistical Classification of Diseases and Related Health Problems (ICD) such as the ICD-9 medical classification list or the ICD-10 medical classification list or future versions of ICD or other codes. Such codes may be referred to herein as medical or diagnosis codes. In another example, information related to medical codes 230 may include data such as the American Medical Association's (AMA) CPT data code files that provide at least a list of CPT procedural codes.

[0050] The laboratory management data store 205 in FIG. 2 contains policies database 240. A policy may comprise evidence based guidelines for one or more diseases, illnesses, medical tests, etc. In one example, information related to policies database 240 includes information that may be used to offer suggestions regarding tests or procedures that are typically followed for a particular illness, system or set of symptoms, or other evidence-based information. These tests can include genetic tests. In one example, a set of questions related to one or more policies, illnesses or one or more symptoms may be stored in database 240. The laboratory management data store 205 in FIG. 2 includes information related to orders 245. For example, information related to orders 245 can include information related to health care providers that have placed an order, information related to patients for which an order has been placed, information related to the tests that have been performed, billing information, payment information, accounts receivable information, order status, one or more laboratories associated with orders, test results, or a combination thereof.

[0051] The laboratory management data store 205 in FIG. 2 comprises information related to laboratories 250. For example, a laboratories database 250 may contain information such as location, costs for various tests, turnaround time, type of tests performed, current capacity levels, historical information related to tests that have been performed by one or more laboratories, current information regarding one or more orders such as order statuses, addresses, personnel, contacts, usernames, passwords, other identification, or other laboratory information. In examples, the laboratories database 250 may contain information to distinguish internal laboratories from external laboratories. Internal laboratories can include laboratories owned by or affiliated with one or more organizations operating a laboratory benefits management system. For example, if an organization is operating the laboratory benefits management system described herein and the organization owns a laboratory, in one example, the laboratory can be considered an internal laboratory. Examples of external laboratories can include laboratories not owned or operated by an organization operating the laboratory benefits management system. For example, in one example, an organization may own several laboratories, but none of the internal laboratories perform a particular test that has been ordered. In this example, the laboratories database 250 may contain information for an external laboratory that has the capability to perform the test. Numerous other examples or additional information that may be stored in the laboratories database 250 will be obvious to one of skill in the art.

[0052] The laboratory management data store 205 in FIG. 2 contains information related to laboratory test results 260, including genetic test results. Information related to laboratory test results 260 can include information such as the actual results of the test, suggested follow-up tests, historical information based on past test results, diagnostic information, information related to medical guidelines or thresholds for one or more tests, and other information related to test results. The laboratory management data store 205 in FIG. 2 includes information related to claims from claims database 270. For example, information related to claims can include the payment status for claims, whether the claim has been submitted to a health plan provider, eligibility verification information, benefits determination information, whether a claim requires editing, whether the claim needs or has been adjusted, or other information related to one or more claims.

[0053] The laboratory management data store 205 in FIG. 2 contains a decision support module 272. This decision support module includes computer program code instructions that can be executed on a processing device of a decision support server connected to a decision support engine and includes support for molecular or genetic testing in addition to other laboratory testing. A typical laboratory management data store 205 may contain multiple genetic support modules. A decision support module is a stored file that includes data describing correlations of test identifiers for a laboratory or laboratories to decision support tests as well as to information such as whether additional information such as guidelines for using or interpreting the genetic test results should be provided with the test results, or whether a genetic counselor should be engaged. Genetic laboratory tests ordered within the laboratory management system can be correlated to specific test identifiers, information, and genetic counselor recommendations for test laboratories using the decision support system.

[0054] In various examples, information stored in data stores 205, 280, 285, and 290 may contain information stored in data store 195 shown in FIG. 1 according to various examples. It should be understood that there can be many other aspects that may need to be stored in data stores 205, 280, 285, or 290, or some combination thereof. In various examples, information shown in data store 205 may be stored in any number of data stores including, but not limited to, data store 280, 285, or 290. In some examples, data store 205 may access or store information, or both, in one or more data stores, such as data store 280, 285, or 290. For example, in one example, data store 290 may contain laboratory test results 260. In this example, data store 205

may be able to access information or store information related to laboratory test results 260 by accessing data store 290 through network 275. One or more data stores may be associated with any number of entities. For example, data store 280 may be associated with a health care provider such as a hospital or a doctor's office. In one example, data store 280 may be associated with a hospital and one or more satellite branches such as other facilities located in surrounding communities. In other examples, data store 280 may be associated with multiple hospitals or other facilities owned, affiliated with, or related to one another. Data store 285 may be associated with a health plan provider such as an insurance company. Data store 290 may be associated with one or more labs such as an internal laboratory or an external laboratory. It should be understood that information may be stored in any appropriate mechanisms or in additional mechanisms in one or more of data stores 205, 280, 285, or 290.

[0055] Referring back to FIG. 1, data store 195 is operable, through logic associated therewith, to receive instructions from various devices — such as server 190, other data stores, networks 105 or 125, other devices (i.e. 130, 145, 175, etc.), or a combination thereof — and obtain, update, or otherwise process data in response thereto. As one example, a doctor's office 110 may obtain laboratory information using desktop computer 115 to the server 190 through network 105. In this case, the server 190 may process the order at least by querying the data store 195 to verify the identity of the doctor's office and, if the doctor's office is authorized, process the request for information. It should be understood that there can be many other aspects that may need to be stored in the data store 195, such as page image information or access rights information, which can be stored in any appropriate mechanisms or in additional mechanisms in the data store 195.

[0056] In FIG. 1, numerous entities, such as hospital 120 and internal laboratory 170, are shown. In various examples, any number of entities may be associated with network 105 or can send information to server 190 or receive information from server 190, or some combination thereof. In the example shown in FIG. 1, health care providers, including hospital 120 and doctor office 110, health plans, laboratories, as well as patient 140 are in communication with network 105. A health care provider can be any personnel or facility that provides health care services to one or more patients. A patient can be anyone who receives treatment from a health care provider. In FIG. 1, a customer representative 150 is in communication with network 105. In examples, a customer representative 150 may be one or more companies or individuals that

provide support to patients 140 or entities (i.e. hospital 120, internal laboratory 170, health plan provider 160, etc.), or both. For example, a health plan provider 160 may call a customer representative 150 to verify the status of a laboratory test that was ordered for a patient, and/or to obtain benefit information based on patient information, laboratory information and/or health provider information. Numerous entities may be in communication with network 105, additional networks, other entities, or additional devices according to various examples of the present invention.

[0057] The environment in an example is a distributed computing environment utilizing several computer systems and components that are interconnected via communication links, using one or more computer networks or direct connections. However, it will be appreciated by those of ordinary skill in the art that such a system could operate equally well in a system having fewer or a greater number of components than are illustrated in FIG. 1. Thus, the depiction of the system 100 in FIG. 1 should be taken as being illustrative in nature, and not limiting to the scope of the disclosure.

[0058] In an example the system comprises a web portal. The web portal may be horizontal or vertical, or a combination of a horizontal portal and a vertical portal. A health care provider may access patient information, health plan information and/or laboratory information through the portal. In an example, a health care provider may be presented with a single web page that brings together and/or aggregates content from other systems and/or servers, and/or a database, or databases, that include patient information, health plan information and/or laboratory information. A web portal may also be configured to provide an example or examples of application functionality described herein (e.g. to perform a method of the present invention). In this type of example, the web portal may be hosted on a portal server that includes connectivity to an application server.

[0059] By way of example, service-oriented architecture (SOA) is one example of how a portal can be used to deliver application server content and functionality. The application server or architecture performs the actual functions of the application. This application server is in turn connected to database servers and may be part of a clustered server environment. High-capacity portal configurations may include load balancing equipment. SOAP, an XML-based protocol, may be used for servers to communicate within this architecture. The server hosting the portal may only be a “pass through” for the user. By use of portlets, application functionality can be

presented in any number of portal pages. For the most part, this architecture is transparent to a user.

[0060] An example of the operation of a laboratory benefit management system according to one example of a method is set forth below. The example will be described with respect to the environment shown in FIG. 1.

[0061] A method begins when a patient visits a health care provider. For example, referring to FIG. 1, the patient 140 may visit a health care provider physician at a doctor's office 110. Once the patient visits the health care provider 110, the health care provider reviews patient information, and may input additional patient information, for example in conjunction with an examination of the patient. For example, referring to FIG. 1, the physician at the doctor's office 110 may determine that the patient's current symptoms and medical history. The physician could access an example of the present invention through a web portal on a computing device, 115. The physician could access patient information through the web portal and could also access health plan information and/or laboratory information. The physician, and/or another health care provider, may also input new patient information, including the patient's medical condition through the web portal. The patient information, including updated patient information, health plan information and laboratory information are received and/or accessed.

[0062] Patient information and/or health plan information may be reviewed, input and/or communicated by any number of persons. For example, referring to FIG. 1, personnel in the doctor's office 110 may review, input and/or communicate medical information, e.g. through a portal. In examples, a physician, a nurse, an administrative assistant, other office personnel, or other persons associated with a health care provider may review, input and/or communicate patient information and/or health plan information through one or more electronic devices, such as devices 130, 135, 115 shown in FIG. 1 or another suitable electronic device. For example, a physician, a physician's assistant and/or a nurse may review and/or input patient information, such as one or more current symptoms for a patient, and communicate patient information via an electronic device and the physician, physician's assistant and/or a nurse may be presented with laboratory test options on the electronic device in view of the communication. In another example, a physician, a physician's assistant and/or a nurse physician may communicate patient information and a desired genetic laboratory test via an electronic device and the physician,

physician's assistant and/or nurse may be presented with one or more alternatives for additional and/or replacement genetic laboratory tests based at least in part on the received communication.

[0063] Patient and/or health plan information may be sent in any number of ways. In one example, personnel associated with a health care provider may use one or more devices to electronically send information to an organization. For example, referring to FIG. 1, a nurse associated with doctor's office 110 may use desktop computer 115 to send an email to a laboratory benefits organization associated with server 190 and the email may contain patient and/or health plan information. In another example, a person communicating patient information and/or health plan information may visit a website designed to receive the information. For example, referring again to FIG. 1, a doctor may visit a website associated with a laboratory benefits organization using desktop computer 115 by sending a request to server 190 through network 105. In response to the request, the server 190 may send a response to the desktop computer 115 through network 105. The website may contain one or more security measures, such as requiring a username and password or a digital certificate, to verify the authenticity of the doctor submitting the information. For example, the server 190 may access data store 195 to determine whether information received from the desktop computer 115 associated with the doctor's office 110 successfully authenticates a user of the desktop computer 115. In this example, once the authenticity of the doctor has been verified, the website may contain one or more forms that the doctor can fill out to input patient information for one or more patients. In another example, patient and/or health plan information may be received by server 190 from various devices through an application programming interface (API) call. In various examples, one or more applications, such as a desktop application or a Windows®-based application, associated with the health care provider may be executed that facilitates submitting patient and/or health plan information. For example, tablet computer 130 associated with hospital 120 may contain an application that can be executed by a user to submit information to a laboratory benefits service organization. The application may be able to communicate with other devices, such as server 190, through network 105 and network 125.

[0064] When a device, such as tablet computer 130 or desktop computer 115, sends/accesses patient information and/or health plan information, another device may receive the information. For example, if an administrator at hospital 120 uses tablet computer 130 to send/access information, then server 190 may receive the information through network 105 and

network 125. In examples, a device receiving the information may process the request. For example, if server 190 receives information from desktop computer 115, then server 190 may process the received information.

[0065] Processing the information may comprise determining a patient's eligibility for health plan benefits using patient information and/or health plan information. Processing may further comprise comparing patient information and/or health plan information to a database to determine patient eligibility. In an example, processing the information may further comprise analyzing patient information, health plan information, and/or laboratory information and presenting the submitter of the information, e.g. a health care professional, with options for at least one of a laboratory test and/or a laboratory facility based on the information. In an example, processing information comprises comparing information to a policy or policies and presenting the information submitter, e.g. a health care professional, with options based on patient information, health plan information and/or laboratory information. A policy is described in further detail below.

[0066] In an example, a device sending information and a device receiving information may send and receive information back and forth to present a health care provider, or another user of the system, e.g. a health plan provider, with alternatives, including alternative laboratory tests, and/or alternative laboratories. The laboratories presented may be selected on any number of criteria, including but not limited to, health plan benefit information, laboratory expertise with a test or tests, laboratory processing time, laboratory fee information, and similar information used by health care providers and/or health plan providers to select a laboratory for diagnostic testing.

[0067] In an example the processing of information may comprise determining a need for additional information. For example, if patient information is in some way incomplete then the processing device may request additional information by calling out to the submitting device. By way of a non-limiting example, a particular laboratory test may be not be offered to a pregnant woman and the patient information submitted to the processing device may lack information relating to whether the woman is currently pregnant. In processing the information, the processing device may call out with a request that the patient's pregnancy status be included in patient information, for example through health care provider input of the status. By way of another non-limited example, a policy for a particular genetic laboratory test may suggest a

prerequisite laboratory test. The processing device may call out with a request that information relating to the prerequisite test be included in patient information, for example through health care provider input, or through a comparison to historical patient information maintained in a database. Those of ordinary skill in the art will recognize that there are many additional examples of information that may be desired in processing. As noted herein, processing may also comprise determining a patient's eligibility for health plan benefits using patient information and health plan information. The foregoing examples may also relate to information desired to determine a patient's eligibility for health plan benefits.

[0068] Information may be sent back and forth between a health care provider's computer and a computer associated with the laboratory benefits system. For example, as a health care provider communicates symptoms of a patient, for example as part of patient information, this information may be sent to the computer associated with the laboratory benefits system. In an example, a server associated with the laboratory benefits system may process patient information, health plan information and laboratory information in view of a policy and communicate a possible genetic test option and/or options; a laboratory and/or laboratories; and/or health plan benefit information for presentation to the health care provider. In an example, information generated by processing, for example processing with respect to a policy or policies, may be communicate to a patient, for example through a patient device in communication with the network; a health plan provider, for example through a health plan provider device in communication with the network and/or a laboratory, for example through a laboratory device in communication with the network. Thus, in an example, a system or method of the present invention facilitates information flow among parties involved in providing patient care.

[0069] In an example, information may be received that contains one or more genetic tests for one or more patients to be ordered. In another example, information may contain present or historical, or both, information related to one or more patients and this information may be used in processing with reference to a policy or policies to determine one or more recommended tests. Information can include current and/or past medical statistics, current and/or past biographical information, current and/or past laboratory orders, current and/or past laboratory results, current and/or past symptoms, current and/or past diagnoses, current and/or past treatments, current and/or past prescriptions, current and/or past indications, current and/or

past health care providers, current and/or past insurance providers, medical codes such as ICD-9 codes, other medical information, or a combination thereof. Numerous other examples or implementations, or both, will be obvious to one of skill in the art or are disclosed herein.

[0070] As noted herein, once medical information has been received, the information may be processed. The processing may occur through a decision support component. Physician decision support may present a physician with options, for example options for genetic and other laboratory tests for a patient, based on patient information, health plan information and/or laboratory information. For example, if processing patient information suggests an illness, frequently ordered laboratory tests for that illness may be presented. If the information includes information relating to one or more genetic laboratory tests and/or laboratory test results, processing may result in presenting additional laboratory tests. The one or more additional laboratory tests can be presented on the received patient information, health plan information and/or laboratory information, medical information for a patient, past medical information for a patient, medical information for a population of patients, evidenced-based medical guidelines, information corresponding to one or more laboratories, information corresponding to one or more health care providers, information corresponding to one or more insurance providers, information corresponding to one or more laboratory system management providers, other medical information, or a combination thereof. In one example, if the information comprises an order for one or more genetic laboratory tests, processing may result in the presentation of one or more alternative laboratory tests.

[0071] Information provided, and/or decision support information, may be accessed, collected, and/or verified. For example, information contained in a request may be verified against one or more medical classification lists such as ICD-9, ICD-10, or CPT data. In one example, a policy comprising evidence based guidelines may be used to determine one or more laboratory tests — including, but not limited to, additional and/or alternative genetic or other laboratory tests if the received information includes an order for one or more genetic or other laboratory tests — for one or more patients associated with the received information. For example, information related to a patient's medical history may be accessed and used to determine whether one or more additional or alternative tests for the patient may be presented based at least in part on one or more evidence based guidelines. Similarly, information related to a patient's symptoms may be contained in the information or otherwise accessed and used to

determine whether one or more laboratory tests for the patient or patients can be recommended based at least in part on one or more evidence based guidelines. In some examples, a patient's medical history, past symptoms, present symptoms, or a combination thereof, may be used to determine one or more laboratory tests. For example, received information may comprise a patient's current symptoms which are used to determine one or more suggested laboratory tests for the patient. In one example, information comprises symptoms as well as a laboratory test for a patient and the symptoms are used, at least in part, to determine one or more additional or alternative tests for the patient. Other information, such as a patient's medical history, may be used in connection with a patient's symptoms to determine one or more tests to be presented.

[0072] Processing may also be used to determine a patient's health plan eligibility and benefits for the one or more laboratory tests to be performed. Patient eligibility and benefits may be determined in any number of ways. In one example, patient eligibility and benefits are verified using information contained in one or more data stores. In another example, server 190 may query one or more external data stores, such as health plan provider data store 285 shown in FIG. 2, to make a determination as to whether a patient 140 is eligible and what benefits a patient should receive. In examples, various records may be kept regarding one or more orders or laboratory tests. For example, records may be kept regarding responsible payor or payors, an amount owed, addresses, one or more statuses of an order, etc. Variations are within the scope of this disclosure and will be apparent to one of skill in the art. As noted herein, eligibility information may be included in information presented to a health care provider and/or other users.

[0073] Processing may in addition, or in the alternative, include processing of laboratory information, health plan information and/or patient information to develop an option or options for a laboratory or laboratories to perform a test, e.g. a test requested by a health care provider and/or a test presented to a health care provider through the processing described herein with reference to a policy or policies. In an example, processing may present options for one or more laboratories to perform at least a portion of a test. Such a determination may be based on any number of factors. For example, a determination may be based on a timeframe for completing at least a portion of the order. In this example, a laboratory that has the capacity to provide laboratory results for the portion of the order may be selected. For example, if an order specifies a particular genetic test and ten laboratories are available to complete the genetic test, then the

laboratory with the overall lowest cost for performing the genetic test may be chosen. A determination can be based on other factors such as location of the laboratory, whether the laboratory is an in-network or out-of-network laboratory, whether the laboratory is owned or operated by the laboratory benefits organization, or other factors. Numerous various are disclosed herein and others will be apparent to one of skill in the art.

[0074] Processing may also include processing laboratory information comprising status of an order; laboratory results; laboratory reimbursement; and/or other items of interest to a health care provider, patient, health plan provider and/or laboratory. Information on these, or similar, items may be presented to a health care provider for review. For example, if an external laboratory is selected to perform a laboratory test, the status of the laboratory test may be tracked. The status of the laboratory test may include information such as whether a sample related to the test has been collected, the historical location of the sample, a current location of the sample, whether the laboratory test has been started, an expected completion date for the laboratory test, whether the results of a laboratory test are available, whether the results of a laboratory test have been received, or other status information. In examples, status information may be exchanged between various devices. For example, referring to FIG. 1, an internal laboratory 170 may send status information to server 190 through network 105 which is stored in data store 195. In one example, status information may be sent from server 190 to an external laboratory 180 through network 105.

[0075] As noted above, various entities may be able to access at least some information regarding a laboratory test. For example, a physician or other personnel in doctor's office 110 may be able to view the status of one or more laboratory tests. A physician may be able to view the results of one or more laboratory tests, including genetic tests. In one example, a health care provider can customize the presentation of results of one or more genetic tests. For example, one health care provider may customize test results so that only raw data related to the genetic test is sent in the test results. Another health care provider may customize test results so that raw data as well as graphical indications are shown in a test results report. In another example, the health care provider can customize the test results report to include historical medical information related to one or more patients. In yet another example, the health care provider can customize test results reports to include one or more recommendations based at least in part on the test results. In some examples, one or more persons associated with a health care provider can

customize test results reports. For example, a health care provider may have a customized test results report template and a doctor employed by the health care provider may have another customized test results report template. Thus, various entities or people associated with various entities, or both, may be able to customize test reports. In some examples, a patient may be able to customize test results reports. Variations are within the scope of this disclosure and will be apparent to one of skill in the art.

[0076] An example of a physician decision support component of a laboratory benefit management system is set forth below. For example, one or more operations described with respect to decision support may be performed in the processing component discussed above. The description will be made with respect to FIG. 1, which illustrates an example system 100 for implementing aspects in accordance with various examples.

[0077] Physician decision support (PDS) may be a feature of an example of a system and/or a method of the present invention. In an example, physician decision support assists a health care provider in selecting a laboratory test, or tests, for a patient based on current medical guidelines and may also facilitate test ordering. The laboratory test or tests may be or included one or more genetic tests. In an example, at the point-of-order and care, a system and/or method will enable a health care provider to select a laboratory that is qualified to perform the selected tests according to published criteria. As will be appreciated by those of ordinary skill in the art, such tools assist health care providers in optimizing the choice of test for their patients and in selecting a laboratory with expertise to perform the selected tests.

[0078] The physician decision support may begin with processing of patient information. The processing may comprise analyzing patient information and applying a policy and/or policies to provide options for laboratory tests. The options for laboratory tests may be further processed with reference to laboratory information, and/or health plan information. The laboratory test options and/or the laboratory options may be presented to a health care provider. In certain examples, the laboratory test options and/or laboratory options may be integrated with an ordering system of a laboratory.

[0079] The processing of laboratory information may comprise verification of a test. A test verification may be based on one or more medical classification lists. For example, a laboratory test requested for a patient may be verified against an ICD-9 or ICD-10 medical classification list. In an example, the request contains a code that represents a laboratory test to

be performed for a patient. The code specified in the request may be compared with codes provided in ICD-10 to determine whether the code is a valid code. In one example, if the code specified in the request is also listed in the ICD-10 list, then a determination may be made that the code is valid. Otherwise, in this example, the code specified in the request may be determined to be invalid. A request may contain a name of a laboratory test to be performed. In this example, a code — such as an ICD-9, ICD-10, or CPT code — may be assigned for the laboratory test based at least in part on the name of the laboratory test. For example, if the name of the laboratory test provided in the request matches a name of a laboratory test listed in an ICD-10 classification list, then the ICD-10 number associated with that laboratory test may be assigned.

[0080] In one example, a classification code for a laboratory test may be assigned that closely matches the name of a laboratory test provided in a request. In some examples, if a code cannot be ascertained for one or more laboratory tests specified in a request, then information is sent to the requestor asking for more information. For example, if a request is received by server 190 from tablet computer 130 for a laboratory test and server 190 cannot determine a classification code for the laboratory test, then server 190 may send a response to the tablet computer 130 requesting additional information for the laboratory test. As an example, the server 190 may request that a classification code for the laboratory test be provided. As another example, the server 190 may request that a revised name for the laboratory test be submitted. In one example, the server 190 may provide the tablet computer 130 with a list of potential laboratory names and the user of the tablet computer 130 can select the appropriate laboratory name. Once additional information has been input into the tablet computer 130, then an updated response may be sent from the tablet computer 130 to server 190 through network 105.

[0081] In performing a test verification for at least a portion of a request, information may be requested from one or more data stores in one or more locations. In one example, server 190 accesses information stored in data store 195 in performing a test verification for at least a portion of an order. For example, data store 195 may contain a list of ICD-10 codes. In this example, a laboratory test specified in a request received by server 190 may be compared to the list of ICD-10 codes in data store 195 to verify that the laboratory test specified in the request is valid. In another example, server 190 accesses information stored in one or more external data stores to perform a test verification for at least a portion of an order. For example, referring to

FIG. 2, a data store related to a health plan provider 285 may contain a classification list of various laboratory tests. In this example, server 190 may access information stored in data store 285 to perform a test verification. In one example, the test is a genetic test. As with other tests, the genetic test may be mapped to particular labs. Further, and as with other tests, the genetic test may be mapped to one or more policies.

[0082] Processing of patient information in view of a policy may result in the selection of one or more laboratory tests for presentation to a health care provider. A determination as to whether one or more laboratory tests are presented to a health care provider may be made in any number of ways. In one example, a determination as to whether one or more laboratory tests are available may be based on a policy comprising evidence-based guidelines. Evidence-based guidelines may be derived from any number of medical sources including, but not limited to, journals, articles, case studies, publications, various data stores containing medical information, or other medical literature. In some examples, evidence based guidelines can be based on clinical trials, risk-benefit analyses, medical literature, meta-analysis, or a combination thereof. Evidence based guidelines may be based on one or more symptoms, illnesses, policies, or a combination thereof. In one example, evidence based guidelines may be tailored to one or more patients based at least in part on a patient's current symptoms or medical history, or both. As will be realized by those of ordinary skill in the art, there may exist situations where a health care provider provides information relating to a test that he/she thinks is appropriate based on patient information. In an example, the health care provider's test may be presented together with one or more alternative laboratory's tests based on processing such as that described herein.

[0083] In one example, a data store 195 containing a policy comprising evidence based guidelines is accessed to determine whether one or more tests are recommended. For example, a request received by server 190 may contain an illness or a disease for a patient, such as high cholesterol. In this example, server 190 accesses data store 195 to determine if there are any policies relating to tests that are recommended based on the illness or disease provided in the request for the patient and the evidence based guidelines stored in data store 195. In one example, historical medical information for the patient is also used to determine which tests, if any, are recommended. As another example, a request received by server 190 may contain a laboratory test for a patient. In this example, server 190 may access policies comprising evidence based guidelines to determine whether one or more additional or alternative tests

associated with the requested laboratory test is recommended based at least in part on the evidence based guidelines.

[0084] In an example, a determination as to whether present one or more laboratory tests may be made on patient information, comprising current symptoms of a patient. For example, patient information received by server 190 may comprise a list of current and/or past symptoms for a patient. In an example, server 190 accesses data store 195 comprising a policy or policies to determine if there are any tests that are recommended based on the symptoms. In one example, patient information comprising historical medical information for the patient is also used to determine which tests, if any, are recommended. As discussed herein, patient information may comprise current symptoms, medical history, past symptoms, laboratory test performed and the results and a variety of other information set forth above. As will be understood from the preceding discussion, a determination as to whether to present one or more laboratory tests to a health care provider may be made based on at least one datum or set of data included within patient information and/or a plurality of data included with patient information.

[0085] As noted herein, in various examples, a policy, e.g. a policy comprising evidenced based guidelines; symptoms, historical medical information, illnesses or diseases, any laboratory tests, or a combination thereof, may be used to determine one or more tests to present to a health care provider or other user of the system. One or more data stores may be queried in making such a determination. In one example, information is contained in a single data store. For example, in FIG. 1, data store 195 may contain historical medical information for a patient and evidence based guidelines that are used, along with information received in the request, to determine whether one or more tests are recommended. In another example, information is contained in two or more data stores. For example, referring to FIG. 2, data store 205 may contain medical codes, data store 280 may contain evidence based guidelines for the health care provider, and data store 285 may contain historical information for patients. In this example, server 190 may receive a request for a genetic laboratory test and a list of symptoms for a patient. In determining whether one or more tests are recommended, server 190 may access data store 205 for one or more medical codes related to the requested laboratory test, data store 280 for evidence based guidelines based on the list of symptoms for the patient provided in the request or the requested laboratory test, or both, and data store 285 for historical information related to the patient.

[0086] If one or more tests are available then laboratory options are presented to a health care provider. In examples, information presented relating to a laboratory test may include, but is not limited to, one or more classification codes for the laboratory test, a name for the laboratory test, one or more reasons as to why the laboratory test is recommended, medical information related to the recommended laboratory test and a patient for which the laboratory test is recommended, statistics related to the laboratory test, information regarding evidence based guidelines that were used to make the recommendation, one or more medical references regarding the recommendation, other medical information, or a combination thereof. In examples, information presented may be customized. For example, a health care provider may specify that a list of tests and/or laboratories should be presented. A physician in doctor's office 110, however, may specify that a list of laboratory tests as well as the criteria, for example the policy, used to determine the laboratory tests should be provided. In another example, a physician can specify that a laboratory test as well as any relevant medical articles should be presented. Thus, in various examples, customized recommendations may be provided to users based on customization settings of the user or an organization associated with the user. For example, a hospital 120 may determine a level of customization for recommended tests. In one example, a user of the laboratory benefits management system, such as a health care provider, can determine a level of customization for recommended tests.

[0087] The presentation of information to a user of the system, or in a method of the present invention, may be accomplished in any number of ways. In an example, information may be presented on a web page, accessible through a web portal. For example, if a physician is using desktop computer 115 to access a web portal, then the server 190 may send information related to the available tests to desktop computer 115 through network 105. In another example, tablet computer 130 is executing software, such as a touchscreen-enabled application, that presents information to a user of the tablet computer 130. In one example, tablet computer 130 may contain sufficient information on the device to make a determination as to whether additional tests are available and to present additional tests to a user. Such information may be stored on memory in the tablet computer, on a disk drive in the tablet computer, or one or more external storage devices. In another example, tablet computer 130 may send and receive information from other devices, such as server 190.

[0088] Health plan information may be utilized to present patient benefit information relating to one or more laboratory tests, and/or with respect to one or more laboratories. Health plan benefit information, laboratory information and/or laboratory test information may be processed and/or presented in any number of ways. In one example, information is transmitted over hypertext transfer protocol (HTTP). Information may be received via a secure connection. For example, information may be received over hypertext transfer protocol secure (HTTPS). In one example, information is received over a virtual private network (VPN) connection. Information may be received through one or more application programming interfaces (APIs). In an example, information is received from a website associated with a laboratory benefits organization, a health care provider, or a third-party. Information may be transmitted and exchanged in any number of languages or in any number of formats including, but not limited to, ActionScript®, AJAX, ASP, C, C++, HTML, JAVA JavaScript, JSON, JSP, MXML, PHP, XML, or XSLT. In examples, information may be received from one or more data stores. For example, information may be received from a data store associated with a health care provider. Information may be in an archive or compressed format, or both, such as JAR, ZIP, RAR, ISO, or TAR. A combination of protocols, languages, formats, and/or devices may be used to send or receive a response according to various examples.

[0089] In an example, patient eligibility for a laboratory test may be verified using health plan information for the patient. Patient eligibility may be determined in any number of ways. In one example, patient eligibility is verified using information contained in one or more data stores. In another example, server 190 may query one or more external data stores, such as health plan provider data store 285 shown in FIG. 2, to make a determination as to whether a patient is eligible.

[0090] Numerous factors may be used to determine whether a patient is eligible for one or more laboratory tests. In one example, health plan membership data may be used to determine whether a patient is eligible for the one or more laboratory tests. For example, server 190 may query data store 195 to determine whether a patient associated with the one or more laboratory tests is currently an active member in a health plan for a health plan provider. If a determination is made that the patient is an active member in the health plan, then the patient may be determined to be eligible for the one or more laboratory tests. If a determination is made that the patient is not currently an active member in the health plan, then the patient may be determined

to be ineligible for the one or more laboratory tests. As another example, a determination may be made as to whether a patient for which a particular laboratory test is ordered has waited a required period of time since receiving the particular laboratory test or a related laboratory test, or both. If a determination is made that the patient has not waited the required period of time, then an alternative laboratory test for which the period of time is not required may be recommended. In one example, the decision support component asks a health care provider ordering a laboratory test for a patient a series of questions to determine whether the patient is currently eligible to receive the laboratory test under the patient's health plan provider.

[0091] In the case of a genetic test, the questions may be triggered by the particular test code associated with a test. For example, the decision support component may inquire whether the test is being performed to detect a genetic disease, genetic syndrome, or prenatal diagnosis. The answers to these questions may then be used to determine the patient's health plan eligibility to receive the genetic test. Numerous other examples are disclosed herein and variations are within the scope of this disclosure.

[0092] As noted above, patient benefits related to the one or more laboratory tests may be presented to a health care provider and/or another user of the system. For example, a maximum payment for the one or more laboratory tests based on health plan information may be presented. A maximum payment may be based on any number of factors. A maximum payment may be based on the type of laboratory test that will be performed. A maximum payment can be based on a volume or number of laboratory tests performed within a timeframe. In one example, a maximum payment may be based on a turnaround time. For example, a laboratory test that needs completion within two days may have a higher maximum payment than the same laboratory test that needs completion within one week. In examples, a maximum payment may be based on a health plan provider associated with a patient for whom a laboratory test will be performed. For example, a health plan provider may allow a maximum payment for a particular laboratory test. In this example, the maximum payment to an internal or external laboratory may be based at least in part on the maximum payment allowed by the health plan provider.

[0093] In determining patient benefits for the one or more laboratory tests, information stored in one or more data stores may be accessed. For example, referring to FIG. 1, server 190 may access information stored in data store 195. In some examples, information from one or more external sources may be used to determine patient benefits for the one or more laboratory

tests. For example, server 190 may send a request to desktop computer 165 associated with health plan provider 160. In this example, the request may be for a maximum reimbursement amount for a laboratory test associated with a patient having a particular plan. In response to the request, server 190 may receive a response from desktop computer 165. In another example, numerous data stores may be queried to determine benefits. For example, referring to FIG. 2, information stored in laboratory management data store 205, health plan provider data store 285, and laboratory data store 290 may each be queried to determine patient benefits for one or more laboratory tests. For example, laboratory data store 290 may be queried to determine a testing identification number for a laboratory test associated with an order. In this example, information stored in database 245 may be queried to determine a patient associated with the testing identification number. In addition, patient database 215 may be queried to determine a health plan provider and policy number associated with the patient. Furthermore, health plan data store 285 may be accessed to determine a maximum reimbursement price for the laboratory test.

[0094] After information is presented to a health care provider, the provider may select one or more tests to be run, including genetic tests. In an example, after selection a notification may be provided to one or more users of the laboratory management system. For example, if a nurse originally submits an order for a physician, then the nurse or the physician, or both, may receive a notification that the order has been approved. In examples where a request contains tests for multiple patients associated with multiple physicians, then each physician may receive a notification associated with his or her patients.

[0095] In examples, one or more patients may receive a notification related to an order. For example, patient A may receive a notification that a laboratory test has been ordered and approved. A patient may receive information indicating additional steps that the patient needs to complete in order for the order to be finished. In one example, the notification may provide information needed to obtain a sample from the patient. For example, a patient may need to have blood drawn in order to complete a laboratory test. In this example, the notification to the patient may provide a date, time, and location for the patient to have the blood drawn. A notification may contain additional instructions for a patient.

[0096] As will be appreciated from the discussion herein, examples of the present invention may be advantageously used in a health care environment to connect health care providers, payers and diagnostic test providers to deliver high quality, cost effective care to an

individual seeking health care services. In addition to connecting various parties in a health care environment, by requiring that the health care provider, laboratory, genetic counselor, patient, health plan, and testing laboratory complete certain steps during the process, an example of the present invention can control the workflow for testing. For example, a physician may suggest a particular genetic test. A genetic counselor may then examine the request to ensure it is the appropriate test to apply. The request may then be evaluated by the system to determine if the patient is eligible to receive health plan benefits to pay or help pay for the test. Once each step is complete, then the patient can be authorized for the test and then decide whether or not to have the test administered.

[0097] As discussed herein a feature of the present invention comprises decision support. Examples of systems, components and methods of the present invention may provide decision support to assist a user in decision making. Decision support may comprise receiving input and providing a suggested course of action based on the input and data. Input may comprise patient data. Patient data may comprise: identification data, electronic medical record (EMR) data, physical specifications (height, weight, age), medical history, insurance coverage information, family history and the like. Data may comprise data relating to: a patient, a laboratory, clinical outcomes in similar cases, clinical research, specific tests and the like.

[0098] In an example, decision support may comprise a guideline, including but not limited to a guideline relating to: diagnostic test selection, interpretation of test results, follow on testing, additional tests, laboratory selection, identification of appropriate patients for testing, explanation of test results, insurance coverage and insurance coding. A guideline may comprise background data. A guideline may also be sometimes referred to herein as a policy. An example of the present invention may comprise a guideline or policy, or a plurality of guidelines or policies.

[0099] As will be understood by those of skill in the art, background data is often temporal and may be updated to reflect changes in a patient, laboratory, clinical outcomes, clinical research, specific tests and/or other datum. A guideline or policy in an example of the present invention may also be temporal and subject to updating and/or changes in view of altered background data.

[00100] Policies may also relate to conditions or diseases. Examples of conditions and/or diseases include, but are not limited to, allergies (food, insect, mold, dust, animal, chemicals and

the like); diarrhea; celiac disease; Lyme disease; diabetes; arthritis; thalassemia; viral infections; bacterial infections; cold; flu; upper respiratory tract infections; urinary tract infections; gastroenterological conditions; urological conditions; cardiovascular conditions; cancers, including but not limited to: lung, ovarian, prostate, skin, lymphatic, colon, liver, brain, leukemia and other metastatic and non-metastatic cancers, as well as all of the cancers listed by the National Cancer Institute and/or referenced by other clinical diagnostic laboratories now or in the future.

[00101] Policies may also relate to particular health care specialties including, but not limited to, allergy; immunology; cardiology; dermatology; endocrinology; gastroenterology; infectious disease; internal medicine; nephrology; neurology; obstetrics; gynecology; pathology; pediatrics; primary care; psychiatry; rheumatology; urology; routine testing; as well as other existing and/or to be developed specialties.

[00102] As described herein decision support may comprise a policy relating to a diagnostic test; condition, disease and/or specialty. In an example a policy comprises data relating to one or more of a diagnostic test; a condition; a disease; and/or specialty. By way of a non-limiting example, decision support may comprise associating a patient datum or patient data with data relating to one or more of a diagnostic test; a condition; a disease; and/or specialty.

[00103] As noted herein, the information presented in an example of a system or method of the present invention may comprise information relating to laboratory where a test may be performed. The selection of laboratories to be presented may be made based on laboratory information from one or more laboratories. In one example, one or more labs are presented based on the genetic or other test or tests to be presented. For example, a first test and a second test may be presented for a patient. In this example, a first laboratory may perform the first test, a second laboratory may perform the second test, and a third laboratory may perform both the first and the second test. In this example, information may be presented and a decision may be made by a health care provider that the third laboratory should complete the first and second laboratory tests for this order because the third laboratory can perform both tests. In another example, the health care provider may determine that the first laboratory should complete the first laboratory test and that the third laboratory should complete the second laboratory test because of one or more other factors disclosed herein, including, but not limited to, laboratory qualifications, test processing time, health plan benefit information and the like. Furthermore,

the second laboratory may not be chosen to complete the first laboratory test because the second laboratory does not perform the first laboratory test.

[00104] In one example, one or more labs are determined based on processing time. For example, two labs may perform a laboratory test ordered for a patient. In this example, however, processing pursuant to a policy may present information that test results received in one week are desirable. The processing time of one laboratory may allow test results to be received in one week whereas the processing time of another laboratory suggests that test results will not be received in one week. In an example, the information presented may comprise processing times. In a similar fashion, the location of a laboratory may be presented to enable a health care provider to select a laboratory testing facility closer to the health care provider.

[00105] In another example, multiple laboratories may be presented for a single test. For example, one laboratory facility — such as a physician office laboratory — that is in close proximity to a patient may be presented for collecting a sample from the patient for the laboratory test while another laboratory facility may be presented for sample analysis.

[00106] In one example, health plan information may be utilized to present one or more labs based on whether the labs are in network or out of network. For example, if two labs are available to perform a laboratory test for an order and one laboratory is an in-network laboratory and the other laboratory is an out-of-network laboratory, then the in-network laboratory may be presented in a way to distinguish it from the out-of-network laboratory. If only an out-of-network laboratory is available, an example may present a message warning the user that the laboratory is out-of-network and advising the user that using an in-network laboratory may reduce the patient's out-of-pocket costs. In such an example, the user may ignore such a warning.

[00107] In examples, presentation and selection of one or more laboratory may be based on a combination of factors. Selection of a testing facility by a health care provider and/or a patient may also be based on a number of factors, services offered, availability, location, cost, whether the laboratory is an in-network or out-of-network laboratory, or a combination thereof. In an example, health care provider and/or patient laboratory selection criteria comprises at least part of the information presented.

[00108] In examples, one or more laboratory testing facilities may be presented based at least in part on statistical information related to one or more testing facilities. For example, one

or more laboratories may be presented based on the accuracy, reliability, or other statistics associated with a laboratory.

[00109] An example of the present invention may include a test status listing component for determining the status of particular tests for particular patients. For example, in one example, a system may present a list of patients for whom tests have been ordered along with the physician ordering the tests and a status. The status may, for instance, indicate whether or not an insurance provider has approved a particular test requested by a particular physician for a particular patient who is a member of the insurer.

[00110] FIG. 3 is a flowchart illustrating an example of a process 300 for providing enhanced decision support according to one example. In the process shown, the system first receives a member identification at block 302. For example, the user may enter a subscriber number. In another example, the user may search, using for instance the member's first or last name to search for a user and then select the appropriate member.

[00111] The system then receives a diagnostic code at block 304. In one example, the diagnostic code is associated with a genetic test. For example, a particular diagnosis code may be associated with a particular genetic test. In one example, the user may enter the diagnosis code itself, a partial code, or a description or partial description of a test in order to identify the particular code to be entered.

[00112] The system next determines a genetic test to be ordered for the patient at block 306. A genetic test may be mapped to particular testing laboratories. The genetic test may also be mapped to policies. Such an example is capable of utilizing the mapping, including the policies, to determine the appropriate laboratory to recommend to the user.

[00113] The system next evaluates the test and the patient information to determine whether a clinical review is required at block 308. If a clinical review is required, the system may generate a clinical review checklist at block 310. The user can then fill out the checklist in order to allow the genetic test to be ordered by the user and for the appropriate lab to be suggested to the user for selection. The checklist may include a prompt for review by a genetic counselor. Once the determination of whether a clinical review is required is complete and a checklist generated, the process 300 ends at block 312.

[00114] FIG. 4 shows a system for managing genetic test data and genetic test information according to an additional example. System 400 of FIG. 4 includes a decision support server

402. The decision support server 402 may be a function implemented by server 190 of FIG. 1. The decision support server 402 can receive files from FTP server 404, at which various test laboratories deposit order files including data on tests ordered, test information when available, and other related information as described above. The decision support server includes an application database 406 with all necessary information for a decision support application 408 to format and display results in various ways, either through an API or by receiving batch files as will be discussed in further detail below. In some examples, the decision support application 408 is a web page that is pushed to the user's local computer or workstation via a web browser. The application may include scripts that a processing device in the local computer or workstation executes to carry out decision support. The decision support server 402 also includes a case creation module 410 that formats and stores decision report request (case) files in any of various formats. For example, decision report request files can be formatted for one request per test or to include multiple tests in a single request. A decision report request file can include test information, or some intermediate information, such as decision support questions for a provider. The decision support server 402 also includes a privileging rules module 412 that controls where patient information, including genetic test information may be stored and displayed and which entities have access to the information.

[00115] Still referring to FIG. 4, the decision support server may send decision report request files directly to the decision support application for display. Alternatively, if the provider's systems are not completely compatible with the decision report file format, the decision report file can be sent as a batch file to a provider inbox 414 created in non-volatile storage. A notification 416, for example, and Email, can be sent to the provider to notify the provider that a decision report is awaiting review. Rules for handling decision support information and producing report elements are provided by decision support engine 418, which can be accessed by both the decision support server 402 and the decision support application 408. As previously discussed, the decision support application can include multiple portal pages 420 presented by the use of portlets. Decision support engine 418 may be hosted in decision support server 402 or may be hosted in another server in a clustered server environment connected to decision support server 402.

[00116] Decision support server 402 provides format and plan membership eligibility checking, national provider identifier (NPI) lookup and matching, and data validation. The

decision support engine 418 includes a database of rules for providing decision support questions or information to providers and provide a rules engine. The decision support engine 418 also provides a lab compendium index, a diagnosis code index, and an ICD index, all stored in Apache Lucene index files. The information from the index files is cached in a Lucene cache for faster access when processing large amounts of decision support information and genetic test result data.

[00117] FIG. 5 is a flowchart illustrating an example of a process 500 for delivery and display of decision support request files, which may include genetic test information. At block 502, a check is made for errors in file formats or coding of decision support request files. At block 504, a check is made for errors in membership of patients in insurance plans or providers in the physician decision support system as represented in the decision support request files. At block 506, a check is made for mapping and data validity errors. If any of these errors are found, error handling is invoked at block 508. Error handling can include logging errors in a file. These error checks and the error handling can be provided by decision support server 402. Some of the error detection in some examples is accomplished using fuzzy matching logic. This error checking further may use common-service data access object pattern recognition implemented as a procedure stored in the decision support server 402.

[00118] Still referring to FIG. 5, at block 510, a decision report request file is created in a required format. The file is created by case creation module 410 using rules and index information provided by decision support engine 418. In this example, the format can be chosen as format that requires one request file for test ordered, or a format that allows one request file for all eligible tests that are part of the same request from or for a given provider. These formats may also require different time limits from date-of-service for request files to be processed by the provider.

[00119] Continuing with FIG. 5, at block 512, a determination is made as to whether the provider is a provider that is a participating in the PDS system. If so, decision support is provided through the API of the decision support application 408 and the API is populated at block 514. If not, a patient's electronic health record in the provider systems may not be sufficiently compatible with laboratory test ordering and/or reporting systems to directly populate the patient electronic health record with genetic testing information from the decision report request file. Therefore, in this example, if the provider is not participating in the system,

the decision support server 402 looks up and matches the provider using national provider identifier (NPI) data at block 516. The NPI in an order is used to locate the provider organization so that processing can proceed. A provider inbox is created at block 518 of FIG. 5. A batch file including the decision report request file or decision support request files is sent to the inbox at block 520, and a notification is sent to the provider at block 522. In the example of FIG. 4 this notification is sent via Email, however, in other examples, the notification can be sent in other ways. If an Email is used, the Email can be formatted using a style corresponding to the decision request file format.

[00120] In examples, one or more notifications may be provided that indicate that test result information is available. For example, a notification may be sent to a health care provider or a physician, or both, and the notification may indicate that one or more test results for a patient associated with the health care provider or physician are available. A notification may be provided to a patient associated with the laboratory test. In one example, a test information report may automatically be sent to a health care provider, physician, patient, or a combination thereof when test information is saved. As discussed herein, test reports may be customized. Thus, customized test reports may be sent to various parties. A notification or test results, or both, may be sent in numerous ways. For example, a notification or test results may be sent via email, SMS, or an automated telephone call. A notification may be provided in response to a received request.

[00121] Numerous specific details are set forth herein to provide a thorough understanding of the claimed subject matter. However, those skilled in the art will understand that the claimed subject matter may be practiced without these specific details. In other instances, methods, apparatuses or systems that would be known by one of ordinary skill have not been described in detail so as not to obscure claimed subject matter.

[00122] Some portions are presented in terms of algorithms or symbolic representations of operations on data bits or binary digital signals stored within a computing system memory, such as a computer memory. These algorithmic descriptions or representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. An algorithm is a self-consistent sequence of operations or similar processing leading to a desired result. In this context, operations or processing involves physical manipulation of physical quantities. Typically, although not necessarily, such quantities

may take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared or otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to such signals as bits, data, values, elements, symbols, characters, terms, numbers, numerals or the like. It should be understood, however, that all of these and similar terms are to be associated with appropriate physical quantities and are merely convenient labels. Unless specifically stated otherwise, it is appreciated that throughout this specification discussions utilizing terms such as “processing,” “computing,” “calculating,” “determining,” and “identifying” or the like refer to actions or processes of a computing device, such as one or more computers or a similar electronic computing device or devices, that manipulate or transform data represented as physical electronic or magnetic quantities within memories, registers, or other information storage devices, transmission devices, or display devices of the computing platform.

[00123] The system or systems discussed herein are not limited to any particular hardware architecture or configuration. A computing device can include any suitable arrangement of components that provide a result conditioned on one or more inputs. Such computing devices may include, but are not limited to, desktop computers, mobile phones, personal digital assistants (PDAs), tablet computers, laptops, smartphones, Wi-Fi enabled computing devices, 3G or 4G enabled computing devices, or other suitable computing devices. Suitable computing devices include multipurpose microprocessor-based computer systems accessing stored software that programs or configures the computing system from a general purpose computing apparatus to a specialized computing apparatus implementing one or more examples of the present subject matter. Any suitable programming, scripting, or other type of language or combinations of languages may be used to implement the teachings contained herein in software to be used in programming or configuring a computing device.

[00124] Examples of the methods disclosed herein may be performed in the operation of such computing devices. The order of the blocks presented in the examples above can be varied—for example, blocks can be re-ordered, combined, and/or broken into sub-blocks. Certain blocks or processes can be performed in parallel. Thus, while the steps of methods disclosed herein have been shown and described in a particular order, other examples may comprise the same, additional, or fewer steps. Some examples may perform the steps in a different order or in parallel.

[00125] The use of “based on” is meant to be open and inclusive, in that a process, step, calculation, or other action “based on” one or more recited conditions or values may, in practice, be based on additional conditions or values beyond those recited. Headings, lists, and numbering included herein are for ease of explanation only and are not meant to be limiting. The use of “an example”, “one example”, “examples” and similar references is meant as open an inclusive language that not does limit the example from including additional components, steps, features, task or the like described with respect to other examples. A system or method of the present invention may comprise one, or a plurality of the examples described herein.

[00126] While the present subject matter has been described in detail with respect to specific examples thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such examples. Accordingly, it should be understood that the present disclosure has been presented for purposes of example rather than limitation, and does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

CLAIMS

That which is claimed is:

1. A system comprising:
 - a processing device; and
 - a non-transitory computer-readable medium communicatively coupled to the processing device, wherein the non-transitory computer-readable medium includes computer program code executable by the processing device to cause the processing device to perform operations comprising:
 - receiving an order request and patient information in a clustered server environment from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider;
 - producing index information using a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test;
 - storing the index information in a cache;
 - generating, using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processing device to prompt a review by a genetic counselor;
 - producing, using the index information from the cache, a decision report request file corresponding to the genetic laboratory test;
 - determining whether a healthcare provider patient electronic health record is compatible with the decision report request file;
 - populating a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file;
 - receiving a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API;

dynamically generating a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties;

formatting at least one test report of the plurality of test reports for SMS or an automated phone call; and

selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

2. The system of claim 1 wherein the operations further comprises sending the batch file including the decision report request file to a stored inbox based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file.

3. The system of claim 2 wherein the operations further comprise sending a notification of the batch file to the electronic device associated with the provider.

4. The system of claim 3 wherein the operations further comprise looking up the provider using national provider identifier (NPI).

5. The system of claim 1 wherein the operations further comprise checking for errors in the order request using fuzzy matching logic in the clustered server environment.

6. The system of claim 5 wherein the operations further comprise checking for errors in the order request using common-service data access object pattern recognition provided as a procedure stored in the clustered server environment.

7. The system of claim 1 wherein the operations further comprise generating a web portal in a number of portal pages provided to the electronic device associated with the provider in a number of portal pages presented using of portlets.

8. A method comprising:

receiving, in a clustered server environment, by a processing device, an order request and patient information from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider;

producing index information using the processing device and a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test;

storing by the processing device, the index information in a cache;

generating, by the processing device using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processing device to prompt a review by a genetic counselor;

producing, by the processing device using the index information from the cache, a decision report request file corresponding to the genetic laboratory test;

determining, by the processing device, whether a healthcare provider patient electronic health record is compatible with the decision report request file; and

populating, by the processing device, a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file;

receiving, by the processing device, a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API;

dynamically generating, by the processing device, a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties;

formatting at least one test report of the plurality of test reports for SMS or an automated phone call; and

selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

9. The method of claim 8 further comprising sending the batch file including the decision report request file to a stored inbox based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file.

10. The method of claim 9 further comprising sending a notification of the batch file to the electronic device associated with the provider.

11. The method of claim 10 further comprising looking up the provider using national provider identifier (NPI).

12. The method of claim 8 further comprising checking for errors in the order request using fuzzy matching logic in the clustered server environment and common-service data access object pattern recognition provided as a procedure stored in the clustered server environment.

13. The method of claim 8 further comprising generating a web portal in a number of portal pages provided to the electronic device associated with the provider in a number of portal pages presented using portlets.

14. A non-transitory computer-readable medium storing program code executable by a processor to perform operations, the operations comprising:

receiving an order request and patient information in a clustered server environment from an electronic device associated with a provider, the order request corresponding to a genetic laboratory test requested by the provider;

producing index information using a decision support engine hosted in the clustered server environment, the decision support engine including a database of rules associated with the genetic laboratory test;

storing the index information in a cache;

generating, using the index information from the cache and the patient information, a clinical review checklist for the order request configurable by the processor to prompt a review by a genetic counselor;

producing, using the index information from the cache, a decision report request file corresponding to the genetic laboratory test;

determining whether a healthcare provider patient electronic health record is compatible with the decision report request file;

populating a decision support application programming interface (API) corresponding to the provider or producing a batch file for the provider based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file;

receiving a plurality of selections made on the electronic device associated with the provider to define a presentation customization for the decision support API;

dynamically generating a plurality of test result reports, each of the plurality of test result reports being customized in accordance with the presentation customization and the clinical review checklist for a different party from among various parties;

formatting at least one test report of the plurality of test reports for SMS or an automated phone call; and

selectively transmitting the at least one test report to a party from among the various parties using SMS or the automated phone call as formatted.

15. The non-transitory computer-readable medium of claim 14 wherein the operations further comprises sending a batch file including the decision report request file to a stored inbox based on determining whether the healthcare provider patient electronic health record is compatible with the decision report request file.

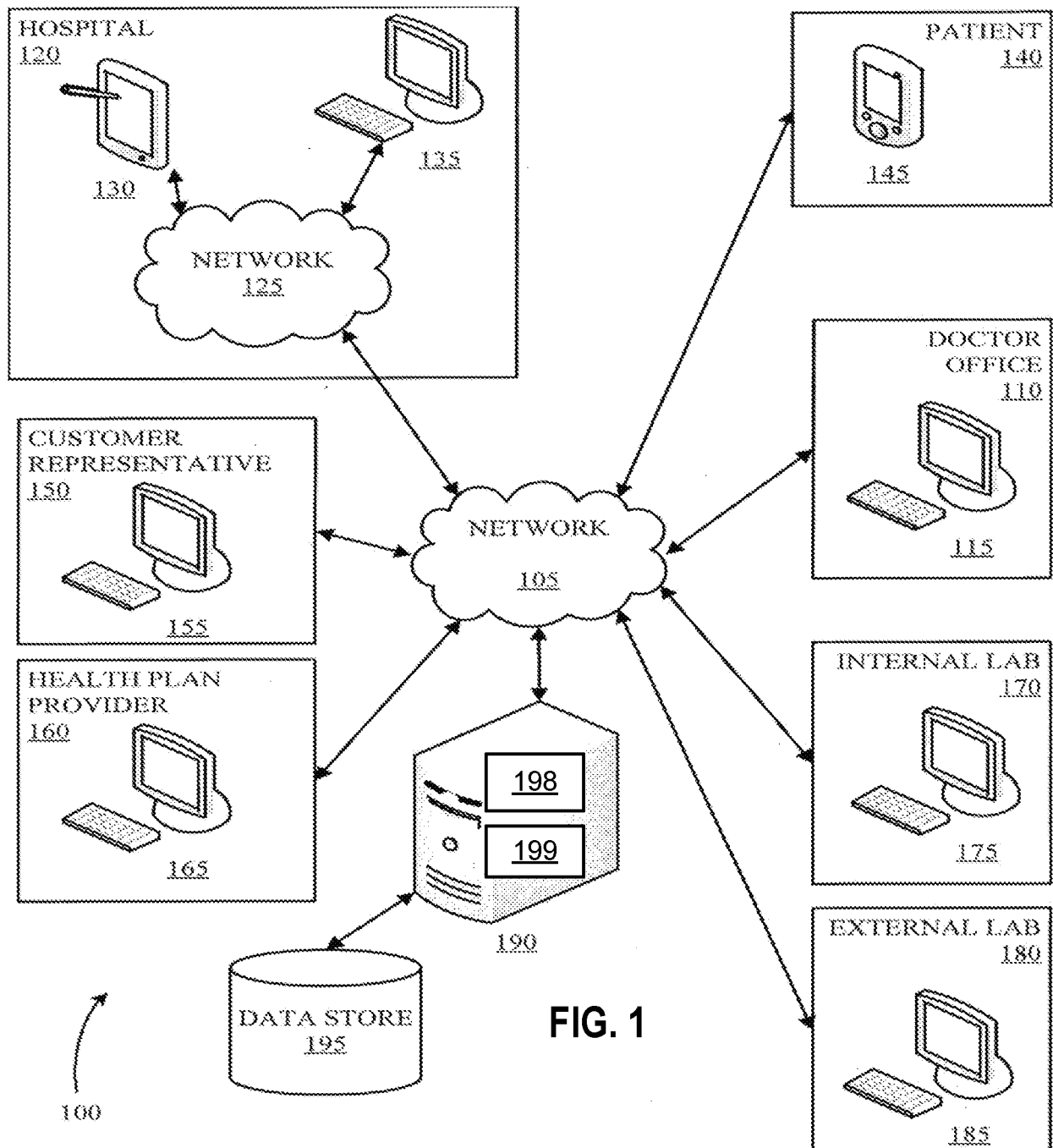
16. The non-transitory computer-readable medium of claim 15 wherein the operations further comprise sending a notification of the batch file to the electronic device associated with the provider.

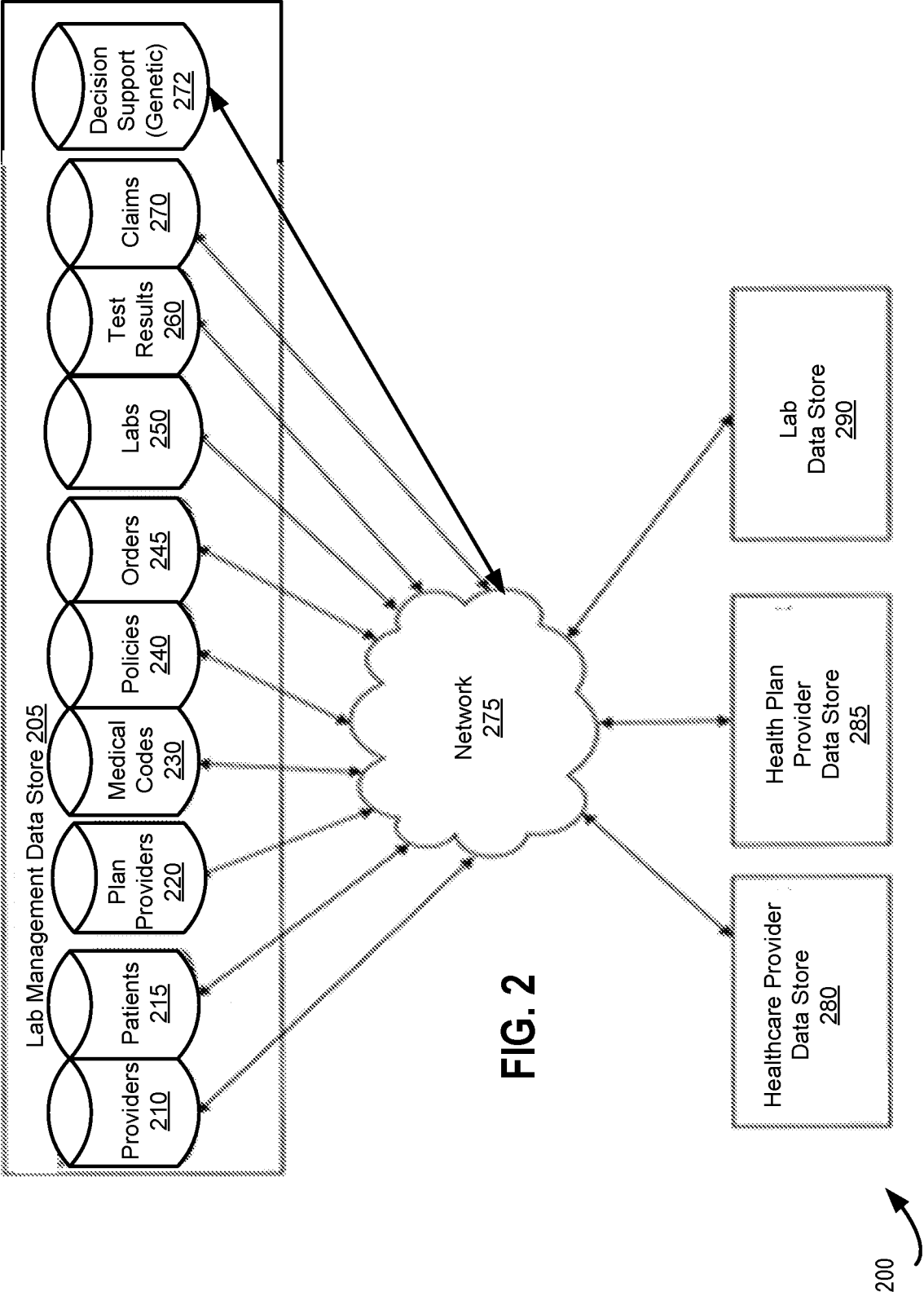
17. The non-transitory computer-readable medium of claim 16 wherein the operations further comprise looking up the provider using national provider identifier (NPI).

18. The non-transitory computer-readable medium of claim 14 wherein the operations further comprise checking for errors in the order request using fuzzy matching logic in the clustered server environment.

19. The non-transitory computer-readable medium of claim 18 wherein the operations further comprise checking for errors in the order request using common-service data access object pattern recognition provided as a procedure stored in the clustered server environment.

20. The non-transitory computer-readable medium of claim 14 wherein the operations further comprise generating a web portal in a number of portal pages provided to the electronic device associated with the provider in a number of portal pages presented using portlets.





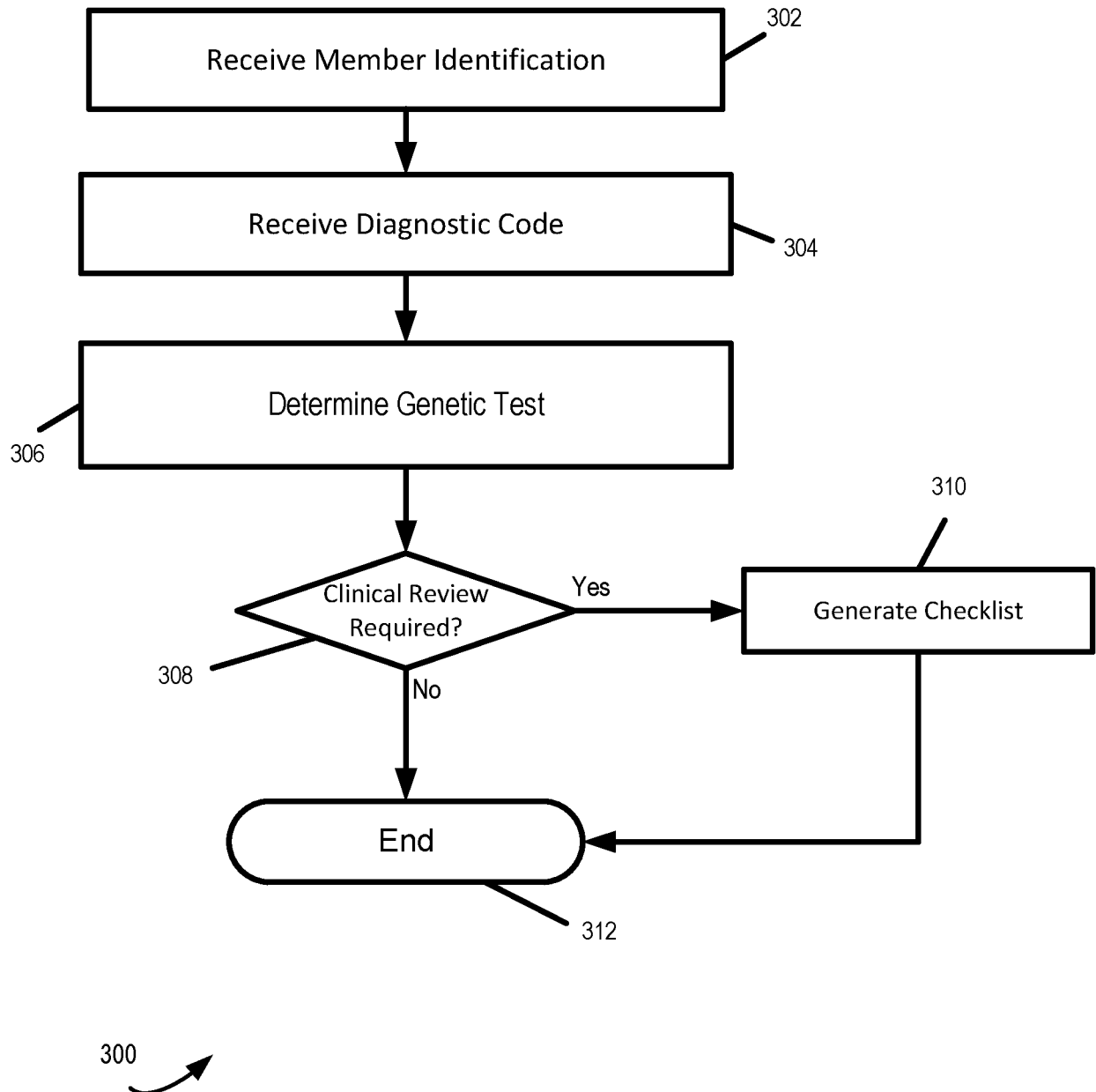


FIG. 3

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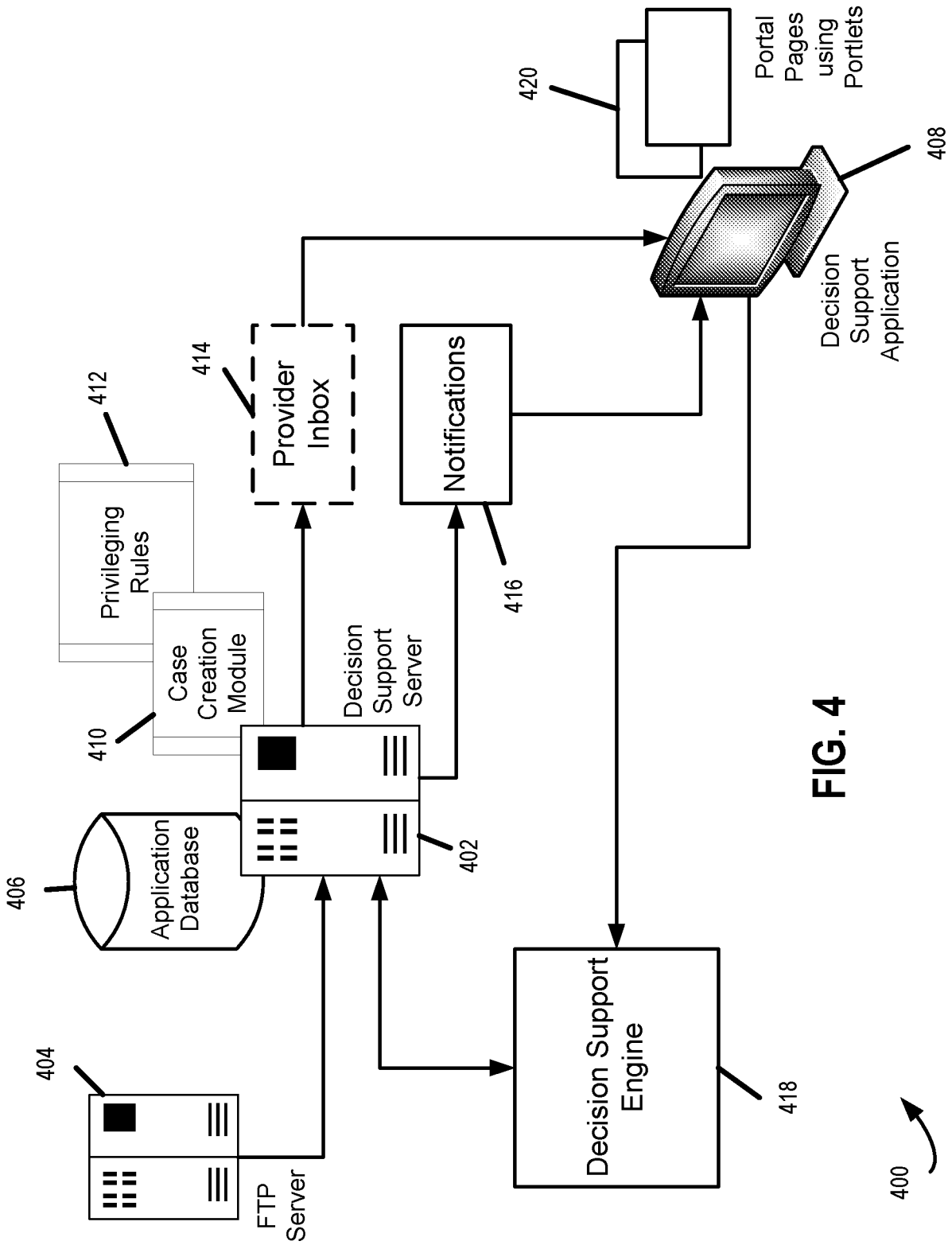


FIG. 4

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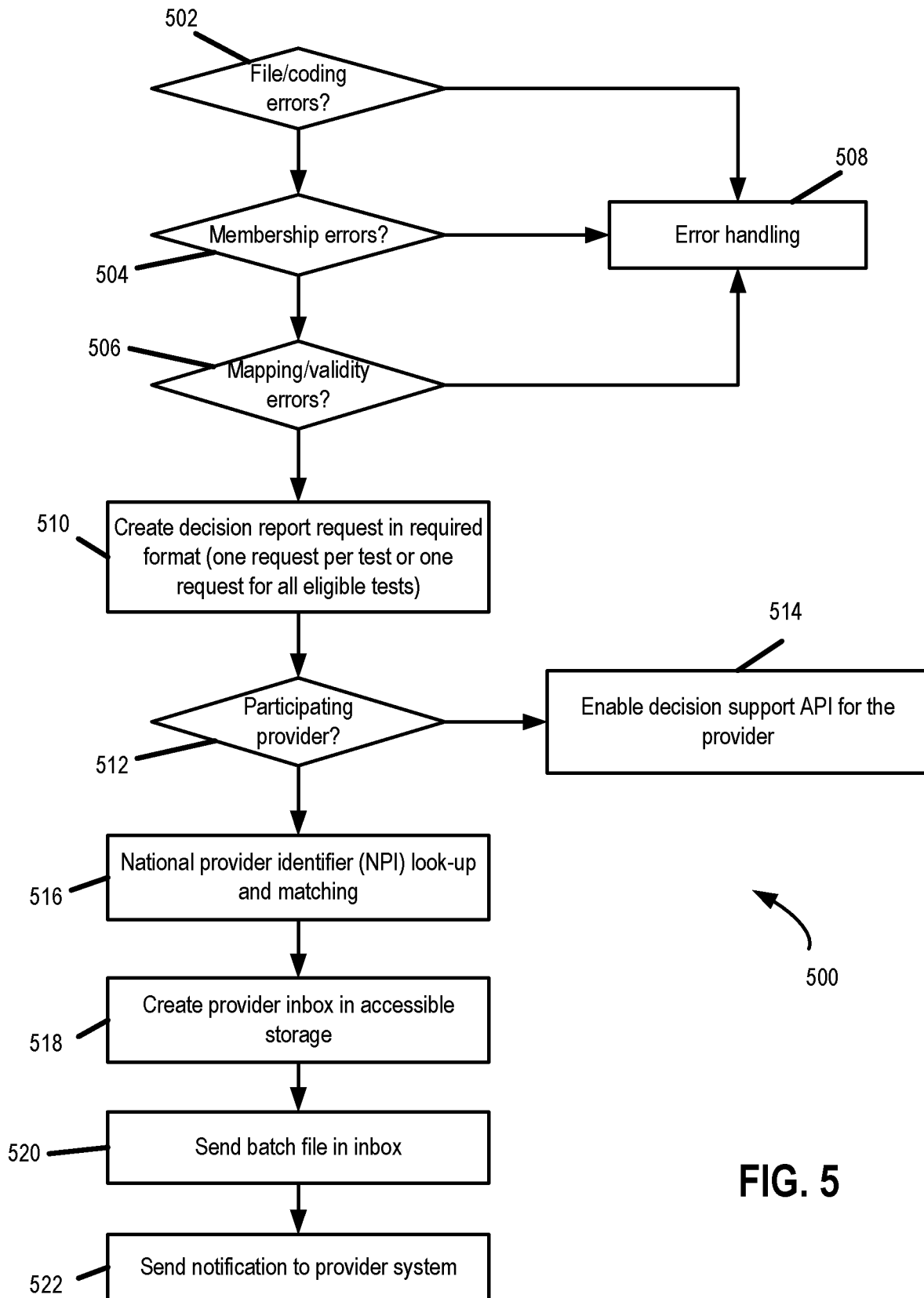


FIG. 5

