United States Patent 12394506
Kind Code B2
Date of Patent August 19, 2025
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Platform for collaborative analysis of electronic records

Abstract

Systems and methods are described, and an example system includes an AI enhanced multi-source health data integration logic that receives a first source electronic health record (EHR) data from a first EHR system and a second source EHR data from a second EHR system, and transforms, according to a knowledge representation schema, health-related information content of the first source EHR data and the second source EHR data to a first source transformed health data and second source transformed health data. The system includes a collaboration platform, configured to host a multi-source transformed health data database, including the transformed first source health data and the transformed second source health data, and hosts AI-enhanced, multiple level telecollaborative analyses by a plurality of participants of the multi-source transformed health data database, generating health management data.

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Appl. No.: **18/200227**

Filed: **May 22, 2023**

Prior Publication Data

Document Identifier	Publication Date
US 20230307103 A1	Sep. 28, 2023

Related U.S. Application Data

continuation parent-doc US 17701933 20220323 US 11908555 child-doc US 18200227
us-provisional-application US 63164659 20210323

Publication Classification

Int. Cl.: **G16H10/60** (20180101); **G06F16/20** (20190101); **G06F16/25** (20190101); **G06F17/40** (20060101); **G06F21/62** (20130101); **G06Q10/00** (20230101); **G06Q90/00** (20060101); **G16H40/67** (20180101); **G16H50/20** (20180101); **G16H80/00** (20180101)

U.S. Cl.:

CPC **G16H10/60** (20180101); **G06F16/20** (20190101); **G06F16/25** (20190101); **G06F16/254** (20190101); **G06F17/40** (20130101); **G06F21/6245** (20130101); **G06Q10/00** (20130101); **G06Q90/00** (20130101); **G16H40/67** (20180101); **G16H50/20** (20180101); **G16H80/00** (20180101);

Field of Classification Search

CPC: G06F (16/254); G06F (16/20); G06F (16/25); G06F (17/40); G06F (21/6245); G06F (21/6236); G16H (10/60); G16H (40/67); G16H (50/20); G16H (80/00); G06Q (10/00); G06Q (90/00)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
10338958	12/2018	Kamboj	N/A	G06F 9/3851
10642856	12/2019	Chu	N/A	G06F 21/6218
11082487	12/2020	Jain et al.	N/A	N/A
11424012	12/2021	Rai	N/A	N/A
11514289	12/2021	Otte	N/A	G06N 20/00
2004/0236786	12/2003	Medicke et al.	N/A	N/A
2005/0262190	12/2004	Mamou	709/203	G06Q 10/10
2008/0046292	12/2007	Myers et al.	N/A	N/A
2009/0006467	12/2008	Visscher	N/A	N/A
2009/0080408	12/2008	Natoli et al.	N/A	N/A
2009/0094674	12/2008	Schwartz et al.	N/A	N/A
2013/0159258	12/2012	Belisle	707/654	G06F 16/23
2013/0238349	12/2012	Sethumadhavan et al.	N/A	N/A
2014/0350961	12/2013	Csurka et al.	N/A	N/A
2016/0210427	12/2015	Mynhier et al.	N/A	N/A
2016/0267150	12/2015	Gubau i Forné et al.	N/A	N/A
2017/0076046	12/2016	Barnes et al.	N/A	N/A
2018/0011922	12/2017	Sethumadhavan et al.	N/A	N/A
2018/0225345	12/2017	Gilder et al.	N/A	N/A

2019/0005200	12/2018	Zimmerman et al.	N/A	N/A
2019/0065683	12/2018	Korpman et al.	N/A	N/A
2020/0104723	12/2019	Reissner	N/A	G06F 8/38
2020/0176098	12/2019	Lucas et al.	N/A	N/A
2020/0349288	12/2019	Jun et al.	N/A	N/A
2021/0104304	12/2020	Davidovics et al.	N/A	N/A
2021/0241871	12/2020	Burnett et al.	N/A	N/A
2022/0292372	12/2021	Joshy	N/A	G06F 16/122
2023/0004574	12/2022	Hu	N/A	G06F 8/433

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2371127	12/2001	GB	N/A

OTHER PUBLICATIONS

Kai et al. "Authentic Data Space: A Security Data Co-Existence Schema Based on Tagging Technique," 2017, 2017 International Conference on Computer Systems, Electronics and Control, pp. 1472-1476 (Year: 2017). cited by examiner
Geilm et al. "FactDAG: Formalizing Data Interoperability in an Internet of Production" IEEE Internet of Things Journal, vol. 7, No. 4, pp. 3243-3253, Apr. 2020 (Year: 2020). cited by examiner

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Primary Examiner: Adams; Charles D

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 17/701,933 filed on Mar. 23, 2022; which claims the benefit of priority from U.S. provisional application 63/164,659, filed Mar. 23, 2021, entitled "AI-ENHANCED, USER PROGRAMMABLE, SOCIALLY NETWORKED SYSTEM OF ELECTRONIC HEALTH RECORD (EHR) SYSTEMS," the disclosure which is incorporated by reference in its entirety.

FIELD
(1) Embodiments disclosed herein generally relate to systems and methods for collaborative analysis of electronic records including electronic health records and health management.
BACKGROUND
(2) The respective electronic health record (EHR) systems of the different components of the Department of Homeland Security (DHS), e.g., the Transportation Safety Agency (TSA), Federal Emergency Management Authority (FEMA), and DHS Headquarters, have differences, e.g., in system architecture, record standards, and user-interface, that can render it impractical to pool collection of common-interest informational content from any one component, e.g., the Coast Guard, with other DHS components or with third-parties, e.g., consultants, other contractors.
SUMMARY
(3) In an embodiment, an example system provides for artificial intelligence (AI) enhanced, user programmable, and socially networked medical record exchange, and medical and public health situation assessment and response management, and the example system includes a multi-source health data integration logic, configured to perform operations including: receiving a first source electronic health record (EHR) data from a first EHR system and a second source EHR data from a

second EHR system, transforming a health-related information content of the first source EHR data to a first source transformed health data, in accordance with a knowledge representation schema, and transforming a health-related information content of the second source EHR data to a second source transformed health data, in accordance with the knowledge representation schema. The example system further includes a collaboration platform, coupled to the multi-source health data integration logic, and configured to host a multi-source transformed health data database that includes the transformed first source health data and the transformed second source health data, and host a telecollaboration among a plurality of participants, regarding a content of the multi-source transformed health data database. The example system also includes a health data analysis and AI tool, hosted by the collaboration platform, configured to generate a health management data, based at least in part on an analyzing of the multi-source transformed health data database and at least a portion of the telecollaboration.
(4) In another embodiment an example system provides for sovereignty protective extraction and collaborative analysis of information content of electronic health records and associated medical and public health situation assessment. Features of this example system include an information extracting, sovereignty protective wrapping logic, configured to perform operations including receiving an electronic health record (EHR) data from an EHR system, and wrapping, in an EHR system-specific sovereignty protective wrapper, a genericized form of a health-related information content of the EHR data. Features of this example system also include a staging database, coupled to the information extracting, sovereignty protective wrapping logic, and configured to store, in accordance with the EHR system-specific sovereignty protective wrapper, the genericized form of the health-related information content of the EHR data. Features of this example system also include a transform and concept alignment logic, coupled to the staging database, and configured to perform a transforming of the genericized form of the health-related information to a transformed interoperable health-related data; and include a collaboration platform, coupled to the transform and concept alignment logic, and configured to perform a hosting of a telecollaborative analysis of the transformed interoperable health-related data. In the example system, features of the hosting include a wrapping, in a telecollaboration participant specific sovereignty protective wrapper, a telecollaboration data associated with telecollaboration participant, and a maintaining during the telecollaborative analysis of the transformed interoperable health-related data, a sovereignty of the transformed interoperable health-related data in accordance with the EHR system-specific sovereignty protective wrapper, and a sovereignty of the telecollaboration data associated with the telecollaboration participant in accordance with the telecollaboration participant specific sovereignty protective wrapper.
(5) Other features and aspects of various embodiments will be understood from reading the following detailed description in conjunction with the accompanying drawings. This summary is not intended to identify key or essential features, or to limit the scope of the invention, which is defined solely by the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a functional block diagram of an example system-of-systems for artificial intelligence (AI) enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(2) FIG. **2** shows by annotation of FIG. **1** a logic flow of data pipeline aspects and concept and model pipeline aspects, and of actionable information in various systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public

health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(3) FIG. **3** is a functional block diagram of an example implementation of the combined staging database block in the FIG. **1** system and other systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management, in accordance with one or more embodiments.
(4) FIG. **4** is a logic flow diagram of an example process in sovereignty protective transferring of data into and out from the combined staging database of the FIG. **1** system, for various systems and methods for artificial intelligence enhanced medical record exchange, medical and public health situation assessment and health service resource and response management, in accordance with one or more embodiments.
(5) FIG. **5** is function block diagram of an example implementation of a virtual data warehouse and collaboration platform function block for the FIG. **1** system and various other systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management, in accordance with one or more embodiments.
(6) FIG. **6** shows by graphic overlay on FIG. **5** an example general configuration of a multi-participant telecollaboration that can be hosted on a common platform aspect of systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(7) FIG. **7** is a diagram illustrating an example configuration of a software development kit (SDK) for multi-contributor maintenance of a multi-tool suite of analysis apps, with an example plurality of analysis apps, that can be an AI enhanced multi-tool analysis resource for coupling to a multi-institutional knowledge database, for the FIG. **1** system and various other systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(8) FIG. **8** is a diagram illustrating an example configuration of the curated applications block of the FIG. **1** example system, with a representative plurality of third party and user contributed applications, for the FIG. **1** system and various other systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(9) FIG. **9** is a diagram illustrating an example configuration of the graphical user interface (GUI) block of the FIG. **1** system, with a representative plurality of widgets and other features, for the FIG. **1** system and various other systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(10) FIG. **10** is a functional block diagram of an example adaptation of the FIG. **1** system, showing incorporation of the staging database configuration of FIG. **3**, and the FIG. **4** diagrammed flow of sovereignty protective transferring of data into and out from the combined staging database, for various systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.
(11) FIG. **11** shows, by graphic overlay of flow arrows on FIG. **10**, data pipeline aspects and certain concept and model pipeline aspects, and flow of actionable information and decisions, for the FIG. **10** system and other systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation

assessment, and health services resource and response management in accordance with one or more embodiments.

(12) FIGS. **12**A and **12**B show a two-sheet arrangement of a functional block diagram and supported process flow diagram of another example system in accordance with one or more embodiments for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(13) FIGS. **13**A and **13**B show a two-sheet arrangement of a functional block diagram and supported process flow diagram showing aspects of an example system in general accordance with the FIG. **10** system for medical and public health service resource and response management via AI enhanced medical record exchange, feeding concept generation and dynamic updating of multi-institutional knowledge database coupled to AI enhanced multi-tool analysis resources in accordance with one or more embodiments.

(14) FIG. **14** is a process flow diagram showing certain features and aspects shown in FIG. **13**A and elsewhere in this disclosure, for AI enhanced medical record exchange and common platform collaboration-based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(15) FIG. **15** is a process diagram, with annotation showing process inter-block flows, for an implementation of an example process according to methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(16) FIG. **16** shows a process flow diagram of an example implementation of multiple external source data receiving and input processing, and an example information extraction, transformation, and document sovereignty wrapper processing in the FIG. **15** process for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(17) FIG. **17** shows a process flow diagram of an example implementation **1700** of combined staging database processing in the FIG. **15** process for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(18) FIG. **18** shows a process flow diagram of an example implementation of transform and concept alignment processing in the FIG. **15** process for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(19) FIG. **19** shows a process flow diagram of an example implementation of the FIG. **15** transformed, interoperable data processing for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(20) FIG. **20** shows a process flow diagram of an example alternative or further implementation of multiple external source data receiving and input processing, for the FIG. **15** process in methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(21) FIG. **21** shows a process flow diagram of an example alternative or further implementation of the transform and concept alignment processing in the FIG. **15** process, in methods for AI enhanced medical record exchange and common platform collaboration based medical and public health

situation assessment, and health services resource and response management in accordance with one or more embodiments.
(22) FIG. **22** is a functional block schematic of an example implementation of a computing system on which aspects of the present disclosure can be practiced.
(23) FIG. **23** shows a schematic view of the system.
(24) FIG. **24** shows a schematic view of the collaboration platform.
(25) FIG. **25** shows a schematic view of the access interface.
(26) FIG. **26** shows a schematic view of data flow in an embodiment of the system.
(27) FIG. **27** shows a schematic view of data flow in an embodiment of the system.
(28) FIG. **28** shows an embodiment of the phenotype engine.
(29) FIG. **29** shows a schematic view of the data modeler.
(30) FIG. **30** shows an example of a sovereignty wrap.
(31) FIG. **31** shows an example of a nested sovereignty wrap.
(32) FIG. **32** shows a schematic diagram of the data modeler with details removed to show the entire modeler in one figure.

DETAILED DESCRIPTION

(33) In the drawings, like reference numerals designate identical or corresponding parts throughout the several views. The drawings are generally not drawn to scale unless specified otherwise or illustrating schematic structures or flowcharts. As used herein, the words “a,” “an” and the like generally carry a meaning of “one or more,” unless stated otherwise.
(34) In one example environment, a multi-source health data integration logic receives electronic health record (EHR) data from a plurality of different EHR data sources. Two or more of the EHR data sources may be mutually independent EHR management systems. The mutually independent EHR management systems may have respectively different architectures, may use respectively different file standards, and may have respectfully different configurations for user interface. The mutually independent EHR management systems can be respective EHR management systems of different components of a governmental organization, such as but not limited to the DHS. The mutually independent EHR management systems can be respectively different systems used by different private entities, or by different countries' governmental entities.
(35) The multi-source health data integration logic's receiving of the EHR data from the mutually independent EHR management systems can be transparent to the different systems' users.
(36) In an example environment, the multi-source health data integration logic can receive provenanced data, which can define, as well as selectively adapt and modify, data provenance rules from the various EHR management systems. The multi-source health data integration logic can then extract health and health related information for the EHR data received from the different EHR management systems and, using the received data provenance rules, wrap the extracted health and health related information in provenance rule compliant sovereignty wrappers, and store the wrapped health and health related information in a staging database. In an embodiment, the staging database can be configured to function as a data lake, which can feed a common platform and a multiple participant telecollaboration that can be hosted by and monitored or sensed by the common platform.
(37) The common platform, the user interfaces to the common platform, as well as participant selection processes, and various resources supporting the common platform can be configured to a progression or evolution to what can be a target population and population makeup. The configurations can be such that the target population makeup can include, for example, participants of different skill sets, different individual and organizational positions, participants with access to different kinds processing resources. Configuration of common platform architecture, the user interfaces, and various processing resources can be for individuals as participants, and for organizations, formal or informal, private or governmental, as participants.
(38) Embedded in or coupled to the common platform monitoring and sensing resources can be

logic configured to construct, and dynamically update what can be “virtual institutional knowledge database,” based on the sensed telecollaboration dynamics, e.g., inter-participant exchanges, analyses by individual participants, and analyses by groups of participants. The analyses can include, for example, neural networks.

(39) An example system in accordance with one or more embodiments for AI enhanced, user programmable, socially networked medical record exchange, and medical and public health situation assessment and response management can include a multi-source health data integration logic and a collaboration platform coupled to the multi-source health data integration logic. The multi-source health data integration logic can be configured to perform operations including receiving a first source EHR data from a first EHR system and a second source EHR data from a second EHR system, transforming a health-related information content of the first source EHR data to a first source transformed health data, in accordance with a knowledge representation schema, and transforming a health-related information content of the second source EHR data to a second source transformed health data, in accordance with the knowledge representation schema. In an embodiment, features of the collaboration platform can include, but are not limited to, configuration to host a multi-source transformed health data database that includes the transformed first source health data and the transformed second source health data, and to host a telecollaboration among a plurality of participants, regarding a content of the multi-source transformed health data database. In an embodiment, a system can include a health data analysis and AI tool, which can be hosted by the collaboration platform, and can be configured to generate a health management data, based at least in part on an analyzing of the multi-source transformed heath data database and at least a portion of the telecollaboration.

(40) In one or more embodiments, the health data analysis and AI tool can be a health data first analysis tool, and the system can further comprise a published software development kit, interfacing to the collaboration platform. The published software development kit can be configured to support a suite of health data analysis and AI tools, and the suite of health data analysis and AI tools can include the first health information analysis and AI tools. In an embodiment, the published software development kit can be further configured to be accessible to a plurality of third parties, for respective contributions to the suite of health data analysis and AI tools.

(41) In one or more embodiments, the knowledge representation schema can be configured, the transforming the health-related information content of the first source EHR data to the transformed first source health data can be configured, or transforming the health-related information content of the second source EHR data to the transformed second source health data can be configured, or any combination or sub-combination thereof, to align a concept represented by the health-related information content of the first source EHR data with a concept represented by the health-related information content of the second source EHR data.

(42) In one or more embodiments, the multi-source health data integration logic can be further configured to receive and to transform a healthcare model configuration data to a healthcare model transformed configuration data, in accordance with the knowledge representation schema. In an aspect, the collaboration platform that is further configured to host the healthcare model transformed configuration data, and the health data analysis and AI tool can be further configured to generate the health services management data further based, at least in part, on a healthcare model that is configured based, at least in part, on the healthcare model transformed configuration data.

(43) In one or more embodiments, the multi-source health data integration logic can be further configured to generate, for the first source transformed health data, a first system sovereignty data, and to generate, for the second source transformed health data, a second system sovereignty data. In the one or more embodiments the collaboration platform can be further configured to include, in the hosting the multi-source transformed health data database, or in the hosting the

telecollaboration, or both, an automated enforcement of rules of engagement in a usage, e.g., by the telecollaboration, of the transformed first source health data and the transformed second source health data. The rules of engagement can include a first rule of engagement for usage, e.g., by the telecollaboration of the transformed first source health data. The first rule of engagement can be based, at least in part, on the first system sovereignty data. The rules of engagement can include a second rule of engagement for usage, e.g., by the telecollaboration of the transformed second source health data. The second rule of engagement can be based, at least in part, on the second system sovereignty data.

(44) The system may be further configured wherein the multi-source health data integration logic is configured to: receive at least a portion of the first EHR system sovereignty specification from the first EHR system; and receive at least a portion of the second EHR system sovereignty specification from the second EHR system.

(45) The system may be further configured such that the multi-source health data integration logic comprises: a data extraction and wrapping logic, configured to generate a first genericized health-related data and a first metadata, based at least in part on an extracting of at least a portion of the health-related information content from the first EHR data. The data extraction and wrapping logic may be configured to generate a second genericized health-related data and a second metadata, based at least in part on an extracting of at least a portion of the health-related information content from the second source EHR data. The multi-source health data integration logic may comprise a staging database, configured to: store the first genericized health-related data, the first metadata, and the first system sovereignty data, and store the second genericized health-related data, the second metadata, and, in association with the second genericized health-related data and the second metadata, the second system sovereignty data. The multi-source health data integration logic may comprise a transformation logic, configured to transform, to the knowledge representation schema, the first genericized health-related data, the first metadata, the second genericized health-related data, and the second metadata.

(46) In one or more embodiments, the data extraction and wrapping logic can be further configured to generate the first system sovereignty data as a first sovereignty wrapper, and the first sovereignty wrapper can include a first source provenance wrapper, a first source persistent encryption wrapper, and a first source rules of engagement wrapper. The data extraction and wrapping logic can be further configured to generate the second system sovereignty data as a second sovereignty wrapper, and the second sovereignty wrapper can include a second source provenance wrapper, a second source persistent encryption wrapper, and a second source rules of engagement wrapper.

(47) One or more configurations of the system may be configured to provide sovereignty protective extraction and collaborative analysis of information content of electronic health records, and associated medical and public health situation assessment. Some configurations may include: an information extracting, sovereignty protective wrapping logic, configured to perform operations including, receiving an electronic health record (EHR) data from an EHR system, and wrapping, in an EHR system-specific sovereignty protective wrapper, a genericized form of a health-related information content of the EHR data. The system may include a staging database, coupled to the information extracting, sovereignty protective wrapping logic, and configured to store, in accordance with the EHR system-specific sovereignty protective wrapper, the genericized form of the health-related information content of the EHR data. The system may comprise a transform and concept alignment logic, coupled to the staging database, and configured to perform a transforming of the genericized form of the health-related information content to a transformed interoperable health-related data. The system may also comprise a collaboration platform, coupled to the transform and concept alignment logic, and configured to perform a hosting of a telecollaborative analysis of the transformed interoperable health-related data, the hosting including: a wrapping, in a telecollaboration participant specific sovereignty protective wrapper, a telecollaboration data associated with a telecollaboration participant, and a maintaining during the telecollaborative

analysis of the transformed interoperable health-related data, a sovereignty of the transformed interoperable health-related data in accordance with the EHR system-specific sovereignty protective wrapper, and a sovereignty of the telecollaboration data associated with the telecollaboration participant in accordance with the telecollaboration participant specific sovereignty protective wrapper.

(48) Some configurations of the system may include a published software development kit, interfacing to the collaboration platform, and supporting a suite of health data analysis and AI tools, accessible to a plurality of participants, for respective contributions to the suite of health data analysis and AI tools. Some configurations of the system may include the information extracting, sovereignty protective wrapping logic being further configured to receive a model data, defining a model and, in response, perform a wrapping, in a third-party supplier model information SP wrapping, a genericized form of an information content of the model data. Some configurations of the system may include the transform and concept alignment logic being further configured to also perform: configuring the transformed interoperable health-related data according to a knowledge representation schema supported by the collaboration platform, configuring the model data according to the knowledge representation schema, and aligning a concept represented by the transformed interoperable health-related data with a concept represented by the model data.

(49) Various methods for artificial intelligence (AI) enhanced, user programmable, and socially networked medical record exchange, and medical and public health situation assessment and response management are contemplated. Such methods may include receiving a first source electronic health record (EHR) data from a first EHR system and a second source EHR data from a second EHR system; transforming a health-related information content of the first source EHR data to a first source transformed health data, in accordance with a knowledge representation schema; transforming a health-related information content of the second source EHR data to a second source transformed health data, in accordance with the knowledge representation schema: hosting, on a collaboration platform, a multi-source transformed health data database, which includes the transformed first source health data and the transformed second source health data; hosting a telecollaboration among a plurality of participants, regarding a content of the multi-source transformed health data database; and hosting a health data analysis and AI tool, by the collaboration platform, health information analysis and AI tool, the health data analysis and AI tool being configured to generate a health management data, based at least in part on an analyzing of the multi-source transformed health data database and at least a portion of the telecollaboration.

(50) Methods of use may include interfacing to the collaboration platform a published software development kit, supporting a suite of health data analysis and AI tools, the published software development kit being accessible to a plurality of participants, for respective contributions to the suite of health data analysis and AI tools.

(51) Methods of use may also include the transforming the health-related information content of the first source EHR data to the transformed first source health data being configured, or the transforming the health-related information content of the second source EHR data to the transformed second source health data being configured, or any combination or sub-combination thereof, to align a concept represented by the health-related information content of the first source EHR data with a concept represented by the health-related information content of the second source EHR data.

(52) Methods of use may also contain receiving and transforming a healthcare model configuration data to a healthcare model transformed configuration data, in accordance with the knowledge representation schema; hosting the healthcare model transformed configuration data on the collaboration platform; and generating the health management data further based, at least in part, on a healthcare model that is configured based, at least in part, on the healthcare model transformed configuration data.

(53) Method of use may include generating, for the first source transformed health data, a first

system sovereignty data; generating, for the second source transformed health data, a second system sovereignty data; and the hosting the multi-source transformed health data database, or the hosting the telecollaboration, or a combination of the hosting the multi-source transformed health data database and the hosting the telecollaboration including: an automated enforcing of a first rule of engagement in a usage, by the telecollaboration, of the transformed first source health data, the first rule of engagement being based, at least in part, on the first system sovereignty data, and an automated enforcing of a second rule of engagement in a usage, by the telecollaboration, of the transformed second source health data, the second rule of engagement being based at least in part on the second system sovereignty data.

(54) Method of use may include storing a first EHR system sovereignty specification, corresponding to the first EHR data; storing a second EHR system sovereignty specification, corresponding to the second EHR data; generating the first system sovereignty data based, at least in part, on the first EHR system sovereignty specification; and generating the second system sovereignty data based, at least in part, on the second EHR system sovereignty specification.

(55) Method of use may contain the steps of receiving at least a portion of the first EHR system sovereignty specification from the first EHR system; and receiving at least a portion of the second EHR system sovereignty specification from the second EHR system.

(56) Some of method of use may include: receiving a first provenance data, indicating at least an ownership of a health information content of the first EHR data; receiving a second provenance data, indicating at least an ownership of a health information content of the second EHR data; generating a first genericized health-related data and a first metadata, based at least in part on an extracting of at least a portion of the health information content from the first EHR data; generating a second genericized health-related data and a second metadata, based at least in part on an extracting of at least a portion of the health information content from the second EHR data; generating the first system sovereignty data based at least in part on the first provenance data; and generating the second system sovereignty data based at least in part on the second provenance data.

(57) Some method of use may include generating the first system sovereignty data as a first sovereignty wrapper, the first sovereignty wrapper including a first source provenance wrapper, a first source persistent encryption wrapper, and a first source rules of engagement wrapper; and generating the second system sovereignty data as a second sovereignty wrapper, the second sovereignty wrapper including a second source provenance wrapper, a second source persistent encryption wrapper, and a second source rules of engagement wrapper

(58) In an embodiment, features including data curation provided by the disclosed combination of the multi-source health data integration logic, data extraction and sovereignty protective wrapping provided by the data extraction and wrapping logic, and multiple participant collaboration provided by a hosted by the virtual collaboration platform can include what can be referenced as AI enhanced medical record exchange. The medical record exchange feature can bring medical and contextual data, analytics, decisions, and collaboration from across multiple sources onto a single secure medical information platform. Features of medical record exchange include multilevel, persistent, embedded cybersecurity. The cybersecurity is provided, for example, by tightly sequestering electronic personal health information (ePHI) and limiting access to appropriate roles, data attributes, and dynamic policies across all workflows. The medical record exchange can track data provenance throughout the analysis pipeline and can use persistent encryption methods to automate enforcement of the rules of engagement that data owners have agreed upon.

(59) Medical record exchange can accept the burden of data integration with minimal disruption to operations of the different source systems' users. Benefits of minimal disruption can include support, for example and without limitation, reaching across multiple individual components of a large organization, each having their own individual EHR systems, for individual operational decisions by the individual EHR systems, while delivering the necessary tools for evidence-based oversight, management, and coordination of medical activities across the entire organization.

Medical record exchange provides, therefore, a sophisticated, usable, integration platform, without requiring a single commercial EHR for the entire organization.

(60) Implementation can be a system of systems, agnostic to the specifics of its source systems, but able to detect and strengthen their interconnections and unify them as a single information framework built for analysis and collaboration. The design of the medical record exchange can leverage an array of tools of modern data science and AI to create functional interoperability across an organization's components' individual medical record systems, without mandating preconceived requirements, and thus freeing components to determine for themselves what tools and processes are best suited to meet their unique mission needs.

(61) FIG. **1** shows a functional block schematic of an example of an electronic health record system **100** for medical and public health situation assessment and response management in accordance with one or more embodiments. Features of the system **100**, in overview, can include but are not limited to AI-enhanced medical record exchange, extraction, genericizing and storing in a staging database the health information contents of EHR data from a plurality of EHR systems. Further features can include transformation logic, which can be configured for transforming the EHR data to a transformed EHR data, e.g., using a knowledge representation schema, and feeding the transformed EHR data to collaboration platform supported multi-user telecollaboration, which is described in more detail in later sections of this disclosure. The telecollaboration, as will be described include, via the platform, a suite of tools analysis for a per-project, per-case, per-task, and per-document-management. The hosted telecollaboration can further provide peer review and root cause analysis and automated delivery of relevant information to the right person at the right time. The analysis tools can include data integration, data modeling, data analysis, concept recognition, concept alignment, visualization, and decision support tools.

(62) Features can include a monitoring of telecollaboration events and, e.g., via subscription terms, maintaining a database of participants' relevant credentials, based at least in such features, generating a multi-institutional knowledge database. The generation can be continuing, which can produce a dynamic updating of the multi-institutional knowledge database.

(63) In an embodiment, the FIG. **1** system **100** can include a multi-source health data integration logic **102** configured to receive what can be large amounts of electronic health information (eHI) carried in EHRs, from a personal health information (ePHI), in various forms and file structures maintained by a plurality of different, mutually independent EHR systems, e.g., a first EHR system **104-1**, second EHR system **104-2** . . . , and Nth EHR system **104**-N (collectively “EHR systems **104**”). The eHI can include electronic personal health information (ePHI) and can include other non-personal health information. The EHRs can be in various forms and file structures maintained by the different EHR systems **104**. Additional resources and particular features and combinations thereof, described in more detail in subsequent paragraphs include resources supporting novel processes providing, but not limited to, extraction and transformation to a generic form of the information content and related metadata of the EHRs, and EHR system-specific, adaptable sovereignty protective wrapping of the generic transformed information content and related metadata. Additional features and combinations thereof can include resources supporting novel process providing but not limited to transform and concept alignment processes that transform the generic form of the information content and related metadata of the EHRs to a transformed interoperable data. The transform includes conversion or transformation of the multiple sourced health information and metadata to a genericized health-related data. The genericized health-related data can be transformed again to the interoperable data. In an embodiment, the interoperable data can be aligned to logic structure of a virtual data warehouse and collaboration platform, which can be configured to host, for example, multiple participant collaborative analyses and using platform supported knowledge representation schema of a described in greater detail in subsequent paragraphs.

(64) Referring to FIG. **1**, in an embodiment, the multi-source health data integration logic **102** can

be configured to receive other health and health-related data from additional sources **106**. In an aspect, the multi-source health data integration logic **102** can be configured to also receive third party model data from one or more third-party model suppliers **108**. For purposes of description, operations and processes of receiving data from EHR systems **104**, additional sources **106**, and third-party model suppliers **108**, e.g., collection, management, and supplying data to the multi-source health data integration logic **102**, is represented on FIG. **1** as data curation **110**.

(65) In an embodiment the multi-source health data integration logic **102** can receive, associated with the ePHI from the EHR systems **104**, the additional data from the additional data sources **106**, and the model data from the third-party model suppliers **108**. The multi-source health data integration logic can also receive source-specific permissions and conditions data from one or more of the above-identified data sources. For example, as shown in FIG. **1**, the multi-source health data integration logic **102** can receive from the first EHR system **104-1** a first EHR system electronic source-specific permissions and conditions data (labeled "PMN/Cond-1"), hereinafter referenced as "first EHR PMN/CD," and can receive from the Nth EHR system **104-**N another source-specific permissions and conditions data (labeled "PMN/Cond-N"), hereinafter referenced as "Nth EHR PMN/CD." For purposes of description, permissions and conditions data received from the different EHR systems **104** will be referenced collectively as "EHR permissions and conditions data, which will be alternatively recited as "EHR PMN/CD."

(66) In an embodiment, the FIG. **1** multi-source health data integration logic **102** can receive, from the additional sources **106**, permissions and conditions data, which is hereinafter referenced collectively as "additional sources permissions and conditions data" and, alternatively, as "ADS Data PMN/CD." In an embodiment, the FIG. **1** multi-source health data integration logic **102** can receive, from the third-party model suppliers **108**, permissions and conditions data that is hereinafter referenced as "third party model sources permissions and conditions data" and, alternatively, "Third Party Model PMN/CD."

(67) It will be understood that in the context of the present disclosure the above-introduced letter strings "PMD/CD," "EHR PMN/CD," and "ADS Data PMN/CD" are coined letter strings that serve only as reduced letter count representations, respectively, of the word sequences "source-specific permissions and conditions data," "EHR system source-specific permissions and conditions data," and "additional source, source-specific permissions and conditions data," and none of these coined letter strings, as used herein, possesses, imports, or applies any intrinsic meaning.

(68) The EHR PMN/CD received at the multi-source health data integration logic **102** can include, identify, reference, define, specify, and/or embody (hereinafter collectively "include") respective EHR system sovereignty specifications. For example, the first EHR PMN/CD can include a first EHR system **104-1** sovereignty specification, the second EHR PMN/CD can include a second EHR system **104-2** sovereignty specification, and so forth, with the Nth EHR PMN/CD including an Nth EHR system **104-**N sovereignty specification. The EHR system sovereignty specifications received from the EHR systems **104** can in turn include, identify, reference, define, specify, and/or embody (hereinafter collectively "include") respective EHR sovereignty rules. For example, the first EHR system **104-1** sovereignty specification can include first EHR system **104-1** sovereignty rules, the second EHR system **104-2** sovereignty specification can include second EHR system **104-2** sovereignty rules, and so forth, with the Nth EHR system **104-**N sovereignty specification including Nth EHR system **104-**N sovereignty rules.

(69) In an embodiment the multi-source health data integration logic **102** can be configured such that new permissions and conditions data may not be required for each data received from the described sources. For example, the multi-source health data integration logic **102** can be configured such that, prior to a given reception of EHR data from an nth EHR system **104-***n*, an nth EHR system PMN/CD can be received and stored, and then used for subsequent EHR-n data. In an embodiment, the multi-source health data integration logic **102** can receive updated EHR

permissions and conditions data from one or more of the EHR systems **104**. In another embodiment, the multi-source health data integration logic **102** can receive data with embedded identifiers of permissions and conditions, referencing an earlier received set of permissions and conditions data.

(70) In an embodiment, the multi-source health data integration logic **102** can be configured to store up to N different EHR system sovereignty specifications, and based at least in part on same, to generate, select, construct, assemble. or configure (hereinafter collectively "generate") appropriate EHR system-specific rules. The multi-source health data integration logic **102** can include, for example, as translation feature that can translate the stored EHR system sovereignty specifications to appropriate rules, protocols, and formats native to the multi-source health data integration logic **102**.

(71) In an embodiment, data ownership can be singular or multilateral, and new ownership with additional data sovereignty rules can accrue during data transformational processes. In an example accrual, ownership and sovereignty rules can be nested as value of the information content is added during data modeling.

(72) In an embodiment, one or more of the EHR system **104** sources, or one or more of the additional sources **106**, or one or more of the third part model sources **108**, or any combination of such sources, can provide information without data sovereignty rules. In an embodiment the multi-source health data integration logic **102** can be configured with one or more default sets of sovereignty rules, and with default rule selection logic for configurations with more than one set of default sovereignty rules.

(73) In an embodiment, system **100** features can include, but are not limited to, collecting, pooling, and virtual platform supporting of collective, collaborative, and multilevel analysis of received EHR system sourced information, while protecting the data sources' respective data sovereignty rules. System features for protecting data sovereignty rules can include features of the multi-source health data integration logic **102**. Such features can include an information extraction and data sovereignty wrapping logic **112** and, coupled to the logic **112**, a combined staging database **114**. For brevity, the word string "information extraction and data sovereignty wrapping logic" will be alternatively recited in the remainder of this disclosure as "IE-DSW logic." It will be understood that, as used in this disclosure, "IE-DSW" is an arbitrary coined string that serves only as a reduced letter count representation of the word sequence "information extraction and data sovereignty wrapping," and, as used herein, does not possess, import, or apply any intrinsic meaning.

(74) In an embodiment, the IE-DSW logic **112** can extract from the above-described data received from data curation **110**, e.g., extract ePHI data from data sourced by the EHR systems **104**, extract additional information, e.g., additional health and health-related information, from data sourced by the additional sources **106**, and extract model data from data sourced by the third-party model suppliers **108**. In an embodiment, the IE-DSW logic **112** can also translate the extracted information to what can be a generic information or knowledge representational language (hereinafter "generic form"). The IE-DSW logic **112** can, in an embodiment, wrap the generic form information in source-specific sovereignty protective wrappers, configured to provide sovereignty protection in accordance with the received rules and permissions data described above. Example protective wrapper configurations, features, and aspects are described in more detail in later paragraphs, e.g., in one or more paragraphs referencing FIG. **3**. As will be understood from reading this disclosure in its entirety, in various embodiments sovereignty protective features can be overarching, and can extend beyond direct operations of the wrappers applied by the IE-DSW logic **112**.

(75) In an embodiment, the combined staging database **114** can include a staging database first logic portion configured to store a staging database first portion **116** of extracted, generic transformed information content of EHR data received from EHR systems **104** (which can include generic transformed EHR system sourced ePHI data **116-1** and generic transformed EHR metadata

116-2) and can include EHR system SP specification data **116-3**. For purpose of description, the extracted, generic transformed EHR system sourced ePHI data **116-1** will be alternatively referenced as "GTR EHR system sourced ePHI" **116-1** and the generic transformed EHR metadata **116-2** will be alternatively referenced as "GTR EHR metadata" **116-2**.

(76) In an embodiment, the combined staging database **114** can include a staging database second portion **118** that can store the generic transformed additional source health data **118-1**, generic transformed additional source metadata **118-2**, and additional source SP specification data **118-3**. As visible in FIG. **1**, the combined staging database **114** can also include a staging database third portion **120** that can store the generic transformed third-party supplier model data **120-1**, generic transformed third-party supplier metadata **120-2**, and third-party supplier SP specification data **120-3**.

(77) It will be understood that the staging database first logic portion that stores the staging database first portion **116**, the staging database second logic portion that stores the staging database second portion **118**, and staging database third logic portion that stores the staging database third portion **120** are logic delineations, which are not intended as any limitation of hardware-software implementation or allocation of functionalities, hardware or software architecture of implementations.

(78) Feedback loop **122** can provide feedback of primary data requirements to data sources, e.g., EHR systems **104**, additional data sources **106**, and third-party models suppliers **108**.

(79) Referring to FIG. **1**, the multi-source health data integration logic **102** can include a transform and concept alignment logic **124**. The transform and concept alignment logic **124** can be configured to transform the content of combined staging database **114** first logic section, for storage or hosting as transformed interoperable data **126**, on a virtual data warehouse and collaboration platform **128**, described in greater detail in subsequent paragraphs. Features of and processes performed in generating the transformed interoperable data, including the labeled bridge between the transformed component data and the derived concept market, and the respective bridges between the transformed additional sources data and the derived concept market, the hosted telecollaboration data and the derived concept market and the transformed third party model data and the derived concept market, are described in greater detail in reference to FIG. **5**.

(80) The transform and concept alignment logic **124** can include first logic section **124-1** configured to align, for the collaboration platform, related concepts in the different EHR data from EHR systems **104**, and second logic section **124-2** configured to align, for the collaboration platform, related concepts in the different data received from the additional sources **106**, and third logic section **124-3** configured to align related concepts in the model configuration data received from the third-party model suppliers **108**.

(81) Tools that can be applied by the transform and concept alignment logic **124** can include formal ontologies, e.g., Web Ontology Language (OWL), the National Information Exchange Model (NIEM), and other knowledge representation schemata. Tools that can be applied by the transform and concept alignment logic **124** can include non-ontological knowledge representations, e.g., an integrated phenotype reference model. Tools that can be applied by the transform and concept alignment logic **124** can include standardized vocabularies, e.g., Systematized Nomenclature of Medicine (SNOMED), AI tools such as machine learning (ML), and deep learning (DL), and data dictionaries.

(82) In embodiment, the system **100** can include a feedback loop **130**, which can provide feature engineering feedback from the virtual data warehouse and collaboration platform **128** to the transform and concept alignment logic **124**.

(83) In an embodiment, the system **100** can include a published software development kit (SDK) **132**. Features of the published SDK **132** can include distributed competition based updating of applications implementing the above-described analysis tools. Features of the SDK **132** are described in more detail later in this disclosure, including description in reference to FIG. **7** of an

example configuration.
(84) In an embodiment, the system **100** can include an app market **134**, which can provide for curated contributions from users and third parties. Various features of the app market **134** are described in more detail later in this disclosure, including description in reference to FIG. **8** of an example configuration. Such features include system-integral protection or tendency against obsolescence, by the app market **134** and by a combination of the app market **134** and the published SDK **132**, e.g., particularly configuring the SDK **132** to promote, or inherently produce, or both, Application Programming Interface (API) supplier to API supplier competition.
(85) In an embodiment the system **100** can include a Graphical User interface (GUI) **136**. Features of the GUI **136** can include ready configurability, e.g., a low barrier to accessibility and easily personalized home page with user-added widgets. These and other features of the GUI **136** are described in more detail later in this disclosure, including description in reference to FIG. **9** of an example GUI implementation and an operational configuration thereof.
(86) In an embodiment, the system **100** can include a feedback loop **138**, which can be configured to feed back to the virtual data warehouse and collaboration platform **128** information regarding, for example, collaboration participants' patterns of using system **100** resources. The feedback loop **138** can be arranged, for example, within a combination that can include a monitor of the GUI **136** configured to detect GUI use information reflective of user patterns of using the apps on the app market **134** and interfaces to a form or such information or portions of such information may be obtained, for example, via monitoring the GUI **136**.
(87) FIG. **2** is a flow diagram showing example flows through system **100**, indicated by flow arrows superposed on a copy of the FIG. **1** functional block diagram of system **100**. The process flows include a data pipeline flow **202**, representing a concept and model pipeline flow **204**. Decision pipeline flow **206** represents generation of actionable information for decisions by end users from processes on the example system for AI-enhanced health service resource and response management in accordance with various embodiments.
(88) FIG. **3** shows a logic schematic of a combined staging database **300**, which can be an example implementation of the FIG. **1** system **100** combined staging database **114**. In an embodiment, the combined staging database **300** can be configured to store the GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2** in a sovereignty protective wrap, and to configure the sovereignty protective wrap based at least in part on the EHR system SP specification data **116-3**. For purposes of description, recitation hereinafter of “sovereignty protective” will be alternatively use the following abbreviated form: “SP.” It will be understood that “SP” as used herein is a coined letter string that serves only as a reduced letter count representation of the word sequence “sovereignty protective,” and in the context of this disclosure does not possess, import, or apply any intrinsic meaning.
(89) Systems for AI-enhanced health service resource and response management in accordance with various embodiments, such as but not limited to system **100** can, based in part on SP wrap configurations and SP wrapping processes disclosed herein, maintain rules of engagement with, protect sovereignty of and protect against unauthorized access to GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2**. In an embodiment, the combined staging database **300** can generate or form SP wrapping with a multilayer configuration. An example multilayer SP wrapping configuration can comprise a three-layer wrapping such as the example three-layer configuration of the EHR information SP wrapping **302**. As shown in FIG. **3**, the three-layer configuration of the EHR information SP wrapping **302** includes an EHR source-specific provenance layer **302-1**, EHR source-specific persistent encryption layer **302-2**, and EHR source-specific rules of engagement layer **302-3**.
(90) In an embodiment, the combined staging database **300** can also the store the generic transformed additional source health data **118-1** and the generic transformed additional source metadata **118-2**, collectively referenced for purposes of description as “additional source generic

transformed information," with additional source information SP wrapping **304**. Purposes and functions of the additional source information SP wrapping **304** can be, for example. as described above for the EHR information SP wrapping **302** for the GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2**, i.e., maintaining rules of engagement with, protecting sovereignty of, and protecting against unauthorized access to generic transformed additional source health data **118-1** and generic transformed additional source metadata **118-2**. In an embodiment, configuration of additional source information SP wrapping **304** can be based at least in part on the additional source SP specification data **118-3**. In an embodiment, the additional source sovereignty protective wrap can be, but is not necessarily, a multilayer wrap configuration such as the examples of additional source information SP wrapping **304** visible in FIG. **3**. The example comprises an additional source provenance layer **304-1**, additional source persistent encryption layer **304-2**, and additional source rules of engagement layer **304-3**.

(91) With continuing reference to FIG. **3**, in an embodiment the combined staging database **300** can store the generic transformed third-party supplier model data **120-1** and generic transformed third-party supplier metadata **120-2**, collectively referenced for purposes of description as "third-party model information," with third-party model information SP wrapping **306**. Purposes and functions of the third-party supplier model information SP wrapping **306** can be, for example. as described above for the EHR information SP wrapping **302** for the GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2**, i.e., maintaining rules of engagement with, protecting sovereignty of, and protecting against unauthorized access to third-party model information. In an embodiment, third-party supplier model information SP wrapping **306** can be based at least in part on the third-party supplier SP specification data **120-3**. In an embodiment, the third-party supplier model information SP wrapping **306** can be, but is not necessarily, a multilayer wrap configuration such as the examples of third-party supplier model information SP wrapping **306** visible in FIG. **3**. The example comprises a third-party supplier provenance layer **306-1**, third-party suppler persistent encryption layer **306-2**, and third-party suppler rules of engagement layer **306-3**.

(92) It will be understood that "three-layer" as used herein, in the context of sovereignty protective wrap, can be a logic representation that is not necessarily limiting as to any sequencing or ordering of operation. It will also be understood that certain sovereignty protective wrap(s) for the GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2** are not necessarily configured identically to the sovereignty protective wrap(s) for the generic transformed additional source health data **118-1** and generic transformed additional source metadata **118-2**, or to the sovereignty protective wrap(s) for the generic transformed third-party supplier model data **120-1** and generic transformed third-party supplier metadata **120-2**. It will be further understood that new ownership with additional data sovereignty rules can accrue during data transformational processes **124**, and that that logic **112** can be iteratively reapplied based on feedback from logic **124** to create nested accrual, ownership and sovereignty rules as value of the information content is added during data modeling.

(93) FIG. **4** is a process flow diagram illustrating a flow **400** of a computerized process, in accordance with various embodiments, for performing SP transferring of data from the above-described external data sources, i.e., the EHR systems **104**, additional sources **106**, and third-party model suppliers **108**, into and out from the combined staging database **114**. Example features and operations of the flow **400** will be described in reference to the FIG. **1** system **100**. This is to assist in focusing description of the flow **400** on features of the process. It is not intended to limit practices of the flow **400** to the FIG. **1** system **100**. In an embodiment, features of the flow **400** can include computerized information extracting and data sovereignty wrapping **402**, and features thereof include loading into the combined staging database **114** appropriately SP wrapped generic transformations of information content of data received from the above-described external data sources. The computerized information extracting and data sovereignty wrapping **402** can be performed, for example, by the IE-DSW logic **112**. Implementations of the IE-DSW logic **112**

include, but are not limited to, a general purpose programmable computer that includes a processor coupled to a tangible, non-transitory storage medium that stores or embodies computer-executable instructions that, when executable by the processor, cause the processor to perform in accordance with the described computerized information extracting and data sovereignty wrapping **402**. Example implementations of the general purpose programmable computer are described in more detail later in this disclosure, for example, in reference to FIG. **20**.

(94) Features of the flow **400** can also include computerized transforming and concept aligning **404**, and features thereof include aligning of related concept information and transformation of such information to an interoperable form for use, for example, by collaborative analysis resources and processes hosted by the virtual data warehouse and collaboration platform **128**, as described in more detail in later paragraphs. The computerized transforming and concept aligning **404** can be performed, for example, by the transform and concept alignment logic **124**. Implementations of the transform and concept alignment logic **124** can include, but are not limited to, a general purpose programmable computer, such as described above for implementation of the IE-DSW logic **112**.

(95) Referring to FIG. **4**, in an embodiment, information extracting and data sovereignty wrapping **402** can include a first branch IE-DSW processing **406**, which can be for EHR system sourced ePHI data received from EHR systems **104**, a second branch IE-DSW processing **408**, which can be for additional source data received from additional sources **106**, and can include a third branch IE-DSW processing **410**, e.g., for third-party supplier model data received from third-party model suppliers **108**. For purposes of describing embodiments and example features and operations thereof, the first branch IE-DSW processing **406** will be alternatively referenced as the "EHR source IE-DSW processing" **406**, the second branch IE-DSW processing **408** will be alternatively referenced as the "additional source IE-DSW processing" **408**, and the third branch IE-DSW processing **410** will be alternatively referenced as the "third-party source IE-DSW processing" **410**.

(96) FIG. **4** illustrates a data lake **114** where a large volume of data has been cleaned and staged, ready for analysis, but the data are still largely in their original form and maintain much of their original architecture. The data is in the same platform, some basic translations may have been made (e.g. true NULLs for a database that used "N/A"s), and security features may have been attached. With the data in the same platform, the data modeler **1**A can process the next step. The data modeler **1**A may align like concepts that are available from within the records to generate a model. In some cases, a model may be an integrated phenotype reference model ("IPRM") (**1220** on FIG. **12**B).

(97) As stated above, description of features and operations in the EHR source IE-DSW processing **406** assumes EHR system sourced data that can include ePHI data and EHR metadata. Regarding EHR source SP specifications, in accordance with various embodiments the flow **400** can receive these specifications via EHR system **104** sourced data. Such embodiments can include EHR system SP specification data that carries the SP specifications in their entirety. In other embodiments, the EHR system SP specification data may include an identifier of or a reference to EHR source SP specifications that may be stored, for example, by a memory resource that can be coupled to or otherwise accessible to computer resources performing the EHR source IE-DSW processing **406**, e.g., the above-described general purpose computer implementation of the IE-DSW logic **112**. These are only examples of providing the flow **400** EHR source SP specification information, additional source SP specification information, and third-party source SP specification information to the flow **400**, and are not intended as a limitation on the scope of practices in accordance with disclosed embodiments.

(98) In an embodiment, implementations for providing additional source SP specifications from the additional sources **106** to the additional source IE-DSW processing **408**, or providing third-party source SP specifications from the third-party model suppliers **108** to the third-party model source IE-DSW processing **410** can include, for example, implementations as described above for providing EHR source SP specifications to the EHR source IE-DSW processing **406**.

(99) Referring to FIG. **4**, in an embodiment, the EHR source IE-DSW processing **406** can include, in response to receiving ePHI data from EHR systems **104**, a first branch information extracting **406**A, which extracts ePHI content and EHR metadata from the EHR system sourced ePHI data. In an embodiment, following, merged with, or otherwise associated with the first branch information extracting **406**A (hereinafter collectively encompassed by "associated with," where explicitly stated or made clear from its context to mean otherwise) can be a first branch transforming **406**B. Features of the first branch transforming **406**B can include transforming the extracted information content of the PHI data and EHR system metadata to GTR EHR system sourced ePHI data **116-1** and GTR EHR metadata **116-2**. In an embodiment, EHR source IE-DSW processing **406** can also include, associated with the first branch transforming **406**B, a first branch loading **406**C, and features thereof can include loading the generic ePHI and generic EHR sourced metadata into, respectively, a generic ePHI template and generic EHR metadata template. In one or more embodiments, the EHR source IE-DSW processing **406** can also include, for example, associated with the first branch loading **406**C, a first branch source-specific SP wrapping **406**D the template loaded generic ePHI and generic EHR sourced metadata with an SP wrapping that complies with the EHR sovereignty specification, e.g., as defined by or referenced by EHR system SP specification data **116-3** included with the EHR system sourced ePHI data In an embodiment, operations in the first branch source-specific SP wrapping **406**D can include storing the SP wrapped generic ePHI and generic EHR sourced metadata in the combined staging database **114** in accordance with the SP wrapping.
(100) In an embodiment, additional source IE-DSW processing **408** can be in response to receiving additional health data from additional sources **106**, and can include a second branch information extracting **408**A and, for example, associated with the second branch information extracting **408**A, a second branch transforming **408**B. In an embodiment, for example, associated with the second branch transforming **408**B, can be a second branch template loading **408**C and, associated therewith can be a second branch source-specific SP wrapping **408**D. The second branch information extracting **408**A can include, for example, extracting health information content from the additional source health data The second branch transforming **408**B can include, for example, transforming the extracted additional source information and extracted metadata into, respectively, generic transformed additional source health data **118-1** information and generic transformed additional source metadata **118-2**. Features of the second branch template loading **408**C can include loading the generic transformed additional source health data **118-1** into a second branch additional source generic data template and loading the generic transformed additional source metadata **118-2** into an additional source generic metadata template. In an embodiment, second branch source-specific SP wrapping **408**D can include wrapping the template loaded form of the generic transformed additional source health data **118-1** and template loaded form of the generic transformed additional source metadata **118-2** with an SP wrapping that complies with additional source sovereignty specification, e.g., additional source SP specification data **118-3**.
(101) In an embodiment, third-party model source IE-DSW processing **410** can include, in response to receiving the third-party source model data from third-party model suppliers **108**, a third branch information extracting **410**A, and associated therewith can be a third branch transforming **410**B. Associated with the third branch transforming **410**B can be third branch template loading **410**C, and associated therewith can be a third branch SP wrapping **410**D. The third branch information extracting **410**A can include, for example, extracting information content from third-party supplier model data from the third-party model suppliers **108** and the third branch transforming **410**B can include transforming the extracted model information to generic transformed third-party supplier model data **120-1** information and generic transformed third-party supplier metadata **120-2**. The third branch template loading **410**C can include loading the generic transformed third-party supplier model data **120-1** and generic transformed third-party supplier metadata **120-2** into a third branch template. The third branch SP wrapping **410**D can include third-

party supplier specific SP wrapping the third branch template loaded form of the generic transformed third-party supplier model data **120-1** and generic transformed third branch template loaded form of the generic transformed third-party supplier metadata **120-2** with an SP wrapping that complies with third-party supplier sovereignty protective specification, e.g., **120-3**.

(102) Referring to FIG. **4**, in an embodiment, features of the transform and concept aligning **404** can include alignment of related concept information and transformation of such information to an interoperable representation. As will be understood by persons of ordinary skill upon reading this disclosure and practicing its various embodiments, the alignment includes specific alignments to knowledge representation schemata, and to analysis algorithm structures supported by the virtual data warehouse and collaboration platform **128**. For example in processes in accordance with the present disclosure, process flow, operations therein, and other features that are in, or that support "transformation of such information to an interoperable representation" can include but are not limited to: formal ontologies, e.g., OWL and NIEM, interoperable representation" can include but are not limited to: formal ontologies, e.g., OWL and NIEM. Tools that can be applied by the transform and concept alignment logic **124** can include non-ontological knowledge representations, e.g., an integrated phenotype reference model and other knowledge representation schemata. Tools that can be applied by the transform and concept alignment logic **124** include standardized vocabularies, e.g., SNOMED, data dictionaries, AI tools such as neural nets trained for phenotyping and other analyses by ML and deep learning, and data dictionaries. As also described in more detail in later sections of this disclosure, the above-listed example tools, applied by or through methods and systems in accordance with this disclosure, can provide, among other features, dimensional conformity and alignment of related concepts in a manner enabling efficient multi-participant collaborative, multi-layer analyses of multi-sourced health related information.

(103) The transform and concept aligning **404** can be described as including a first branch transform and concept alignment processing **412**, e.g., for receiving, extracting information content and performing particular processing of EHR system-sourced data, including SP wrapping information content in accordance with EHR system SP specifications, such as ePHI and other data from the EHR systems **104**, a second branch transform and concept alignment processing **414**, e.g., for additional source data, such as health-related information from the additional sources **106**, and a third branch transform and concept alignment processing **416**, e.g., for third-party models **108**.

(104) As shown by the FIG. **4** example implementation, first branch transform and concept alignment processing **412** can include first branch consolidating **412**A, first branch conforming **412**B, first branch dimensionalizing **412**C, and first branch codification of the total arc of EHR system-sourced data transformations **412**D (labeled "Codify Trxfm hx" in block **412**D on FIG. **4**).

(105) Second branch transform and concept alignment processing **414** can include second branch consolidating **414**A, second branch conforming **414**B, second branch dimensionalizing **414**C, and second branch codification of the total arc of additional source data transformations **414**D (labeled "Codify Trxfm hx" in block **414**D on FIG. **4**).

(106) Third branch transform and concept alignment processing **416** can include third branch consolidating **416**A, third branch conforming **416**B, third branch dimensionalizing **416**C, and third branch codification of the total arc of third-party model source data transformations **416**D (labeled "Codify Trxfm hx" in block **416**D on FIG. **4**).

(107) FIG. **5** is a functional block diagram of an example of an implementation **500** of a virtual data warehouse and collaboration platform **128** for the FIG. **1** system **100** and for various other systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management, in accordance with one or more embodiments. For purposes of description, the implementation **500** of the virtual data warehouse and collaboration platform **128** will be alternatively referenced as "VDW-CP **500**." As used herein, "VDW-CP" is a coined, alternative form for reciting "virtual data warehouse and collaboration platform," having no

intrinsic meaning. It will be understood that, as used in this disclosure, “VDW-CP” is an arbitrary coined letter string that serves only as a reduced letter count representation of the word sequence “virtual data warehouse and collaboration platform” and, as used herein, does not have, import or carry any intrinsic meaning.

(108) In an embodiment, VDW-CP **500** can store transformed ePHI information **502-1** and transformed EHT metadata **502-2** within a first VDW-CP transformed SP wrapper **504**. The first VDW-CP transformed SP wrapper **504** can include a first VDW-CP transformed SP provenance layer **504-1**, a first VDW-CP transformed SP persistent encryption layer **504-2**, and a first VDW-CP transformed SP rules of engagement layer **504-3**. In an embodiment, the VDW-CP **500** can construct the first VDW-CP transformed SP wrapper **504** based at least in part on the EHR information SP wrapping **302**, or on EHR source SP specification data, e.g., EHR system SP specification data **116-3** on which, as described above in reference to FIG. **3**, the EHR information SP wrapping **302** may be based.

(109) In an embodiment, the VDW-CP **500** can store transformed additional source information **506-1** and transformed additional source metadata **506-2**, within a second VDW-CP transformed SP wrapper **508**. The second VDW-CP transformed SP wrapper **508** can include a second VDW-CP transformed SP provenance layer **508-1**, a second VDW-SP transformed SP persistent encryption layer **508-2**, and a second VDW-CP transformed SP rules of engagement layer **508-3**. In an embodiment, the VDW-CP **500** can construct the second VDW-CP transformed SP wrapper **508** based at least in part on additional source information SP wrapping **304** or on additional source SP specification information, received from third-party model suppliers **108**, on which additional source information SP wrapping **304** can be based. In an embodiment, the VDW-CP **500** can store transformed third-party source model information **510-1** and transformed third-party source metadata **510-2** within a third VDW-CP transformed SP wrapper **512**. The third VDW-CP transformed SP wrapper **512** can include a third VDW-CP transformed SP provenance layer **512-1**, a third VDW-CP transformed SP persistent encryption layer **512-2**, and a third VDW-CP transformed SP rules of engagement layer **512-3**. In an embodiment, the VDW-CP **500** can construct the third VDW-CP transformed SP wrapper **512** based at least in part on third-party supplier model information SP wrapping **306**, or third-party source SP specification data, e.g., third-party supplier SP specification data **120-3** on which the third-party supplier model information SP wrapping **306** can be based.

(110) Referring to FIG. **5**, the VDW-CP **500** can store hosted telecollaboration data **514-1** and hosted telecollaboration metadata **514-2**, within a VDW-CP telecollaboration SP wrapper **516**. The VDW-CP telecollaboration SP wrapper **516** can include a VDW-CP telecollaboration SP provenance layer **516-1**, a VDW-CP telecollaboration SP persistent encryption layer **516-2**, and a VDW-CP telecollaboration SP rules of engagement layer **516-3**. In an embodiment, the VDW-CP **500** can construct the VDW-CP telecollaboration SP wrapper **516** based at least in part on external sources' SP specification data that was received by and used by the FIG. **4** information extracting and data sovereignty wrapping **402** for performing the appropriate SP wrapping.

(111) In an embodiment, the “based at least in part on,” can include, for example, direct use of the external sources' SP specification data, e.g., for generating the EHR system SP specification data **116-3**, additional source SP specification data used for generating additional source SP specification data **118-3**, and third-party supplier SP specification information for generating third-party supplier SP specification data **120-3**, or portions thereof. In an embodiment, “based at least in part on” can include indirect use of the external sources' specification data, for example, using information regarding the EHR information SP wrapping **302**, the additional source information SP wrapping **304**, or the third-party supplier model information SP wrapping **306**, or any combination or sub-combination thereof. In an embodiment, such information regarding the EHR information SP wrapping **302**, additional source information SP wrapping **304**, or third-party supplier model information SP wrapping **306** can be provided to the computerized transforming and concept

aligning **404**, for example, via the virtual data warehouse and collaboration platform **128**.
(112) In an embodiment, construction of the VDW-CP telecollaboration SP wrapper **516** can be further based at least in part on the SP specification data provided by various among the external sources, e.g., to the data curation **110**. In one or more embodiments, provided can include, but are not limited to, consistency and reliability in forming the VDW-CP telecollaboration SP wrapper **516** with a configuration that can maintain sovereignty protection, throughout the various multi-participant analyses supported on the virtual data warehouse and collaboration platform **128**.
(113) FIG. **5** shows the virtual data warehouse and collaboration platform **128** supporting a meta-meta-data **518**, which can be information about the metadata. As an illustrative example of a meta-meta-data **518**, assume that metadata associated with a first EHR record includes a medical concept identified from the content of the first record and listed in the derived concept market with a specified degree of certainty; assume further that metadata associated with a second EHR record includes a medical concept identified from the content of the second record and listed in the derived concept market with its own degree of certainty. An example of meta-meta-data **518** can be information regarding the degree of certainty that the two concepts from EHR first record and EHR second record represent the same medical concept.
(114) FIG. **5** also shows a derived concept market **520** and storage, e.g., on the virtual data warehouse and collaboration platform **128**, an indication of a Patient **0**, of a Disease X, and an Anomaly as indications of common conformed dimensions. Patient **0**, Disease X, and Anomaly are teaching examples of common conformed dimensions that may be contained within the derived concept market **520**. Lines are shown on FIG. **5**, attaching each concept to each of the individual data marts **502-1**, **506-1**, **510-1**, and **514-1**. One cluster **522** of the lines represents an example state of the bridge shown on FIG. **1** between the transformed component data and the common conformed dimensions within the derived concept market **520**. Another cluster **524** of the lines represents an example state of the bridge on FIG. **1** between the transformed additional source data and the common conformed dimensions in the derived concept market **520**. Another cluster **526** represents an example state of the FIG. **1** bridge between the transformed hosted telecollaboration data and the common conformed dimensions in the derived concept market **520**, and another cluster **528** represents an example state of the FIG. **1** bridge between the transformed third party models and the common conformed dimensions in the derived concept market **520**.
(115) FIG. **6** shows by graphic overlay on FIG. **5** one example general configuration of a multi-participant telecollaboration as can be hosted on the virtual data warehouse and collaboration platform **128** of FIG. **1** of systems and methods for artificial intelligence enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments. The general configuration includes a visible plurality of participants **602**, interconnected by communication links **604**. The participants **602** can be individuals, can be business entities, academic institutions, or government agencies. The communication links **604** can represent extant communications, communication resources, agreements for periodic communication, agreements for “as needed” communication between multiple participants **602**. The FIG. **6** quantity or population of graphical images labeled “602” is based in part on drafting considerations, and is not intended as any statement of preference or limitation on practices according to disclosed embodiments.
(116) FIG. **7** shows a logic schematic of a specific software development kit (SDK) **700** implementation of the system **100** SDK **132**, configured to enable, through novel features and novel combinations of such features with features of system **100**, multi-contributor maintenance coupled with evolution of a multi-tool suite of analysis apps. The multi-contributor maintenance and coupled evolution provides a robust multi-tool suite of analysis apps. The multi-tool suite of analysis apps can, in turn, provide AI enhanced multi-tool analysis resource for coupling to a multi-institutional knowledge database, for the FIG. **1** system and various other systems and methods for

AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(117) The FIG. **7** SDK **700** implementation includes natural language processing (NLP) and text analytics tools **702**A; statistical analysis tools **702**B; Graphical User Interface (GUI) and Data Visualization (Data Viz) tools **702**C; relation and collaboration tools **702**D; geospatial tools **702**E; AI, machine learning (ML), and deep learning (DL) modeling tools **702**F; policy operationalization tools **702**G; gaming scenario tools **702**H; query engine(s) **7021**; project and task management tools **702**J; import and export tools **702**K; and data integrity and security tools **702**L. The above-listed example plurality of SDK tools will be collectively referenced as “FIG. **7** SDK tool suite **700**.” It will be understood that the SDK tool suite **700** is an example, not a limitation of what can be many different SDK tool suites that may be used in practices according to disclosed embodiments, and the appended claims. Regarding aspects of differences of the different SDK tool suites, examples include difference with respect to the number of different analytics tools, and different combinations of the tools, and respective configurations of the tools.

(118) It will be understood that allocation and arrangement of hardware, software, and combination hardware-software resources in implementations of the SDK tool suite **700** are not necessarily grouped, segmented, or partitioned in accordance with above-listed individual analytic tools. Further, implementations of various of the analytics tools can include functionalities overlapping functionalities of other of the analytics tools. As an illustrative, non-limiting example, various implementation of the gaming scenario tools **702**K can include functionalities of, or can be constructed or evaluated, or both, using ML and other AI tools.

(119) FIG. **8** shows a logic schematic of an example of a configuration **800** of a curated applications resource that can be provided, for example, by the app market **134** of the FIG. **1** system **100**. The configuration **800** shows examples of third party and user contributed applications for the FIG. **1** system and for various other systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments. The groupings of the applications into app market first applications regions **802** and app market second applications regions **804** are for logistics of figure labeling, and are not intended to convey any grouping as to functionality, configuration, or features.

(120) FIG. **9** shows a logic schematic of an example configuration **900** of the GUI **136** of the FIG. **1** system **100**, with illustrative examples of widget GUI regions **902-1**, **902-2**, . . . **902**-R (collectively “GUI first widget regions **902**”), “R” being any integer and widget GUI regions **904-1**, **904-2**, . . . , **904**-S (collectively “GUI second widget regions **904**”), “S” being any integer. The groupings of the widget regions into GUI first widget regions **902** and GUI second widget regions **904** are for logistics of figure labeling, and are not intended to convey any grouping as to functionality, configuration, or features. Widgets associated with the GUI first widget regions **902** and GUI second widget regions **904** can be for system **100** and for processes and methods supported by same, or by other systems or system configurations according to this disclosure, for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(121) FIG. **10** shows a function block schematic with certain logic details of an example adaptation of the FIG. **1** system, including the FIG. **3** configuration of the combined staging database **114** in accordance with FIG. **2** and with the FIG. **3** implementation of the sovereignty protective wrapping feature. FIG. **10** also shows the FIG. **4** flows of transferring of data into and out from the combined staging database. The FIG. **10** adaptation can provide an environment for various systems and methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response

management, in accordance with one or more embodiments.

(122) FIG. **11** shows a graphic overlay on FIG. **10** of FIG. **2** flow annotations for the data pipeline flow **202**, concept and model pipeline flow **204**, and actionable information and decision pipeline **206**, representing the above-described features as provided by FIG. **10** system adaptation. Features of the FIG. **11** system can include, without limitation, sovereignty protective extraction, via, for example, and information extracting, sovereignty protective wrapping logic such as implemented by the IE-DSW logic **112**. The IE-DSW logic **112** provides for receiving an EHR data, e.g., from one of the EHR system sources **104** and in response, wrapping, in an EHR system-specific sovereignty protective wrapper, a genericized form of a health-related information content of the EHR data. Such features are provided, for example, by the IE-DSW logic **112** functions, shown in FIG. **11** and described earlier in reference to FIG. **4**, of first branch information extracting **406**A, first branch transforming **406**B, first branch loading **406**C, and first branch source-specific wrapping **406**D. The FIG. **11** combined staging database **114** provides a staging database, coupled to the information extracting, sovereignty protective wrapping logic, i.e., to the IE-DSW logic **112**, and configured to store, in accordance with the EHR system-specific sovereignty protective wrapper, the genericized form of the health-related information content of the EHR data. The FIG. **11** system also includes the transform and concept alignment logic **124**, coupled to the combined staging database **114**, and configured to perform a transforming of and aligning of the genericized form of the health-related information to a transformed interoperable health-related data. Various features of the features of the transforming and aligning are described above, and such features and additional features are described in more detail in subsequent paragraphs, e.g., in reference to FIG. **18** and, regarding a further configuration, in reference to FIG. **21**. In an embodiment, the FIG. **11** system also provides collaboration platform **128**, which is coupled to the transform and concept alignment logic **124**, and is configured to perform a hosting of a telecollaborative analysis of the transformed interoperable health-related data. Telecollaborative analysis can be provided by one or more of the participants, e.g., one or more of the participants **602** visible in FIG. **6**. Features of the collaboration platform **128** can also include, provided for example, by the VDW-CP telecollaboration SP wrapper **516** described in detail in reference to FIG. **5**, a wrapping, in a telecollaboration participant specific sovereignty protective wrapper, of a telecollaboration data associated with a telecollaboration participant. The collaboration platform **128** can also provide, as described in reference to FIG. **5**, a maintaining during the telecollaborative analysis of the transformed interoperable health-related data, a sovereignty of the transformed interoperable health-related data in accordance with the EHR system-specific sovereignty protective wrapper, and a sovereignty of the telecollaboration data associated with the telecollaboration participant in accordance with the telecollaboration participant specific sovereignty protective wrapper.

(123) FIGS. **12**A and **12**B are a two-sheet arrangement of a functional block and supported process diagram of another example system in accordance with one or more embodiments for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(124) FIG. **12**A and FIG. **12**B, viewed together, are a graphical representation of logic operations and processes for which the transform and concept alignment logic **124** can be configured. A further of view of these processes is shown on FIG. **13**A. Referring to FIG. **12**A, in an embodiment, features can include an AI-computed interoperability mapping **1202**, such as represented in table form in the figure It will be understood that the computed cells of the table representing the AI computed interoperability mapping produces probabilistic, not binary, dimensional conformity and alignment of related concepts, and therefore if the table were larger the cells could be filled by a shading having respective cell-specific degree of grey. In an embodiment, the AI-computed interoperability mapping **1202** can provide an AI-leveraged interoperability path **1204**. In an embodiment, a validation, such as manual validation may be utilized, as represented by

persons **1206** on the AI-leveraged interoperability path **1204**. Manual validation may not be essential, but can be used, e.g., to have the "human-in-the loop."

(125) In an embodiment, manual mapping of interoperability, such as represented on the figure by individuals **1208**, can generate a manual interoperability map **1210**, such as represented on the figure by another table. The manual interoperability map **1210** can provide a manually mapped interoperability path **1212**. In accordance with one or more embodiments, cross-support can be provided, by exchanging **1214** of information between the AI-leveraged interoperability path **1204** and the manually mapped interoperability path **1212**.

(126) Referring to FIG. **12**B, the data plot **1216** represents secondary analytics that, together with the AI neural network **1218**, can support the integrated phenotype reference model **1220**, and can directly provide output to the collaborative network **1222**.

(127) FIGS. **12**A and **12**B show example of features of analytics and artificial intelligence. Example features of analytics can include, but are not limited to, traditional statistical analysis, and example aspects of AI can include machine learning techniques in which executable code can dynamically alter behavior based on information from monitoring and sensing resources. FIGS. **12**A and **12**B fit into the 124 column of FIG. **13**A. FIGS. **12**A and **12**B are a pictorial representation of 124, and show in much more detail how the processes listed in 124 are accomplished.

(128) FIGS. **13**A and **13**B are a two-sheet arrangement of functional block and associated process diagram showing aspects of an example system in general accordance with the FIG. **10** system for medical and public health service resource and response management via AI enhanced medical record exchange feeding concept generation and dynamic updating of multi-institutional knowledge database coupled to AI enhanced multi-tool analysis resources in accordance with one or more embodiments.

(129) FIGS. **12**A-B show examples of features of analytics and artificial intelligence. Example features of analytics can include, but are not limited to, traditional statistical analysis, and example aspects of AI can include machine learning techniques in which executable code can dynamically alter behavior based on information from monitoring and sensing resources. FIGS. **12**A-B fit into the 124 column of **13**A. FIGS. **12**A and B are a pictorial representation of 124, and show in much more detail how the written processes listed in 124 are accomplished.

(130) Below is element **1224** of FIG. **12**B enlarged to show detail and improve readability of the text.

(131) TABLE-US-00001 PHEN100 FK503 37% 84% FK301 41% 70% FK402 13% 53% FK202 9% 63% FK201 41% 98% FK101 14% 79% FK203 31% 92% FK303 33% 53% FK401 21% 60% PHEN200 FK501 3% 93% FK103 37% 64% FK402 39% 69% FK502 48% 55% FK302 13% 52% FK503 20% 53% FK101 23% 59% FK303 33% 70% FK102 18% 54% FACT FK101 19% FK301 85% FK401 98% FK402 50% FK502 33% FK403 8% FK202 70% FK103 11% FK101 13% FK102 77% FK101 3% FK501 22% FK103 0% FK401 59% FK203 8% FK401 56% FK303 52% FK102 77% FK503 25% FK503 1% DIM100 PK101 34295 PK102 22701 PK103 72076 DIM200 PK201 11651 PK202 26049 PK203 98725 DIM300 PK301 77314 PK302 63976 PK303 72909 DIM400 PK401 44249 PK402 57004 PK403 53722 DIM500 PK501 89727 PK502 10925 PK503 93379

(132) Referring to FIG. **13**A, each of the EHR data source **1302**, additional parties data source **1304**, and third party model data source **1306** can be piped through all the processes of the transform and concept alignment logic **124**, and can emerge at jump points (c), (d), and (e), ready for the data warehouse **126**. For purposes of description, the processes of the transform and concept alignment logic **124**, which, in an embodiment, comprise consolidate, conform, dimensionalize, and codify may be collectively referred as "analytics and AI engine." In an embodiment, the emergence at jump points (c), (d), and (e), described above, can be considered as entry points, in a logic sense, into the large meta-database shown as the derived concept market **520** on FIG. **5**, and

as the derived market concept **1902** on FIG. **19**.

(133) FIG. **14** is a logic diagram of flows of certain features and aspects shown in FIG. **13**A. In an embodiment, flows include data curation **110**. Features of the data curation **110** can include filtering of data received from external sources, such as but not limited to ePHI and other health information received from a plurality of independent, differently structured instances of EHR systems **104**, additional health related information from additional sources **106**, and analysis model information from a plurality of third-party model suppliers **108**. In an embodiment, the filters can be configured in accordance with trusted third-party brokered data use agreements (DUAs) and other contracts. In one or embodiments, such filters can be applied to each contributed dataset. Also enforcement of the filters can persist through many layers of many different transformations, different users, and different collaborative groups of users. Such application and persistence can help ensure data sovereignty throughout the system and the methods supported by the system. The data sovereignty can be enforced, and maintained throughout IE-DSW logic **112** extraction, genericizing, e.g., transformation to generic form, loading of the transformed generic form information and metadata, e.g., into templates, and wrapping as per source-specific SP specifications. Further features can include adaptability of the combined staging database **114** to store, and maintain data sovereignty of the multiple sources' metadata. This feature has significant benefits, as metadata can grow considerably during each transformation and as differently provenanced data are integrated.

(134) Referring to FIG. **14**, as described above, transform and concept alignment logic **124** can include a published API **1402** that can support transform and concept aligning with resources that include analyses tools **1404** achieving dimensional conformity and alignment of related concepts, from: formal ontologies (e.g., OWL), reference models (e.g., NIEM). Standardized vocabularies (e.g., SNOMED), clustering **1406**, for example, unsupervised DL trained AI clustering, other neural networks **1408** providing ML/DL trained AI phenotyping, data dictionaries, both supervised and unsupervised techniques and data dictionaries. In an embodiment, the provided phenotyping retrieves, compares, and updates concept relationships in the Integrated Phenotype Reference Model **1410**. Such alignment of related concepts facilitates collaboration on the collaboration platform **128**, which can foster, for example, efficient multi-participant collaborative, multi-layer analyses of health-related information from a large of independent EHR systems and other sources.

(135) FIG. **15** shows a master diagram of a process **1500**, in an implementation of a method of artificial intelligence (AI) enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments. The FIG. **15** master diagram is arranged for convenience of description to comprise four logic flow portions. The arrangement into four logic flow portions is for convenience of description, including rendering various process-internal flows as inter-portion flows, thereby facilitating description of certain features. The arrangement into four logic portions is not intended as any limitation, or any indication of preference as to physical distribution or grouping of hardware, or allocation of functionality to hardware. The arrangement into logic portions is also not intended as a statement that arrangement into logic portions is necessary for description.

(136) In an embodiment, the process **1500** can include a receiving and IE-DSW processing **1502**, a combined staging database processing **1504**, a transforming and concept alignment processing **1506**, and a transformed, interoperable processing **1508**. The receiving and IE-DSW processing **1502** can be an example implementation of the data curation **110** processes described above, e.g., in reference to FIG. **1**, as well as an example implementation of the IE-DSW processing **402** also described above, e.g., in reference to FIG. **4**, and as visible by the flow arrows passing through the in FIGS. **10**, **11**, **13**A, and **14**. The combined staging database processing **1504** can be an example implementation of the SP wrapped storing processes described above as performed by the combined staging database **114**. The transforming and concept alignment processing **1506** can be an example implementation of the transform and concept alignment logic **124** described above,

e.g., in reference to FIGS. **12**A and **12**B. The transformed, interoperable processing **1508** can be an example implementation of the virtual data warehouse and collaboration platform **128** described above, e.g., in reference to FIG. **13**B.

(137) Visible on FIG. **15**, a dotted line box encloses the graphic block for the IE-DSW processing **1502**, and within the dotted line are references to FIG. **16** and FIG. **20**. The references indicate FIG. **16** and FIG. **20**, which are described in detail later, showing respective flow diagrams of example implementations of the receiving and IE-DSW processing **1502**. In like manner, on FIG. **15** are three additional respective dotted line boxes, which surround, respectively, the combined staging database processing **1504** block, the transforming and concept alignment processing **1506** block, and the transformed, interoperable processing **1508** block. Within the dotted line box surrounding the combined staging database processing **1504** is a reference to FIG. **17**, and within the dotted line box surrounding the transformed, interoperable processing **1508** is a reference to FIG. **19**. These references indicate that FIG. **17** and FIG. **19**, each described in more detail later in this disclosure, show, respectively, a detailed flow diagram of an example implementation of the combined staging database processing **1504**, and a detailed flow diagram of an example implementation of the transformed, interoperable processing **1508**. Within the dotted line box surrounding the transforming and concept alignment processing **1506** are references to FIG. **18** and FIG. **21**, both of which are described in more detail later in this disclosure. These references that FIG. **18** and FIG. **21** show detailed flow diagrams of, respectively, a first example implementation and a second example implementation of the transforming and concept alignment processing **1506**.

(138) FIG. **15** shows for the receiving and IE-DSW processing **1502** a flow input “DI” and flow outputs “A,” “B,” “C,” “D,” and “E,” and shows for the combined staging database processing **1504** flow inputs A, B, and C, and flow outputs “F,” “G,” and “H.” FIG. **15** also shows for the transforming and concept alignment processing **1506** flow inputs F, G, D, and “P,” and flow outputs “I,” “J,” “K,” “L,” “M,” “N,” and “O,” and shows for the transformed, interoperable processing **1508** flow inputs H, I, J, K, L, M, N, and **0**, and flow output P.

(139) FIG. **16** and FIG. **20** show the same flow inputs and outputs as FIG. **15** shows for the receiving and IE-DSW processing **1502** that for which FIG. **16** and FIG. **20** show implementations. FIGS. **17** and **19** show, respectively, the same flow inputs and outputs as FIG. **15** shows for the combined staging database processing **1504**, and the transformed, interoperable processing **1508** that the FIGS. **17** and **19** flows respectively implement. FIG. **18** and FIG. **21** show the same flow inputs and outputs as FIG. **15** shows for the transforming and concept alignment processing **1506**, for which FIG. **18** and FIG. **21** show implementations.

(140) Interconnecting, in accordance with the interconnects visible on FIG. **15**, the respective flow inputs and outputs of FIGS. **16**, **17**, **18**, and **19** will form an integrated flow schematic of an example detailed implementation of the process **1500**. Substituting the FIG. **20** implementation for the FIG. **16** implementation of the receiving and IE-DSW processing **1502**, using interconnects visible on FIG. **15**, the respective flow inputs and outputs of FIGS. **20**, **17**, **18**, and **19**, will form an integrated schematic of another example detailed implementation of the process **1500**. In like manner, substituting the FIG. **21** implementation for the FIG. **18** implementation of the transforming and concept alignment processing **1506**, and interconnecting, in accordance with the interconnects visible on FIG. **15**, the respective flow inputs and outputs of FIGS. **16**, **17**, **21**, and **19**, will form a unitary flow schematic showing another example detailed implementation of the process **1500**. In addition, substituting the FIG. **20** for the FIG. **16** implementation of the receiving and IE-DSW processing **1502**, in combination with substituting the FIG. **21** implementation for the FIG. **18** implementation of the transforming and concept alignment processing **1506**, and interconnecting the figures as described above, forms an integrated flow schematic of yet another example detailed implementation of the process **1500**.

(141) An embodiment in accordance with the FIG. **15** process **1500** will now be described, assuming the FIG. **16** implementation of the receiving and IE-DSW processing **1502**, the FIG. **17**

implementation of the combined staging database processing **1504**, the FIG. **18** implementation of the transforming and concept alignment processing **1506**, and the FIG. **19** implementation of the transformed, interoperable processing **1508**. For purposes of description, an example of the process **1500** in accordance with this example implementation, will be referenced as the "first implementation process **1500**." An example instance of the first implementation process **1500** will be described assuming the system **100** as the environment, and assuming that the external source is a particular one of the EHR systems **104**, there is no DUA in place between the entity managing the system **100** and the particular one of the EHR systems **104**, that the DUA includes the SP specifications for performing the SP wrapping, and that third-party model supplier **108** models are already loaded onto the virtual data warehouse and collaboration platform **128**.

(142) Descriptions of various features of and of example operations according to the process **1500** include references to FIG. **1** and to other appended figures. Such references are to further assist in understanding of the process **1500**, through illustration by examples. Such references are not intended as a statement that practices in accordance with disclosed embodiments are limited to system **100** or to above disclosed implementations of the system **100** logic blocks.

(143) Referring to FIG. **16**, in an embodiment, operations in the first implementation process **1500** can include, e.g., responsive to receiving an EHR data from a particular one of the EHR systems **104**, proceeding to the process flow **1600**, and in the process flow **1600** determining **1602** whether there is a DUA between the entity managing the system **100** and the particular one of the EHR systems **104**. As stated above, it is assumed for this example that no DUA is in place. Accordingly, the determining **1602** returns a negative result and, in response, the process flow **1600** can proceed to computerized DUA formation **1604**. The computerized DUA formation **1604** can include a DUA generation resource. In an embodiment, the DUA can determine, or can embody the SP specifications for subsequent wrapping, in later operations of the process flow **1600**. In an embodiment, the DUA can encode an identifier for the SP specifications, and the process flow **1600** can include operations for storing the SP specifications in a manner retrievable, for example, using the encoded identifier. In one or more embodiments, SP specification can be communicated pursuant to or associated with creation of the DUA, between the source of the dataset (e.g., EHR system **104**), and an entity managing the process **1500**.

(144) In an embodiment, on completion of the computerized DUA formation **1604** the process flow **1600** can proceed, e.g., via a return path **1606**, to determining **1608** the type of the received external sourced data. Reasons for determining **1608** the type of the received health-related data can include configuring the subsequent step, which can be the preprocessing **1610**. As will be described in more detail in reference to the FIG. **20** alternative configuration "type[s]," determining **1608** can include streaming health data, bulk-type load health data, real-time EHR system user entered data, and other examples. Assuming the received EHR data is of a type recognized or acceptable to the determining **1608**, the process flow **1600** can proceed to preprocessing **1610** the received data into a common format configured for feeding the first of subsequent steps. In one or more embodiments, for particular data transfers, operations at **1608** and **1610** may require performance only once, e.g., at the beginning of the data transfer.

(145) From the preprocessing **1610** the process flow **1600** flow can then proceed to extracting **1612** which the information content, e.g., ePHI information content and EHR metadata information from EHR data. The process flow **1600** can then proceed to transforming **1614** the extracted information and metadata, e.g., ePHI information and EHR metadata information, to a generic transformed PHI information and generic transformed EHR metadata, and then to loading **1616** the generic transformed PHI information and generic transformed EHR metadata into the preliminary staging resource **1618**. In one or more embodiments, the preliminary staging resource **1618** can function as a buffer memory, for holding transformed generic form health information and transformed, generic form metadata prior to wrapping, as described in more detail in the following paragraphs.

(146) The extracting **1612**, transforming **1614**, and loading **1616** can be example implementations

of operations in the computerized information extracting and data sovereignty wrapping **402** described above in reference to FIG. **4**. For example, the extracting **1612** and transforming **1614** can be implementations, respectively, of the first branch information extracting **406**A and first branch transforming **406**B, and the loading **1616** can be an implementations of the first branch loading **406**C.

(147) With continuing reference to FIG. **16**, over intervals following storing the generic transformed PHI information and EHR metadata in the preliminary staging resource **1618**, the process flow **1600** can proceed to detecting **1620** structure of the generic transformed PHI information and generic transformed EHR metadata. For example, after the detecting **1620**, the process flow **1600** can proceed to correcting **1622** for data type, and managing **1624** data corruptions. In an embodiment, over time intervals that may be concurrent with, or separate from time intervals corresponding to the detecting **1629**, correcting **1622**, and managing **1624**, operations in the process flow **1600** can include an encryption and key managing process **1626** configuring a wrapping **1628** that, when applied, can include encrypting and wrapping the generic form health-related data and generic form metadata as received, after any correcting **1622** for data type, and any managing **1624** of data corruptions. In an embodiment, the configuring operations by the encryption and key managing process **1626** can include, for example, loading a process, e.g., computer-executable instructions into a computer resource allocated, or dedicated, or assigned to perform the wrap process. The process, in various embodiments, can be configure in accordance with the DUA, i.e., to meet the SP specifications defined by the DUA. The configuring can include defining an SP wrapper for the external sources information and metadate, for example, assuming an EHR system **104** source, an SP specification for an EHR information SP wrapping such as the EHR information SP wrapping **302** described above.

(148) Referring to FIG. **15** and FIG. **16**, in an embodiment, information for use by, or for controlling aspects of the encryption and key managing process **1626** can be exchanged, via flow input-output point D, between the key managing process **1626** and a database that can be internal to the transform, concept alignment processing **1506**, which is described in more detail later in this disclosure.

(149) In an embodiment, operations in the process flow **1600** can include, over one or more time intervals subsequent to above-described configuring operations by the encryption and key managing, feeding output of the wrapping **1628** to the combined staging database processing **1504**, via flow output point of the process flow **1600** and into flow input point A of the processing **1504**. The combined staging database processing **1504** can then store wrapped, generic transformed versions of EHR system **104** sourced health-related information and metadata.

(150) In an embodiment, operations in the process flow **1600** can include communication to the combined staging database processing **1504** of information regarding the wrapping and encryption applied by wrapping **1628**. The communication can be, for example, from flow output point B to flow input point B of the combined staging database processing **1504**.

(151) In an embodiment, the process flow **1600** can also include outputting information regarding any one or more among detecting **1620** structure of the generic transformed PHI information and generic transformed EHR metadata, correcting **1622** for data type, and managing **1624** data corruption. As visible in FIG. **16**, in an implementation, the process flow **1600** can output such information, for example from process flow **1600** flow output point C to flow input point C of the combined staging database processing **1504**.

(152) In an embodiment, the process flow **1600** can include a policy-based schedules and triggers process and, in an example implementation, said process can feed information, from example, from flow output point E to representative flow input point E of the external sources **1501**.

(153) Referring to FIGS. **1**, **4**, **15**, and **16**, it will be understood that operations in the extracting **1612**, transforming **1614**, and loading **1616** can be performed, for example, by the IE-DSW logic **11**. Referring to the same figures, together with FIG. **17**, the combined staging database processing

1504 can implement the combined staging database **114** described above.

(154) FIG. **17** shows a process flow diagram of an example implementation of the combined staging database processing **1504** in the FIG. **15** process **1500**. The implementation can be for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(155) Referring to FIG. **17**, the implementation logic can include a data lake **1702** and, in an embodiment, the data lake **1702** can be provided with role-, attribute-, and dynamic policy-based access controls. An example of role-based and attribute-based access controls can include qualifications or permissions assigned to participants, e.g., participants **602**, to access data with particular attributes as specified in an appropriate DUA. An example of dynamic policy-based access controls can include changing the assigned permissions to access data with particular attributes, depending on the situational context. Proof of such qualifications or permissions can be communicated, as an example, by a subscription name, password sequence, or comparable verification protocol. In an embodiment, operations of the data lake **1702** can include, e.g., via flow pads A and B on FIGS. **16** and **17**, communication of suitably wrapped EHR information and EHR metadata, respectively. Flow output pads of the FIG. **17** resource include an output pad F and output pad G.

(156) FIG. **18** shows a flow diagram of an example process flow **1800** that can implement the transform and concept alignment processing **1506** in the FIG. **15** process **1500**. The example process flow **1800** can be further to AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments. Description of operations according to the process flow **1800** will use certain assumptions. One is that EHR system **104** sourced dataset described above has been received by the FIG. **16** process flow **1600**, i.e., information content and metadata have been extracted, genericized, and stored in an SP wrapping in the combined staging database processing **1504**, e.g., as per the FIG. **17** implementation. The receiving, as visible in FIG. **18**, can be via process flow **1800** flow reception points F and G, respectively, connected to FIG. **17** flow output points F and G.

(157) In overview, operations of the process flow **1800** include interoperable processing **1802**, for transforming into one or more alternative collaboration platform **128** supported knowledge presentation schema concepts represented by the genericized information content of, for example, the EHR system **104** sourced dataset and metadata store in the FIG. **17** data lake **1702** and metadata storage **1704**.

(158) Operations according to process flow **1800** will be described in reference to the example EHR dataset. However, in one or more embodiments, and in various applications of such embodiments concept information carried or embodied in the external source data, e.g., EHR system **104** sourced data, may span multiple datasets, combinations of datasets and results of processing datasets. Description of example operations of the interoperable processing **1802** will therefore assume that prior processing has accumulated a usable content of databases that feed the interoperable processing **1802**. For example, it will be assumed that prior processing, or a preloading, or operations in particularly configured start-up process, or combinations thereof, have loaded the process flow **1800** first database **1808**, holding deep learning, machine learning data, and loaded the process flow **1800** second database **1810**, holding integrated phenotype reference model information, and the process flow **1800** third database **1812**, holding text annotation, indexing, windowing, and accrued corpus characteristics data. Likewise, it will be assumed that prior processing, or a preloading, or operations in particularly configured start-up process, or combinations thereof, have loaded the process flow **1800** fourth database **1814**, holding user data, user input and behavior patterns, as well as social network performance and characteristics data. It will also be assumed that prior processing, or a preloading, or operations in particularly configured

start-up process, or combinations thereof, have loaded the process flow **1800** database **1816**, holding data dictionaries and interoperability maps available for interactive updating by the interoperability processing **1802**.

(159) It will be understood that "loaded," in this context, can encompass a loading of the identified databases, and of other of the process flow **1800** databases as will be described, that is sufficient such that successive operations, based on successively obtained new datasets, e.g., new EHR system **104** sourced datasets, will reliably produce a convergence of system or process state to a stable steady state.

(160) In an embodiment, various operations in the process flow **1800** can be configured to receive, in addition to the wrapped, genericized health related information and associated genericized metadata, run-time access to reference terminology, ontology and encoding data from a resource of reference terminology, ontology and encoding databases, and one or more information exchange standardized model references. Regarding the reference terminology, ontology and encoding databases, in an embodiment these can include, for example, as visible in FIG. **18**, a first reference terminology, ontology and encoding database **1804-1**, a second reference terminology, ontology and encoding database **1804-2**, . . . , and a Qth reference terminology, ontology and encoding database **1804**-Q (collectively "reference terminology, ontology and encoding databases **1804**"). Q can be any integer, including integer one. Regarding the information exchange standardized model references, an example configuration, also visible in FIG. **18**, can include information exchange standardized model reference **1806**.

(161) Referring to FIG. **18**, it will be understood the representation of the reference terminology, ontology and encoding databases **1804** by separate blocks is a logical representation and is not intended as any limitation as to physical arrangement or separation of respective storage. Implementation of the reference terminology, ontology and encoding databases **1804** can include, for example, storage of multiple reference terminology, ontology and encoding databases **1804** in common, shared storage space of a common, shared storage resource. Implementation of one or more of the reference terminology, ontology and encoding databases **1804** can also include remote storage of, or subscription access to one or more of the reference terminology, ontology and encoding databases **1804**.

(162) In an embodiment, operations in the process flow **1800** can include receiving and applying interoperability processing **1802** to wrapped, genericized medical and public health related information, and wrapped, genericized metadata, e.g., via accesses of the data lake **1702**. Such accesses can be initiated, for example, by the process flow **1800**, e.g., associated with a user or collaboration of users of the collaboration platform **128** using applications in the app market **134**. As visible in FIG. **15**, instances of interoperability processing **1802** can receive, by pushes to the process **1802** or by accesses performed by the process **1802**, reference terminology, ontology and encoding data from the up to Q reference terminology, ontology and encoding databases **1804-1**, **1804-2**, . . . , **1804**-Q, together with information exchange standardized model data from the information exchange standardized model reference **1806**; deep learning, machine learning, and other models data, from the process flow **1800** first database **1808**; phenotype reference model information from the process flow **1800** second database **1810**; text annotation, indexing, windowing, and accruing corpus characteristics data from the process flow **1800** third database **1812**; user data, input and behavior, social network performance and characteristics data from the process flow **1800** fourth database **1814**; and data dictionary(ies) and interoperability map(s) data from the data dictionary(ies) and interoperability map(s) database **1816**. Results of the interoperability processing **1802** can be loaded as common conformed dimensions, which could have either fuzzy or crisp degrees of certainty, into the process flow **1800** fifth database **1818**.

(163) Referring to FIGS. **1**, **15**, **18**, and **19**, it is seen that the common conformed fuzzy and crisp dimensions data can implement the hosting, on the virtual database and collaborative platform **128**, of transformed and EHR sourced health related information, for collaborative analyses by the FIG.

15 process **1500**, a transformed, interoperable processing **1508**.
(164) Referring to FIG. **18**, operations in the process flow **1800** can include, in addition to the above-described interoperability processing **1802**, a process flow **1800** artificial intelligence data analytics processing **1820**, applied to transformed generic EHR data from the FIG. **17** data lake **1702** and metadata storage **1704**, also using reference terminology, ontology and encoding data from the up to Q reference terminology, ontology and encoding databases **1804-1**, **1804-2**, . . . , **1804-**Q, together with information exchange standardized model data from the information exchange standardized model reference **1806**, and input of integrated phenotype reference model information from the process flow **1800** second database **1810** and text annotation, indexing, windowing, and accruing corpus characteristics data from the process flow **1800** third database **1812**. Results of the process flow **1800** artificial intelligence data analytics processing **1820** can be loaded, as updates or supplements to deep learning, machine learning, and other model data in the process flow **1800** first database **1808**.
(165) Operations in the process flow **1800** can also include, in addition to the above-described interoperability processing **1802** and process flow **1800** artificial intelligence data analytics processing **1820**, a process flow **1800** phenotype processing **1822**, applied to transformed generic EHR data from the FIG. **17** data lake **1702** and metadata storage **1704**, also using reference terminology, ontology and encoding data from the up to Q reference terminology, ontology and encoding databases **1804-1**, **1804-2**, . . . , **1804-**Q, together with information exchange standardized model data from the information exchange standardized model reference **1806**, and text annotation, indexing, windowing, and accruing corpus characteristics data from the process flow **1800** third database **1812**. Results of the process flow **1800** phenotype processing **1822** can be loaded, as updates or supplements integrated phenotype reference model data in the process flow **1800** second database **1810**.
(166) Operations in the process flow **1800** can include, in addition to the above-described interoperability processing **1802**, process flow **1800** artificial intelligence data analytics processing **1820**, and process flow **1800** phenotype processing **1822**, a natural language processing **1824**, also applied to transformed generic EHR data from the FIG. **17** data lake **1702** and metadata storage **1704**, also using reference terminology, ontology and encoding data from the up to Q reference terminology, ontology and encoding databases **1804-1**, **1804-2**, . . . , **1804-**Q, and the information exchange standardized model data from the information exchange standardized model reference **1806**. Results of the process flow **1800** natural language processing **1824** can be loaded, as updates or supplements to text annotation, indexing, windowing, and accruing corpus characteristics data in the process flow **1800** third database **1812**.
(167) In an embodiment, the process flow **1800** fifth database **1818** content of common conformed fuzzy and crisp dimensions data, as updated by the interoperability processing **1802**, the process flow **1800** first database **1808** content of deep learning, machine learning, and other model data, as updated by the process flow **1800** artificial intelligence data analytics processing **1820**; the process flow **1800** second database **1810** content of integrated phenotype reference model data as updated by the process flow **1800** phenotype processing **1822**, and the process flow **1800** third database **1812** content of text annotation, indexing, windowing, and accruing corpus characteristics data as updated by the process flow **1800** natural language processing **1824** can feed any one, or any combination or sub combination among the following example configuration of process flow **1800** processes: information retrieval and information push processing **1826**; clinical decision support and workflow support processing **1828**; pattern and anomaly detection processing **1830**; spatiotemporal predictive models processing **1832**; data visualization and data manipulation processing **1834**; and user experience and collaboration tools processing **1836**.
(168) In an embodiment, the process flow **1800** can also include a code repository and a data transformations archive **1838**.
(169) FIG. **19** illustrates a functional block schematic of a virtual data warehouse and collaboration

network **1900**, hosting an interoperable data resource, showing an example implementation of the FIG. **15** virtual data warehouse and collaboration platform and interoperable data resource, for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(170) FIG. **20** shows a process flow diagram of an example of a process flow **2000** of operations in the FIG. **16** process flow **1600**, comprising a specific implementation of the determining **1608** of data type and format and a corresponding specific implementation of the converting by preprocessing **1610** of received data type and format to a common format. In an example instance, operations of the process flow **2000** can include a determining **2002** of whether the EHR data is streaming data. Assuming the determining **2002** produces a positive result, the process flow **2000** can proceed to continuous data processing **2004**, which can feed appropriately formatted continuous data to the extracting **1612**, for processing as described in reference to FIG. **16**.

(171) In an embodiment, assuming the determining **2002** produces a negative result, the process flow **2000** can proceed sequentially, to determining **2006** whether the received EHR data is a user input, e.g., in real time to an EHR system standard GUI or other interface, and if the answer is "yes," can proceed to forms processing **2008**. In such an embodiment, if the determining at **2006** obtains a negative result, the process flow **2000** can proceed to determining **2010** if the received EHR data is a scrape and, if "yes," can proceed to crawler processing **2012** and then to extracting **1612**, for processing as described in reference to FIG. **16**. If the result of the determining **2010** is negative, the process flow **2000** can proceed to determining **2014** whether the EHR data is part of, e.g., a beginning of a bulk load and, if the answer is "yes," can proceed to secure upload processing **2016** and then, as described above, to processing as described in reference to FIG. **16**. In the example configuration visible in Fig. if the result of the determining **2014** is negative, the process flow **2000** can proceed to determining **2018** whether the EHR data is a specified connection, i.e., is in a form acceptable to the process, and, if the answer is "yes," can proceed to source processing **2020**, and then proceed to extracting **1612** and further operations as described in reference to FIG. **16**.

(172) In an alternative embodiment, two or more of the determining steps can be performed in parallel or substantially in parallel, and the combination of operations can be collectively referenced as "EHR data type determination."

(173) FIG. **21** shows a process flow diagram of an example alternative or further implementation of the transform and concept alignment processing in the FIG. **15** process for methods for AI enhanced medical record exchange and common platform collaboration based medical and public health situation assessment, and health services resource and response management in accordance with one or more embodiments.

(174) The alternative includes Reference Medical terminology, ontology and coding (T, O, & C) **2102-1**, Reference Laboratory T, O, & C **2102-2**; Reference Medication T, O, & C **2102-3**, Reference Social Determinants of Health T, O, & C **2102-4**; Additional Reference T, O, & C **2102-5**; and National Information Exchange Model Reference **2102-6**.

(175) Computer System

(176) FIG. **22** illustrates in simplified schematic form a computer system **2200**, on which aspects of the present disclosure can be practiced. The computer system **2200** can include a hardware processor **2202** communicatively coupled to an instruction memory **2204** and to a data memory **2206** by a bus **2208**. The instruction memory **2204** can be configured to store, on at least a non-transitory computer readable medium as described in greater detail below, executable program code **2210**. The hardware processor **2202** may include multiple hardware processors and/or multiple processor cores. The hardware processor **2202** may include cooperation with hardware processors from different devices. The computer system **2200** may execute one or more basic instructions included in the executable program code **2210**. The computer system **2200** can include a network

interface **2212** communicatively connected to the bus **2208**, for interfacing to a wide area network (WAN), e.g., the Internet **2214**. Also communicatively connected to the bus **2208** can be a GUI **2216**. The computer system **2200** may also include a mass storage **2218**, which can be accessible to the hardware processor **2202** via the bus **2208**.

(177) Relationship between Hardware Processor and Executable Program Code

(178) The relationship between the executable program code **2210** and the hardware processor **2202** is structural; the executable program code **2210** is provided to the hardware processor **2202** by imparting various voltages at certain times across certain electrical connections, in accordance with binary values in the executable program code **2210**, to cause the hardware processor to perform some action, as now explained in more detail.

(179) A hardware processor **2202** may be thought of as a complex electrical circuit that is configured to perform a predefined set of basic operations in response to receiving a corresponding basic instruction selected from a predefined native instruction set of codes.

(180) The predefined native instruction set of codes is specific to the hardware processor; the design of the processor defines the collection of basic instructions to which the processor will respond, and this collection forms the predefined native instruction set of codes.

(181) A basic instruction may be represented numerically as a series of binary values, in which case it may be referred to as a machine code. The series of binary values may be represented electrically, as inputs to the hardware processor, via electrical connections, using voltages that represent either a binary zero or a binary one. The hardware processor interprets the voltages as binary values.

(182) Executable program code may therefore be understood to be a set of machine codes selected from the predefined native instruction set of codes. A given set of machine codes may be understood, generally, to constitute a module. A set of one or more modules may be understood to constitute an application program or “app.” An app may interact with the hardware processor directly or indirectly via an operating system. An app may be part of an operating system.

(183) FIG. **23** shows a data preparation system **100**A illustrating a first data provider **110**A configured to provide a data information file **111**A; a multi-source health data integration logic **120**A configured to receive **110**P said data information file **111**A from the first data provider **110**A. The multi-source health data integration logic **120**A containing: an information extractor **122**A configured to extract information from the data information file **111**A; an information control wrapper logic **12**A configured to wrap the data information file with an information control wrapper **134**A. The multi-source health data integration logic may also comprise an information loader **126**A. The multi-source health data integration logic **120**A may be configured generate **120**P cleaned and sovereignty wrapped data (transformed interoperable data). The system may include a staging database **130**A configured to receive cleaned and sovereignty wrapped data (transformed interoperable data) from the multi-source health data integration logic **120**A; said staging database comprising a plurality of staged records **131**A. The staged records may comprise an information control wrapper **134**A configured to restrict usage of the data information; extracted information **132**A in a standardized format; wherein the extracted information contains electronic health records; metadata **136**A configured to provide details about the extracted information; origin data **137**A comprising source information of the extracted information; ownership data **138**A comprising information about what data provider owns the extracted information; encryption data **139**A comprising information on how to encrypt the extracted information. The system **100**A may comprise a pre-warehouse logic **140**A configured to receive said staged records **131**A from the staging database; said pre-warehouse logic may comprise a codification logic **142**A; a dimensionalization logic **144**A; a conformation logic **146**A; a consolidation logic **148**A, and a transformation and alignment logic **149**A to transform and align related concepts; said transformation and alignment logic comprising a knowledge representation tool and an analysis tool. The pre-warehouse logic **140**A may be configured to generate **140**P transformed interoperable data warehoused in **141**A. The system may comprise a collaboration platform **150**A configured to

receive said warehoused data **141**A. The warehoused data may be stored in data warehouse **141**B. The pre-warehouse logic **140**A may further be configured to generate **200**P new sovereignty data arising from data transformation.

(184) Referring to FIG. **24**, the collaboration platform **150**A may be configured to provide: a derived concept market **151**A containing warehoused data **141**A stored in a data warehouse **141**B in common conformed dimensions. The collaboration platform may comprise one or more bridges **152**A connecting a transformed component data **210***a*, transformed additional source data **212**A, hosted telecollaboration interoperable data **214**A, and transformed third party models **216**A.

(185) Referring back to FIG. **23**, the system may comprise an access interface **160**A configured to make said warehouse data accessible to a user **161**A.

(186) As shown in FIG. **25**, the access interface **160**A may comprise: an app market place **330**A; a graphic user interface **340**A; and a software development kit **300**A. As shown in FIG. **23**, the warehouse data may be accessible to the first data provider **110**A via the access interface **160**A.

(187) The first data provider may comprise a computer. The computer may comprise a tangible computer readable data storage device for storing, in a non-transitory manner, electronic personal health information and electronic source specific permission and conditions data; a tangible computer memory for storing of set of computer readable instructions; a network interface configured to facilitate communication between the first data provider and the multi-source health data integration logic; and a microprocessor configured to execute the computer readable instructions.

(188) The system **100** may comprise a server. The server may comprise a tangible server readable data storage device for storing, in a non-transitory manner, the staging database; a tangible server memory for storing of set of server readable instructions including the multi-source health data integration logic; and a microprocessor configured to execute the server readable instructions. The server may comprise a tangible server readable data storage device for storing, in a non-transitory manner, the collaboration platform and warehoused data; a tangible server memory for storing of set of server readable instructions including the warehouse logic; and a microprocessor configured to execute the server readable instructions. The system may comprise a plurality of data providers . . . a second data provider **110**B is shown in FIG. **23**.

(189) Referring to FIG. **25**, the system may comprise an access interface **160**A. The access interface may comprise an app market place **330**A, graphic user interface **340**A, and an SDK **330**A. The app market place **330**A may comprise user apps **331**A and third party apps **332**A. The graphic under interface **340**A may comprise a homepage **341**A and widgets **342**A. The software development kit **300**A may comprise natural language processing tools **311**A, statistical tools **312**A, data visualization tools **313**A, relation and collaboration tools **314**A, geospatial tools **315**A, artificial intelligence, machine learning, and deep level modeling tools **316**A, policy operationalization tools **317**A, gaming scenario tools **318**A, query engines **319**A, project & task management tools **320**A, import and export tools **321**A, and data integrity and security tools **322**A.

(190) Referring to FIG. **26**, an exemplary system is shown comprising a data source **400**A comprising a data provider **110**A and multi-source health data integration logic **120**A; a staging database **130**A comprising staged records **131**A. Said staging database may receive data from the data source **400***a* through a data pipelines **400**P. The data source **400**A may receive data back from analytics and AI engine **420**A through a primary data requirements feedback loop **401**P. The data source **400**A may be configured to adjust its primary data **402**A based on the primary data requirements feedback loop **401**P. The system may comprise an interoperability mapper **410**A configured to map data from the staging database **130**A using at least one of an automated mapping process **415**A or a manual mapping process **416**A. The system may comprise an analytics and artificial intelligence engine **420**A configured to receive and provide feedback regarding data mapped for interoperability **411**P to and from the interoperability mapper **410**A. The analytics and artificial intelligence engine **420**A may comprise a neural network **422**A; data plot generator **424**A;

and an integrated phenotype reference model **426**A. The data preparation logic **120**A may receive data back from the analytics and artificial intelligence engine through a nested sovereignty feedback loop **421**P. The system may comprise an access interface **160**A configured provide access to the integrated phenotype reference model **426**A. The access interface **160**A may receive actionable information **420**P from the analytics and artificial intelligence engine **420**A. The interoperability mapper **410**A may be configured to receive data back from the access interface **160**A through a feature engineering requirements feedback loop **431**P. The analytics and artificial intelligence engine **420**A may be configured to receive data back from the access interface **160**A through a utilization patterns feedback loop **441**P. The analytics and artificial intelligence engine **420**A may be configured to adjust neural network **422**A settings based on the utilization patterns. The data source **400**A may be configured to receive data back from the analytics and artificial intelligence through a feature engineering requirements feedback loop; said data source may adjust data elements included in provided records based on the feature engineering requirements.

(191) FIG. **27** shows an exemplary system comprising: a data provider **110**A configured to provide data in a data format; a data use agreement generator **512**A configured to check whether the data provider **110**A has an existing data use agreement **510**A in place; and if not, generating a data use agreement **513**P for the data provider. The system may comprise a policy generator **514**A configured to setup policy-based schedules and triggers **515**P; an encryption logic **516**A configured to encrypt data & manage keys **517**P for data from the data provider. The system may comprise a data format determination logic **521**A configured to receive and determine a data format of the data sent by the data provider **110**A. The data format selected from the list consisting essentially of: streaming **521**A, user input **522**A, scrape **523**A, bulk load **524**A and a specified connection **525**A. They system may comprise a data format converter **530**A configured to convert the data from the data provider to a common input format based on the data format determined by the data format determination logic. The data format converter **530**A may comprise: a continuous data processor **531**A, a forms processor **532**A, a crawler processor **533**A, a secure uploader **534**A, and a source processor **535**A. The system may comprise a multi-source health data integration logic **120**A configured to generate prepared data based on received data converted by the data format converter. The multi-source health data integration logic may comprise an information extractor **122**A, transformation and alignment logic **149**A, and an information loader **128**A. The system may comprise a preliminary staging database **520**A configured to receive prepared data from the multi-source health data integration logic. The system may contain a data integrity manager **564**A configured to maintain the integrity of data in the preliminary staging database. The data integrity manager **546**A may comprise a structure detector **542**A and a data type corrector **544**A. The system may comprise an information control wrapper logic **124**A configured to wrap the data from the preliminary staging database, apply the data use agreement, and encrypt the data. The system may comprise a staging database **550**A configured to receive and store data from the information control wrapper logic. The system may comprise a phenotype engine **600**A configured to receive data from the staging database. The system may comprise a collaboration platform **150**A configured to receive data from the phenotype engine **600**A. The phenotype engine **600**A may comprise a behavior model **625**A configured to receive utilization patterns from the collaboration platform **150**A. The phenotype engine **600**A may be configured to receive data from an external data source **518**A. The external data source **518**A may be configured to receive encrypted data from the encryption data logic.

(192) FIG. **28** illustrates a phenotype engine **600**A. The phenotype engine may comprise a plurality of reference sources **610**A. The first reference source **611**A and second reference source **612**A may comprise reference data. The phenotype engine **600**A may comprise a reference data processor **620**A comprising: a natural language processor **621**A, phenotype processor **622**A, artificial intelligence data processor **623**A, and interoperability processor **624**A. The phenotype processor may be configured to generate an integrated phenotype reference model (see FIG. **12**B, **1220**). The

system may comprise a reference data processor **620**A configured to access a behavior database **625**A and an interoperability map **626**A. The phenotype engine **600**A may comprise a reference database **630**A configured to receive processed data from the reference data processor **620**A. The reference database **630**A may comprise syntax data storage **631**A, phenotype data storage **632**A (for storing the integrated phenotype reference model **1220**), deep learning data storage **633**A, and dimension data storage **634**A. The phenotype engine **600**A may comprise an output generator **640**A configured to output data. The output generator **640**A may comprise an information retriever **641**A, workflow support **624**A, pattern detector **643**A, predictive modeler **644**A, data visualizer **645**A, and user experience optimizer **646**A. The phenotype engine may comprise a code repository **650**A configured to receive output date from the output generator. The phenotype engine may comprise a collaboration platform **150**A connected to an access platform. The collaboration platform **150**A and access platform may be configured to provide access to the output data to a user. The interoperability processor **624**A may configured to receive utilization and pattern data **660**P from the collaboration platform **150**A. The first reference **610**A of the phenotype engine may comprise a first set of terminology, ontology, and encoding data, and the second reference includes a second set of terminology, ontology, and encoding data. The references may comprise an information exchange standardized model reference. The first reference may include a set of medical terminology, ontology, and encoding data, and the second reference may include a set of laboratory terminology, ontology, and encoding data. The behavior database **625**A may comprise user data, input and behavior data, social network performance, and social network characteristics. The dimension data storage **634**A may comprise common confirmed, fuzzy, and crisp dimension data. The syntax data storage **631**A may comprise text annotation, indexing, winnowing, and accruing corpus characteristic data. The phenotype data storage **632**A may comprise an integrated phenotype reference mode. The deep learning database **633**A may comprise deep learning and machine learning data. The information retriever **641**A may be configured to perform information retrieval and push processing. The workflow support **642**A may be configured to provide clinical decision support and workflow support. The pattern detector **643**A may be configured to provide pattern detection and anomaly detection. The predictive modeler **644**A may be configured to generate spatiotemporal predicative models. The data visualizer **645**A may be configured to provide data visualization and manipulation tools. The user experience optimizer **646**A may be configured to optimize user experience and provide collaboration tools. The phenotype engine may comprise a reference source, wherein the reference source is a computer database. The database may contain a microprocessor, storage media, system memory, computer executable code, and networking hardware; said computer executable configured to cause the reference source to provide information to the reference database processor. The phenotype engine may comprise a server. The server may comprise a microprocessor, storage media, system memory, computer executable code, and networking hardware. The computer executable code may be configured to cause the microprocessor to implement the reference data processor, output generator, and collaboration platform.

(193) FIG. **29** illustrates a data modeler **1**A that may be configured collect, prepare, aggregate, update, share, protect, and generate a model **1**B (such as an integrated phenotype reference model **1220**, see FIG. **12**B) for users to access to improve their ability to conduct research and improve performance and accuracy of their research and/or services. In some configurations, the data modeler updates its generated model **1**B (e.g. integrated phenotype reference model) based on the queries and access patterns of its users. The data model may be based on underlying data **1**C. In some configurations, the data modeler **1**A may comprise: a data preparation system **100**A comprising data preparation logic **120**A; staging database **130**A for storing prepared data as staged records; phenotype engine **600**A for generating a model such as an integrated phenotype reference model; pre-warehouse logic **140**A for transforming, consolidating, conforming, dimensionalizing and codifying staged records; a collaboration platform **150**A for storing warehoused data **141**A;

and an access interface **160**A for providing access to the warehoused data and integrated phenotype reference model. In an example, the data modeler may be configured to collect the provider data, prepare the provider data, aggregate the provider data, update the warehoused data, share the warehoused data, protect the warehouse data, and generate an integrated phenotype reference model for users to access and conduct research via access interface.

(194) FIG. **32** shows a schematic diagram of the data modeler **1**A with details removed to show the entire modeler in one figure. FIG. **32** basically represents an exemplary configured of FIGS. **17**, **18**, **19**, and **20** in a single combined figure. Machine learning feedback data **32**A, automated pipeline self-modification processing **32**B, policy and standards repository **32**C, policy and standards editor **32**D are shown. Some example elements are included to help with understanding of this figure such **1812** (text annotation, indexing, windowing, and accruing corpus characteristics), phenotype processing **1822**, data lake **1702**, information retrieval and push processing **1826**, derived market concept **1902**, and data warehouse and collaborative network **1900**.

(195) Some aspects of the data modeler **1**A do not need interoperability with every last data element. In some cases, the data modeler **1**A finds and aligns concepts such as medical and public health (MPH) concepts and relevant law enforcement (LE) concepts. The integrated phenotype reference model may create a pattern language, rather than a dictionary per se, of the key concepts in medical and public health & law enforcement that can be cognitively manipulated, analogous to business concepts like customers or products or regional markets in other contexts.

(196) The integrated phenotype reference model **1220** may be analogized to link charts & evidence boards which are popular in law enforcement television shows. A core phenotype may be one of the concepts on the board with a thumbtack and strings coming and going. In the integrated phenotype reference model, each core phenotype may then also include some satellite concepts that are related and frequently co-occur within the records. The “integrated” part of the integrated phenotype reference model may refer an association of medical, public health, and law enforcement sharing the same model. In some cases, their concepts and satellites overlap one another in a large network.

(197) As an example, the medical and public health concept of opioid overdose has related satellite concepts such as heroin, fentanyl, needle exchange, transdermal, unconscious, naloxone, and myriad street names, but the phenotype may also include law enforcement concepts such as dealer and transnational cartel, etc. Other core concepts in the integrated phenotype reference model, such as the Sinaloa Cartel, could have overlapping satellites, such as a transnational cartel, and the satellites could then help to connect opioid overdose with the Sinaloa Cartel.

(198) Consolidation logic (FIG. **23**, **149**A) may be configured to find and consolidate data that is to be aligned. The data lake **114** can have different kinds of contextual data and other models, and not all of it will always need alignment. Consolidation generally involves records, such as medical and law enforcement records in the data lake. Transformation and alignment logic may be used to align the core concepts within those records. FIG. **4** shows a consolidate step **412**A which performs similar functions as the consolidate logic (FIG. **23**, **149**A).

(199) Conformation logic (FIG. **23**, **146**A) may be configured to analyze source records to determine whether they are relevant to a recognized phenotype, optionally, within a degree of certainty. In other words, the conformation logic is where a source record is determined to be talking about a recognized phenotype, within a degree of certainty. The conformation logic is where the pre-warehouse logic **140**A may index original data records (e.g. adding metadata) to the relevant phenotype in the integrated phenotype reference model, provide a degree of certainty, and tag evidence within the record (e.g., the words or phrases) that was used for the determination. FIG. **4** shows a confirmation step **412**B which performs similar functions as the confirmation (FIG. **23**, **146**A).

(200) In an example, if the data preparation system **100**A were processing a record that included unconscious and naloxone, but nothing else, the pre-warehouse logic **140**A, FIG. **23** or multi-source health data integration logic FIG. **1**, **102** may index the record as a possible opioid overdose,

with a certain confidence interval (e.g. 65% confidence), and tag or highlight those two words (unconscious and naloxone) in the record. Continuing the example, another record in the data warehouse **141**B may contain information regarding unconscious and fentanyl. The pre-warehouse logic may similarly index to the opioid overdose phenotype, but with a lesser degree of confidence (e.g. maybe only 50% confidence.) In this example, the data preparation system **100**A or the multi-source health data integration logic FIG. **1**, **102** has conformed original disparate records into the same reference model. Such conformation facilitates data aggregation and/or data modeling. Thereby providing enhanced functional interoperability without manual mapping.

(201) Dimensions are concepts the data modeler **1**A may use within a model such as integrated phenotype reference model **1220**, whether a core concept or a satellite concept. In aggregate, the dimensions may form a lexicon of words, phrases, lab tests, medications, diagnosis codes, etc., including synonyms and near synonyms, and including multilingual variants. Dimensionalization logic is configured to dimensionalize (provide dimensionalization) dimensions. Dimensionalization may including tagging of the content or dimensions that the dimensionalization logic recognizes. Dimensionalization may be performed to facilitate conformation.

(202) Codification logic **142**A (or archive logic) may be configured to archive or store results (e.g. generate archived data) from the transformation and alignment logic **149**A. E.g. the codification logic **142**A may store how we got what we got out of the alignment process. If the data preparation system **100**A, FIG. **23** (multi-source health data integration logic **102**, FIG. **1**) made a misidentification, or missed an important identification, the archived data generated by the codification logic **142**A may provide sufficient information for the phenotype processor to rebuild the integrated phenotype reference model. The phenotype processor **622**A may be configured to rebuild a part of the integrated phenotype reference model **1220** using the archived data. The phenotype processor **622**A may be configured to analyze archived data and determine how a mistake occurred. In some embodiments, situations, codification logic will encode the archived data, rather than simply saving all the integrated phenotype references models and original data. The codification logic **142**A may be configured to store enough information in that archived data so that the data preparation logic may rebuild the model (e.g. an integrated phenotype reference model) without having to save it in its entirety.

(203) Rules of engagement may include a wrapper (e.g. a rules of engagement wrapper). In some examples, a rules of engagement wrapped is derived from the data use agreement (**513**P, FIG. **27**). A rules of engagement data wrapper may determine how the data within the wrapper may be used. For example, the rules of engagement data wrapper may control which parts of the data (attribute-based access controls), by whom (role-based access controls), and under which circumstances (context-based access controls). Coupled with persistent encryption and provenance meta-data (explained below), these variables help construct a zero trust system. In some configurations, even a true zero-trust system may be developed. This may be preferable to systems that just rely on checking the user credentials (which are not true zero trust systems). Through the deployment of true zero trust system, collaborators can be marketplace competitors or lack any mutual trust.

(204) Persistent encryption relates to securing the data itself, not just the perimeter of the data modeler **1**A. In some configurations, persistent encryption embodiments may include system-wide persistent encryption . . . encryption that persists through the data modeler **1**A.

(205) Provenance may include a wrapper (e.g. a provenance wrapper). Data with a provenance wrapper may provenance information. Provenance information may provide the data modeler **1**A with information concerning source or origin of the data. Data in the data preparation system **100**A may be provided by data providers **110**A. The provenance wrapper may indicate who these data providers are. Provenance information may be existent even in aggregated states. Provenance wrappers and/or provenance information may be used by data preparation logic **120**A, phenotype engine **600**A and other components of the data modeler **1**A. Provence information may be used by the data modeler **1**A to track and correct misinformation, disinformation, and malinformation

throughout the data modeler and/or integrated phenotype reference model. Many modeling techniques in modern data science, particularly deep learning models, are nonlinear and can display chaotic dynamics (exquisite sensitivity on initial conditions). Such system may be vulnerable to data doping, which relates to intaking a dataset that has critical errors in it; critical errors designed to disrupt modeling in a way that is very difficult to discern. Tracking provenance allows the data modeler **1**A to find all the data from a potential corrupted source, even when it has been aggregated and subsumed within integrated phenotype reference model, and reverse engineer its effects. The data modeler may comprise malicious data analyzer (FIG. **28**) configured to detect misinformation, disinformation, and/malinformation. The data analyzer may be configured to use the provenance wrapper and/or provenance information to identify a source of the malicious data. The data modeler may comprise a model repair engine to remove and/or repair the malicious data. The malicious data analyzer **660**A and model repair engine may be configured to interface with the code repository **650**A, the collaboration platform **150**A, or the data lake.
(206) Sovereignty wrapping relates to the summary effect of rules of engagement, encryption, and provenance. Sovereignty wrapping provides a data owner with control (in some case absolute control) of their data. Data wrapped with a sovereignty wrap (e.g. including rules of engagement, encryption, and provenance) may be controlled by the data owner even if the data is removed from the data modeler **1**A.
(207) Dynamic policy operations (**702**G in the SDK of FIG. **7**, **317**A in FIG. **25**) may provide nuance to the sovereignty. Granular access controls based on role and data attributes tend to evolve over time, depending on context, potentially dynamically in sometime in the context of a crisis, for example. Dynamic policies manage the evolving access requirements in real time by applying role- and attribute-based policies in accordance with the changing context.
(208) FIG. **30** illustrates a schematic diagram of data sovereignty wrapping **700**A. FIG. **30** illustrates a data cloud **701**A. “Nested Sovereignty” (see FIG. **31**) extends the nuance even further. Data is element **701**A. Analytics is elements **702**A. Models is elements **703**A. Nested sovereignty **710**A may be generated by feedback loop (**122**, FIG. **1** or **190**P FIG. **23**). Nested sovereignty may recognize different equities represented across the original data, the preliminary analytics, and the data's inclusion in larger models. Each step may add new value and new ownership, and each of the products may require sovereignty over that new value. Although shown below as a linear progression for clarity, the nested relationships can be branching.
(209) As an example, imagine a patient arrives at the doctor's office for an appointment. The patient brings with them his/her demographics, complaints, and body. He or she should have complete sovereignty over that data, now and into the future. Now the doctor sees the patient and adds a considerable amount of value: retrieves subtleties of the symptoms, pulls out relevant aspects of the context, describes some astute physical findings, orders clarifying tests, and in the end, applies a label (diagnosis) to the situation. The patient does not own that work, the doctor does, but the patient still owns their original data. The doctor's data is irrelevant without the patient's, so these are not parallel values, but nested values, hence the need to develop nested sovereignty.
(210) Continuing the example, now the data are pulled up by an analyst who has been surveilling for the peculiar physical findings that the doctor has recorded. The analyst then aggregates with similar cases and does some brilliant modeling that determines we have detected a new disease process, subtly buried in wrong diagnoses. Neither the patient nor the doctor owns this new value, although they do retain the value that they contributed. This notion of nested sovereignty has the effect of allowing control over raw data to be independent of the control of derivative data, as is needed when analysis on open-source data produces a classified result, for example.
(211) As a side observation, nested sovereignty has the ability to create a new economic basis for medical data transactions: if the value of medical data can be controlled by its various owners, it can enter a free market where pharmaceutical companies, insurers, governments, and so own could purchase the data for their needs. In short, medical data can be commoditized and traded. Patients

might receive royalties for the use of their data (think of the case of Henrietta Lacks), doctors can receive royalties for the astuteness of their observations and the quality of their records (sloppy and irrelevant data are rampant across medicine), and analysts could receive payment for the use of their results in improving the public's health. This is analogous to digital rights management of products in the entertainment industry.

(212) The data modeler **1**A, generated model **1**B, and model data **1**C can help unify medical and public health and law enforcement concepts using dimensions (from the lexicon). The essence of making subtle or unusual connections is that the data modeler **1**A uses vector space to see what is in the neighborhood. Dimensions may be crafted precisely enough (despite possible linguistic variations) to be relatively independent of all other dimensions. Then a record that has been dimensionalized (tagged with all the dimensions found within it, each with an associated degree of confidence).

(213) A vector calculator (FIG. **23**, **144**B) may produce a vector where the amplitude of the vector is determined by the frequency (count) with which that dimension occurred within the record. The vector calculator may include all dimensions together to create a vector for the record. The vector calculator may normalize the vector so that it has a total vector length of 1.0. The vector calculator may determine the cosine between vectors, an arithmetic problem, that can be performed by the vector calculator on the fly computationally. Close concepts in a neighborhood would have the smallest cosines between their vectors (i.e., they necessarily have overlapping satellite concepts in the integrated phenotype reference model). As some dimensions may include some degree of uncertainty, the vector that represents a record may be a bit fuzzy, so nearest neighborhood can be contextually tighter or looser. In FIGS. **10** and **26**, five feedback loops are illustrated. In some configurations, they may be designed a single process with multiple inputs and outputs along with a storage capacity.

(214) Referring to FIGS. **10** and **26**, Loop **138** on FIG. **10** (**441**P on FIG. **26**) goes from the GUI to the data warehouse and returns utilization patterns—which widgets and apps are getting the most use. Loop **130** (**431**P) goes from the data warehouse/collaborative platform/Access Interface **160**A to the Analytics and AI Engine **420** and returns feature engineering and new phenotype connections. Loop **122** (**421**P) goes from the Analytics and AI Engine **420** to the Data Source (**400**A) and adds nested sovereignty information as analyses and models are built. Loop **123** (**401**P) goes from the Analytics and AI Engine to the source data owners and returns primary data requirements to them. FIG. **26** also shows a feedback loop, **411**P, between the Analytics and AI Engine and the interoperability mapping processes, which uses the feedback to help speed up the manual mapping and to help refine the computed integrated phenotype reference model mapping.

(215) The collaboration platform **150**A may be configured to tracks how users behave on the data model **1**A. For example, users may be frequently looking at (querying, discussing in threads, using dashboards, etc.) data that have been indexed to two concepts that the integrated phenotype reference model didn't have connections between. The machine learning algorithm flags a possible connection between the two concepts, but it's assumed to start with. As the behavior pattern gets reinforced with ongoing use, the machine learning presents the connection to the humans-in-the-loop involved with the interoperability and phenotyping processes who can validate it and perhaps note details as to the nature of the connection. When the new connection is validated, it becomes apparent that the connection was evident to subject matter experts but not intrinsic to the source data (otherwise the integrated phenotype reference model would already have detected the connection), so the humans can provide feedback to the source data owners suggesting that their primary data is not capturing an important relationship that subject matter experts on the platform are needing/leveraging. This provides an incentive to collect new source data or to modify (or clean up) data that is otherwise relevant but was somehow getting lost. The net result is the new source data can be used to make the connection evident to the integrated phenotype reference model algorithms, and the knowledge representation tightens up and becomes more relevant. This is an

example of the human-machine collaboration intrinsic to the functioning of the platform—perhaps not unlike how the use of a car is inherently a human-machine collaboration.

(216) Computer Program Product

(217) A computer program product is an article of manufacture that has a computer-readable medium with executable program code that is adapted to enable a processing system to perform various operations and actions.

(218) A computer-readable medium may be transitory or non-transitory.

(219) A transitory computer-readable medium may be thought of as a conduit by which executable program code may be provided to a computer system, a short-term storage that may not use the data it holds other than to pass it on.

(220) The buffers of transmitters and receivers that briefly store only portions of executable program code when being downloaded over the Internet is one example of a transitory computer-readable medium. A carrier signal or radio frequency signal, in transit, that conveys portions of executable program code over the air or through cabling such as fiber-optic cabling provides another example of a transitory computer-readable medium. Transitory computer-readable media convey parts of executable program code on the move, typically holding it long enough to just pass it on.

(221) Non-transitory computer-readable media may be understood as a storage for the executable program code. Whereas a transitory computer-readable medium holds executable program code on the move, a non-transitory computer-readable medium is meant to hold executable program code at rest. Non-transitory computer-readable media may hold the software in its entirety, and for longer duration, compared to transitory computer-readable media that holds only a portion of the software and for a relatively short time. The term, “non-transitory computer-readable medium,” specifically excludes communication signals such as radio frequency signals in transit.

(222) The following forms of storage exemplify non-transitory computer-readable media: removable storage such as a universal serial bus (USB) disk, a USB stick, a flash disk, a flash drive, a thumb drive, an external solid-state storage device (SSD), a compact flash card, a secure digital (SD) card, a diskette, a tape, a compact disc, an optical disc; secondary storage such as an internal hard drive, an internal SSD, internal flash memory, internal non-volatile memory, internal dynamic random-access memory (DRAM), read-only memory (ROM), random-access memory (RAM), and the like; and the primary storage of a computer system.

(223) Different terms may be used to express the relationship between executable program code and non-transitory computer-readable media. Executable program code may be written on a disc, embodied in an application-specific integrated circuit, stored in a memory chip, or loaded in a cache memory, for example. Herein, the executable program code may be said, generally, to be “in” or “on” a computer-readable media. Conversely, the computer-readable media may be said to store, to include, to hold, or to have the executable program code.

(224) Creation of Executable Program Code

(225) Software source code may be understood to be a human-readable, high-level representation of logical operations. Statements written in the C programming language provide an example of software source code.

(226) Software source code, while sometimes colloquially described as a program or as code, is different from executable program code. Software source code may be processed, through compilation for example, to yield executable program code. The process that yields the executable program code varies with the hardware processor; software source code meant to yield executable program code to run on one hardware processor made by one manufacturer, for example, will be processed differently than for another hardware processor made by another manufacturer.

(227) The process of transforming software source code into executable program code is known to those familiar with this technical field as compilation or interpretation and is not the subject of this application.

(228) User Interface

(229) A computer system may include a user interface controller under control of the processing system that displays a user interface in accordance with a user interface module, i.e., a set of machine codes stored in the memory and selected from the predefined native instruction set of codes of the hardware processor, adapted to operate with the user interface controller to implement a user interface on a display device. Examples of a display device include a television, a projector, a computer display, a laptop display, a tablet display, a smartphone display, a smart television display, or the like.

(230) The user interface may facilitate the collection of inputs from a user. The user interface may be graphical user interface with one or more user interface objects such as display objects and user activatable objects. The user interface may also have a touch interface that detects input when a user touches a display device.

(231) A display object of a user interface may display information to the user. A user activatable object may allow the user to take some action. A display object and a user activatable object may be separate, collocated, overlapping, or nested one within another. Examples of display objects include lines, borders, text, images, or the like. Examples of user activatable objects include menus, buttons, toolbars, input boxes, widgets, and the like.

(232) Communications

(233) The various networks are illustrated throughout the drawings and described in other locations throughout this disclosure, can comprise any suitable type of network such as the Internet or a wide variety of other types of networks and combinations thereof. For example, the network may include a wide area network (WAN), a local area network (LAN), a wireless network, an intranet, the Internet, a combination thereof, and so on. Further, although a single network is shown, a network can be configured to include multiple networks.

CONCLUSION

(234) For any computer-implemented embodiment, “means plus function” elements will use the term “means;” the terms “logic” and “module” have the meaning ascribed to them above and are not to be construed as generic means. An interpretation under 35 U.S.C. § 112(f) is desired only where this description and/or the claims use specific terminology historically recognized to invoke the benefit of interpretation, such as “means,” and the structure corresponding to a recited function, to include the equivalents thereof, as permitted to the fullest extent of the law and this written description, may include the disclosure, the accompanying claims, and the drawings, as they would be understood by one of skill in the art.

(235) To the extent the subject matter has been described in language specific to structural features or methodological steps, it will be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or steps described. Rather, the specific features and steps are disclosed as example forms of implementing the claimed subject matter. To the extent headings appear in this description, they are for the convenience of the reader, not as limitations or restrictions of the systems, techniques, approaches, methods, or devices to those appearing in any section. Rather, the teachings and disclosures herein can be combined or rearranged with other portions of this disclosure and the knowledge of one of ordinary skill in the art. This disclosure generally encompasses and includes such variation. The indication of any elements or steps as “optional” does not indicate that all other or any other elements or steps are mandatory. The claims define the invention and form part of the specification. Limitations from the written description are not to be read into the claims.

(236) Certain attributes, functions, steps of methods, or sub-steps of methods described herein may be associated with physical structures or components, such as a module of a physical device that, in implementations in accordance with this disclosure, make use of instructions (e.g., computer executable instructions) that may be embodied in hardware, such as an application-specific integrated circuit, or that may cause a computer (e.g., a general-purpose computer) executing the

instructions to have defined characteristics. There may be a combination of hardware and software such as processor implementing firmware, software, and so forth, to function as a special purpose computer with the ascribed characteristics. For example, in embodiments a module may comprise a functional hardware unit (such as a self-contained hardware or software or a combination thereof) designed to interface the other components of a system such as through use of an application programming interface (API). In embodiments, structures for a module a module can be according to the module's function or set of functions, e.g., in accordance with a described algorithm. This disclosure may use nomenclature that associates a component or module with a function, purpose, step, or sub-step to identify the corresponding structure which, in instances, includes hardware and/or software that function for a specific purpose.
(237) While certain implementations have been described, these implementations have been presented by way of example only and are not intended to limit the scope of this disclosure. The novel devices, systems and methods described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions, and changes in the form of the devices, systems and methods described herein may be made without departing from the spirit of this disclosure.

Claims

1. A data modeler for generating a model comprising: a server; said server comprising: a tangible server readable data storage device for storing, in a non-transitory manner, a staging database; a tangible server memory for storing a set of server readable instructions including data preparation logic; a microprocessor configured to execute the server readable instructions; a first data provider configured to provide a data information file containing data; a multi-source health data integration logic configured to receive said data information file from the first data provider; the multi-source health data integration logic containing: an information extractor configured to extract information from the data information file; a phenotype engine configured to generate an integrated phenotype reference model: an information control wrapper logic configured to: wrap the data information file with an information control wrapper; apply a data use agreement; and encrypt the data; the information control wrapper configured to restrict usage of the data information file; a provenance wrapper comprising source information from the first data provider; the data modeler configured to track and correct misinformation through the integrated phenotype reference model by using the provenance wrapped source information; the multi-source health data integration logic configured to generate cleaned and sovereignty wrapped data wrapped with a sovereignty wrap; the staging database configured to receive the cleaned and sovereignty wrapped data from the multi-source health data integration logic; said staging database comprising: a plurality of staged records comprising the information control wrapper configured to restrict usage of the data information file; extracted information in a standardized format; wherein the extracted information contains electronic health records; metadata configured to provide details about the extracted information; the source information of the extracted information; ownership data comprising information about what data provider owns the extracted information; encryption data comprising information on how to encrypt the extracted information; pre-warehouse logic configured to receive said staged records from the staging database; said pre-warehouse logic comprising: codification logic; dimensionalization logic; conformation logic; consolidation logic, and transformation and alignment logic to transform and align related concepts; said transformation and alignment logic comprising a knowledge representation tool and an analysis tool; the pre-warehouse logic configured to generate transformed interoperable data; a collaboration platform configured to receive warehoused data; said collaboration platform comprising: a derived concept market containing warehoused data in conformed dimensions; and a bridge to provide transformed component data, transformed additional source data, hosted telecollaboration data, and transformed third party models; an access interface configured to make said warehoused data and model

accessible to a user; and said warehoused data accessible to the first data provider via the access interface; a primary data requirements feedback loop configured to send primary data requirements back to a data source from the staging database; the data source configured to adjust the data source's primary data based on the primary data requirements feedback loop; an interoperability mapper configured to: map data from the staging database using at least one of an automated mapping process and a manual mapping process; and receive feature engineering requirements data back from the access interface through a feature engineering requirements feedback loop; and an analytics and artificial intelligence engine configured to receive data mapped for interoperability from the interoperability mapper.

2. The data modeler of claim 1 wherein the first data provider is a computer comprising: a tangible computer readable data storage device for storing, in a non-transitory manner, electronic personal health information and electronic source specific permission and conditions data; a tangible computer memory for storing a set of computer readable instructions; a network interface configured to facilitate communication between the first data provider and the data preparation logic; and a microprocessor configured to execute the computer readable instructions.

3. The data modeler of claim 1 comprising a second data provider.

4. The data modeler of claim 1 further configured to collect the data information file, prepare the data information file, aggregate the data information file, update the warehoused data, share the warehoused data, protect the warehoused data, and generate an integrated phenotype reference model for users to access and conduct research via the access interface.

5. The data modeler of claim 1 wherein the access interface comprising: an app market place; a graphic user interface; and a software development kit.

6. The data modeler of claim 5 wherein: the app market place comprises user apps and third party apps; the graphic user interface comprises a homepage and widgets; and the software development kit comprises natural language processing tool, statistical tools, data visualization tools, relation and collaboration tools, geospatial tools, artificial intelligence, machine learning, and deep level modeling tools, policy operationalization tools, gaming scenario tools, query engines, project & task management tools, import and export tools, and data integrity and security tools.

7. The data modeler of claim 1 wherein the codification logic is configured to: archive data from the transformation and alignment logic and multi-source health data integration logic; the archived data generated by the codification logic providing sufficient information for a phenotype processor to rebuild an integrated phenotype reference model; encode the archived data rather than saving all the integrated phenotype reference model and original data; and store enough information in the archived data to rebuild the integrated phenotype reference model without having to save the integrated phenotype reference model in the integrated phenotype reference model's entirety.

8. The data modeler of claim 7 wherein the phenotype processor is configured to: analyze archived data and determine how a mistake occurred; and rebuild a part of the integrated phenotype reference model using the archived data without having to save the integrated phenotype reference model in the integrated phenotype reference model's entirety.

9. The data modeler of claim 8 wherein said staging database is configured to: receive data from the first data provider through a data pipeline; and adjust the staged records based on the feature engineering requirements data.

10. The data modeler of claim 9 wherein the analytics and artificial intelligence engine comprises a neural network; data plot generator; and an integrated phenotype reference model.

11. The data modeler of claim 10 wherein the analytics and artificial intelligence engine is configured to: receive utilization patterns data back from the access interface through a utilization patterns feedback loop; and adjust neural network settings based on the utilization patterns data.

12. The data modeler of claim 1 comprising a data use agreement generator configured to check whether the first data provider has an existing data use agreement in place; and if not, generating a data use agreement for the first data provider; and a policy generator configured to setup policy-

based schedules and triggers.

13. The data modeler of claim 1 comprising a data format converter containing a continuous data processor, a forms processor, a crawler processor, a secure uploader, and a source processor.

14. The data modeler of claim 13 wherein the data format converter is configured to convert the data from the first data provider to an input format based on a data format determined by a data format determination logic.

15. The data modeler of claim 1 further comprising: a reference data processor comprising: a natural language processor, phenotype processor, artificial intelligence data processor, and interoperability processor; the reference data processor configured to access a behavior database and an interoperability map; a reference database configured to receive processed data from the reference data processor; said reference database comprising syntax data storage, phenotype data storage, deep learning data storage, and dimension data storage; a pattern detector configured to provide pattern detection and anomaly detection; a predictive modeler configured to generate spatiotemporal predicative models; a data visualizer configured to provide data visualization and manipulation tools; a user experience optimizer configured to optimize user experience and provide collaboration tools; and a code repository configured to receive output data from an output generator.

16. The data modeler of claim 15 wherein: the collaboration platform and access platform is configured to provide access to the output data to the user; and the interoperability processor configured to receive utilization and pattern data from the collaboration platform.

17. The data modeler of claim 1 wherein: the sovereignty wrap comprises: rules of engagement, encryption, and provenance; and data that has been sovereignty wrapped; and the sovereignty wrapped data is controllable by an owner of the sovereignty wrapped data during and after the data has been removed from the data modeler.

18. The data modeler of claim 1 comprising: multilevel, persistent, embedded cybersecurity for sequestering electronic personal health information (ePHI); automated enforcement of rules of engagement through tracked data provenance through an analysis pipeline and persistent encryption; a staging database first logic portion storing generic transformed (GTR) electronic health record (EHR) system sourced ePHI data and GTR EHR metadata; and a sovereignty protective wrap protecting the GTR EHR system sourced ePHI and GTR EHR metadata against unauthorized access to GTR EHR system sourced ePHI and GTR EHR metadata.

19. The data modeler of claim 18 comprising: a rules of engagement data wrapper around the data for determining rules of engagement; the rules of engagement configured to define how the data within the rules of engagement data wrapper may be used; and the rules of engagement data wrapper controlling: which parts of the data may be used through attribute-based access controls; who may use the data through role-based access controls; and under which conditions the data may be used through context-based controls; and automated enforcement of the rules of engagement.

20. The data modeler of claim 1 comprising: an artificial intelligence enhanced medical record exchange configured to curate data through a combination of multi-source health data integration logic, data extraction by a data extraction logic, sovereignty protective wrapping by a wrapping logic, and multiple participant collaboration hosted by a virtual collaboration platform; the artificial intelligence enhanced medical record exchange configured to bring medical data and contextual data, analytics, decisions, and collaboration from across multiple sources onto a single secure medical information platform; and the multi-source health data integration logic configured to receive electronic personal health information carried in electronic health records (EHRs) in various forms and file structures maintained by a plurality of different mutually independent electronic health record systems.

21. A method of generating a model comprising: a first data provider generating a data information file containing data; a multi-source health data integration logic receiving said data information file from the first data provider; a phenotype engine generating an integrated phenotype reference

model: an information extractor extracting information from the data information file; an information control wrapper logic wrapping the data information file with an information control wrapper; applying a data use agreement; and encrypting the data; the information control wrapper restricting usage of the data information file; providing a data modeler with provenance information concerning source of the data; tracking and correcting misinformation within the integrated phenotype reference model through the use of the provenance information; the multi-source health data integration logic generating cleaned and sovereignty wrapped data; a staging database receiving the cleaned and sovereignty wrapped data from the multi-source health data integration logic; said staging database comprising: a plurality of staged records comprising the information control wrapper configured to restrict usage of the data information file; extracted information in a standardized format; wherein the extracted information contains electronic health records; metadata configured to provide details about the extracted information; origin data comprising source information of the extracted information; ownership data comprising information about what data provider owns the extracted information; encryption data comprising information on how to encrypt the extracted information; pre-warehouse logic receiving said staged records from the staging database; said pre-warehouse logic comprising: codification logic; dimensionalization logic; conformation logic; consolidation logic, and transformation and alignment logic to transform and align related concepts; said transformation and alignment logic comprising a knowledge representation tool and an analysis tool; the pre-warehouse logic configured to generate transformed interoperable data; a collaboration platform receiving warehoused data; said collaboration platform comprising: a derived concept market containing warehoused data in conformed dimensions; and a bridge providing transformed component data, transformed additional source data, hosted telecollaboration data, and transformed third party models; and an access interface making said warehoused data and model accessible to a user; a primary data requirements feedback loop sending send primary data requirements data back to a data source from the staging database; the data source adjusting the data sources's primary data based on the primary data requirements feedback loop; an interoperability mapper mapping data from the staging database using at least one of an automated mapping process and a manual mapping process; the interoperability mapper receiving feature engineering requirements data back from the access interface through a feature engineering requirements feedback loop; and an analytics and artificial intelligence engine receiving data mapped for interoperability from the interoperability mapper.

22. The method of claim 21 comprising: collecting the data information file; preparing the data information file; aggregating the data information file; updating the warehoused data; sharing the warehoused data; protecting the warehoused data; and generating an integrated phenotype reference model for users to access and conduct research via the access interface.

23. The method of claim 21 comprising: archiving data from the transformation and alignment logic and multi-source health data integration logic; the archived data generated by the codification logic providing sufficient information for a phenotype processor to rebuild an integrated phenotype reference model; encoding the archived data rather than saving all the integrated phenotype reference model and original data; and storing enough information in the archived data to rebuild the integrated phenotype reference model without having to save the integrated phenotype reference model in the integrated phenotype reference model's entirety.

24. The method of claim 22 comprising: a phenotype processor analyzing archived data and determining how a mistake occurred; and the phenotype processor rebuilding a part of the integrated phenotype reference model using the archived data without having to save the integrated phenotype reference model in the integrated phenotype reference model's entirety.

25. The method of claim 24 comprising: receiving data from the first data provider through a data pipeline; adjusting the staged records based on the feature engineering requirements data; and adjusting primary data based on a primary data requirements feedback loop.

26. The method of claim 25 comprising: receiving utilization patterns data back from the access interface through a utilization patterns feedback loop; and adjusting settings in a neural network-based on the utilization patterns data.
27. The method of claim 21 comprising: checking whether the first data provider has an existing data use agreement in place; and if not, generating a data use agreement for the data provider; and setup policy-based schedules and triggers with a policy generator.
28. The method of claim 21 comprising a data format converter converting the data from the first data provider to an input format based on a data format determined by a data format determination logic.
29. The method of claim 21 comprising: a reference data processor accessing a behavior database and an interoperability map; and a reference database receiving processed data from the reference data processor; said reference database comprising syntax data storage, phenotype data storage, deep learning data storage, and dimension data storage; a pattern detector providing pattern detection and anomaly detection; a predictive modeler generating spatiotemporal predicative models; a data visualizer providing data visualization and manipulation tools; a user experience optimizer optimizing user experience and providing collaboration tools; and a code repository receiving output data from an output generator.
30. The method of claim 29 comprising: the collaboration platform and access platform providing access to the output data to a user; and an interoperability processor receiving utilization and pattern data from the collaboration platform.
31. The method of claim 21 comprising an owner of the data controlling the sovereignty wrapped data while the data is in the data modeler; removing the sovereignty wrapped data from the data modeler; the owner of the data controlling the sovereignty wrapped data after the sovereignty wrapped data has been removed from the data modeler; wherein the sovereignty wrap comprises: rules of engagement, encryption, and provenance; and data that has been sovereignty wrapped.
32. The method of claim 21 comprising: determining rules of engagement defining how the data within a rules of engagement data wrapper be used; the rules of engagement data wrapper controlling: which parts of the data may be used through attribute-based access controls; who may use the data through role-based access controls; and under which conditions the data may be used through context-based controls; and automating enforcement of the rules of engagement by tracking data provenance through an analysis pipeline and using a persistent encryption method.
33. The method of claim 32 comprising: providing multilevel, persistent, embedded cybersecurity by sequestering electronic personal health information (ePHI); tracking data provenance in the integrated phenotype reference model; enforcing the rules of engagement for all users of the integrated phenotype reference model; a staging database first logic portion storing generic transformed (GTR) electronic health record (EHR) system sourced ePHI data; protecting sovereignty of GTR EHR system sourced ePHI and GTR EHR metadata; and protecting against unauthorized access to GTR EHR system sourced ePHI and GTR EHR metadata.
34. The method of claim 21 comprising: an artificial intelligence enhanced medical record exchange curating data through a combination of multi-source health data integration logic, data extraction by a data extraction logic, sovereignty protective wrapping by a wrapping logic, and multiple participant collaboration hosted by a virtual collaboration platform; the artificial intelligence enhanced medical record exchange bringing medical data and contextual data, analytics, decisions, and collaboration from across multiple sources onto a single secure medical information platform; and the multi-source health data integration logic receiving electronic personal health information carried in electronic health records (EHRs) in various forms and file structures maintained by a plurality of different mutually independent electronic health record systems.