



A public health perspective on using electronic health records to address social determinants of health: The potential for a national system of local community health records in the United States



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ABSTRACT

Community health records (CHRs) are defined as “a curated set of population-level indicators that describe the health and quality of life of a geographic community”. CHRs encompass clinical, social determinants of health (SDOH), and public health data aggregated at the neighborhood level. If developed and deployed across communities, CHRs provide an opportunity to track and enhance population health on a regional or national level.

Electronic Health Records (EHRs), if linked across providers, can document certain indicators of SDOH in addition to capturing clinical data for residents of a community. Moreover, EHR-derived patient-level SDOH information could be collated with geographic level public health and social services information to create the basis for neighborhood-specific CHRs.

An EHR-derived CHR – relative to current survey-based assessments used by public health agencies in the United States and other countries – could dramatically increase the scope, quality, and timeliness of data available for planning interventions targeted at SDOH factors at both the consumer and small-area levels.

EHR-derived CHRs, if assembled across neighborhoods, could also offer a significant value to the society by providing population-level SDOH data across various regions and eventually nationwide.

1. Rationale

The 2014 report by the United States (U.S.) President’s Council of Advisors on Science and Technology (PCAST) identifies a comprehensive set of actions for enhancing healthcare across the nation through greater use of systems-engineering principles [1]. To achieve some of these goals, Van Brunt – a member of the PCAST committee – eloquently outlines a set of recommendations for implementing community health records (CHRs) nationally [2]. He defines CHRs as “a curated set of population-level indicators that describe the health and quality of life of a geographic community” [2]. The roadmap offers recommendations to standardize terminology, vocabulary, and meta-data structure. It also advises to create a national system of CHRs by coordinating data collection of geographic level social and public health surveys. Van Brunt further discusses a wide variety of CHR applications for public health and community planning, and suggests how place-based CHR data, when linked to electronic health records (EHRs), can provide a “vulnerability index.” This index of community level social/behavioral determinants of health (SDOH) information is expected to facilitate medical interventions [2].

Given the current ubiquitous nature of EHRs in clinical care in the U.S. and across other high income and industrialized countries, they have the potential near-future capability to capture SDOH data that can feed into CHR systems [3]. EHRs could even be leveraged as the basis for the CHR infrastructure by integrating other data sources, such as public health surveys and data from non-health sectors (e.g., crime or air quality data) [2]. For instance, selected lifestyle and social domains such as race, ethnicity, preferred language, alcohol drinking, and smoking status are often documented in EHRs’ structured data. Also, EHR’s unstructured data (e.g., free-text clinical notes) contain information on selected environmental and social domains such as

housing issue, social connection/isolation, and income/financial resource strain.

While EHR-derived SDOH data are not sufficient to constitute a complete CHR, it is an integral component of, or perhaps the basis for, such a population-level CHR system. For example, the latitude and longitude of each person’s home address in EHR can be used to extract SDOH data from geo-coded data sources, such as public health surveys and aggregated data originating from non-health sectors.

EHR-derived SDOH could also feed into the digital infrastructure for the “learning health system”, a healthcare system that aligns science, informatics, incentives, and culture to continuously improve and innovate the clinical care, clinical and health services research, patient education and self-management, safety and cost monitoring, and also public health surveillance and intervention [4].

Moreover, EHRs have the advantage that their data elements are captured in near-real time, on a patient-level, and at very low additional cost. The well-established tendency among clinical providers towards creating large scale integrated electronic databases for population health management has already generated an environment in which EHRs are becoming a major asset to assess population health at the geographic level [5,6]. The severe resource and administrative challenges associated with de-novo collection of SDOH-relevant data for every neighborhood by public health agencies in the United States and similar agencies in other countries, suggests that the secondary use of EHR data may be the only viable route for certain measures to create a national system of CHRs. Such a CHR system would enable addressing population health at the geographic level while taking into account a number of patient-level and clinical characteristics. For instance, CHRs provide a platform to assess hospitalization rate in a community using EHR data on individuals’ characteristics (e.g., age, sex, race, and chronic disease comorbidities) while taking into account the

characteristics of the neighborhood the individuals live in (e.g., access to healthy food options and healthcare services), using data from public health surveys and non-health sectors (e.g., the U.S. Census Bureau's American Community Survey [7]).

The goal of this paper is to discuss how EHRs could help to create the basis for a national system of geographic-based CHR.

2. SDOH-focused national framework for CHR

Beyond ad hoc surveys and periodic vital record assessments, there is currently no nationally standardized electronic record system (in terms of definition, content, vocabulary, common data model, or data documentation process) in the U.S. that can be used to describe the health of neighborhoods across the nation. The nation sorely needs a system of CHR that would represent a central electronic repository. These CHR would eventually serve to integrate and link population-level data now being stored in isolated digital silos. Fig. 1, presents a schema of the central position that a geographic-level CHR could play in integrating data from disconnected sectors to capture and collate SDOH information on every community in the U.S. In the following we discuss the EHR-CHR connection, highlight some of the properties of EHRs in the U.S., and suggest how they could form the basis for an SDOH-focused CHR national framework.

3. Value of EHRs in supporting CHR infrastructure

3.1. The high volume and velocity of EHR data

The 2009 U.S. Federal HITECH Act served to jump-start the adoption of EHRs throughout the country. Today, virtually all hospitals and the majority of ambulatory medical settings have EHRs [8,9]. Over the past several years, the Meaningful Use program – the EHR incentive program by the Center for Medicare and Medicaid Services (CMS) – required that EHRs capture at least some standardized information on SDOH (e.g., race, ethnicity, and smoking status) [10]. The program also required movement towards the exchange of reportable information between medical providers and public health agencies [11]. These efforts facilitate the interoperability and sharing of health information among clinical providers as well as between providers and public health agencies, although there is a long way to go until these exchanges become universal [12,13].

Despite existing challenges with EHRs, the number of Americans with access to medical providers that are documenting their needs in EHRs is at historically high levels [8]. This is true even in disadvantaged communities where the greatest majority of residents have at least some of their medical or social needs documented within the EHRs maintained by community providers. Taken together, the expansion of EHRs, the inclusion of at least some standardized SDOH relevant information, and the start of EHR exchange with public health agencies [6] provide the opportunity to aggregate data describing both medical and SDOH needs of patients within a community [14]. Current CHR-like databases used by U.S. state or local public health agencies rely almost exclusively on survey data from a sample of the population. For instance, the U.S. Census Bureau's American Community Survey [7] generates data that help determine the distribution of over \$675 billion in federal and state funds each year. The survey is administered to about 1% of the U.S. population annually (i.e., approximately 3.5 million persons year) [7]. And, Center for Disease Control and Prevention's (CDC) flagship survey, the Behavioral Risk Factor Surveillance System (BRFSS), interviews about 400,000 individuals annually [15].

These surveys offer validated metrics and provide high quality data, but they do not approach either the volume or velocity (i.e., currency/timeliness) of the patient specific data that can today, or in the near future, be obtained via EHRs. By comparison, about 95% of U.S. hospitals and more than 60% of office-based healthcare professionals had EHRs that met Meaningful Use standards in 2016, a number that has been growing since then [8,9]. Given the wide adoption of EHRs in the U.S., it can be assumed that most Americans have detailed digital information currently stored in the EHR system of one or more of their medical providers and these data are often updated multiple times a year.

3.2. Pinpointing geo-accuracy of individual-level EHR data

In contrast to EHR data, which allow for the calculation of the latitude and longitude of each person's home address, most U.S. survey-based data offer the CHR far less granular information to define a neighborhood; at times they provide only the county of residence, which may consist of hundreds of thousands or even millions of people. CHR-based analyses at such a large-area jurisdiction level – similar to the County Health Rankings [16] – would mask significant neighborhood level variations in SDOH risk [17].



Fig. 1. Sectors and Data Sources of a Community Health Record.

3.3. EHR interoperability and standardization

A weakness of EHRs in the U.S. is the lack of sufficient interoperability across providers [18], although major efforts are underway to increase the standardized exchange of EHR data across the nation [3]. The Office of National Coordinator for Health IT (ONC) proposes a national roadmap for interoperability and actively promotes vocabulary and content standards to all clinical organizations [19]. In addition, CMS is providing financial incentives to support these standards. For instance, the ONC's Quality Reporting Document Architecture (QRDA) represents a Clinical Document Architecture (CDA)-based standard (of the Health Level 7 - HL7 consortia) defining the structure of medical records for exchanging electronic quality measures to assess the care of providers treating Medicare beneficiaries and other patients [20]. Given that Medicare's new Merit Based Incentive (MIPS) program (a component of new CMS quality payment program to reward value and better outcomes) has practically replaced the Meaningful Use program, the new incentives will positively impact coordinated care and EHR interoperability among other targets.

These standardized metrics are relevant to the roll out of future CHR's that might be built from linked EHRs. For example, one of CMS' latest requirements is that all in-scope clinicians apply standardized processes and definitions within their certified EHR to screen for and document SDOH-related patient risk factors concerning food security, employment, and housing [20]. Such initiatives are fiscally backed by Medicare and other payers, and offer a strong and expanding framework for the collection of consistent and

Table 1
Current Challenges of the EHR-based CHR's.

I. Data Governance
CMS's Meaningful Use initiative required hospitals and physicians' offices to actively engage with public health agencies by submitting electronic data such as immunization and syndromic surveillance data. Although this program started as a data-governance discourse between clinical providers and public health agencies, many challenges remain with regard to defining what data should or could be shared [11].
II. Legal and Privacy Issues
1. Collection and collation of sensitive data requires special attention to security, confidentiality and ethical principles.
2. Existing regulations (e.g., HIPAA) may or may not be adequate for EHR-based CHR's, as new types and sources of data (e.g., housing or social services) and new levels of aggregation (e.g., neighborhoods) go beyond the original scope of the law.
III. Technical Challenges
1. Over the past decade there have been numerous advances in medical informatics and computer sciences applied to healthcare. However, some technical challenges remain with regard to collecting and collating SDOH data for EHR-based CHR's. These challenges include: <ol style="list-style-type: none"> linking records where no MPI exists (e.g., addressing the patient matching problem and the difficulty of identifying the same patient across multiple sites with no MPI) increasing the completeness and accuracy of SDOH data captured in EHRs accessing non-coded EHR clinical free-text notes – where most of the SDOH information currently resides (e.g., by using text mining/natural language processing tools) [27] applying advanced analytics to these massive and complex electronic databases (e.g., such as artificial intelligence and machine learning techniques) [28]
2. The coding systems (e.g., ICD-10) and taxonomies (e.g., SNOMED) that are used to categorize SDOH factors are still not fully developed and do not capture the full depth and breadth of important social and behavioral information.
3. Operational interoperability challenges – separate from the legal/governance challenges described above – still limit the sharing and collation of many types of EHR data across and within communities.
IV. Challenges to Effective Use of SDOH Data
New IT infrastructure and tools as well as operational guidelines are needed for the effective and efficient collection and application of SDOH data within clinical and population health workflows.

CHR: Community Health Records, CMS: Centers for Medicare and Medicaid Services, EHR: Electronic Health Records, HIPAA: Health Insurance Portability and Accountability Act, ICD: International Classification of Disease, MPI: Master Patient Index, SDOH: Social Determinants of Health, SNOMED: Systematized Nomenclature of Medicine.

interoperable EHR-derived data relevant to SDOH. Indeed, the growing standardization and availability of EHR-derived SDOH data contrast with the less encouraging trajectory of most other types of routine electronic data accessible to U.S. state and local public health agencies [2,3].

4. Current challenges and future steps

Expanded access to care, wider EHR adoption, incentives to standardize the capture of SDH data, and requirements that EHRs be used to share information with public health agencies, represent powerful trends in support of the collection and collation of electronic SDOH information about almost all U.S. residents. Accordingly, EHR-derived patient-level SDOH data, in conjunction with current and enhanced public health data systems, can be used to construct CHR's for all neighborhoods and regions in the nation. These databases can potentially serve as the basis for public health surveillance systems to help address many of the nation's key medical and socio/behavioral health problems. For instance, they would provide patient-level data to map the regional prevalence of a disease, whereas such geographic distributions are currently presented using survey data (e.g., CDC's obesity [21], heart disease hospitalization [22], and drug overdose maps

Table 2
Future Steps to Address Challenges Related to the EHR-Based CHR's.

I. Data Governance
The ultimate goal will be a set of comprehensive and progressive data governance provisions that allow secure interoperability across all in-scope clinical providers and public health agencies in every community across the U.S. Following are two recommendations to achieve this goal; <ol style="list-style-type: none"> HIEs should play a significant role in coordinating and curating EHR-derived data from across the community. Such a key role necessitates the active participation of HIEs in efforts to resolve data governance issues on a community-wide basis rather than individual providers [29]. CMS has supported public health departments to access clinical quality reporting data through the adoption of data provenance standards and frameworks established by ONC for EHR-based quality reporting [30]. To address key legal challenges associated with data sharing, DHHS agencies (e.g., ONC, CMS, CDC and FDA), regional HIEs, and state and local public health agencies should continue their efforts to align policy and regulation.
II. Technical Advancement
Although HIEs are a driving force in the facilitation of data exchange among healthcare providers and public health agencies, additional steps are required to support interoperable EHRs and continuous data gathering and sharing through HIEs [30]; <ol style="list-style-type: none"> CMS and other DHHS agencies should expand incentive and funding programs to promote the sharing and meaningful application of EHR-based CHR's. FHIR [31], a standard for exchanging healthcare information electronically, provides an opportunity on a local level for various data owners to work together, effectively extract patient data in a meaningful way, and aggregate certain metrics with integrity on a periodic basis into CHR's to avoid double counting data. Some of the key issues to be considered are: <ol style="list-style-type: none"> Patient opt-in and automatically pulling in patient data without prior individual authorization. This issue may be manageable through "operational" privacy permission. Institutional opt-in and getting the organizations in a local region to participate in it. Institutions' discretion on data sharing and participation in it.
III. Effective Use of SDOH Data
<ol style="list-style-type: none"> For providers, EHR-based tools should be developed to systematically identify and act on the patients' SDOH-related needs. As part of the clinical process, SDOH-related digitally-supported workflows will be needed to integrate the collection and review of SDOH factors, identify options to address uncovered needs, order referrals to appropriate services, and track outcomes [5]. New decision support tools will also be needed by public health agencies. For example, user friendly geographic and visualization approaches will be needed to gain value from these increasingly large and complex community level data. Population-level case finding and predictive modeling tools will be needed to help identify communities with the greatest levels of SDOH-related need [32,33].

CDC: Centers for Disease Control and Prevention, CHR: Community Health Records, CMS: Centers for Medicare and Medicaid Services, DHHS: Department of Health and Human Services, EHR: Electronic Health Records, FDA: Food and Drug Administration, FHIR: Fast Healthcare Interoperable Resources, HIE: Health Information Exchanges, ONC: Office of National Coordinator for Health IT, SDOH: Social Determinants of Health.

across the country) [23,24]. Moreover, these EHR-based CHR could provide a key tool to help bridge the gap between medical and public health organizations; [25] it would provide a basis for cross-sector coordination to target social risk factors at both the individual and population-levels.

Although the potential is considerable, before the EHR-based CHR will become a commonplace source of SDOH information for public health, a number of challenges will need to be surmounted [26]. Some of these challenges and possible approaches for addressing them are discussed in Tables 1 and 2.

Collating EHR and public health data on SDOH will rapidly move the U.S. towards an advanced system of community health records (CHRs). EHR-based CHR would provide public health agencies a 21st Century digital support framework that most are lacking today [13]. The interventions that could be supported by CHR would go a long way towards helping the nation achieve a positive return on its massive investment in EHRs. In supporting this type of meaningful use at the population-level, arguably, CHR would help put the “H” back in E-H-R and would significantly improve the health and wellbeing of our nation, one community at a time.

Authors' contributions

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Conflicts of interests

None.

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