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Research and Applications

Documenting social determinants of health-related clinical activities using standardized medical vocabularies

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ABSTRACT

Objectives: Growing recognition that health is shaped by social and economic circumstances has resulted in a rapidly expanding set of clinical activities related to identifying, diagnosing, and intervening around patients' social risks in the context of health care delivery. The objective of this exploratory analysis was to identify existing documentation tools in common US medical coding systems reflecting these emerging clinical practices to improve patients' social health.

Materials and Methods: We identified 20 social determinants of health (SDH)-related domains used in 6 published social health assessment tools. We then used medical vocabulary search engines to conduct three independent searches for codes related to these 20 domains included in common medical coding systems (LOINC, SNOMED CT, ICD-10-CM, and CPT). Each of the 3 searches focused on one of three clinical activities: Screening, Assessment/Diagnosis, and Treatment/Intervention.

Results: We found at least 1 social Screening code for 18 of the 20 SDH domains, 686 social risk Assessment/Diagnosis codes, and 243 Treatment/Intervention codes. Fourteen SDH domains (70%) had codes across all 3 clinical activity areas.

Discussion: Our exploratory analysis revealed 1095 existing codes in common medical coding vocabularies that can facilitate documentation of social health-related clinical activities. Despite a large absolute number of codes, there are addressable gaps in the capacity of current medical vocabularies to document specific social risk factor screening, diagnosis, and interventions activities.

Conclusions: Findings from this analysis should help inform efforts both to develop a comprehensive set of SDH codes and ultimately to improve documentation of SDH-related activities in clinical settings.

Key words: social determinants of health, LOINC, SNOMED CT, International Classification of Diseases

INTRODUCTION

A growing literature substantiates the health impacts of social and economic factors related to housing, food, employment, educational attainment, income, and neighborhood safety.^{1–5} Together with recognition of the cost and quality deficiencies of the US health care system,^{6–8} the evidence that social risks shape health has contributed to increased interest around identifying key social determinants of

health (SDH) and addressing actionable social and economic needs through the health care delivery system. Major professional groups, including the American Academy of Pediatrics,⁹ the American Academy of Family Physicians,¹⁰ the Agency for Healthcare Research and Quality,¹¹ and the Institute for Healthcare Improvement,¹² have issued calls for health care systems to collect and act on patients' social risk information. This has led to multiple clinical

innovations, including a wide range of social needs screening tools and practice-based interventions.^{13–15} Emerging evidence suggests some of these initiatives can reduce social risks, improve health outcomes, and generate cost savings.¹⁶

Making interoperable data available on specific social risks and related clinical interventions could influence care for individual patients by enabling point-of-care data exchange among involved clinical and social services providers.¹⁷ At the panel or practice level, social data aggregation across different sites could be used to improve population health management, including documenting social needs within a patient population, implementing and evaluating interventions to address these needs, and using social risk data to refine care delivery models.¹⁸ Information on social risks could also be used to compensate health systems serving socially complex populations, whether through risk-adjusted capitation or via direct reimbursement or incentives for care that addresses social needs.¹⁹ These data also could support community-level health improvement efforts by enabling health care institutions to contribute to community-level data aggregation and exchange with social service providers, public health departments, and other nonprofit and government partners with shared interests in identifying, improving, and tracking SDH-related needs.²⁰ Finally, information on social risks could strengthen research on interventions undertaken to mitigate their health impacts.¹⁷

Each of these uses could be facilitated by systematically collected, standardized, interoperable data on patients' social risks, and interventions to respond to identified needs. Yet SDH-related needs are rarely captured in clinical documentation systems.^{21–23} The inconsistency between ideal state and current practice helps to explain the growing interest at federal and state levels about how to make related SDH data more readily available. Several expert groups, including the National Academy of Medicine (NAM)¹⁷ and the National Quality Forum¹⁹ have noted that a lack of standardized, interoperable terminology for social risk data collected, and acted on in health care settings remains an obstacle to both scaling and studying social risk-related initiatives. In one previous effort to incorporate standardized social data into electronic health records (EHRs), the Office of the National Coordinator for Health Information Technology (ONC) 2015 Edition Health IT Certification Criteria final rule included an optional Social, Psychological, Behavioral criterion for EHR vendors to add coding capacity for NAM's *Recommended Social and Behavioral Domains and Measures*.^{24,25} Other nonfederally sponsored initiatives also have contributed to developing coding standards for specific social risk screening tools and interventions.^{26,27}

Prior analyses have found health IT standards vary in their capacity to capture information about specific social needs, for example housing²⁸ and occupation.^{29,30} These previous studies largely focused on how to capture specific EHR-based social risk data for research purposes. To our knowledge, no analysis to date has characterized the current capacity of health IT vocabulary systems to document the breadth of SDH clinically relevant activities (including activities related to social needs screening, social risk diagnoses, and related treatment) across multiple SDH domains. To guide future efforts toward generating comprehensive social risk health IT standards, we conducted an exploratory analysis of codes currently available across four major terminology systems for the set of SDH domains included in common social health screening tools.

METHODS

We conducted a systematic search of four of the most commonly used medical vocabulary systems (SNOMED CT, ICD-10-CM,

LOINC[®], and CPT[®]) in the US to identify screening, assessment, and intervention codes that could be used to document actual clinical practices related to social health activities. Since the focus of this study was on identifying existing codes that could be applied to current clinical practice activities, we included ICD-10-CM rather than ICD-11. Although ICD-11 was released internationally in 2018, the earliest that US practices will transition to ICD-11 is 2022.³¹ Furthermore, the focus of this study was on outpatient settings so we did not include ICD-PCS. Terminology standards related to vaccines, radiology, and pharmacology were considered unlikely to be relevant to SDH clinical activities and therefore also excluded from the search strategy.³² Though there may be other SDH-relevant codes in newer terminology standards (eg Ontology of Medically Related Social Entities³³), we focused this preliminary work on more common terminologies relevant to US practice settings.

Selection of SDH domains

We identified 20 SDH domains covered in six of the most widely used SDH screening tools in the US (Table 1), including: (1) the NAM's 2014 *Recommended Social and Behavioral Domains and Measures* report, which is the basis for the ONC Social, Psychological, and Behavioral data certification criterion for EHRs¹⁷; (2) the National Association of Community Health Center's PRAPARE survey³⁴; (3) the Center for Medicare & Medicaid Innovation's Accountable Health Communities (AHC) survey³⁵; (4) the Health Leads questionnaire³⁶; (5) the University of Maryland's SEEK tool³⁷; and (6) the WE CARE survey.³⁸ We excluded behavioral and mental health domains covered in the multidomain instruments since this study was focused on the availability of codes related to social and economic risk factors.

For three SDH domains identified in these tools (finances, housing, safety), we itemized subdomains that had different implications for assessment and treatment within a broader parent domain. In these cases, we added search terms specific to those subdomains, though search results were included under the parent domain.

SDH-related clinical activities

Across SDH domains, we searched for codes related to specific clinical activities (Screening, Assessment/Diagnosis, and Treatment/Intervention),²⁶ since different types of SDH information are generated during different clinical activities.^{13,39–48}

1. SDH Screening: This category includes codes both for individual screening questions and codes for panels of screening questions, as well as codes that report whether screening procedures have been performed;
2. SDH Assessment/Diagnosis: Codes that capture provider assessment or diagnosis of social needs, whether based on provider interpretation of social screening results or other information;
3. SDH Treatment/Intervention: Codes that summarize actions undertaken to help address identified social needs. These were subdivided into Referrals, Education/Counseling, and Provision of Services/Orders.

Medical vocabulary search

After identifying the SDH domains, two authors (A.A., S.D.) conducted three searches, each dedicated to one of the three clinical activities: Screening, Assessment/Diagnosis, and Treatment/Intervention. The systematic, multidatabase searches included the LOINC database,⁴⁹ the US version of the SNOMED CT browser,⁵⁰

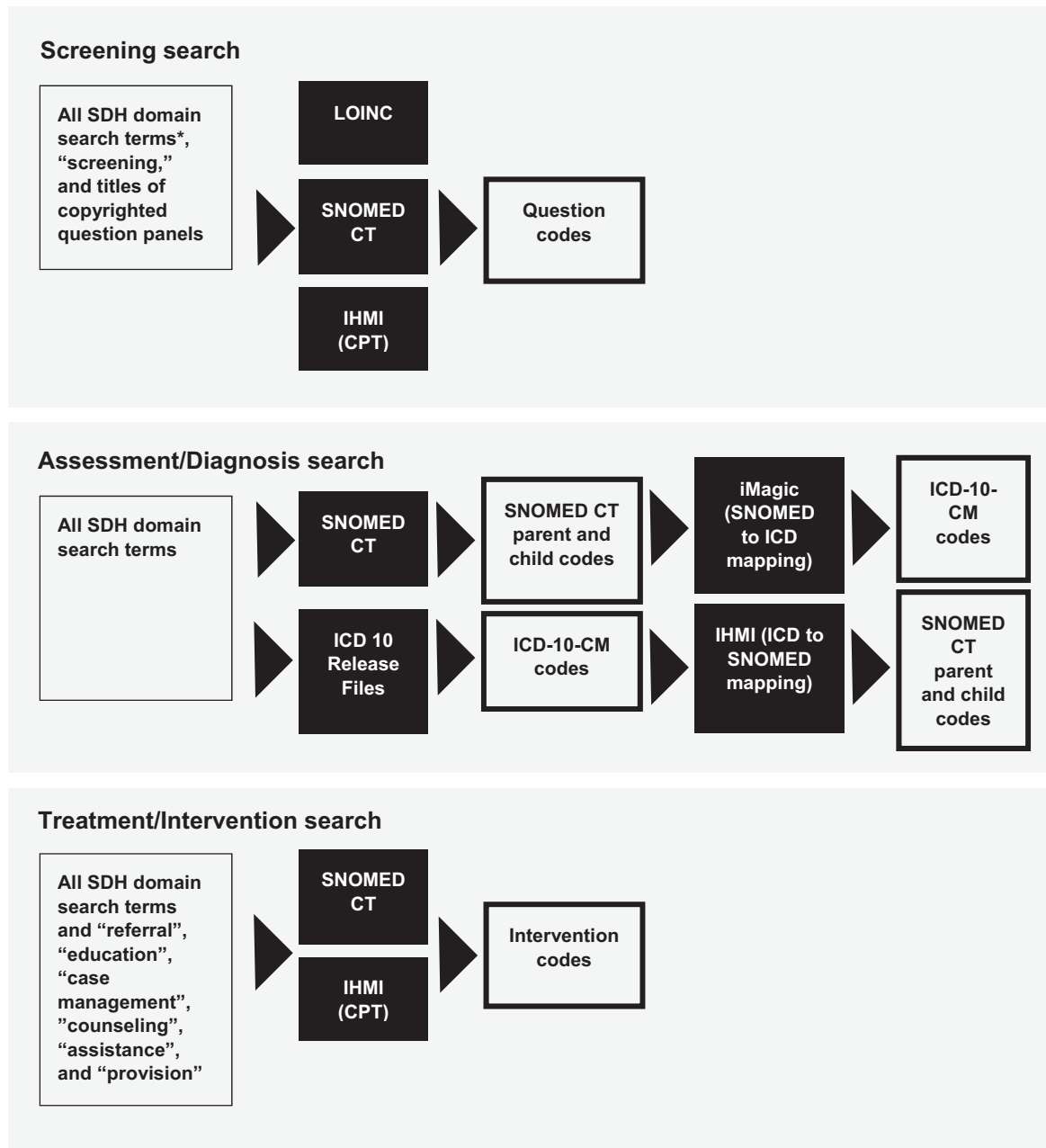


Figure 1. Diagram of database search processes for screening, assessment/diagnosis, and treatment/interventions categories. *“All SDH domain search terms” refers to the set of search terms described in [Supplementary Table S1](#), which was used in all three searches. Black boxes refer to databases that were searched.

the National Center for Health Statistics’ 2018 ICD-10-CM release files,⁵¹ and the American Medical Association’s Integrated Health Model Initiative (IHMI) search tool for CPT codes,⁵² and were conducted between August 1, 2017 and March 1, 2018. A set of search terms (see [Supplementary Table S1](#)) was used for each search, with additional terms included in specific searches as described below and shown in [Figure 1](#).

The search terms were compiled based on the SDH domain names, terms used in the 6 screening tools, an open internet search for terms related to each SDH domain, a CPT resource developed by the American Academy of Pediatrics, and additional search terms recommended by analysts from the 4 standards development organizations.⁵³ We included “General (nonspecific)” codes, which we

searched for using terms related to more overarching social health topics (eg “social determinants of health”). For each search, identified codes were included if both reviewing authors agreed the code was relevant to the selected SDH domain. If codes were relevant to social needs in general, but not domain-specific, codes were moved to the General SDH category.

For the Screening search, the LOINC, SNOMED CT, and IHMI (for CPT) databases were queried using all search terms, and the additional term “screening.” We added search terms for titled question panels from AHC, NAM, and Health Leads questionnaires. In LOINC and SNOMED, in cases where questions are part of a larger question panel, the whole panel has one code; each individual question has a code; and all answers have codes. We included only the

panel codes in our results. When items were not part of a panel, we included specific question codes.

For the Assessment/Diagnosis search, we queried the SNOMED CT database using all search terms. For each result, we then used embedded SNOMED CT relationship logic to find the highest domain-specific concept in the hierarchy, “the parent,” and followed this relationship logic to include all associated, relevant child codes. Next, we searched the ICD-10-CM release files (via Adobe Reader pdf search) for all search terms. We again followed established relationship logic to include relevant parent and child codes. We then used two tools to find related, mapped codes for each search result: the National Library of Medicine’s iMAGIC tool⁵⁴ for SNOMED CT to ICD-10-CM maps and the IHMI tool for bidirectional maps. All domain-specific, mapped parent and child codes were included in results. Since no external cause codes can be primary codes at the point of diagnosis, ICD-10-CM external cause codes (V-Y) were excluded.

For the Treatment/Intervention search, the SNOMED CT and IHMI (CPT) databases were queried using all search terms and the additional intervention terms “referral,” “education,” “case management,” “counseling,” “assistance,” and “provision.” These results were then subdivided into the following categories: Referral, Counseling/Education, and Provision of Services/Orders codes.

RESULTS

We found 133 Screening question or screening panel codes, 33 Screening procedure codes, 686 Assessment/Diagnosis codes, and 243 Treatment/Intervention codes across LOINC, SNOMED CT, ICD-10-CM, and CPT (Table 2). All identified codes are available online so that they can be updated as new codes are developed.⁵⁵ Below we present an analysis of the identified codes and coding gaps.

Distribution of codes across activities and domains

Every SDH domain was represented in at least 1 clinical activity area and the majority of domains (70%, $n = 14$) had codes in all 3 clinical activity areas. Five domains (Child care, Clothing, Incarceration, Immigration/Migration, and Veteran status) lacked codes in 1 activity area. One domain (Residential Address) had only codes related to Screening. Domains with particularly high numbers of codes (number of codes above the mean in every clinical activity) were Education, Employment, Housing, Safety, and Social Connections/Isolation.

Screening codes

The majority of SDH domains (90%, $n = 18$) were coded in 1 or more screening panels or independent screening questions. The actual questions used in the 6 social screening tools, however, were not consistently encoded verbatim. Screens that incorporated validated question panels were more likely to be encoded. For instance, though every domain included in the NAM tool had a corresponding LOINC or SNOMED CT-coded question panel (meaning the questions were validated, copyrighted measures), none of the SEEK or WECARE items had a code corresponding to the specific questions used in that instrument. The questions in the remaining three tools were partially coded in LOINC and SNOMED CT (range 25% to 38% of domains with a coded question panel). Table 3 summarizes the availability of Screening codes in relation to the question panels used in the 6 screening tools.

Across LOINC and SNOMED CT, there were 118 unique coded questions/question panels related to SDH domains. In 15 cases, questions or panels were coded in both LOINC and SNOMED CT.

Table 1. 20 SDH domains and subdomains (bullets) included in six US social risk screening tools^{17, 34–38}

Access to health care
Child care
Clothing
Education
Employment
Finances
Income/poverty
Financial stress
Food
Housing
Housing instability/insecurity
Housing quality
Immigration/migration
Incarceration
Primary language
Race/ethnicity
Residential address
Safety
Intimate partner violence
Child abuse
Neighborhood safety
Social connections/isolation
Stress
Transportation
Utilities
Veteran status
General SDH (not domain-specific)

In all other cases, LOINC and SNOMED CT coded different questions related to the same social domains. For example, within the “Stress” domain, only LOINC has a code for the Occupational Stress Questionnaire, only SNOMED CT has a code for the Life Events Inventory, and both LOINC and SNOMED CT have codes for the Perceived Stress Scale. Two SDH domains had no encoded screening questions (“Clothing” and “Incarceration”).

In addition to codes relating to domain-specific questions 50% ($n = 10$) of the domains had a SNOMED CT procedure code to account for whether screening had been conducted for that domain. Two additional CPT codes represented nondomain specific social screening procedures.

Assessment/diagnosis codes

Nearly all social domains (90%, $n = 18$) had Assessment/Diagnosis codes, with a median of 20 Assessment/Diagnosis codes per SDH domain, including SNOMED CT and ICD-10-CM child and parent codes. Two domains lacked Assessment/Diagnosis codes: “Childcare” and “Residential Address.” Most of the existing Assessment/Diagnosis codes were SNOMED CT child codes (426 out of 686). There were fewer SNOMED CT parent codes since parent codes were rarely domain-specific and/or did not reflect assessments. Six domains lacked any domain-specific ICD-10-CM codes (“Childcare,” “Clothing,” “Primary Language,” “Residential Address,” “Transportation,” and “Utilities”). We found 37 general social ICD-10-CM codes. As described earlier, these codes were related generally to social needs, but not to a specific SDH domain.

Treatment/intervention codes

In the Treatment/Intervention search, most domains (75%, $n = 15$) had at least one SNOMED CT code for each subcategory: Referral,

Table 2. Total numbers of codes resulting from the three multidatabase searches

Domain/Subdomain	Social screening		Social assessment/diagnosis			Social treatment/intervention			
	LOINC questions, question panels/protocol codes	SNOMED CT questions, question panels/protocol codes	SNOMED CT procedure codes	SNOMED CT parent codes	SNOMED CT child codes	ICD-10-CM codes	SNOMED CT referral codes	SNOMED CT counseling/education codes	SNOMED CT provision of services codes
Access to health care	5	1	0	3	18	3	2	1	6
Child care	1	0	1	0	0	0	1	1	8
Clothing	0	0	0	0	3	0	1	1	1
Education	6	7	0	9	35	7	3	1	4
Employment	4	7	1	16	59	10	1	6	10
Finances	6	5	2	4	27	2	2	1	5
Income/poverty	2	4	1	2	21	2			
Financial stress	4	1	1	2	6	0			
Food	3	0	1	0	8	2	2	3	3
Housing	9	4	2	18	52	4	6	3	16
Instability/insecurity	7	4	0	9	25				
Quality	2	0	2	9	27				
Immigration/migration	4	1	0	3	11	1	0	0	0
Incarceration	0	0	0	9	20	4	2	2	2
Primary language	6	4	1	1	8	0	2	1	2
Race/ethnicity	6	2	0	0	1	1	0	1	0
Residential address	1	1	0	0	0	0	0	0	0
Safety	8	5	10	32	88	58	3	16	15
General safety (type not specified)	1	1	4	9	19	23	1	6	7
Child abuse	1	0	2	14	24	10	1	5	2
Intimate partner violence	4	0	3	9	35	25	1	4	1
Neighborhood safety	2	4	1	0	10	0	0	1	5
Social connections/isolation	13	5	6	10	34	6	3	6	13
Stress	6	6	5	8	18	7	2	8	15
Transportation	2	0	0	1	13	0	1	1	6
Utilities	1	0	0	2	12	0	0	1	3
Veteran status	1	2	0	3	6	5	0	0	0
General	1	0	2	8	13	23	18	14	5
CPT codes	0	0	2	0	0	0	3	9	1
Totals									
Total number of codes		133	33		686			243	
Mean number codes per domain (SD)		6.7 (5.6)	1.6 (2.6)	6.4 (8.1)	21.3 (22.7)	6.7 (13.2)		11.5 (11.3)	

Gray indicates subdomains, for which codes are counted in the parent domain (for totals and means). In cases where a subdomain is blank (eg Treatment/Intervention codes for Housing and Finances), codes found did not specify subdomain. CPT codes are listed separately because there were so few and only one was domain-specific (Transportation). Since external cause codes can be primary codes at the point of diagnosis, ICD-10-CM external cause codes (V-Y) are not included in these results, but interested readers can find the numbers the external cause codes in [Supplementary Table S2](#). Readers can review the actual codes in each category by visiting <http://sirenetwork.ucsf.edu/tools-resources/mmi/compendium-medical-terminology-codes-social-risk-factors>.

Counseling/Education, and Provision of Service. On average, SDH domains had more Treatment codes for Provision of Service/Orders (mean 5.7 codes/SDH domain) than for the other Treatment subcategories (mean 3.7 Counseling/Education codes/SDH domain, and 2.5 Referral codes/SDH domain). As shown in [Table 2](#), five SDH domains (25%) had no Referral code; three domains (15%) had no Counseling/Education code; and four domains (20%) had no Provision of Service code. Three SDH domains had no Treatment/Intervention codes in any subcategory (“Immigration/Migration,” “Residential Address,” and “Veteran Status”).

DISCUSSION

Health care systems in the US are increasingly encouraged to implement social screening tools and to intervene to reduce patients’ social risks in clinical settings.⁹⁻¹² In this exploratory analysis, we aimed to better understand how existing health IT vocabularies could help document this rapidly expanding set of clinical activities. The search of four major medical vocabularies (LOINC, SNOMED CT, ICD-10-CM, and CPT) yielded 1095 codes related to 20 SDH domains found in common social screening tools in use across the US. Since this was not a comprehensive content coverage analysis, the number of codes we found is likely to be a conservative estimate.

Table 3. Availability of screening codes corresponding to specific questions of six screening tools

Domain	Subdomain	LOINC/SNOMED CT codes for question panels used in screening tools					
		AHC	Health Leads	NAM	PRAPARE	SEEK	WE CARE
Access to health care			○		●		
Child care			○		○	○	○
Clothing					○		
Education		○	○	●	●		○
Employment		○	●		●		○
Finances	Income/poverty				●		
	Financial stress	●		●			
Food		●	○		○	○	○
Housing	Housing instability/insecurity	○	○		○		○
	Housing quality	○			●		
Immigration/migration			●		○		
Incarceration					○		
Primary language		○	●		○		
Race/ethnicity				●	●		
Residential address				●	●		
Safety	General safety (including nonspecific abuse)	○	○		○		
	Child abuse					○	
	Intimate partner violence			●	●	○	
	Neighborhood safety						
Social connections/isolation	○		●	○			
Stress	●		●	○	○		
Transportation	○	○		○			
Utilities	○	○		○		○	
Veteran status				○		○	
Total percentage of domains included in screener that are represented fully or partially in existing codes		25% (3/12)	27% (3/11)	100% (7/7)	38% (8/21)	0% (0/5)	0% (0/7)

● indicates LOINC and/or SNOMED CT codes existed for all questions/answers in this domain on the screening tool.

● indicates that LOINC and/or SNOMED CT codes existed for some questions/answer choices on the screening tool in this domain.

○ indicates no questions/answers in this domain on the screening tool had corresponding LOINC and/or SNOMED CT codes.

Gray boxes indicate that domain is not part of the screening tool.

Usefulness of current codes to meet practice needs

An important question surfaced by our results is how to interpret recent studies that suggest clinical activities around patients' socioeconomic circumstances are rarely captured in electronic documentation.^{21–23} Though the total number of codes was much higher than we hypothesized we would find, our analysis suggests that existing SDH codes do not consistently match practice needs. For example, in our screening analysis, coded questions in LOINC and SNOMED CT failed to routinely correspond to the specific questions/answers in the social screening tools. In other cases where the screening tool questions matched available codes, coded answers varied. For instance, the Hunger Vital SignTM in SEEK includes *yes/no* responses whereas in AHC it includes *often/sometimes/never* responses, but coded answers only corresponded to the AHC version of the question. In another example, though 14 different Assessment codes exist for “Utilities,” they typically indicate lack of utilities (eg SNOMED CT codes 423798004 “Lack of cooling in house;” 105535008 “Lack of heat in house;” 105536009 “Living in housing without electricity”) rather than referring to inability to pay for utilities. Yet clinical screening tools and interventions often focus on affordability (eg inability to pay bills), which was not included in codes related in this domain. There were also specific instances where there were no relevant codes for particular SDH domains or

corresponding clinical activities. For example, there were no Screening codes for “Clothing” or “Incarceration”; no Assessment/Diagnosis codes for “Child care”; and no Treatment/Intervention codes for “Immigration/Migration” or “Veteran Status”. Ten of 20 domains lacked screening procedure codes (ie indicating whether screening was conducted at all). Overall, there were many more SDH Assessment/Diagnosis codes than codes for documenting screening procedures, screening results, or interventions, which limits the capacity to record these clinical activities.

Although our results suggest that existing SDH codes are insufficient to document existing SDH clinical activities, a comprehensive analysis of the quality of match between existing codes and clinical activities was outside the scope of this exploratory work. To conduct this critical next step, clinical content experts (patients and providers), policy makers, and informaticists will need to achieve consensus on what is “useful” for SDH codes to document—which screening panels, what level of granularity, which interventions, and for what purposes. We suggest this would be best accomplished by a domain-by-domain, multistakeholder process to further evaluate the utility of existing codes to meet clinical practice needs. Future efforts both to harmonize and organize codes by domain (eg by using value sets) and across clinical workflows could make social codes both more easily accessible and more easily aggregated across systems.⁵⁶

As reimbursement policies related to social screening and interventions in clinical settings develop, this interoperability also will help ensure that any required documentation is matched by available standards.

Limitations

The goal of this work was to explore the existing capacity for SDH coding in four medical vocabulary systems. Beyond the limitations inherent in an exploratory approach, the study was constrained by search engine rules. We were also limited by the set of social domain search terms. Although we included key terms relevant to each domain that were recommended by consulting experts, it is possible we missed important terms. A strength of our design was that we cross-checked findings with additional references and obtained feedback on the design and search output from a broad group of national experts, including leaders from the four standards development organizations.

Next steps

By conducting a clinically framed analysis to describe the capacity of medical vocabularies to reflect SDH-related activities, our findings help to translate a largely hypothetical national conversation about whether SDH clinical activities should be coded to a more pragmatic conversation on how existing SDH codes are organized and where to supplement, modify, or replace codes to align with clinical workflows. Future work driven by experts in specific domains and in partnership with informaticists and standards development organizations could focus on a more mature set of SDH domains (eg food insecurity) in order to develop more streamlined processes for code generation, maintenance, and utilization. Given the rapid expansion of SDH-related activities in the US health care system, there is a short window where such a process could make a substantive contribution to standardization.

CONCLUSION

Health care sector activities around SDH have reached a level that demands more standardized collection of SDH and social needs-specific data in EHRs. This can facilitate patient care, population health management, community health improvement, value-based payment, and research. This exploratory analysis of the current capacity of medical coding vocabularies to capture common SDH domains and related clinical activities reveals a wide range of available SDH codes. It also highlights important coding gaps. Additional effort is required to ensure that the existing codes align with practice-based activities. As coding gaps are filled, code value sets could help maximize interoperability by grouping like codes across different vocabularies. A more comprehensive, coherent, user-friendly SDH code set could in turn facilitate a rapidly evolving set of health care use cases.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

CONTRIBUTORS

AA, SD, CF, and LG all contributed to the work presented, including the generation of content for and revision and refinement of the manuscript.

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