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.\textsuperscript{13–15} Emerging evidence suggests some of these initiatives can reduce social risks, improve health outcomes, and generate cost savings.\textsuperscript{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 service providers.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{20} Finally, information on social risks could strengthen research on interventions undertaken to mitigate their health impacts.\textsuperscript{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.\textsuperscript{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)\textsuperscript{17} and the National Quality Forum\textsuperscript{19} 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 report, which is the basis for the ONC Social, Psychological, and Behavioral data certification criterion for EHRs\textsuperscript{17}; (2) the National Association of Community Health Center’s PRAPARE survey\textsuperscript{14}; (3) the Center for Medicare & Medicaid Innovation’s Accountable Health Communities (AHC) survey\textsuperscript{13}; (4) the Health Leads questionnaire\textsuperscript{36}; (5) the University of Maryland’s SEEK tool\textsuperscript{17}; and (6) the WE CARE survey.\textsuperscript{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),\textsuperscript{26} since different types of SDH information are generated during different clinical activities.\textsuperscript{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,\textsuperscript{49} the US version of the SNOMED CT browser.\textsuperscript{50}
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

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.**
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. 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 area) 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.
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 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 |
| 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.
Access to health care

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/or SNOMED CT failed to routinely correspond to the specific domains included in screeners, 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 usefulness of existing codes to meet clinical practice needs. Future efforts 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

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/or 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 Sign™ in SEEK includes questions/answers in the social screening tools. In other cases 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

### 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 |
|-------------------------------|----------------------------------|------------------------------------------------------------------|
| 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 screen |                         | 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.
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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