

International Classification of Diseases, Tenth Revision, Clinical Modification social determinants of health codes are poorly used in electronic health records

Yi Guo, PhD^{a,b}, Zhaoyi Chen, PhD^a, Ke Xu, MS^{a,b}, Thomas J. George, MD^c, Yonghui Wu, PhD^{a,b}, William Hogan, PhD^a, Elizabeth A. Shenkman, PhD^a, Jiang Bian, PhD^{a,b,*}

Abstract

There have been increasing calls for clinicians to document social determinants of health (SDOH) in electronic health records (EHRs). One potential source of SDOH in the EHRs is in the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) Z codes (Z55–Z65). In February 2018, ICD-10-CM Official Guidelines for Coding and Reporting approved that all clinicians, not just the physicians, involved in the care of a patient can document SDOH using these Z codes.

To examine the utilization rate of the ICD-10-CM Z codes using data from a large network of EHRs.

We conducted a retrospective analysis of EHR data between 2015 to 2018 in the OneFlorida Clinical Research Consortium, 1 of the 13 Clinical Data Research Networks funded by Patient-Centered Outcomes Research Institute. We calculated the Z code utilization rate at both the encounter and patient levels.

We found a low rate of utilization for these Z codes (270.61 per 100,000 at the encounter level and 2.03% at the patient level). We also found that the rate of utilization for these Z codes increased (from 255.62 to 292.79 per 100,000) since the official approval of Z code reporting from all clinicians by the American Hospital Association Coding Clinic and ICD-10-CM Official Guidelines for Coding and Reporting became effective in February 2018.

The SDOH Z codes are rarely used by clinicians. Providing clear guidelines and incentives for documenting the Z codes can promote their use in EHRs. Improvements in the EHR systems are probably needed to better document SDOH.

Abbreviations: ADI = area deprivation index, AHA = American Hospital Association, EHRs = electronic health records, ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification, PCORI = patient-centered outcomes research institute, SDOH = social determinants of health, US = the United States.

Keywords: electronic health records, International Classification of Diseases, tenth revision, clinical modification, social determinants of health

1. Introduction

In the past decade, there has been an increasing recognition of the powerful role of social determinants of health (SDOH) in shaping people's health across a broad variety of health outcomes.^[1] The

World Health Organization defines SDOH as the conditions in which people are born, grow, live, work, and age.^[2] These factors include social circumstances and environmental exposure such as education, employment, food, housing, social support, and

Editor: Poonam Gupta.

YG and ZC contributed equally to this work.

This research was partially supported by the National Institutes of Health (NIH)'s National Cancer Institute (NCI) R01 CA246418 and R21 CA245858, NIH's National Institute on Aging (NIA) R21 AG068717, and PCORI ME-2018C3-14754.

This work was funded in part by the Cancer Informatics Shared Resources of the University of Florida Health Cancer Center. Drs. Guo, Wu, and Bian were funded in part by the National Institutes of Health (NIH)'s National Cancer Institute (NCI) R01 CA246418 and R21 CA245858, NIH's National Institute on Aging (NIA) R21 AG068717, and PCORI ME-2018C3-14754.

The authors have no conflicts of interest to disclose.

The data that support the findings of this study are available from a third party, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are available from the authors upon reasonable request and with permission of the third party.

^a Department of Health Outcomes and Biomedical Informatics, College of Medicine, University of Florida, ^b Cancer Informatics Shared Resources, University of Florida Health Cancer Center, ^c Division of Hematology & Oncology, Department of Medicine, College of Medicine, University of Florida, Gainesville, FL.

* Correspondence: Jiang Bian, 2197 Mowry Road, Suite 122, Gainesville, FL 32610 (e-mail: bianjiang@ufl.edu).

Copyright © 2020 the Author(s). Published by Wolters Kluwer Health, Inc.

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

How to cite this article: Guo Y, Chen Z, Xu K, George TJ, Wu Y, Hogan W, Shenkman EA, Bian J. International Classification of Diseases, Tenth Revision, Clinical Modification social determinants of health codes are poorly used in electronic health records. *Medicine* 2020;99:52(e23818).

Received: 4 May 2020 / Received in final form: 9 October 2020 / Accepted: 19 November 2020

<http://dx.doi.org/10.1097/MD.00000000000023818>

psychosocial factors. There is a growing body of evidence demonstrating the significant impact of SDOH, such as education and employment, on a wide range of health outcomes.^[1] It has been estimated that that SDOH could be responsible for up to 40 percent of all preventable deaths in the United States (US), whereas better medical care is responsible for a much smaller proportion, 10–15 percent, preventable deaths in the US.^[3–5] All the evidence suggests that efforts to improve health need to look beyond the healthcare system as the key driver of health, and start to address the social and environmental factors that influence health outcomes.

Given the strong evidence that SDOH impacts health, there have been increasing calls for clinicians to document and attend to these factors.^[6] In 2014, the Institute of Medicine (IOM) of the U.S. National Academy of Sciences recommended that 10 social and behavioral domains be documented in electronic health records (EHRs).^[7,8] These factors included race/ethnicity, education, financial resource strain, stress, depression, physical activity, nicotine use/exposure, alcohol use, social connections/social isolation, exposure to violence, and neighborhood characteristics (e.g., census-tract median income).^[7] Since then, healthcare systems have explored ways to capture data on SDOH and integrate them with patients' EHRs.^[9,10] For instance, a set of EHR-based SDOH data collection tools have been developed and tested in several community health centers.^[11]

Beyond the efforts of creating new SDOH collection and integration tools, 1 potential source of SDOH data already exists in EHRs. There is a specific subset of the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes, the Z codes (Z55–Z65), that are intended to document patient's SDOH related to their socioeconomic, occupational, and psychosocial circumstances. To promote the use of these Z codes, the American Hospital Association (AHA) Coding Clinic published advice in February 2018 that allows all clinicians (eg, nurses), not just the physicians, involved in the care of a patient to document SDOH using these Z codes.^[12] In the same month (February 2018), this advice was officially approved by the ICD-10-CM Cooperating Parties and incorporated into the ICD-10-CM Official Guidelines for Coding and Reporting.^[13]

The goal of the current study was to examine the utilization of the ICD-10-CM Z codes between 2015 to 2019 using data from a large collection of EHRs in the OneFlorida Clinical Research Consortium,^[14] 1 of the 13 Clinical Data Research Networks funded by Patient-Centered Outcomes Research Institute (PCORI). As a network, OneFlorida provides care for more than 50% of Floridians through 4,100 physicians, 914 clinical practices, and 22 hospitals covering all 67 Florida counties. In this study, we reported the utilization rates of the SDOH Z codes at both the encounter and patient levels, and tested whether the rates differed by period (before and after the approval of the AHA advice for documenting Z codes), age group, sex, race-ethnicity, encounter type, and payer type. We further compared the rates of selected Z codes to the rates of their corresponding social problems reported in the population using US census data. To our knowledge, there exists no studies that have examined the utilization of the ICD-10-CM Z codes using data from a large network of EHRs. One prior study has reported a low utilization of the ICD-9-CM V codes, the predecessor of the ICD-10-CM Z codes, based on inpatient discharge data from 2013.^[15] Our study fills important knowledge gaps beyond the scope of that study because:

- (1) the Z codes were expanded to cover more SDOH aspects than the V codes,
- (2) the prior study only included inpatient data whereas our study included more encounter types, and
- (3) our study included multiple years of EHR data, encompassing February 2018, the month when Z code reporting by all clinicians was officially approved.

2. Methods

2.1. Data source

This study was approved by the University of Florida Institutional Review Board. We obtained EHR data between October 1, 2015, the date of ICD-10 implementation, and October 31, 2019 (study period) from OneFlorida.^[16] OneFlorida contributing to the national Patient-Centered Clinical Research Network funded by PCORI. As the largest health data repository in Florida, the scale of OneFlorida data is ever-growing with a collection of longitudinal and robust patient-level records of ~15 million Floridians and over 463 million encounters, 917.6 million diagnoses, 1 billion prescribing records, and 1.17 billion procedures as of December 2018. OneFlorida follows the national Patient-Centered Clinical Research Network Common Data Model, including patient demographics, enrollment status, vital signs, conditions, encounters, diagnoses, procedures, medications, and lab results.

We have also obtained data indicative of SDOH at the zip code or census tract level, including the Area Deprivation Index (ADI),^[17] and education attainment, employment, and poverty data from the US Census Bureau's American Community Survey.^[18] The ADI is an area-level metric that describes neighborhood disadvantages in income, education, employment, housing quality, and other socioeconomic variables. It allows rankings of neighborhoods by socioeconomic status disadvantage, and can be used to inform health care delivery and policy. A higher ADI score indicates greater risks of deprivation, higher vulnerability, or SDOH problems.

2.2. ICD-10-CM Z Codes for SDOH

In the ICD-10-CM, the Z codes for SDOH are grouped into 9 categories: Z55 (Problems related to education and literacy), Z56 (Problems related to employment and unemployment), Z57 (Occupational exposure to risk factors), Z59 (Problems related to housing and economic circumstances), Z60 (Problems related to social environment), Z62 (Problems related to upbringing), Z63 (Other problems related to primary support group, including family circumstances), Z64 (Problems related to certain psychosocial circumstances), and Z65 (Problems related to other psychosocial circumstances). We summarized these codes and the descriptions of the corresponding risk factors in Table 1.

2.3. Statistical Analysis

We examined the Z code utilization at both the encounter and the patient level. First, at the encounter level, we identified all encounters in the OneFlorida EHR data during the study period (October 1, 2015 – October 31, 2019). The ICD-10-CM Z code utilization rate was defined as the number of encounters with an SDOH Z code per 10,000 encounters. We calculated the utilization rate overall as well as stratifying by age group, sex,

Table 1**Social determinants of health ICD-10-CM code categories.**

ICD-10-CM code category	Risk factors
Z55 – Problems related to education and literacy	Illiteracy, schooling unavailable, underachievement in a school, educational maladjustment and discord with teachers and classmates.
Z56 – Problems related to employment and unemployment	Unemployment, change of job, threat of job loss, stressful work schedule, discord with boss and workmates, uncongenial work environment, sexual harassment on the job, and military deployment status.
Z57 – Occupational exposure to risk factors	Occupational exposure to noise, radiation, dust, environmental tobacco smoke, toxic agents in agriculture, toxic agents in other industries, extreme temperature, and vibration.
Z59 – Problems related to housing and economic circumstances	Homelessness, inadequate housing, discord with neighbors, lodgers and landlord, problems related to living in residential institutions, lack of adequate food and safe drinking water, extreme poverty, low income, insufficient social insurance and welfare support.
Z60 – Problems related to social environment	Adjustment to life-cycle transitions, living alone, acculturation difficulty, social exclusion and rejection, target of adverse discrimination and persecution.
Z62 – Problems related to upbringing	Inadequate parental supervision and control, parental overprotection, upbringing away from parents, child in welfare custody, institutional upbringing, hostility towards and scapegoating of child, inappropriate excessive parental pressure, personal history of abuse in childhood, personal history of neglect in childhood, Z62.819 Personal history of unspecified abuse in childhood, Parent-child conflict, and sibling rivalry.
Z63 – Other problems related to primary support group, including family circumstances	Absence of family member, disappearance and death of family member, disruption of family by separation and divorce, dependent relative needing care at home, stressful life events affecting family and household, stress on family due to return of family member from military deployment, alcoholism and drug addiction in family.
Z64 – Problems related to certain psychosocial circumstances	Unwanted pregnancy, multiparity, and discord with counselors.
Z65 – Problems related to other psychosocial circumstances	Conviction in civil and criminal proceedings without imprisonment, imprisonment and other incarceration, release from prison, other legal circumstances, victim of crime and terrorism, and exposure to disaster, war and other hostilities.

ICD-10-C = International Classification of Diseases, Tenth Revision, Clinical Modification.

race/ethnicity, encounter type, payer, and site type, respectively. Sites in OneFlorida were grouped into academic and non-academic. Differences in the rates across categories in the stratifying variables were tested using chi-squared tests. Second, at the patient level, we calculated the percentage of unique patients in the OneFlorida EHRs who had any of the Z codes or each of the Z codes overall as well as stratifying by age group, sex, race/ethnicity, and site type. Differences in the percentages across categories in the stratifying variables were tested using chi-squared tests. Lastly, to explore whether the use of Z codes in the EHRs was reflective of greater social problems measured in the neighborhoods (zip code), we

- (1) examined whether having the Z codes was associated with high ADI using logistic regression, and
- (2) compared the rates of Z code to the rates of corresponding social problems reported in the US census.

In the logistic models, the dependent variable was ADI, and the independent variables included the presence of a Z code, age, gender, race/ethnicity, and number of visits. We used the 90th percentile as the cutoff point for ADI to define patients who had SDOH problems.^[19] For social problems reported in the US census, we obtained data on education attainment (rates of 5th grade or less education), employment (unemployment rate), and poverty (poverty rate).

3. Results

We summarized the utilization rates (per 10,000 encounters) for the SDOH Z codes in Table 2. In the over 710 million encounters identified, the overall Z codes utilization rate was 270.61 per 10,000 encounters. The most commonly used category of Z codes was Z59, problems related to housing and economic

circumstances, for which the utilization rate was 265.28 per 10,000 encounters. The utilization rates ranged from 0.07 to 1.24 per 10,000 encounters for the other categories of SDOH Z codes. Since the reporting guideline was changed in February 2018, the overall SDOH Z codes utilization rate increased from 255.62 to 292.79 per 10,000 encounters ($P < .001$). On the other hand, the increase in utilization was not consistent across the code categories. The utilization rates increased for Z55 ($P < .001$), Z59 ($P < .001$), Z60 ($P < .001$), Z62 ($P < .001$), and Z63 ($P < .001$), but decreased for Z56 ($P < .001$) and Z64 ($P < .001$).

Across the age groups, the utilization rate for the SDOH Z codes was the highest among adults aged 65 years or older (933.12 per 10,000 encounters). This rate was significantly higher than that among adults aged 18–64 (139.11 per 10,000 encounters; $P < .001$) and children (11.35 per 10,000 encounters; $P < .001$). Among adults, the most commonly used Z code category was Z59, with the rate being 931.48 and 135.40 per 10,000 encounters for adults aged 18 to 64 and adults aged 65 years or older, respectively. Among children, the most commonly used Z code categories were Z55, problems related to education and literacy (3.81 per 10,000 encounters), and Z62, problems related to upbringing (3.24 per 10,000 encounters). Further, the SDOH Z codes utilization rate was significantly higher among women compared to men (313.23 vs 210.27 per 10,000 encounters; $P < .001$). Across the race-ethnic groups, the SDOH Z codes utilization rate was the highest among Hispanics (338.77 per 10,000 encounters), followed by non-Hispanic whites (265.14 per 10,000 encounters). The rate was significantly lower among non-Hispanic blacks (195.17 per 10,000 encounters) and other races (87.48 per 10,000 encounters).

Across the encounter types, the utilization rate for the SDOH Z codes was 12.60, 6.62, 7.17, and 1469.99 per 10,000 encounters for ED, inpatient, outpatient, and other type visits, respectively.

Table 2
Encounter-level rates of social determinants of health Z code assignment in OneFlorida.

	Encounters (N)	Overall rate	Z55 Problems related to education and literacy	Z56 Problems related to employment and unemployment	Z57 Occupational exposure to risk factors	Z59 Problems related to housing and economic circumstances	Z60 Problems related to social environment	Z62 Problems related to upbringing	Z63 Other problems related to primary support group, including family circumstances	Z64 Problems related to certain psychosocial circumstances	Z65 Problems related to other psychosocial circumstances
Overall Period	710,960,910	270.61	1.24	0.24	0.07	265.28	0.77	1.17	1.15	0.22	0.47
< 02/2018	424,320,731	255.62	1.16	0.23	0.07	250.68	0.73	1.05	1.00	0.23	0.47
≥ 02/2018	286,640,179	292.79	1.35	0.24	0.07	286.91	0.82	1.35	1.36	0.20	0.48
Age group											
<18	211,469,618	11.35	3.81	0.01	0.02	0.73	0.70	3.24	2.10	0.01	0.73
18–65	347,699,582	139.11	0.15	0.46	0.12	135.40	0.74	0.42	0.90	0.44	0.48
≥65	151,771,513	933.12	0.14	0.04	0.03	931.48	0.92	0.03	0.38	0.00	0.10
Unknown	20,197	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gender											
Female	422,294,679	312.23	0.76	0.21	0.06	307.46	0.71	1.12	1.17	0.37	0.37
Male	287,886,647	210.27	1.95	0.27	0.09	204.12	0.85	1.26	1.11	0.00	0.62
Unknown	779,584	6.98	0.01	0.08	1.26	5.26	0.03	0.09	0.19	0.04	0.03
Race											
NHW	268,719,239	265.14	0.76	0.27	0.09	259.62	0.93	1.48	1.35	0.16	0.47
NHB	168,891,955	195.17	1.08	0.29	0.05	190.05	0.60	1.21	1.02	0.27	0.61
Hispanics	171,274,075	338.77	2.16	0.15	0.05	333.40	0.47	0.71	1.07	0.35	0.40
Other	9,592,384	87.48	0.97	0.30	0.42	82.85	0.42	0.96	1.02	0.17	0.38
Unknown	92,483,257	317.03	1.23	0.19	0.07	311.90	1.17	1.08	0.93	0.08	0.37
Encounter Type											
ED	94,710,071	12.60	0.05	0.79	0.11	9.21	0.25	0.67	0.92	0.03	0.56
Inpatient	137,620,589	6.62	0.08	0.24	0.02	2.92	0.47	1.52	0.78	0.19	0.40
Outpatient	350,895,081	7.17	2.18	0.16	0.10	0.65	0.36	1.28	1.53	0.32	0.59
Unknown	127,735,169	1469.99	0.78	0.02	0.04	1464.78	2.58	0.89	0.65	0.11	0.15
Payer Type											
Medicare	133,863,902	1259.96	0.18	0.11	0.02	1257.18	2.01	0.07	0.27	0.01	0.12
Medicaid	418,826,048	53.96	1.78	0.24	0.03	47.47	0.51	1.75	1.32	0.31	0.55
Other Public	2,791,370	3.64	0.27	0.04	0.10	2.44	0.09	0.19	0.29	0.01	0.22
Private	28,999,308	3.87	0.14	0.24	0.26	1.65	0.10	0.24	0.88	0.13	0.23
No Payer	3,768,826	22.25	0.09	0.64	0.17	18.83	0.21	0.49	1.48	0.02	0.33
Other	3,601,529	6.70	0.01	0.21	0.68	2.68	0.31	1.82	0.57	0.03	0.39
Unknown	119,109,927	7.55	0.87	0.37	0.20	2.51	0.46	0.65	1.60	0.19	0.69
Site type											
Academic	107,921,493	8.18	0.98	0.42	0.21	2.46	0.51	0.71	1.88	0.23	0.79
Non-academic	603,039,417	317.57	1.28	0.20	0.05	312.32	0.81	1.26	1.01	0.22	0.42

ED=emergency department, NHB=non-Hispanic black, NHW=non-Hispanic white. All rates are per 10,000.

All the Z code categories were used significantly more often during outpatient visits compared to ED and inpatients visits. For all the encounter types, Z59 was the most commonly used Z code category. Across the payers, the utilization rate for the SDOH Z codes was the highest for Medicare (1259.96 per 10,000 encounters) and the lowest for private payers (3.87 per 10,000 encounters) and other public payers (3.64 per 10,000 encounters). Z59 was the most commonly used Z code category across all the payer types. In addition, the overall utilization rate for the SDOH Z codes was significantly higher in non-academic health centers (317.57 per 10,000 encounters) compared with academic health centers (8.18 per 10,000 encounters).

At the patient level, a total of 8,789,207 unique patients were identified in the OneFlorida data during the study period. We summarized the number of patients who had records on any of the 9 categories of Z codes in Table 3. Overall, 2.03% of the patients had at least 1 Z code reported. The most common Z code was Z59, with 0.89% of the patients reporting problems related to housing and economic circumstances. The utilization rates ranged from 0.03% to 0.32% for the other categories of SDOH Z codes.

Across the age groups, the utilization rate for the SDOH Z codes was the highest among adults aged 65 years or older (3.27%). This rate was significantly higher than that among

adults aged 18 to 64 (1.89%; $P < .001$) and children (1.82%; $P < .001$). Among adults, the most commonly used Z code category was Z59, 1.06% for adults aged 18 to 64, and 2.98% for adults aged 65 years or older, respectively. Among children, the most commonly used Z code categories were Z55, problems related to education and literacy (0.71%). Different from findings at encounter level, the SDOH Z codes utilization rate was higher among men compared to women (2.20% vs 1.94%; $P < .001$). Across the race-ethnic groups, the SDOH Z codes utilization rate was the highest among non-Hispanic whites (2.40%), followed by non-Hispanic Black (2.20%). The rate was significantly lower among Hispanics (1.64%) and other races (0.73%). In addition, the overall utilization rate for the SDOH Z codes was higher non-academic health centers (2.23%) compared with academic health centers (1.22%).

We summarized results from the logistic regression in Table 4. Compared to those with no Z code, patients who had any Z code were more likely to have a high ADI (OR=1.65; 95% CI: 1.62–1.68). For the association between each of individual Z code and ADI, patients with the Z code were more likely to have a high ADI compared to patients without the Z code, except for Z55, problems related to education and literacy (OR=0.90; 95% CI: 0.85–0.95), and Z57, occupational exposure to risk factors, (OR=0.98; 95% CI: 0.82–1.18).

Table 3
Patient-level rates of social determinants of health Z code assignment in OneFlorida.

	Number of Patients (N)	Any Z code	Z55 Problems related to education and literacy	Z56 Problems related to employment and unemployment	Z57 Occupational exposure to risk factors	Z59 Problems related to housing and economic circumstances	Z60 Problems related to social environment	Z62 Problems related to upbringing	Z63 Other problems related to primary support group, including family circumstances	Z64 Problems related to certain psychosocial circumstances	Z65 Problems related to other psychosocial circumstances
Overall	8,789,207	2.03%	0.31%	0.10%	0.03%	0.89%	0.09%	0.26%	0.32%	0.07%	0.13%
Age group											
<18	3,665,305	1.89%	0.71%	0.01%	0.01%	0.08%	0.11%	0.51%	0.46%	0.00%	0.15%
18–65	4,052,366	1.82%	0.02%	0.19%	0.05%	1.06%	0.06%	0.11%	0.24%	0.15%	0.13%
>=65	1,071,536	3.27%	0.01%	0.02%	0.02%	2.98%	0.08%	0.10%	0.14%	0.00%	0.05%
Gender											
Female	4,883,985	1.94%	0.20%	0.09%	0.02%	0.83%	0.08%	0.28%	0.34%	0.12%	0.11%
Male	3,758,489	2.20%	0.45%	0.01%	0.03%	1.00%	0.09%	0.26%	0.30%	0.00%	0.15%
Unknown	146,733	0.35%	0.00%	0.00%	0.03%	0.28%	0.00%	0.00%	0.01%	0.00%	0.00%
Race											
NHW	3,131,211	2.40%	0.21%	0.12%	0.03%	1.18%	0.10%	0.37%	0.40%	0.05%	0.14%
NHB	1,762,672	2.20%	0.31%	0.13%	0.02%	0.90%	0.10%	0.30%	0.34%	0.09%	0.20%
Hispanics	2,462,138	1.64%	0.47%	0.05%	0.02%	0.56%	0.06%	0.13%	0.25%	0.11%	0.08%
Other	230,091	0.73%	0.08%	0.06%	0.07%	0.24%	0.05%	0.08%	0.14%	0.01%	0.06%
Unknown	1,203,095	1.83%	0.27%	0.08%	0.02%	0.90%	0.08%	0.24%	0.26%	0.02%	0.09%
Site type											
Academic	1,382,291	1.22%	0.12%	0.11%	0.06%	0.38%	0.06%	0.11%	0.30%	0.02%	0.17%
Non-academic	7,237,328	2.23%	0.34%	0.09%	0.02%	1.01%	0.09%	0.30%	0.33%	0.08%	0.12%

NHB=non-Hispanic black, NHW=non-Hispanic white3.

We summarized the rates of selected Z codes and their corresponding social problems reported in the US Census Bureau’s 2017 American Community Survey in Table 5. According to the US Census, an estimated 1.9% of the adults had 5th grade or less education in Florida. In contrast, a mere 0.31% of the adult patients in the OneFlorida network received a code of Z55, problems related to education and literacy, between 2015–2019. A similar under-reporting of Z codes for employment and poverty data. The estimated unemployment rate in 2017 was 7.2% in Florida, whereas Z56, problems related to employment and unemployment, was only recorded for 0.10% of the adults in OneFlorida between 2015 to 2019. Further, it was estimated that 13% of the adults in Florida had an income below the federal poverty level. However, Z59, problems related to housing and economic circumstances, was only recorded for 0.89% of the adults in OneFlorida between 2015–2019. The percentage of the adults in OneFlorida with the Z codes was

consistently lower than the rates of corresponding social problems reported in the US Census Bureau across the gender and race subgroups.

4. Discussion

In this study, we examined the utilization of the ICD-10-CM Z codes in the EHRs from a large PCORI-funded clinical data research networks. Although the Z codes have existed for a few years now, we found a low rate of utilization for these codes that could help document the social and environmental factors in the EHRs. We also found that the rate of utilization for these Z codes increased since the official approval of Z code reporting from all clinicians, not just the physicians, involved in the care of a patient by the AHA Coding Clinic and ICD-10-CM Official Guidelines for Coding and Reporting became effective in February 2018.

Our results from the regression models show that the presence of the Z codes is associated with a high ADI, except for Z55 problems related to education and literacy and Z57 occupational exposure to risk factors. First, the non-significant relationship between Z57 and the ADI is expected since the ADI does not consider variables related to occupational exposure to risk factors. Further, many risk factors for Z55 are specific for children, such as underachievement in a school, educational maladjustment and discord with teachers and classmates, which might have led to the reversed ADI-Z55 relationship. Second, the significant relationships between the Z codes (other than Z57) and the ADI suggest that the presence of the Z codes is reflective of the variations in social problems in the population. Neighborhoods (zip codes) that are of high deprivation or high social vulnerability have higher rates of patients reporting the SDOH Z codes.

On the other hand, although the Z codes are reflective of the variations in social problems in the population, they are severely underutilized considering the published rates of certain social problems. The rates of the selected Z codes were significantly and consistently lower than the rates of corresponding social

Table 4
Adjusted odds ratios for comparing area deprivation index between those with and without Z code.

With vs. Without Z code	High vs. Low ADI Adjusted OR
Any Z code	1.65 (1.62, 1.68)
Z55	0.90 (0.85, 0.95)
Z56	2.27 (2.13, 2.42)
Z57	0.98 (0.82, 1.18)
Z59	1.90 (1.85, 1.95)
Z60	1.20 (1.10, 1.31)
Z62	1.77 (1.70, 1.85)
Z63	1.53 (1.46, 1.59)
Z64	1.53 (1.40, 1.67)
Z65	3.31 (3.16, 3.46)

ADI=Area Deprivation Index, OR=Odds Ratio.
High means > 90th percentile; Low means ≤ 90th percentile.
ORs were adjusted for age, gender, race/ethnicity, and number of visits.

Table 5
Comparing Z codes data to US Census data.

	Z55 Problems related to education and literacy	Education attainment (5 th grade or less) ^a	Z56 Problems related to employment and unemployment	Unemployment rate [†]	Z59 Problems related to housing and economic circumstances	Individual income is below poverty level [†]
Overall	0.31%	1.90%	0.10%	7.2%	0.89%	13.0%
Gender						
Male	0.45%	1.98%	0.01%	6.8%	1.00%	14.4%
Female	0.20%	1.82%	0.9%	6.8%	0.83%	16.5%
Race						
NHW	0.21%		0.12%	6.0%	1.18%	10.9%
NHB	0.31%		0.13%	11.8%	0.90%	24.8%
Hispanics	0.47%		0.05%	6.9%	0.56%	19.8%
Other	0.08%		0.06%	8.0%	0.24%	21.1%

^a Education attainment data obtained from census 2000.

[†] Employment and poverty data were obtained from ACS 2007.

problems (education, unemployment, and poverty) reported by the US Census Bureau. One reason for the underutilization of the Z codes in the EHRs is that clinicians are simply not screening for social problems in the clinical setting. Screening for health-related social problems is fundamentally different from screening for traditional medical problems, for which many screening and diagnostic tools are available. While clinicians are aware of the importance of SDOH on health, most of them have inadequate training on how to respectfully extract information related to the sensitive SDOH issues, such as housing insecurity and unemployment, from their patients and how to respond to patients' concerns. Further, screening for SDOH can detect adverse social circumstances that require resources beyond the scope of clinical care. Resources for resolving the social needs are often scarce, and clinicians do not always know the available referral resources for the detected needs. Garg et al. warned about the unintended consequences of screening for SDOH in clinical care, especially when referral resources are unavailable for addressing the identified social needs.^[20] As a result, clinicians are often uncomfortable inquiring about patients' social problems. Another reason for the underutilization of the Z codes in the EHRs is that, in some cases, clinicians do document SDOH in routine care, but they do so in clinical notes more often than using the Z codes. In a recent study, Navathe et al evaluated the prevalence of 7 social factors using both clinical notes and structured EHR data and found that all 7 factors were identified at significantly higher rates in clinical notes.^[21] For example, the prevalence of poor social support increased from 0.4% using ICD codes and structured EHR data to 16.0% using clinical notes. This observed disconnect may be because clinicians often times do not perceive these social problems as directly affecting clinical care, and assigning an appropriate ICD code to the identified social problem requires additional effort with no incentives. Nonetheless, advanced methods such as natural language processing (NLP) are increasingly used to identify SDOH in clinical notes.

To promote Z code use and better document SDOH in EHRs, providing clear coding guidelines can be a useful first step as we show that Z code use has increased since the AHA recommendation. However, solely relying on these encounter-level Z codes for SDOH documentation may not be the best strategy for several reasons. First, the Z codes only cover a subset of all SDOH factors. Second, ICD code use in EHRs is often driven by billing needs, limiting the use of EHRs for other purposes. Third, documenting SDOH at the encounter-level can be impractical due to clinical workflow constraints such as limited visit time. Improvements in EHR systems (e.g., allowing documenting some

SDOH in patients' social history) are needed to support a holistic and systematic approach for tracking SDOH.

4.1. Limitations

Our study has a few limitations. When analyzing the association between Z code utilization and ADI, we correlated patients' individual level data with the neighborhood level measurement and made broad assumptions on ADI over time and space. For instance, the particular ADI measurement used in our analysis was constructed based on American Community Survey (ACS) 5 year estimates in 2011 to 2015. Also, due to the lack of residential mobility data, we used a single zip-code over all encounters, which may have introduced non-differential misclassification.

5. Conclusions

Although there is an increasing recognition of the importance of SDOH and calls for clinicians to document and attend to these factors in the EHRs, the SDOH Z codes are rarely used by clinicians. Providing clear guidelines and incentives for documenting the Z codes can promote their use in EHRs. Improvements in the EHR systems are probably needed to better document SDOH.

Author contributions

Conceptualization: Yi Guo.

Formal analysis: Zhaoyi Chen, Ke Xu.

Methodology: Yi Guo, Zhaoyi Chen, Jiang Bian.

Writing – original draft: Yi Guo, Zhaoyi Chen, Jiang Bian.

Writing – review & editing: Yi Guo, Zhaoyi Chen, Ke Xu, Thomas George, Yonghui Wu, William Hogan, Elizabeth A Shenkman, Jiang Bian.

References

- Braveman P, Gottlieb L. The social determinants of health: it's time to consider the causes of the causes. *Public Health Rep* 2014;129(Suppl 2):19–31.
- Social determinants of health. World Health Organization. <https://www.who.int/health-topics/social-determinants-of-health>. Published 2017. Accessed November 28, 2020.
- McGinnis JM, Williams-Russo P, Knickman JR. The case for more active policy attention to health promotion. *Health Aff (Millwood)* 2002;21:78–93.
- Blackman PH. Actual causes of death in the United States. *JAMA* 1994;271:659–61.

- [5] Danaei G, Ding EL, Mozaffarian D, et al. The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Med* 2009;6:e1000058.
- [6] Institute of Medicine. *Primary Care and Public Health: Exploring Integration to Improve Population Health*. Washington, DC: National Academies Press (US); March 28, 2012. <https://doi.org/10.17226/13381>. Accessed November 28, 2020.
- [7] Institute of Medicine. *Capturing Social and Behavioral Domains and Measures in Electronic Health Records: Phase 2*. Washington, DC: National Academies Press (US); January 8, 2015. <https://doi.org/10.17226/18951>. Accessed November 28, 2020.
- [8] Adler NE, Stead WW. Patients in context—EHR capture of social and behavioral determinants of health. *N Engl J Med* 2015;372:698–701.
- [9] Bazemore AW, Cottrell EK, Gold R, et al. “Community vital signs”: incorporating geocoded social determinants into electronic records to promote patient and population health. *J Am Med Inform Assoc* 2016;23:407–12.
- [10] Gold R, Cottrell E, Bunce A, et al. Developing Electronic Health Record (EHR) strategies related to health center patients’ social determinants of health. *J Am Board Fam Med* 2017;30:428–47.
- [11] Friedman NL, Banegas MP. Toward addressing social determinants of health: a health care system strategy. *Perm J* 2018;22:18–095.
- [12] Resource on ICD-10-CM Coding for Social Determinants of Health | AHA. American Hospital Association. Available at: <https://www.aha.org/dataset/2018-04-10-resource-icd-10-cm-coding-social-determinants-health>. Accessed March 30, 2020.
- [13] Centers for Medicare and Medicaid Services (CMS), National Center for Health Statistics (NCHS) USD of H and HS (DHHS). *ICD-10-CM: Official Guidelines for Coding and Reporting - FY 2019* (October 1, 2018 - September 30, 2019).; 2018.
- [14] OneFlorida – Clinical Research Consortium. Available at: <https://onefloridaconsortium.org/>. Accessed March 30, 2020.
- [15] Torres JM, Lawlor J, Colvin JD, et al. ICD social codes: an underutilized resource for tracking social needs. *Med Care* 2017;559:810–6.
- [16] Shenkman E, Hurt M, Hogan W, et al. OneFlorida clinical research consortium: linking a clinical and translational science institute with a community-based distributive medical education model. *Acad Med* 2018;933:451–5.
- [17] Kind AJ, Jencks S, Brock J, et al. Neighborhood socioeconomic disadvantage and 30 day rehospitalizations: an analysis of medicare data. *Ann Intern Med* 2014;16111:765–74.
- [18] Bureau UC. American Community Survey (ACS). The United States Census Bureau. Available at: <https://www.census.gov/programs-surveys/acs>. Accessed March 12, 2020.
- [19] Flanagan BE, Gregory EW, Hallisey EJ, et al. A social vulnerability index for disaster management. *Journal of Homeland Security and Emergency Management* 2011;8:3.
- [20] Garg A, Boynton-Jarrett R, Dworkin PH. Avoiding the Unintended Consequences of Screening for Social Determinants of Health. *JAMA* 2016;3168:813–4.
- [21] Navathe AS, Zhong F, Lei VJ, et al. Hospital readmission and social risk factors identified from physician notes. *Health Serv Res* 2018;532:1110–36.