Review Article

Using area-level measures of social determinants of health to deliver improved and effective health care

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Abstract: There is growing emphasis on social determinants of health (SDoH) and their role in health care outcomes and health care delivery. Despite the importance of SDoH in determining individual health, this information is not routinely or systematically captured during clinical encounters. Providers cite lack of time, hesitation to ask patients for personal information, and lack of confidence in addressing social risk factors as barriers to the routine collection and use of SDoH in clinical practice. SDoH have been operationalized as composite scores of measures spanning several domains such as transport, income, crime, housing, and built environment at the area level. Living in deprived neighborhoods has been associated with adverse health outcomes. Several national and international efforts have focused on using area-level measures of SDoH to describe area-level deprivation information, or its counterpart, opportunity that measures potential for human progress, to communicate implications for individual and population health outcomes. We provide an overview of the current state of the field to orient readers to area-level measures of SDoH. We briefly discuss potential applications and limitations of area-level SDoH, as well as, implications for health care and health policy. Our overview is likely to help with the design and evaluation of health care interventions that aim to use area-level measures of SDoH.

Keywords: Area-level deprivation; poverty areas; social determinants of health (SDoH); healthcare disparities; medically underserved area; population health management

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Introduction

Social determinants of health (SDoH) are "the conditions in the places, where people live, learn, work, and age" (1). A combination of interrelated trends in public health have renewed interest in examining the "place" effect (2). First, clinical care explains 10% to 20% of health outcomes (3). Second, neighborhood characteristics may help in understanding the causes of social inequalities. Three,

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advances in computing power, geographic information systems (GIS), and statistical techniques like multi-level modeling allow for more sophisticated and detailed examination than in the past (2). SDoH can be assessed at the individual as well as the area level. The purpose of this report is to provide an introduction to area-level SDoH measured as deprivation or opportunity, give a brief description of area-level SDoH in the United States, and discuss current and potential applications of area-level SDoH measures in health care.

Area-level deprivation or area-level opportunity

Deprivation is "a state of observable and demonstrable disadvantage relative to the local community or the wider society or nation" (4). Opportunity, often contrasted with deprivation, is defined as "a range of circumstances that open doors to economic mobility and human progress" (5). Poverty and deprivation, though used interchangeably, are distinct. Deprivation refers to people's unmet needs and poverty refers to a lack of resources to meet those needs. Results from the Whitehall II study illustrated by the differential effects of neighborhood socioeconomic status. Individual poverty while living in an affluent neighborhood was not associated with negative health consequences, whereas living in a deprived neighborhood was associated with adverse health outcomes among poorer individuals (6). Area-level deprivation reflects aggregate measures of SDoH at the neighborhood level. Indeed, the role of neighborhood has been highlighted by the Moving to Opportunity experiment. Neighborhoods that children grew up in influenced prospects for upward income mobility in adulthood (7).

Area-level SDoH in the United States

SDoH have been operationalized as composite scores of indicators spanning several domains such as transport, income, crime, housing, etc. at the geographic level. These scores in turn reflect deprivation or opportunity. Area-level measures of SDoH have long been in use in countries like New Zealand and the United Kingdom. The New Zealand Index of Deprivation (NZDep), now in its fifth iteration, has been used for guiding resource allocation, community advocacy, and research. NZDep is used in capitation funding formulae for primary health care services, District Health Boards, and social services (8). Similarly, indices of multiple deprivation have been developed for each of the countries in the United Kingdom (9) and integrated in health care delivery.

A variety of area-level measures of SDoH have been developed in the US, some are national in scope, while others are specific to individual states. Neighborhoods have been operationalized based on administrative definitions as census tracts (CT), census block groups, or zip codes (2). The National Opportunity Index is a composite score of measures of education, economy, health, and community. It was developed to aid policymakers to identify and increase opportunity at the county and state levels (5). The Social Vulnerability Index (SVI) developed by the Centers for Disease Control and Prevention (CDC) used 15 variables at the CT level. The SVI was created to aid local officials in identifying the support communities would require in preparing for or recovering from disasters (10). The Area Deprivation Index (ADI) used US Census data at the CT level to calculate a score of deprivation (11). It has been adapted to reflect deprivation at the census block group level as a measure of neighborhood ADI. Studies using neighborhood ADI have shown higher readmission among Medicare patients living in the top 15% deprived neighborhoods. Further, compared to patients living in less deprived neighborhoods, those living in highly deprived neighborhoods were 70% more likely to be readmitted to the hospital within 30 days (12,13). Together, these studies suggest that there is a certain level of supportive services necessary for communities, which once met, outcomes like readmission tend to be driven by individual-level factors.

The Utah ADI and the Ohio Opportunity Index (OOI) are two examples of area-level SDoH measures at the state level. The Utah ADI has been used in a "learning healthcare" system for community needs assessment, identifying high risk patients for care management and evaluating the impact of deprivation on the treatment of hypertension (14). Developed by the Ohio Department of Medicaid and researchers at The Ohio State University, the OOI was created to provide insights about patients' SDoH to health care providers and provide policymakers with information to make better decisions to alleviate health disparities across the state. OOI is a composite of seven domains—transportation, education, employment, housing, health, access to services, and crime (15).

Deprivation was reframed as opportunity based on feedback from the project sponsors. The OOI score is low for areas of high deprivation and high for areas of low deprivation (15). Linking the OOI scores for CTs with locations of service provision and specific health outcomes

could aid in targeting areas in need of resources.

SDoH in healthcare in the United States

Two trends have renewed focus on SDoH in the United States. First, the measurement of health care outcomes instead of health care processes. Second, the realignment of health care from a volume-based to a value-based system (16,17). Patients' ability to manage their health is affected by non-medical factors such as the neighborhood they live in, which has implications for setting treatment goals and care delivery. SDoH may be negatively or positively associated with health. Social risk, sometimes used synonymously with SDoH, refers to adverse social conditions associated with health. Social need, on the other hand, depends on individual preferences and priorities underscoring shared-decision making between patient and provider (18).

Individuals with unmet social needs tend to have poor control of hypertension, diabetes, and cholesterol, and have higher Emergency Department (ED) utilization (19). Therefore, hospitals, clinicians, and Accountable Care Organizations (ACO) caring for a large proportion of patients with social risk factors may be unfairly penalized, further exacerbating disparities. In response, the National Quality Forum (NQF) revised its proscription against adjustment for sociodemographic factors. Upon reviewing the evidence, the NQF recommended adjustment for some measures affected by SDoH like glycemic control, and against adjustment for others such as central line infections, which are largely under hospital control (16).

Despite the importance of SDoH in determining an individual's health, this information is not routinely or systematically captured during clinical encounters. In 2014, the Institute of Medicine (now the National Academy of Medicine) recommended the collection of a minimum of 10 SDoH and one neighborhood-level SDoH (20). In a national network of 100 community health centers, 50% of the screening for SDoH occurred in four centers alone. Of the seven recommended domains, half the screenings included responses to only one domain (21). The debate regarding universal and comprehensive screening for SDoH during the clinical encounter is ongoing (22). Increased physician burden in recording SDoH that takes away time spent on patient care is a growing concern (23). Further, physicians have expressed concerns over making the patient uncomfortable asking for social risk factors, lack of direction in using the collected SDoH information, not having appropriate resources or infrastructure to address social risk factors, and lack of confidence in their capacity to address SDoH (22,24). Furthermore, the development of screening tools for SDoH has outpaced studies of their reliability and validation. As a result, screening positive on current SDoH tools may not meet a threshold that would warrant assistance according to the patient (25).

Applications of area-level SDH

Systematic SDoH collection is a time-consuming and expensive undertaking. It requires provider training, building a referral system, fostering relationships with social services organizations, and integrating SDoH collection tools and electronic inventories into the system (26). Another critical step is the creation of workflows for administering an SDoH assessment, identifying care team members performing the SDoH assessment, and tracking of referrals and follow-ups (27). In lieu of collecting SDoH information from patients, the wealth of area-level measures of SDoH may be leveraged and incorporated into the electronic health record (EHR) (28). Area-level measures of deprivation have been successfully used in New Zealand and the United Kingdom to deliver health care (29). It is interesting to note that the United Kingdom uses area-level measures of SDoH despite a health system that can potentially facilitate routine capture of individual-level SDoH (30).

The availability of aggregated area-level measures of SDoH or "community vital-signs" in the EHR enable both patients and providers to engage in patient-centered and community-oriented care that factors the neighborhood context (31). For example, the Utah Area-Deprivation Index serves as a proxy for patient-level SDoH (14). This approach may be valuable to health systems with limited resources to collect patient-level SDoH. The Population Health Assessment Engine (PHATE) is a mapping tool that integrates SDoH and clinical data. PHATE has been used to map the geographic distribution of individuals screening positive for food insecurity to make appropriate referrals to community resources (32). High-cost and high-utilizers of health care called "hot-spotters" have been managed with care coordination (33). However, there is evidence suggesting that targeting hot-spotters may not contribute to substantial cost savings (34). As hot-spotters may live in deprived communities, "cold-spotting" such communities for the purpose of designing interventions to better link primary care with social services and public health may in turn decrease both cold spots and hot spots (35). Healthcare

systems can use area-level measures of SDoH to focus their limited resources on identifying and addressing disparities in cold spots. In a study of the relationship between an area-based measure of breast cancer screening and late stage breast cancer (LSBC) in Appalachia, higher deprivation measured by the ADI was associated with higher incidence of LSBC. Area deprivation better explained area-based effects of poverty than socio-economic status. Further, better regional access to breast cancer screening was associated with lower incidence of LSBC. Overall, the study emphasized the importance of developing policies that formalize links among screening centers, health care providers, and community advocacy groups in underserved areas to promote cancer screening (36).

Geospatial approaches to quantify and visualize SDoH not only better capture the complexity and spatial heterogeneity (37), but also facilitate intuitive use by stakeholders. Previously, GIS was successfully used within a primary care network to map practice management and population data, thereby revealing variation between actual clinic service areas and the medically underserved areas. A need for technical assistance and dynamic mapping was expressed at the time (38). Today, many area-level SDoH have been operationalized as dashboards for intuitive use by stakeholders. The SVI is available as an interactive map (10); the neighborhood ADI has been visualized as the Neighborhood Atlas (39); and the OOI has been visualized as an interactive dashboard (15).

The US lags behind other countries in the use of area-level measures of SDoH for health policy and reimbursement purposes. Some notable exceptions include the Massachusetts Managed Care Model and the ACO with Medicaid waiver in Hennepin Health (HH) in Minnesota (30). The Massachusetts model was created after the Medicare Access and Children's Health Insurance Plan Reauthorization Act of 2015, which emphasizes value-based rather than volume-based care. Risk adjustment was performed to allocate funds to health plans. Policymakers in Massachusetts combined SDoH and diagnostic codes to create a reimbursement model. In addition to demographic factors and individual-level SDoH, a neighborhood stress score was incorporated into the model (40). The HH model focused on adult patients without dependents living at or below 75% of the federal poverty level. Six months of enrollment into the HH ACO reduced hospitalizations and ED use, and increased dental visits and use of primary care. While the study did not use area-level composite measures of SDoH, a combination of area-level indicators and individual-level SDoH were employed (41).

The importance of SDoH in health care is indisputable. Nevertheless, evidence is emerging of a gap between the number of patients screening positive for social risk factors and those actually desiring assistance (42) with implications for health systems planning on implementing screening for SDoH. While this may be attributable to inadequate testing of the psychometric properties of the SDoH screening tool, it is likely patients do not consider the clinical encounter as the right setting to discuss social needs (42). It is important to gain a better understanding of the factors associated with accepting social care from health care providers. Further, area-level SDoH should be evaluated and tested in interventions as knowledge of the pathways linking SDoH and health outcomes is limited (43,44).

Limitations of using area-level SDH

Area-level measures of SDoH reflect neighborhood levels of deprivation and not levels of deprivation of the individuals residing there. Therefore, deprived areas may have a large proportion of people who are not deprived at the individual level and vice versa. Consequently, a patient's residence in a deprived neighborhood must not be conflated with social risk. Although it is important to define area-level deprivation to pursue area-based solutions, other kinds of solutions to address social risk factors should not be overlooked (9). Reliance on census data to construct area-level SDoH poses a limitation as this data is updated in ten-year cycles. However, other sources of administrative data have been successfully used to update and construct area-level measures of SDoH. Composite indices are constructed by combining different indicators in a weighted fashion, therefore changing the indicators may affect the composite index score. Experts have cautioned that the creation of area-level composite measures is a process fraught with debates and complex decision-making. Therefore, users must bear in mind that indices and the dashboards that visualize them are shaped by technical, design, social and political considerations, which may not be entirely objective (45). Lastly, debate persists regarding the appropriateness of the dimensions of deprivation and the geographic unit at which measurements of SDoH are made (46).

Conclusions

Rising interest in the "place" effect and heath inequities has shifted the conversation to innovation in health care delivery

and collaboration between healthcare organizations, public health, and social services. While more evidence is needed pertaining to the collection, validity, and use of individual-level SDoH in improving healthcare, area-level measures of SDoH represent a rich resource of readily-available data that may be used to improve health care delivery.

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