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Integrating Social Determinants of Health in Critical Care

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Abstract

BACKGROUND: Social determinants of health (SDOHs) mediate outcomes of critical illness. Increasingly, professional organizations recommend screening for social risks. Yet, how clinicians should identify and then incorporate SDOHs into acute care practice is poorly defined.

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Additional information: The e-Appendixes are available online under “Supplementary Data.”

RESEARCH QUESTION: How do medical ICU clinicians currently operationalize SDOHs within patient care, given that SDOHs are known to mediate outcomes of critical illness?

STUDY DESIGN AND METHODS: Using ethnographic methods, we observed clinical work rounds in three urban ICUs within a single academic health system to capture use of SDOHs during clinical care. Adults admitted to the medical ICU with respiratory failure were enrolled prospectively sequentially. Observers wrote field notes and narrative excerpts from rounding observations. We also reviewed electronic medical record documentation for up to 90 days after ICU admission. We then qualitatively coded and triangulated data using a constructivist grounded theory approach and the Centers for Disease Control and Prevention Healthy People SDOHs framework.

RESULTS: Sixty-six patients were enrolled and > 200 h of observation of clinical work rounds were included in the analysis. ICU clinicians infrequently integrated social structures of patients' lives into their discussions. Social structures were invoked most frequently when related to: (1) causes of acute respiratory failure, (2) decisions regarding life-sustaining therapies, and (3) transitions of care. Data about common SDOHs were not collected in any systematic way (eg, food and housing insecurity), and some SDOHs were discussed rarely or never (eg, access to education, discrimination, and incarceration).

INTERPRETATION: We found that clinicians do not incorporate many areas of known SDOHs into ICU rounds. Improvements in integration of SDOHs should leverage the multidisciplinary team, identifying who is best suited to collect information on SDOHs during different time points in critical illness. Next steps include clinician-focused, patient-focused, and caregiver-focused assessments of feasibility and acceptability of an ICU-based SDOHs assessment.

Keywords

ethnography; health equity; qualitative methods; social determinants of health

Inequities related to an individual's socioecologic context, including the conditions in which they are born and live, triple the age-adjusted risk of death in the United States.^{1–3} These social determinants of health (SDOHs) impact the development of and recovery from critical illness. Patient characteristics, including low socioeconomic status, Black race, and Hispanic ethnicity, are associated with both the development of respiratory failure and worse outcomes after critical illness.^{4–9} In the year after critical illness, patients living in neighborhoods that are disadvantaged socioeconomically experience more disability⁹ and increased mortality risk after ICU discharge.^{10–12} Social isolation further exacerbates these effects and is captured infrequently with current methods of estimating socioeconomic status.^{13,14} Despite clear relationships among social and environmental factors, critical illness, and poor outcomes, best practices for integrating these known risks into acute care remain undefined.

Multiple professional organizations^{15–18} recommend screening for SDOHs to address health disparities and to promote health equity. However, existing screening instruments were not developed or validated for use in the ICU. Recognizing SDOHs through screening promotes clinician connectedness to patients, resulting in better shared decision-making¹⁹ and value-aligned decisions. Yet, patients and families may experience or fear bias or discrimination

within health care interactions based on their social risks²⁰ and may be reluctant to share SDOHs during acute illness. Indeed, increased attention to social risks may result in stigmatization if not well supported by care processes and clinician education. Clinicians also report moral distress when they are aware of, but feel unequipped to address adequately, patients' social needs and may avoid collecting this information.²⁰ Clinicians additionally may feel pressured by the cognitive load and time limitations to address SDOHs if they are less familiar with how and why to do so.²¹ Clinicians also may assume that other members of the multidisciplinary team are more likely or better equipped to address SDOHs, with a subsequent diffusion of responsibility leading to neglect of screening altogether.^{22,23} These complexities highlight the need to scaffold clinical integration of SDOHs beyond screening.

To reduce SDOHs-related inequities after critical illness and to improve effective use of SDOHs knowledge, first it is necessary to understand how critical care clinicians identify and integrate SDOHs into clinical care. Therefore, we conducted an ethnographic study of critical care practices, interrogating if and how SDOHs are incorporated into patient care during and after critical illness. This hypothesis-generating work informs a preliminary framework for the integration of SDOHs during multidisciplinary critical care.

Study Design and Methods

Study Design, Setting, and Participants

We use the Consolidated Criteria for Reporting Qualitative Research Checklist to report our methods (e-Appendix 1).²⁴ We conducted ethnographic observation of work rounds in three urban medical ICUs across a single academic health system. We sequentially enrolled adult patients aged 18 years or older with acute respiratory failure (ARF) admitted to an ICU between May 3, 2022, and July 29, 2022, based on research team availability. We focused on patients with ARF,²⁵ given the known substantial disparities in ARF outcomes based on patient demographics.^{4,26–28} We excluded patients staffed with an intensivist preceding work rounds, because this precluded observation of initial management discussions. We also excluded patients readmitted to the same ICU team within 30 days, because familiarity with these patients may have changed the discussion around SDOHs. In advance of the study, we introduced all relevant clinicians to the study and provided them with an opportunity to opt out. We excluded patients of one intensivist and one bedside clinician who declined observation.

Two investigators (J. T. C. and J. L. H.) with expertise in qualitative analysis supervised the methods. This study was reviewed and approved by the University of Pennsylvania Institutional Review Board on February 22, 2022, under the protocol number 850668.

Data Collection

Research staff (D. R., H. P., and S. P.) observed rounds up to 4 consecutive days in the ICU per patient, capturing a substantial portion of the anticipated time while receiving mechanical ventilation.²⁹ We reviewed the ICU census each morning at 6 AM and enrolled patients on the first observation day. Enrollment and observation were performed on weekdays and weekends, during the daytime. Observers were present for the duration of

rounds, including board rounds, when clinicians first reviewed major patient updates and plans (eg, remains intubated, will require prone positioning) and possible transitions of care (eg, readiness for discharge to long-term acute care hospital) with the multidisciplinary team present.

Observers held internal (D. R.) and external (H. P. and S. P.) roles to allow for a breadth of perspective on contextualizing SDOHs. External observers spent time in the ICU before formal observations to understand the roles of members of the multidisciplinary team and general structure of rounds. Observers documented findings in field notes, which could include verbatim language or phrases used by clinicians, as well as overall impressions and summaries of the SDOHs discussed, including context of discussions, tone of the conversation, body language or nonverbal cues among team members, who initiated discussions, and who participated. As in traditional ethnographic research, observers asked clarifying questions as needed, integrating themselves into the clinical environment. We also reviewed all patient care notes (eg, progress notes from clinicians, consultant notes, nursing, nutrition, therapy, and social work) on observation days in the electronic medical record (EMR) (e-Appendix 2). We then collected key clinical events and summarized them in a narrative from the 30 days after admission, followed by a final EMR review 90 days after admission to note disposition, if not known previously (e-Appendix 3). EMR review captured explicit or implicit references to prespecified Centers for Disease Control and Prevention (CDC) SDOHs domains and subdomains (eg, discussion of access to food and housing, caregiver support, outpatient clinician visits, and so on) and the clinical context within which these mentions were occurring.

Quantitative Analysis

Using the SDOHs construct of the CDC Healthy People program, we quantified the frequency and type of SDOHs discussed based on the detailed field notes generated by the observers. The CDC construct includes five SDOHs domains, each with three or four subdomains (e-Appendix 4). For each observed patient-day, we counted whether clinicians mentioned each SDOHs subdomain and generated a grid heat map to represent the count data visually.

Qualitative Analysis

We used a constructivist grounded theory and relativist epistemologic approach to represent knowledge relative to a specific context (ie, current definitions of SDOHs in society).³⁰ This adaptation of grounded theory aims to make situational sense of its meaning, and analysis thereby was both inductive and deductive. Data collection and analysis were concurrent to assess theoretical saturation.³¹ Coding was managed using Atlas.ti Scientific Software Development for Mac version 4.7.1–2022-12–21. We combined observational field notes, and EMR review notes were combined into a longitudinal record for each enrolled patient. These records included verbatim language noted on rounds or in the EMR and more extensive contextual notes produced by ethnographic observers and EMR reviewers. We first annotated a subset of records to generate a codebook. Three investigators (D. R., H. P., and S. P.) independently coded and compared coding for 45 patient records (68%) to confirm agreement in code applications and to prevent drift. Intercooder agreement was >

90% at this point, and no further changes were made to the codebook.³² The remainder of the data were coded by one of two investigators. We reflected on personal perspectives and resolved uncertainties through weekly team meetings. Supervising investigators (J. T. C. and J. L. H.) arbitrated questions about codes and themes for which consensus could not be achieved. Additionally, two or three investigators read each patient record and wrote reflective memos that chronicled patient cases to reveal temporal developments not apparent in cross-sectional coding and explicitly encourage reflexivity.³³ After coding and memo creating were complete, we developed a framework for how and when ICU clinicians discussed SDOHs.

Results

Patient Cohort

Of 88 eligible patients (e-Appendix 5), we excluded 17 because of research team availability and five patients because of missed observations. Missed observations were most frequently on the weekends because of a lack of multiple observers to complete observations at multiple sites. The final cohort included 66 patients (Table 1). We spent 201.3 h in observation, with all cohort patients observed on day 1, 55 patients observed on day 2 (two died and nine transferred out of the ICU), 36 patients observed on day 3 (one died, 13 transferred, and five missed), and 18 patients observed on day 4 (13 transferred and five missed).

Patient median age was 65 years, 47% of patients (n = 31) were female, 65.2% of patients (n = 43) identified as Black or African American, and 91.7% of patients (n = 60) spoke English (Table 1). Most required mechanical ventilation (42.4% [n = 28]), and sepsis was the most common admission diagnosis (22.7% [n = 15]). The median Charlson comorbidity index was 5.5, and the median Acute Physiology and Chronic Health Evaluation IV score was 74. Patient median ICU length of stay was 3 days (interquartile range, 2–7 days), and median hospital length of stay was 10 days (interquartile range, 7–18 days). Nine patients (13.6%) died in the hospital within 30 days of admission.

How Clinicians Discuss Social Structures of Patients' Lives

Clinicians never used the term *social determinants of health* during rounds. No patterns or routine use of related terms, including *structural racism* and *health disparities*, were used, but clinicians did frequently mention difficulty with “access to health care” and concerns surrounding “health literacy.” We outline three representative patient narratives to demonstrate how clinicians integrated patients' social structures into care during rounds (e-Appendix 6).

Clinicians approached some CDC domains as the social structures of patients' lives. Clinicians mentioned social and community context most frequently, and rarely mentioned education and access (Table 2). Clinicians discussed social structures most frequently on the first day of admission and less often on both subsequent ICU days and days including care transitions, such as discharge from the ICU (Fig 1). Clinicians discussed patients' social cohesion (ie, social support) during the history of present illness and during a verbal

checklist,³⁴ despite SDOHs assessment not being an explicit component of this checklist. However, no systematic screening, discussion, or management plan was used specifically for individual SDOHs or for integration of SDOHs into routine clinical care.

Education access and quality was the least frequently mentioned domain during observation and EMR review. Civic participation, discrimination, and incarceration were discussed or documented rarely, although social cohesion or the lack thereof was discussed and documented in every patient. At times, clinicians outwardly stated their concerns for bias. One clinician commented, “There were several biases against this patient when he presented to the ED and they hate to say this and have to bring this up but ‘this is a gentleman who had a history of being a frequent flyer’ to the hospital and ‘has a history of incarceration’” (patient C6). For patient A11, the attending noted, “I do not want to be biased against this [patient] who is homeless” and acknowledged that “[the course] would be different if [that patient was] going to a group home or a shelter nearby,” instead of being discharged without secure housing. Patient B1 was admitted for decompensated heart failure and soon after planned to leave “against medical advice.” Clinicians shared concerns that the patient would lack access to care and food security on discharge, but did not explore reasons for how fear of discrimination and subsequent mistrust impacted decision-making. On observation and EHR review, clinicians did not address the patient’s concerns nor did they alleviate this barrier before the discharge against medical advice.

Clinicians demonstrated difficulty in gathering social information during situations of high acuity, where workflow challenges limited their time or they prioritized managing the acute condition. In one example, patient B8 was having a psychological emergency at the start of rounds, where “screaming and rushing around during the presentation of the patient” occurred and the team made statements indicating that they felt distracted.

Clinicians most often included patients’ social structures when discussing: (1) causes of ARF, (2) decisions regarding life-sustaining therapy, and (3) safe transitions of care (Fig 2). To understand the cause of the ARF, clinicians probed access to health care and adherence to outpatient therapies and used clinical reasoning to connect common reasons for ICU admission and so-called typical social risks related to a social history (eg, housing, employment, substance use). During decisions to accept or forgo life-sustaining therapies, clinicians elicited social structures by exploring patient baseline function and their environment to identify patients’ goals for their health and to prognosticate around recovery from critical illness. During care transitions, clinicians arranged follow-up based on how, when, and if patients could access outpatient care routinely.

Understanding the Cause of ARF

Clinicians identified chronic diseases as facilitators or barriers for how patients access care and adhere to recommended therapies (Fig 2). Hematologic and oncologic diagnoses (eg, sickle cell disease, solid tumors, and hematologic malignancies) and solid organ transplantation receipt or candidacy were facilitators of access and improved adherence to care. Clinicians identified that these patients received enhanced social and structural resources, such as ease in reaching clinicians to discuss emergent symptoms or medication adjustments (eg, a direct nursing line), and support from social workers, case managers,

and psychologists. On hearing the team's plan for outpatient follow-up during rounds, one family member brought up that "the patient does not have a primary care physician and that there have been issues with health care access due to health centers closing" (patient A7), indicating the role of the lack of routine care in contributing to critical illness.

Conversely, clinicians discussed that mental health and substance use disorders were barriers to standard care. Clinicians associated such conditions with patient nonadherence and difficulties with accessing preventive care. Clinicians noted that patients with these conditions frequently accessed care in the emergency room, rather than with a primary care physician. Patient A11, who had an underlying diagnosis of severe schizophrenia, was admitted to the ICU for an acute exacerbation of COPD. The intensivist recognized that the schizophrenia interfered with access to stable housing and outpatient inhalers for COPD and led to nutritional deficits with poor access to food. As a result, the team prioritized identifying and engaging the patient's social network to support the patient during and after the critical illness period (e-Appendix 6).

Clinicians specifically considered food security for apparently malnourished patients, patients admitted with volume overload, and patients with severe metabolic derangements. For patient C5, the intensivist mentioned that the patient "could be a possible lung transplant candidate . . . if he stops smoking and manages to put on some more weight." The intensivist also confessed to having additional worries about the patient "having lost a lot of weight despite having food security." The intensivist explained that the patient's BMI was extremely low, around 15 kg/m², and that the team should contact the dietician to help "up the patient's calorie intake." In this example, the intensivist engaged the nutritionist and social worker to see the patient on noting clinical malnourishment. In this context, nutritionists provided broader counseling on types of diets and social workers recommended postdischarge food delivery services. After one patient transferred out of the ICU, the social worker specifically explored the patient's neighborhood and provided information regarding local food banks.

Intensivists identified discrimination as a barrier to accessing care, specifically when clinician bias led to patients being labeled as so-called frequent flyers, a derogatory term describing super-users of acute care that promotes stigmatization (patient C6).³⁵ Intensivists and the primary reporting clinicians recognized that these patients, who lacked access to sufficient outpatient care, showed high use of acute care resources and that ultimately critical illness developed. Intensivists discussed the importance of early attention to and prioritization of outpatient care plans for these patients, including engagement of social supports to ensure the feasibility of proposed plans.

Engaging in Decisions on Life-Sustaining Therapy

Clinicians explored patients' values during decisions to initiate, continue, or forgo life-sustaining therapy, contextualized on the backdrop of the patient functional status before critical illness. Clinicians reviewed patients' employment status and hobbies, how they physically moved through their houses and communities, and who they lived with or depended on for assistance with basic needs. This narrative oriented the goals of critical care to restoring patients to a prior baseline or estimating declines from that baseline after

the acute illness. Ultimately, clinicians used this information to prognosticate outcomes with or without life-sustaining interventions. Conversations were documented in detailed notes and discussions were summarized on rounds. Family members were asked to comment when present. Clinicians asked what patients and family members understood about the patient's medical conditions and what had transpired during the hospital course during these discussions. Clinicians referred to this patient and caregiver knowledge as *health literacy*. Clinicians assessed adequacy of health literacy and used this information in explaining value-aligned critical care. In one example, the reporting clinician relayed that "multiple notes [state] the patient has not been easy to contact as an outpatient, but this is because the patient is frustrated with their outpatient pulmonary providers and is not interested in repeating a lung cancer workup and doing a ton of testing" (patient B7). ICU clinicians explored patient preferences to elicit reasons for why this patient's health literacy and adherence were perceived to be poor and used this information to reengage the patient in discussions of lung transplant in the ICU.

Delineating Care Transitions

Care transitions occurred from the ICU to a hospital ward or a facility (nursing home, rehabilitation, or hospice) and, less frequently, directly home. During transitions, clinicians facilitated access to longitudinal care by scheduling outpatient appointments. When family members or caregivers participated in rounds, clinicians provided reassurance of nonabandonment and that the patient would be cared for after ICU discharge. In one example, the team expressed confusion about "the relationship between the patient and caregivers at home." Going on to note that "the medical record states the patient lives at home with his brother but the sister is the formal caregiver. The team discusses they will need to clarify who is primarily managing the patient at home and whether they would feel comfortable with having him come home," before beginning discharge planning (patient B3).

Patients and caregivers raised concerns about financial implications of facility-based care and how transfer to a rehabilitation facility from the ICU might be "cost prohibitive." For example, patient C22 desired inpatient psychiatric rehabilitation closer to family and friends out of state, which insurance would not cover. For many patients, clinicians engaged social workers and case managers to discuss insurance, transportation, and costs of daily care (eg, tracheostomy care, hemodialysis) with the patient and family as part of the decision-making process.

During rounds, participating family members questioned the quality and safety of the home environment for enabling recovery, particularly for patients who lived alone or who demonstrated significant physical disability during critical illness. One patient's spouse mentioned on rounds that "the patient [is] 'just lying around' [at home] and wondering if that is inhibiting further improvement. She justifies her concern by mentioning that 'something's been off since the last [treatment] in December'" (patient C3). Primary reporting clinicians did not discuss her concerns on rounds further, deferring to consulting physical and occupational therapists. Primary reporting clinicians often discussed functional or home safety concerns with social workers on learning this information. In some instances,

social workers realized this information before the primary reporting clinician, fellow physician, or intensivist and alerted the clinicians to engage physical and occupational therapy in the patient's care or to discuss these issues directly with caregivers.

Patient C16 was admitted with decompensated liver failure, and the possibility of liver transplantation directly impacted the course during the hospital stay and after discharge (e-Appendix 6). Multidisciplinary transplantation evaluation team members saw the patient regularly, including hepatologists, psychiatrists, social workers, and nutritionists. The patient underwent an extensive psychosocial evaluation while hospitalized. Clinicians recognized the patient's substance use disorder may impact the patient's transplant candidacy before transfer from the ICU, and the medical wards team coordinated multiple home visits after discharge to ensure access and adherence to medications, nutrition education, and substance use counseling.

Discussion

In this ethnographic study, we found that clinicians integrate select, limited information on patients' social structures (eg, social network, housing status, access to health care, and access to foods) into their clinical care, often to inform their understanding of ARF development and to guide preference-sensitive decisions on life-sustaining therapy and care transitions. However, no systematic approach to asking about or discussing SDOHs was found. Although the multidisciplinary team often was engaged to address select SDOHs, clinicians did not routinely do so with all SDOHs, with individual comfort and workflow being apparent limitations.

Because the social information clinicians collect is not standardized, this process is highly vulnerable to bias. Challenges to collecting this information in the ICU setting include that patients often are intubated, sedated, delirious, or otherwise unable to communicate. Therefore, clinicians rely heavily on information gathered unsystematically either from family or caregivers, who may not be available or aware of the patient's social structures; from the EMR, where SDOHs information may not be updated nor accurate; or from both. Although ICU clinicians do incorporate SDOHs into some aspects of critical care, missed opportunities remain to assess social contributors to critical illness in a standardized manner and to limit bias and maximize the actionable benefits of conducting unbiased assessments of social risk.

Our framework identified key time points to assess SDOHs during critical illness, given current clinician practice: (1) when understanding the cause of ARF, (2) during decisions on life-sustaining therapies, and (3) at care transitions. The multidisciplinary ICU team could be leveraged to collect this information by maximizing the contribution of nurses, social workers, and physical or occupational therapists. All multidisciplinary team members, as relevant for their area of expertise, should contribute to a critical care social needs assessment. This assessment could be incorporated into an existing ICU checklist³⁴ or during routine clinician handoffs (ie, as a new clinical team takes over care). In all cases, SDOH assessments should prioritize the SDOH domains most associated with individualized patient outcomes and the moments when the information is most clinically

actionable. For example, clinician biases pervade discussions on death and care at the end of life, enhancing racial and socioeconomic status inequities.^{36,37} A standardized assessment of SDOHs before initiating goals of care discussions may highlight individualized values, prior trauma, or other relevant lived experiences, thereby promoting clinician connectedness to patients and their caregivers. This builds mutual trust and respect while overcoming implicit bias when conducted in a way that also minimizes concerns that such information may increase, rather than decrease, bias.

Our study has many strengths including the novel methods, contextual considerations to the ICU, and breadth of clinicians included, yet also has limitations. First, we elected not to make ethnographic observations during highly sensitive goals-of-care family meetings. These topics did come up during rounds, including brief discussions between families present during rounds and clinicians, and we conducted EMR review that including documentation of family meetings and goals-of-care discussions. Therefore, we believe we captured most of these data. Second, clinicians may have changed their behavior or language or may have included content as a result of observations. Given the intentional, knowledge-seeking, and unobtrusive role of the ethnographer in these methods, we believe this is attenuated somewhat in the context of a busy clinical setting where clinician cognitive load already is significant.³⁸ We also limited information about the specific goals and aims of the study to minimize this effect. Third, observers may have introduced personal bias. We mitigated against this by including three observers of different professional roles and backgrounds, collectively reflected on how these identities influenced and interacted with observations throughout the collection and analysis of data, and analyzed the data together with many layers of review. Fourth, our focus on ARF included a heterogeneous population in the ICU, yet may have excluded groups known to experience disparities in ICU outcomes (eg, patients with diabetic ketoacidosis).^{4,26,28,39} Fifth, our findings may represent a specific cultural context based on geography, health system, and ICU structures specific to the local environment, which includes a high proportion of Black and low-income residents in the areas the ICUs serve.^{40,41}

Interpretation

Identifying actionable SDOHs during critical illness has significant potential to reduce known disparities in critical care outcomes. Clinicians routinely, yet unsystematically, address a narrow portion of SDOHs in the ICU, highlighting opportunities for establishing the role of patient-tailored and caregiver-tailored assessments of SDOHs in the ICU setting, validity of SDOH information from surrogates for critically ill patients, and identification of which SDOHs are most associated with poor outcomes or protective of good outcomes to tailor future interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS:

ARF	acute respiratory failure
CDC	Centers for Disease Control and Prevention
EMR	electronic medical record
SDOH	social determinant of health

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Take-home Points

Study Question:

How do critical care clinicians integrate social determinants of health (SDOHs) into clinical care?

Results:

SDOHs are discussed infrequently in the ICU, yet opportunities exist to incorporate them intentionally into interdisciplinary team communication related to the cause of critical illness, decisions on life-sustaining treatment, and transitions of care.

Interpretation:

Routine incorporation of SDOHs in ICU work rounds has value, and prospective patient-centered and family-centered methods are needed to evaluate which SDOHs are most relevant to discuss.

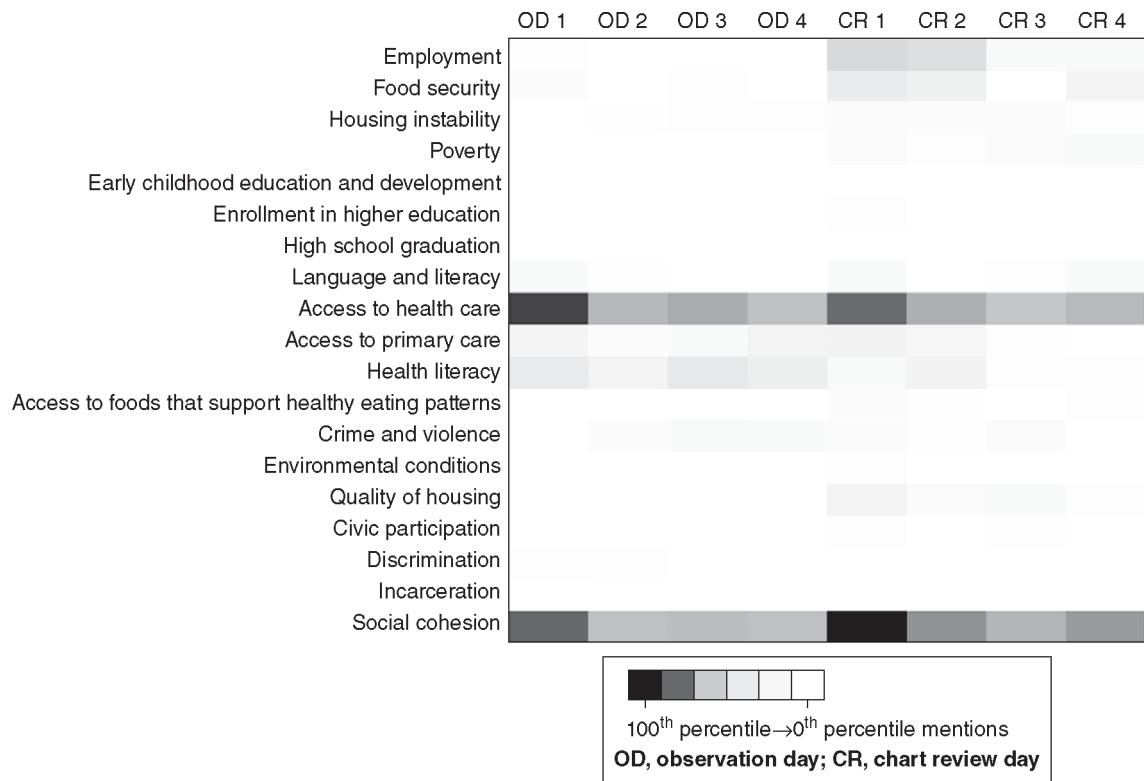
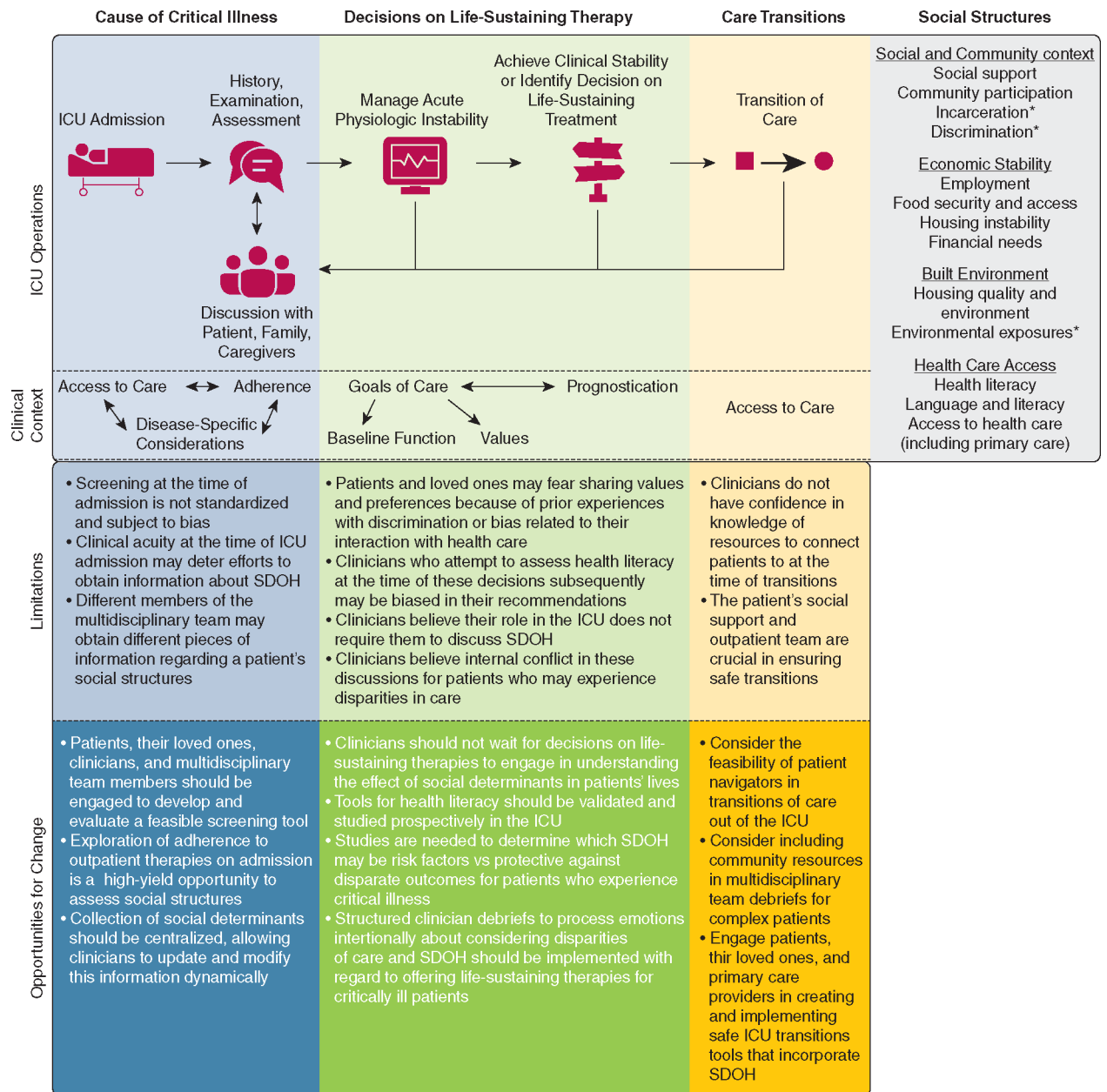


Figure 1 –. Frequency of social structure issues coded by associated social determinant subdomain (along y-axis) mentioned on sequential days during work rounds and in the electronic health record during chart review (along x-axis). Frequency counts have been adjusted for the number of patients observed and chart reviewed each day (eg, 66 patients on day 1, 55 patients on day 2 after 11 patients died or were transferred, and so on). Black indicates the 100th percentile of frequency of mentions (defined as social determinants of health mentions by patient-day divided by the total possible patient-days), gray indicates the 50th percentile, and white indicates the 0th percentile.



ICU, intensive care unit; SDOH, social determinant of health

Figure 2 – Pictorial representation of three time points in critical care workflow when the discussion of social structures in a patient's life may impact clinician decision-making, patient outcomes, or both with relevant clinical context themes. Additionally, we provide limitations commonly encountered at each time point, possible opportunities for system-level change, and a list of social structures that would be useful to consider in a screening instrument at any one of these three time points. SDOH = social determinants of health.

TABLE 1

Patient Characteristics Within the Cohort

Characteristic	Data
Hospitals	
A	26
B	18
C	22
Age on admission, y, median	64 (54–73)
Criterion for acute respiratory failure	
> 6 L/min by nasal cannula	2 (3.0)
CPAP or BPAP	23 (34.8)
High-flow nasal cannula	13 (19.7)
Mechanical ventilation	28 (42.4)
Female sex	31 (47.0)
Hispanic ethnicity	2 (3.0)
Race	
White	15 (22.7)
Black	43 (65.2)
Asian	2 (3.0)
Native Hawaiian or Other Pacific Islander	1 (1.5)
Not defined	5 (7.6)
Primary language	
English	60 (91.7)
Spanish	2 (3.0)
Vietnamese	2 (3.0)
Nepalese	1 (1.5)
Unknown	1 (1.5)
Insurance status (primary coverage)	
Private	15 (22.7)
Medicare	23 (34.8)
Medicaid	21 (31.8)
Other	8 (12.1)
Admission code status	
Full	56 (84.8)
Limited	4 (6.1)
Do not resuscitate/do not intubate	6 (9.1)
Next of kin listed at the time of admission	64 (97.0)
Admission diagnosis	
Sepsis	15
Acute encephalopathy	4
Acute exacerbation of obstructive lung disease	9
Decompensated heart failure	7

Characteristic	Data
Volume overload related to end-stage renal disease	7
Cardiac arrest	5
Aspiration	3
COVID-19	2
Drug-induced pneumonitis	2
Other ^a	12
Charlson comorbidity index	5.5 (3–8)
APACHE II score	22.5 (15–30)
APACHE IV score	74 (55–100)
ICU LOS, d	3 (2–7)
Hospital LOS, d	10 (7–18)
Discharge disposition	
Home or community dwelling	33 (50.0)
Skilled nursing facility	13 (19.7)
Acute care rehabilitation facility	2 (3.0)
Long-term acute care hospital	2 (3.0)
Home hospice	1 (1.5)
Inpatient hospice	1 (1.5)
Died in the hospital	9 (13.6)
Still hospitalized at 30 d	5 (7.6)
Readmitted within 30 d of discharge	6 (9.1)
Died within 90 d	16 (24.2)

Data are presented as No., No. (%), or median (interquartile range). APACHE = Acute Physiology and Chronic Health Evaluation; BPAP = bilevel positive airway pressure; LOS = length of stay.

^aIncludes acute pulmonary embolism, anaphylaxis, atelectasis, carbon monoxide poisoning, cardiogenic shock, diffuse alveolar hemorrhage, epiglottitis, hepatopulmonary syndrome, hypoventilation, pneumothorax, status epilepticus, and upper GI bleed.

TABLE 2

Numeric Count of Whether Each Centers for Disease Control and Prevention-Defined Social Determinant of Health Was Mentioned During Work Rounds Observation in the ICU

SDOHs Domain	Specific SDOH	Total Chart Review Mentions ^a	ICU Observation Mentions					Examples
			Total	Day 1 (n = 66)	Day 2 (n = 55)	Day 3 (n = 41)	Day 4 (n = 23)	
Economic stability	Employment	60	5	3	1	1	0	"[T]he patient . . . experienced a cardiac arrest while at Amtrak, their place of employment. They describe how the patient was found by their coworkers and outlines the resuscitation efforts of EMS and the ED" (patient A16)
	Food security	38	7	5	0	2	0	"The attending reports that access to water might be an issue for the patient and states they could be 'someone without food security' and as a result, these metabolic derangements are related." (patient A11)
	Housing instability	20	7	2	2	2	1	"The attending also confesses that they have additional worries about the patient 'becoming socially isolated' in addition to the patient having lost a lot of weight 'despite having food security.'" (patient C5) "[T]he reporting clinician mentions that the patient has 'housing insecurity' and is 'currently unhoused' and essentially 'living on the street'" (patient A11) "They report the patient has declined BIPAP while here and since she wouldn't be able to go home with BIPAP, and the attending clarifies 'the patient doesn't have a home to deliver it to,' and they are just treating them with O2 by nasal cannula for now." (patient A11) "[T]he reporting clinician mentions the patient lives in West Philly with caretaker but was just at [rehabilitation]." (patient A14)
Education access and quality	Poverty	14	0	0	0	0	0	"[T]he reporting clinician reveals that the patient has been in assisted living since their last hospitalization, but it is not their permanent place of residence." (patient C6)
	Early childhood education and development	0	0	0	0	0	0	N/A
	Enrollment in higher education	6	1	0	1	0	0	"[T]hat the patient has friends at [the hospital] who the reporting clinician assumes are college friends, who have been contacting [the hospital] physicians and staff in order to get covert updates on the patient's wellbeing." (patient C12)
	High school graduation	3	0	0	0	0	0	N/A
	Language and literacy	21	9	7	2	0	0	"They attending is reviewing other notes in the chart as they are wrapping up and mentions that the patient is from Trinidad. The reporting clinician comments that [the patient] did have an accent and it was difficult to tell with their BIPAP on what type of accent it was, but that makes sense." (patient B9) "The attending emphasized that it is key that the son understands (through an interpreter) that the patient shouldn't be forced to eat and that there are meds that home hospice provides

SDOHs Domain	Specific SDOH	Total Chart Review Mentions ^a	ICU Observation Mentions					Examples
			Total	Day 1 (n = 66)	Day 2 (n = 55)	Day 3 (n = 41)	Day 4 (n = 23)	
Health care quality and access	Access to health care	328	89	40	30	12	for pain and anxiety and that there is a phone number that he can call for hospice.” (patient B18) “The attending mentions ‘there is a language barrier’ so we can’t understand what the patient is saying and their son is the only one able to translate.” (patient C7) “The attending also points out the instructions for the medications are in Spanish, which is reassuring that they were actually being given to the patient by someone he was following with who knew [the patient] was Spanishspeaking.” (patient C24) “There is discussion of [the patient] having severe asthma as an outpatient, using rescue inhaler multiple times a day and then running out.” (patient B6)	
		43	10	4	4	3	“They discuss the patient’s HD follow-up will have to be assured, they don’t see any outpatient renal notes, given [the patient] came in volume overloaded and hyperkalemic and hopefully [the patient] was not having this in between HD sessions before.” (patient C24) “The attending asks if the patient has a PCP and whether there is someone to ‘quarterback’ the issue of the patient’s 30-lb weight loss. The reporting clinician explains they will clarify this with the patient and writes this down.” (patient B12) “Patient does not have a PCP so attending does home care orders.” (patient C6)	
Neighborhood and built environment	Health literacy	61	17	9	10	4	“A team member then questions what the patient ‘looks like as an outpatient,’ to which the attending mentions a primary care visit on May 20th of this year.” (patient C2) “The attending then asked the reporting clinician to call the echo lab to get a comment on the [imaging study] and to order steroids but to not give it to [the patient] until either the attending or the reporting clinician explains it to [the patient] since the patient ‘doesn’t believe in steroids.’” (patient B16)	
	Access to foods that support healthy eating patterns	11	2	0	1	0	“The reporting clinician reports this has all really been a ‘medical literacy’ issue because the patient will take some medications and not others.” (patient A13) “[T]he attending mentions that after a conversation with the patient, it is clear that he ‘understands the disease and wants to get better.’” (patient C5)	
	Crime and violence	21	0	4	4	2	“The attending reports that the patient is lymphopenic and reports that a number of the patients admitted to the ICU are actually lymphopenic in the setting of sepsis and this could represent nutritional deficits or chronic myelosuppression from alcohol, for example, if she was still drinking. The attending states ‘infection signs might be difficult.’” (patient A11) “The reporting clinician clarifies that the patient . . . presented to the ED after an assault, and was originally assessed for trauma.” (patient A19)	
Environmental conditions	Environmental conditions	6	1	1	0	0	“The reporting clinician mentions that the patient worked in heating and air conditioning for years before retiring in 2020, and states that it could be a possible cause of their lung issues.” (patient C11)	
	Quality of housing	24	2	1	0	0	“They relay the story that the patient was climbing the steps leading into their home when they became acutely short of breath.” (patient B5)	

SDOHs Domain	Specific SDOH	Total Chart Review Mentions ^a	ICU Observation Mentions					Examples
			Day 1 (n = 66)	Day 2 (n = 55)	Day 3 (n = 41)	Day 4 (n = 23)	Total	
			0	0	0	0		
Social and community context	Civic participation	7	0	0	0	0	N/A	
	Discrimination	8	4	3	0	0	"[H]ighlighting the differences between sickle cell disease and cystic fibrosis research and treatment due to differences in advocacy and 'demographic information.' The care team agrees, and one member . . . mentions that cystic fibrosis receives 8x the research funding that sickle cell disease receives." (patient C4)	
	Incarceration	3	2	0	1	0	"[T]he attending mentioned that the patient's pulse ox values could be inaccurate because of his skin tone." (patient B13)	
	Social cohesion	386	80	36	25	12	"The reporting clinicians mentions the patient has history of DM since [the patient] was a teenager, subsequently was incarcerated and stopped taking medications at that time and [the patient's] diabetes was uncontrolled as a result." (patient B8) "The reporting clinician replied by noting that they don't think he has any family and that he just joined the group home so they have limited information." (patient B13)	

Total No. of patient-days during which each SDOH is listed in sum for chart review and then by ICU observation day. In the header, n is total number of patient-days observed (or total possible SDOH mentions for each category). DM = diabetes mellitus; EMS = emergency medical services; HD = hemodialysis; N/A = not available; PCP = primary care physician; SDOH = social determinant of health.

^aInclude up to 4 days of ICU admission and subsequent 30 days after discharge from the ICU.