Commentary

Integrating social and behavioral determinants of health into patient care and population health at Veterans Health Administration: a conceptual framework and an assessment of available individual and population level data sources and evidence-based measurements

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### Appendix Table

**Appendix Table.** Recommended measures and data sources to address social and behavioral determinants of health in VHA primary care clinics.

| SBDH Domains     | SBDH Sub-domains   | Recommended Measures                                                                 | Data Source & Data Level |
|------------------|--------------------|---------------------------------------------------------------------------------------|--------------------------|
| Sociodemographic | Sexual Orientation | Sexual orientation—identified by an individual  
Gender identity—recorded on individual’s birth certificate or the gender an individual identifies with  
Sexual behavior—preference for sexual relationship | EHR^{1,2,3} Individual Level Data |
| Race/Ethnicity   |                    | American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White, and other. Ethnicity includes two categories: Hispanic or Latino, and Not Hispanic or Latino | EHR^{2,3,4,5,6} Individual Level Data |
| Country of Origin|                    | U.S. born or non-U.S. born and spoken language or preferred language for healthcare   | EHR^{2,3,4,5,6} Individual Level Data |
| Education        |                    | Number of years of time formally spent in school and the highest degree earned        | EHR^{2,6} Individual Level Data |
| Employment       |                    | Formal paid labor market (including self-employment) and type of employment and the conditions that this implies, including exposure to health risks and hazards in the workplace, income, stress, and provision of health care insurance | EHR^{2,6} Individual Level Data |

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| SBDH Domains   | SBDH Sub-domains       | Recommended Measures                                                                 | Data Source & Data Level       |
|---------------|------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| Sociodemographic | Financial Resource Strain | Food Insecurity Public Assistance Food Access                                          | EHR Individual Level Data² & ⁸, Food Access Research Atlas⁹ Population Level Data |
|               |                        | Those using SNAP program for public assistance food access                             |                                |
|               |                        | Individual’s Food Intake NHANES III¹⁰—Which of the following describes the amount of food patient’s household has to eat: Enough to eat, Sometimes not enough to eat, Often not enough to eat | Individual Level Data          |
|               |                        | Housing Insecurity* Multiple moves, crowding, and foreclosure                          | EHR² Individual Level Data     |
| Psychological | Health Literacy²       | The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions | EHR²,³,⁶ Individual Level Data |
|               | Stress                 | Stress means a situation in which a person feels tense, restless, nervous or anxious or is unable to sleep at night because his/her mind is troubled all the time. Does patient feel these kinds of stress these days? A 5-point Likert scale response varying from 1 “not at all” to 5 “very much” | EHR²,³,⁶ Individual Level Data |

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| SBDH Domains  | SBDH Sub-domains                  | Recommended Measures                                                                 | Data Source & Data Level |
|---------------|-----------------------------------|---------------------------------------------------------------------------------------|--------------------------|
| Psychological | Negative Mood & Affect            | PHQ-2 Questionnaire<sup>3,11</sup>—Over the past 2 weeks, how often has the patient been bothered by any of the following problems: 1. Little interest or pleasure in doing things Not at all, Several days, More than half the days, Nearly every day 2. Feeling down, depressed or hopeless Not at all, Several days, More than half the days, Nearly every day | EHR<sup>2,3,6</sup> Individual Level Data |
| Psychological | Conscientiousness, Patient engagement/Activation, Optimism, and Self-efficacy<sup>2</sup> | NIH toolbox self-efficacy survey; the extent to which an individual believes in their ability to change, contains 10 questions measured on a scale of 0-100 in intervals of 10 (0 = minimum 100 = max self-awareness/ability to change) | EHR<sup>2</sup> Individual Level Data & NIH Toolbox<sup>12</sup> Population Level Data |
| Behavioral    | Dietary Patterns                 | Fruits and vegetables spending; average annual fruit and vegetable spending per household and average annual spending on food at home by type of food (information on different eating habits of communities in terms of consumption of food, beverages, organic vs non-organic) | National Household Food, Acquisition and Purchase Survey (FoodAPS)<sup>13</sup>, ESRI Consumer Spending Database, American Time Use Survey Eating and Health<sup>14</sup> Population Level Data |

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| SBDH Domains       | SBDH Sub-domains                          | Recommended Measures                                                                                                                                                                                                 | Data Source & Data Level              |
|--------------------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Behavioral         | Physical Activity                        | On average, how many days per week does the patient engage in moderate to strenuous exercise (like walking fast, running, jogging, dancing, swimming, biking, or other activities that cause a light or heavy sweat)? On average, how many minutes does the patient engage in exercise at this level? | EHR² Individual Level Data            |
|                    | Tobacco Use and Exposure                  | NHIS³,⁵—First or second hand smoking, current/past smoker duration, and quantity                                                                                                                                          | EHR²,³ Individual Level Data          |
|                    | Alcohol Use                              | AUDIT-C¹⁶—How often does the patient have a drink containing alcohol? Never, Monthly or less, 2–4 times a month, 2–3 times a week, 4 or more times a week How many standard drinks containing alcohol does the patient have on a typical day? 1 or 2, 3 or 4, 5 or 6, 7 to 9, 10 or more How often does the patient have six or more drinks on one occasion? Never, Less than monthly, Monthly, Weekly, Daily or almost daily | EHR²,³ Individual Level Data          |
|                    | Social Relationship                       | The proportion not currently married (% unmarried ages ≥ 15: overall population and for race and ethnicity) and also living arrangement (the percentage of people living alone, or living with an unmarried partner) | EHR²,³,⁶ Individual Level Data        |

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| SBDH Domains                  | SBDH Sub-domains                                      | Recommended Measures                                                                                                                                                                                                 | Data Source & Data Level                                      |
|------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Social Relationship          | Social Connections and Social Isolation \(^{17,18,19,20,21}\) | Estimates of how, where, and with whom Americans spend their time, and the full range of nonmarket activities, from childcare to volunteering                                                                                       | The American Time Use Survey \(^{14}\) Population Level Data Data |
|                              | Violence Exposure                                     | Behavior that threatens, attempts or causes physical harm—HARK self-reported instrument;\(^{22}\)                                                                                                                          | EHR\(^2,3\) Individual Level Data                            |
|                              |                                                       | Within the last year, has the patient been humiliated or emotionally abused in other ways by the partner or ex-partner? Yes No                                                                                         |                                                              |
|                              |                                                       | Within the last year, has the patient been afraid of the partner or ex-partner? Yes No                                                                                                                                  |                                                              |
|                              |                                                       | Within the last year, has the patient been raped or forced to have any kind of sexual activity by the partner or ex-partner? Yes No                                                                                  |                                                              |
|                              |                                                       | Within the last year, has the patient been kicked, hit, slapped, or otherwise physically hurt by the partner or ex-partner? Yes No                                                                                  |                                                              |
| Neighborhood Compositional   | Natural Environment                                   | Number of person-days with maximum 8-h average ozone concentration over the national ambient air quality standard (monitored and modeled data)                                                                    | CDC Environmental Public Health Tracking Network\(^24\) Population Level Data |
| Characteristics              | Air Quality\(^{23}\)                                  | Number of person-days with PM2.5 over the national ambient air quality standard (monitored and modeled data)                                                                                                         |                                                              |

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| SBDH Domains                 | SBDH Sub-domains             | Recommended Measures                                                                 | Data Source & Data Level                                                                 |
|-----------------------------|------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Neighborhood Compositional Characteristics | Natural Environment | Water Quality                                                                        | Percent of population potentially exposed to water exceeding a violation limit during the past year | States’ Safe Drinking Water Act Databases—Safe Drinking Water Information System^{25} |
|                             |                              | Childhood Lead Poisoning Levels^{26}                                                 | State surveillance data for children age < 72 months who were tested for lead at least once since January 1, 1997 | CDC National Surveillance Data^{27} |
| Physical/Built Environment  | Housing^{17,18,23,28,20,30,31,32,33,34,35,36,37,38} | Housing Characteristics                                                              | Number of units in structure, year structure built, number of rooms, average household size, house heating fuel, plumbing, kitchen facilities, available telephone service, occupants per room, value of the house | ACS^{8} Population Level Data |
|                             |                              | Housing Insecurity*                                                                  | Geographical mobility in the past year for current residence-state, county and place level, residential stability, housing unit vacancy rate, Homeownership Rate | ACS^{8} and The American Housing Survey^{39} Population Level Data |

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| SBDH Domains                          | SBDH Sub-domains      | Recommended Measures                                                                 | Data Source & Data Level                        |
|--------------------------------------|-----------------------|--------------------------------------------------------------------------------------|-----------------------------------------------|
| Neighborhood Compositional Characteristics | Physical/Built Environment Housing | Homelessness Annual PiT estimates of homelessness in different population in a single night | Department of Housing and Urban Development Population Level Data |
|                                      |                       | Walkability and Access\(^{41,42,43,44,45}\) Geographical Characteristics of Living Space Mode of transportation | 2000 Census Population Level Data | ACS\(^{8}\) and Transit data\(^{46}\) Population Level Data |
|                                      |                       | Walkability Index Composite measure: density-residential and employment (total activity units per acre of land); diversity-land use and destinations (range of land uses by census tract); design-built environment and safety feature (Number of street crossings by census tract); distance- transit accessibility (aggregate frequency of transit service per square mile) | ACS\(^{8}\) and Transit data\(^{46}\) Population Level Data |
|                                      |                       | Street Connectivity Intersection density (number of three-way or greater intersections per unit area) | ACS\(^{8}\) Population Level Data |

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| SBDH Domains                          | SBDH Sub-domains       | Recommended Measures                  | Data Source & Data Level |
|--------------------------------------|------------------------|---------------------------------------|--------------------------|
| Neighborhood Compositional Characteristics | Physical/Built Environment | Walkability and Access<sup>41,42,43,44,45</sup> Access to Healthy Food Options | Food insecurity/food desert |
|                                      |                        |                                       | Food Access Research Atlas<sup>9</sup> Population Level Data |
|                                      |                        |                                       | referenceUSA<sup>47</sup> ESRI Business Analyst Data, <sup>48</sup> U.S. Census Bureau; County Business Patterns<sup>49</sup> Population Level Data |
|                                      |                        |                                       | U.S. Census Bureau; County Business Patterns<sup>49</sup> Population Level Data |
|                                      |                        |                                       | Continued on next page   |
| SBDH Domains                  | SBDH Sub-domains                          | Recommended Measures                                      | Data Source & Data Level                               |
|-------------------------------|-------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------|
| Neighborhood Compositional Environment | Physical/Built Environment                | Walkability and Access<sup>41,42,43,44,45</sup>          | American Hospital Association Data<sup>50</sup> Population Level Data |
|                               |                                           | Access to Healthcare Facility                             |                                                      |
|                               |                                           | Distance from healthcare facility (address/zip code of healthcare facilities) |                                                      |
| Socio-economic                | Social Deprivation Index<sup>19</sup>     | Composite measure: percent living in poverty; black; less than 12 years of schooling; single parent households; single occupant households; percent living in overcrowded conditions (more persons in a dwelling unit than number of rooms); percent of households without a car; percent with high needs measure (the percent of the population under the age of 5 and female between the ages of 15 and 44); and percent of 18- to 64-year old that are unemployed | ACS<sup>8</sup> Population Level Data |
| Social Characteristics of Neighborhood | Income<sup>23,51</sup>                          | Median household income, income self-reported into categories (<$15k; $15k-29,999; 30k-44,999; 45k-59,999; 60k-89,999, >/=90k) | ACS<sup>8</sup> Population Level Data |
|                               | Education<sup>52</sup>                      | School enrollment by detailed level of school for the population 3 years and over, educational attainment for the population 25 Years and over | ACS<sup>8</sup> Population Level Data |
|                               | Employment<sup>30</sup>                      | Detailed occupation for the full-time, year-round civilian employed population 16 years and over | ACS<sup>8</sup> Population Level Data |

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| SBDH Domains                              | SBDH Sub-domains        | Recommended Measures                                                                 | Data Source & Data Level                      |
|------------------------------------------|-------------------------|--------------------------------------------------------------------------------------|----------------------------------------------|
| Neighborhood Compositional Characteristics | Socio-economic          | Social Characteristics of Neighborhood Socioeconomic Index<sup>3,5</sup>               | ACS<sup>8</sup>, Population Level Data      |
|                                          |                         | Recommended Measures: percentage of adults age 25 years or older with less than a high school education; percentage of men who are unemployed; percentage of households with income below the poverty level; percentage of households receiving public assistance; percentage of households with children in which the head of household is female; and median household income. |
|                                          |                         | Denial of the loan and the reason for denial, loan delinquency defined as delinquent loans and leases are those past due thirty days or more and still accruing interest as well as those in nonaccrual status. |
| Economic Distress                        |                         | Health insurance, Medicare, VHA healthcare coverage status by age and sex             | Federal Financial Institution Examination Council<sup>4</sup>, The Federal Deposit Insurance Corporation<sup>5</sup>, Population Level Data |
| Healthcare Access                        |                         | Dissimilarity index (most common measure), isolation index, index of concentration at extremes (ICE), Atkinson Index, entropy, Gini coefficient, the Getis-Ord Gi* statistic. |
| Race/Ethnicity                           | Neighborhood-level Racial Residential Segregation<sup>3,56,57</sup> |                                                                                     | Census 2010 Population Level Data            |

Note: * There are overlaps among different domains of SBDH. For instance, housing insecurity would be included in two different domains.

ACS: American Community Survey, AUDIT-C: Alcohol Use Disorders Identification Test (AUDIT), CDC: Center for Disease Control and Prevention, EHR: Electronic Health Record, ESRI: Environmental Systems Research Institute, HARK: Humiliation, Afraid, Rape, Kick. A 4 item questionnaire to identify intimate partner violence, NHANES III: the third National Health and Nutrition Examination Survey, NIH: National Institute of Health, NIHS: National Health Interview Survey, PHQ-2: Patient Health Questionnaire-2, PiT: Point-in-Time, PM2.5: atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometers, SBDH: Social and Behavioral Determinants of Health, SNAP: Supplemental Nutrition Assistance Program, VHA: Veterans Health Administration.
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