Supplemental materials for:

Ngongo WM, Peterson J, Lipiszko D, et al. Examining how social risk factors are integrated into clinical settings using existing data: a scoping review. *Ann Fam Med*. 2023;21(Suppl 2):S68-S74.

Supplemental Appendix 1 . Embase Search Strategy

Concept #1: Social Determinants of Health (3641525)

'social determinants of health'/exp OR 'health disparity'/exp OR 'health care disparity'/exp OR 'health equity'/exp OR 'health literacy'/exp OR 'social justice'/exp OR 'community medicine'/exp OR 'cultural competence'/exp OR 'transcultural care'/exp OR 'gender identity'/exp OR 'sexuality'/exp OR 'sexual and gender minority'/exp OR 'refugee'/exp OR 'migrant'/exp OR 'racism'/exp OR 'social discrimination'/exp OR 'prejudice'/exp OR 'vulnerable population'/exp OR 'health care planning'/exp OR 'communication barrier'/exp OR 'translating (language)'/exp OR 'socioeconomics'/exp OR 'social class'/exp OR 'medically uninsured'/exp OR 'domestic violence'/exp OR 'partner violence'/exp OR 'minority health'/exp OR 'health care delivery'/exp OR ‘social determinants of health’:ti,ab OR ‘social determinant*’:ti,ab OR ‘social determining factor’:ti,ab OR ‘social factors determining health’:ti,ab OR ‘social health determinant’:ti,ab OR ‘health status disparit*’:ti,ab OR ‘health disparit*’:ti,ab OR ‘healthcare disparit*’:ti,ab OR ‘health care disparit*’:ti,ab OR ‘health equit*’:ti,ab OR ‘health literacy’:ti,ab OR ‘social justice’:ti,ab OR ‘community medicine’:ti,ab OR ‘cultural competenc*’:ti,ab OR ‘culturally competent care’:ti,ab OR ‘cross-cultural care’:ti,ab OR ‘cross-cultural health care’:ti,ab OR ‘cross-cultural healthcare’:ti,ab OR ‘culturally appropriate care’:ti,ab OR ‘culturally appropriate health care’:ti,ab OR ‘culturally appropriate healthcare’:ti,ab OR ‘cuturally competent healthcare’:ti,ab OR ‘culturally congruent health care’:ti,ab OR ‘culturally congruent healthcare’:ti,ab OR ‘trans-cultural care’:ti,ab OR ‘transcultural health care’:ti,ab OR ‘transcultural healthcare’:ti,ab OR ‘gender identity’:ti,ab OR ’gender minorit’:ti,ab OR ‘sex identification’:ti,ab OR ‘sexual identification’:ti,ab OR ‘sexual identity’:ti,ab OR ‘sexual and gender minoriti*’:ti,ab OR ‘sexualit*’:ti,ab OR ‘psychosexualit*’:ti,ab OR ‘sexual minorit*’:ti,ab OR ‘sexual habit’:ti,ab OR ‘sexual hygiene’:ti,ab OR ‘sexual partners’:ti,ab OR ‘sexual reinforcement’:ti,ab OR ‘sexual relation’:ti,ab OR ‘health services for transgender persons’:ti,ab OR ‘refuge*’:ti,ab OR ‘emigrants and immigrants’:ti,ab OR ‘migrant*’:ti,ab OR ‘racism’:ti,ab OR ‘ethnic bias’:ti,ab OR ‘ethnic discrimination’:ti,ab OR ‘ethnic prejudice’:ti,ab OR ‘ethnicism’:ti,ab OR ‘race discrimination’:ti,ab OR ‘racial bias*’:ti,ab OR ‘racial discrimination’:ti,ab OR ‘racial prejudice’:ti,ab OR ‘social discrimination’:ti,ab OR ‘prejudice’:ti,ab OR ‘vulnerable people’:ti,ab OR ‘vulnerable person’:ti,ab OR ‘vulnerable population*’:ti,ab OR ‘health care planning’:ti,ab OR ‘community health planning’:ti,ab OR ‘health and welfare planning’:ti,ab OR ‘healthcare planning’:ti,ab OR ‘medically underserved area’:ti,ab OR ‘underserved neighborhood’:ti,ab OR ‘communication barrier*’:ti,ab OR ‘translating’:ti,ab OR ‘economic value of life’:ti,ab OR ‘indigent health care’:ti,ab OR ‘socioeconomic factors’:ti,ab OR ‘socioeconomics’:ti,ab OR ‘social class’:ti,ab OR ‘sociocultural class’:ti,ab OR ‘socioeconomic class’:ti,ab OR ‘medical indigency’:ti,ab OR ‘medically uninsured’:ti,ab OR ‘underinsured’:ti,ab OR ‘uninsured’:ti,ab OR ‘domestic violence’:ti,ab OR ‘intimate partner violence’:ti,ab OR ‘partner violence’:ti,ab OR ’partner

abuse’:ti,ab OR ‘spouse abuse’:ti,ab OR ‘minority health’:ti,ab OR ‘health services accessibility’:ti,ab OR ‘health care planning’:ti,ab

AND

Concept #2: GIS (66642)

'geographic information system'/exp OR 'remote sensing'/exp OR 'spatial analysis'/exp OR 'geographic mapping'/exp OR 'satellite imagery'/exp OR ‘geographic* information system*’:ti,ab OR ‘GIS’:ti,ab OR ‘global positioning system*’:ti,ab OR ‘GPS’:ti,ab OR ‘Remote Sensing technolog*’:ti,ab OR ‘spatial analys*s’:ti,ab OR ‘geospatial analysis’:ti,ab OR ‘geospatial analyses’:ti,ab OR ‘geo spatial analysis’:ti,ab OR ‘geo spatial analyses’:ti,ab OR ‘kriging*’:ti,ab OR ‘spatial interpolation*’:ti,ab OR ‘spatial autocorrelation*’:ti,ab OR ‘spatial auto correlation’:ti,ab OR ‘spatial auto correlations’:ti,ab OR ‘spatial dependency’:ti,ab OR ‘spatial dependencies’:ti,ab OR ‘kernel density estimation’:ti,ab OR ‘kernel density estimations’:ti,ab OR ‘geographic mapping’:ti,ab OR ‘geographic cartography’:ti,ab OR ‘dasymetric mapping’:ti,ab OR ‘geocoding’:ti,ab OR ‘geo coding’:ti,ab OR ‘choropleth mapping’:ti,ab OR ‘georeferencing’:ti,ab OR ‘geo referencing’:ti,ab OR ‘satellite imagery’:ti,ab OR ‘satellite imageries’:ti,ab OR ‘moderate resolution imaging spectroradiometer':ti,ab OR ‘moderate resolution imaging spectroradiometers’:ti,ab OR ‘medical geography’:ti,ab OR ‘nosogeography’:ti,ab OR ‘geomedicine’:ti,ab OR ‘geographic information system*’:ti,ab OR ‘geographical information system*’:ti,ab OR ‘GIS’:ti,ab OR ‘global positioning system*’:ti,ab OR ‘GPS’:ti,ab OR ‘Remote Sensing Technology’:ti,ab OR ‘remote sensing technologies’:ti,ab OR ‘spatial analysis’:ti,ab OR ‘spatial analyses’:ti,ab OR ‘geospatial analysis’:ti,ab OR ‘geospatial analyses’:ti,ab OR ‘geo spatial analysis’:ti,ab OR ‘geo spatial analyses’:ti,ab

Total Citations: 17117
10 years (2008-2019): 12737
5 years (2013-2019): 8520

Supplemental Appendix 2 . Coding Manual: Title/Abstract Screening

Definitions:

- **Geographic information system (GIS):** GIS refers to a system where geographic information is stored in layers and integrated with geographic software programs so that spatial information can be created, stored, manipulated, analyzed and visualized (mapped). GIS is one form of geospatial technology (see below).

- **Geospatial:** The word "geospatial" is used to indicate that data has a geographic component to it. The record in a dataset have locational information tied to them such as geographic data in the form of coordinates, address, city, or zip code. Other than GIS, other types of geospatial data include GPS data, satellite imagery, and geotagging.

Checklist to code articles IN: Title and abstract must meet all 4 criteria to be coded "in" at screening phase.

1. **Include if discussing geospatial data or GIS programs.**

   Include if it is clear from the title and abstract that the article is either proposing, describing or studying a program related to geospatial/GIS data.
   Include articles that use language related to census track data such as "residential address" even if they do not explicitly say GIS/geospatial otherwise.

2. **Include if it's clear that GIS or geospatial data is being used to identify or address social determinants of health.**

   Include if it is clear that the use of GIS or geospatial data is used within a clinical or healthcare-system context. For example, do not include if the GIS or geospatial data is used to assess population-level health metrics that do not relate to SDOH or health disparities. However, DO include if geospatial data is used to identify patterns of disparities in care, access to health, etc….

   *The primary audience should be for clinicians or allied-health professionals. If it is clear from the article that the findings are related to, for example, public health planning, then the citation should be screened out.

   Example: If the study is surveying number of parks/green spaces in a city (which is related to social determinants of health), but does not have a clinical application – it should be screened out

   *Screen out papers that are primarily methodological or if the findings are primarily relevant for researchers studying GIS, but does not have a clear clinical application.

3. **Include if the paper has the intention of being used or has been used in a healthcare delivery setting**.

   Exclude descriptive studies such as articles that describe SDOH patterns, but do not go to the next step of INTERVENING or RECOMMENDING ways to act upon the SDOH or GIS/geospatial data. Include if the study is describing the process of how GIS/geospatial data is being presented to clinicians or healthcare delivery systems.

4. **Include if program is U.S. based and written in English.**

Do not include the article if the program was not based in the United States or is not written in English.

Note: the Data Extraction Form will ask to identify the type of article being reviewed by the following options. Upon meeting all 4 criteria, INCLUDE if the paper would fit into one of these categories:

- Theoretical report (ex. thought pieces about how geospatial data can be used)
- Descriptive (geospatial data was used; may have discussion with future recommendations)
- Intervention-based (geospatial data was used in an intervention; authors report outcomes or evaluations)

Supplemental Appendix 3. GIS Lit Review Data Extraction Questionnaire

Study Identifiers

- Title of reference (please copy and paste the title)
- Corresponding author
- Contact information
- Type of article
    - Theoretical report (ex. thought pieces about how geospatial data can be used)
    - Descriptive (geospatial data was used; may have discussion with future recommendations)
    - Intervention-based (geospatial data was used in an intervention; authors report outcomes or evaluations)
- Date of publication (year)
- Duration of intervention/time of data capture, if present

Clinical Setting

- Describe the healthcare setting (copy and paste)
- Clinical specialty/department
    - Internal Medicine
    - Family Medicine
    - OB/GYN
    - Pediatrics
    - Emergency Other
- If other, please clarify

Identifying Social Determinants of Health

- What SDoH topics were identified in the intervention?
    - Demographics (e.x., address, age, gender, language, race, ethnicity)
    - Household income
    - Health Insurance status
    - Homeless status
    - Alcohol use
    - Tobacco use and exposure
    - Depression
    - Education and learning
    - Financial resource strain
    - Intimate partner violence
    - Physical activity
    - Social connections and social isolation
    - Stress
    - Sexual orientation/gender identity
    - Food insecurity
    - Other
        - If other, please clarify
- Please copy and paste SDoH description
- Who were primarily responsible for eliciting SDoH information?

    - Data analyst
    - Medical students
    - Medical residents
    - Medical attendings
    - Medical assistants
    - Registered nurses
    - Nurse practitioners
    - Pharmacists
    - Social workers
    - Community health workers
    - Lawyers and paralegals
    - Other
        - If other, please clarify
- SDoH data source(s):
    - Census data
    - Community-level data (ex. community health needs assessment, etc.)
    - Tablet surveys
    - Paper questionnaire methods
    - In-person interviews
    - Other
- Please describe data source (copy and paste description)
- Was GIS or geospatial data used to identify the SDoH? (Yes; No)
- Describe how the intervention identified SDoH

Addressing Social Determinants of Health

- What SDoH topics were addressed in the intervention?
    - Demographics (e.x., address, age, gender, language, race, ethnicity)
    - Household income
    - Health Insurance status
    - Homeless status
    - Alcohol use
    - Tobacco use and exposure
    - Depression
    - Education and learning
    - Financial resource strain
    - Intimate partner violence
    - Physical activity
    - Social connections and social isolation
    - Stress
    - Sexual orientation/gender identity
    - Food insecurity
    - Other
        - If other, please clarify
- Please copy and paste SDoH description
- Who were primarily responsible for eliciting SDoH information?
    - Data analyst

    - Medical students
    - Medical residents
    - Medical attendings
    - Medical assistants
    - Registered nurses
    - Nurse practitioners
    - Pharmacists
    - Social workers
    - Community health workers
    - Lawyers and paralegals
    - Other
        - If other, please clarify
- SDoH data source(s):
    - Census data
    - Community-level data (ex. community health needs assessment, etc.)
    - Tablet surveys
    - Paper questionnaire methods
    - In-person interviews
    - Other
- Please describe data source (copy and paste description)
- Was GIS or geospatial data used to address the SDoH? (e.g., Health Landscape, Aunt Bertha, NowPow) (Yes; No)
- Describe how the intervention identified SDoH

Outcomes

- Did the intervention capture outcomes? (Yes; No)
- How did the intervention capture outcomes? (i.e. how were the outcomes measured?)
- What were the outcomes for the intervention?

Strengths and Limitations

- Were intervention strengths reported? (Yes; No)
- What were the strengths reported?
- Were intervention limitations reported? (Yes; No)
- What were the limitations reported?

References

- Are there specific references in this article that should be checked? (Yes; No)
- If yes, paste the references that should be reviewed

Supplemental Table 1

Article Title, Authors	Method to Identify SDoH	SDoH Variables Identified	Data Sources	Recommendations to Address SDoH/Study Outcomes/ Conclusions
Using Geographic Information Systems (GIS) to Identify Communities in Need of Health Insurance Outreach: An OCHIN Practice-based Research Network (PBRN) Report. Angier et al.	Relevant EHR data was aggregated by patient ZIP code from 52 clinics in Oregon and used patient health insurance information from HealthLandscape, LLC to construct a web-based geographic mapping of insurance coverage by ZIP code.	Patient insurance status (not insured, privately insured, or publicly insured – Medicaid and/or Medicare)	EHR data from 52 OCHIN (the Oregon Community Health Information Network) clinics in Oregon; the Robert Graham Center; the Health Foundation of Greater Cincinnati	EHR data can be integrated in a web-based GIS mapping tool and used by stakeholders to identify areas in need of a specific intervention; use GIS to conduct health insurance research and outreach; apply GIS tools at the clinical level to investigate clinically relevant questions and visualize patient-level characteristics; use GIS tools to engage public health and primary care professionals in novel ways.
Location, Location, Location; Unlike some other major industries, health care incorporates geospatial data only sparingly. But that could change quickly with population health a priority. Baldwin.	The author explores multiple ways in which GIS can be incorporated into mainstream technologies in acute and ambulatory care delivery, along with the challenges and barriers that persist.	Not applicable.	Not applicable.	Geospatial health data should be used as a prerequisite to addressing population health needs.
"Community vital signs": incorporating geocoded social determinants into electronic records to promote patient and population health. Bazemore et al.	Researchers selected a set of Community Vital Signs (VS) to integrate into EHRs. Community VS data were extracted from various online data sources and were added to an EHR using HealthLandscape's geospatial technology and a Community VS Geocoding	Built environment, environmental exposures, neighborhood economic conditions, neighborhood race/ethnic composition, neighborhood resources, neighborhood socioeconomic composition, and	American Community Survey; US Census Bureau; Center for Disease Control and Prevention (CDC); Environmental Protection Agency (EPA); Agency for Toxic Substances and	Continue development and integration of Community VS into EHRs, clinical decisions, and Population Management tools; interprofessional collaboration between researchers, clinical teams, and EHR developers to identify best practices; continue validation and refinement of geographic constructs; assess providers' knowledge, attitudes and skills related to SDoH, patient perception, and

	Application Programming Interface (API).	social deprivation index	Disease Registry (ATSDR); Department of Housing and Urban Development (HUD); United States Department of Agriculture (USDA); the Robert Graham Center	health outcomes associated with integrating Community VS into the EHR; additional research to understand (i) which community data elements best predict health outcomes, (ii) how providers and patients adapt varying definitions of 'community' (iii) how best to make this information available and useful in clinical settings, and (iv) which interventions providers can employ in response to Community VS.
Leveraging Geographic Information Systems in an Integrated Health Care Delivery Organization. Clift et al.	Neighborhood-level hot spot maps of chronic conditions and physical activity measures were constructed in ArcGIS by aggregating Kaiser Permanente's (KP) EHR data from seven KP Regions in eight states (CA, CO, GA, HI, MD, OR, VA, and WA) into census tract rates. KP members' home addresses were also geocoded.	Rates for adult and child obesity, asthma, diabetes, heart disease, hypertension, and physical activity measures.	KP's EHR; Census tracts in all KP region	GIS tools should be used to support more tailored clinical decision-making and operations. Geographically informed interventions should be implemented to better understand and address individual health needs.
The Impact of Neighborhood Environment, Social Support, and Avoidance Coping on Depressive Symptoms of Pregnant African-American Women. Giurgescu et al.	Paper surveys were prospectively administered to pregnant African American women from a medical center in Chicago to determine how personal factors might influence the effects of disadvantaged neighborhood environment on depressive symptoms. Participants' home addresses were geocoded using ArcGIS 9.1; the corresponding 2010 census-block group was obtained. Most participants	Maternal sociodemographic characteristics (age, marital status, education, and income), medical and obstetrical characteristics, the neighborhood environment (objective and perceived physical disorder, social disorder, and violent crime), social support, avoidance coping, and depressive symptoms.	Self-reported survey data; EHR data; US Census Bureau; Chicago Police Department crime summary data	There is a need for individualized intervention strategies for pregnant African American women who perceive their neighborhood to be dangerous or disorderly.

	completed the survey within the clinic and some from home.			
Neighborhood-Level Hot Spot Maps to Inform Delivery of Primary Care and Allocation of Social Resources. Hardt et al.	Descriptive statistics data for residents of Alachua County in North Central Florida were gathered from publicly available data systems to create hot spot density maps of health and social indicators and highlight neighborhood-level disparities. Geocoded birth records were obtained; mothers' home addresses were geocoded and exported in an ArcGIS 9.3 software and projected onto an Alachua County census block group map.	Demographics and socioeconomic characteristics (total population, percentage of persons 25 years and older without a high school diploma, median household income, percentage of population in poverty, and percentage of families headed by a single parent), and health outcomes (births to women whose pregnancy and delivery care was paid for my Medicaid, low-birth-weight births, infant mortality, rates of sexually transmitted infection, child maltreatment, and death rates by selected causes).	US Census Bureau; Baltimore, Maryland-based Annie E Casey Foundation's Kids Count; the Florida Department of Health; WellFlorida Council, Gainesville; UF Family Data Center; Florida Agency for Health Care Administration	The hot spot density maps were widely distributed for the purpose of community engagement, resulting in increased advocacy efforts, new public-private partnerships, a new family resource center, and a mobile clinic.
Geographic Variation in Mortality Among Children and Adolescents Diagnosed With Cancer in Tennessee: Does Race Matter? Lindley et al.	Tennessee Cancer Registry data were analyzed using spatial (ArcGIS 10.2.2, hot spot analysis based on census-tract) and non-spatial analysis techniques to examine the relationship between race and geographic variation in mortality among children and adolescents with cancer.	Individual-level demographics, death information, diagnostic information, and geocoded addresses.	Tennessee Cancer Registry	Clinical efforts should be targeted towards African American children and adolescents living in rural areas due to their experiencing suboptimal healthcare services and unavailable supportive care.
Patient Navigation in Medically Underserved Areas study design: A trial with implications for efficacy, effect	Patient residential addresses were obtained from medical records and were then geocoded using a GIS software, ArcMap 10.1. Census tract numbers were appended to the	Mammogram results, neighborhood socioeconomic status, and racial/ethnic composition factors.	Self-reported data over the phone; EHR data; Census tract data; 2007 – 2011 American Community Survey data; HRSA data;	Study will provide information about effectiveness of patient navigation on improving adherence to screening and early detection services for patients in MUAs.

modification, and full continuum assessment. Molina et al.	residential addresses and used to obtain relevant 2007–2011 American Community Survey data.			
Social Determinants of Adherence to Pulmonary Rehabilitation for Chronic Obstructive Pulmonary Disease. Oates et al.	Researchers conducted a cross-sectional analysis of a database of chronic obstructive pulmonary disease (COPD) patients in an outpatient pulmonary rehabilitation (PR) program (University of Alabama at Birmingham) to identify social determinants of adherence. Patient addresses were geocoded and assigned a Census tract identifier (geocoding tool/process not described).	Adherence to PR; demographic data (age, sex, and race); clinical data (body mass index, current smoking, smoking pack-years, number of co-morbidities); socioeconomic data (variables that reflect aspects of income, wealth, education, occupation, housing, and family structure).	EHR data; 2000 and 2010 Census data; Google Maps.	Individual-level indicators should be supplemented with neighborhood-level social indicators to provide information on social context and living circumstances. Neighborhood-level data could also be used to assess risk of nonadherence to PR and inform interventions.
Neighborhood factors associated with time to resolution following an abnormal breast or cervical cancer screening test. Plascak et al.	Patients in health clinics in the greater Columbus, Ohio were randomized to a patient navigation (NP) intervention. Effects of neighborhood factors on diagnostic time to resolution (TTR), as well as geographic healthcare access and TTR following an abnormal breast or cervical cancer screening test were assessed. Patients' residential addresses were geocoded to the house level to calculate home-to-clinic road distance. Analyses were conducted using Stata Intercooled v. 13, ArcGIS v. 10.2, and GeoDa v. 1.4.6.	Patient-level demographic data (age, race, marital status, and residential address); patient-level healthcare data (health insurance type – public, private, uninsured); patient-level socioeconomic data (employment status, social support, educational attainment, and housing income).	Self-reported data over the phone, in-person, or through questionnaires; EHR data; Census Bureau.	Targeting younger women of lower educational attainment, without health insurance who reside in neighborhoods of lower socioeconomic resources, may improve TTR. Future studies should assess cervical or breast cancer screening occurrences and racial segregation measures on a smaller geographic scale, the association between home-to-clinic distance and cancer outcomes among lower SES urban and rural community members, and the relationship between SES, urban status, home-to-clinic distance, and cancer outcomes using patient-reported travel routes.

Impact of a Neighborhood-Based Curriculum on the Helpfulness of Pediatric Residents' Anticipatory Guidance to Impoverished Families. Real et al.	Researchers sought to promote the sharing of neighborhood-specific advice from pediatric residents to patients during primary care visits through a local neighborhood-focused curriculum. The curriculum was composed of teaching modules focusing on relevant SDH issues within the context of local Cincinnati neighborhoods.	Housing problems (i.e. referral to medical-legal partnership); obtaining healthy food (i.e. food pantry locations, free meal programs); locating safe places to play (i.e. park locations, recreation centers); locating pharmacies (i.e. mapping neighborhoods); assisting families with transportation (i.e. public transportation, insurance-sponsored programs).	Topics were selected based on survey results from families and residents on which subjects needed more coverage during routine clinical care and educational experiences.	Residents reported improved competence in locating safe places for children to play, assisting families with transportation, and advising on obtaining healthy foods. After taking the curriculum, more residents asked their patients about their neighborhood and could identify a website that could be used in the clinical setting compared to before the curriculum. The majority of families found the resident advice to be somewhat or very helpful.
Location, Location, Location: Teaching About Neighborhoods in Pediatrics. Real et al.	Researchers sought to educate pediatric residents on local neighborhood structure and resources through a longitudinal curriculum. The neighborhood-based spiral curriculum ("Geomedicine Curriculum") was implemented to provide residents with a framework that they can use to assess factors relevant to the SDH and intervene within their clinical practice to mitigate effects.	General needs assessment (to determine resident knowledge and consideration of neighborhood location during clinic – location of a grocery store or pharmacy, information about local parks or recreation centers, etc.); targeted needs assessment (to determine curriculum content – food insecurity, medical-legal partnerships, safe play, nutrition, transportation, pharmacies, and social support).	Self-reported data from residents and caregivers using surveys to design the curriculum.	First year residents reported an enhanced understanding of neighborhood resources and a majority of senior residents agreed that the concepts learned were important for clinical practice. Overwhelming majority of residents could name at least one resources to determine information about a patient's neighborhood and to provide neighborhood-specific information to their patients, including information on food pantries, pharmacies, Head Start programs, parks and recreation activities, how to travel to health-related locations, and whether specific patient addresses were the site of reported housing code violations. Most families found residents' advice to be helpful.
The geographic distribution of cardiovascular health in the stroke prevention in healthcare delivery environments (SPHERE)	Researchers linked EHR data from two outpatient primary care clinics at the Ohio State University Wexner Medical Center (OSUWMC) to census tract-level data to geographically	There is implied SDH data when utilizing census tract data for patients: smoking status, body mass index, total cholesterol, blood pressure, fasting glucose, physical activity,	EHR data (OSUWMC's Information Warehouse); Ohio census tracts	Cancer registry data, spatial cluster analysis, and map creation using SAS statistical software could be integrated and embedded in the EHR to inform tailored best practices in preventive medicine for CVH.

study. Roth et al.	characterize cardiovascular health (CVH) and explore potential insights. Patient address data were geocoded using ArcGIS 10.2.	and healthy diet score.		
Factors Associated with Attendance after Referral to a Pediatric Weight Management Program. Shaffer et al.	Geocoding techniques were applied to identify neighborhood-level demographic factors (at the census level) that are associated with patient attendance to a tertiary care pediatric weight management clinic upon referral. Addresses were geocoded using ArcMap 10.x.	Baseline demographic data (date of birth, sex, insurance status, residential address, height, weight, and body mass index), median household income, and percent with at least high school level education.	EHR data; the US Census Bureau 2012 American Community Survey and 2010 decennial census data.	Employ targeted outreach efforts to reach patients who would be at risk to not follow through on a referral; base standard referral to pediatric weight management on BMI criteria for wider range of children with obesity; continue efforts to ensure that all children have health insurance that cover interprofessional interventions for obesity; policymakers should address health barriers including adequate housing, wages, access to education, healthy foods, areas to exercise, and prevention of adverse childhood experiences.
Place Matters: The problems and possibilities of spatial data in electronic health records. Simpson et al.	A qualitative study following the Middle Tennessee Flood of 2010 was conducted to determine how a major life disruption impact self-care in chronic illness and to explore the benefits of linking EHR data with GIS – particularly, providers' ability to identify at-risk populations of patients after the flood and conduct tailored outreach for those with chronic illness.	Participants' diabetes-related routines prior to the flood; the flood event and their evacuation; their current illness management routines and the effectiveness of these routines; how the flood impacted their diabetes and general health; participant body language and physical environment.	Data from in-person, semi-structured interviews at the participants' home; EHR data.	The coordination of EHR data and census-derived data should be done by personnel who understand how to link the GIS data to EHR information for the particular problem in question, and only those with appropriate clinical skills should coordinate and oversee outreach efforts. Providers who have access to environmental data associated with specific patients should offer problem-solving assistance to help build the patient-provider relationship. Additional research should determine if spatio-temporal attributes affect the support needed by various patients.
Utilizing patient geographic information system data to plan telemedicine service locations. Soares et al.	A retrospective study was conducted extracting patient-level GIS data from an EHR to understand the utilization of developmental-behavioral pediatrics (DBP) services at a	Patient demographics (age, gender); primary insurance; primary diagnosis for visit; home address; clinical location where the encounter took place.	EHR data (EpicCare – Epic Systems, Verona, WI, USA); US Postal Service database.	Study demonstrated ability to model potential telemedicine sites for neurodevelopmental pediatrics access in rural areas. Health systems should use GIS to plan for communities in need of specific health services by analyzing patient

	rural integrated health care system to analyze optimal groups of telemedicine locations. Patient addresses were geocoded using ArcGIS 10.1.			demographic data. Future data approaches should be developed in a way that is meaningful to clinicians.
Using Geographic Information Systems to Visualize Relationships Between Perinatal Outcomes and Neighborhood Characteristics When Planning Community Interventions. Suplee et al.	An exploratory study was conducted using GIS to understand neighborhood-level perinatal health outcomes (maternal mortality, birth outcomes) and social determinants of health of urban women from a racially segregated city, Camden, NJ. Birth records were geocoded to street address and then aggregated to census tracts and neighborhoods.	Variables that affect adverse birth outcomes (maternal hypertension disorder, diabetes, and preterm birth); neighborhood characteristics (data on social determinants – race, ethnicity, poverty, and crime data).	EHR data; 2015 US Census Bureau American Community Survey 2009 to 2013; Neighborhood Scout data	Healthcare providers must understand the neighborhood environment to which mothers are discharged with their newborns. Neighborhood characteristics and health outcomes should continue to be studied as they change over time, and postpartum nurses should use GIS maps to inform individualized discharge education and planning. Additionally, awareness for neighborhood characteristics and potential risk factors may inform collaboration efforts between nurses and social workers.
Travel Time Influences Readmission Risk: Geospatial Mapping of Surgical Readmissions. Turrentine et al.	Researchers sought to analyze geographic risk factors influencing hospital readmission rates for general surgery patients using travel time estimated from GIS software. Patient addresses were geocoded with ArcGIS and layered to census data.	Patients who underwent a general surgery procedure at the University of Virginia (UVA) Medical Center; patient primary residence address; travel time from patients' residence to the nearest hospital facility; 30-day postoperative readmission rates.	American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database.	Providers should consider patient distance to the nearest hospital as a potential risk for readmission for general surgery patients. Future studies should evaluate the relationship between patient residence location and use of urgent care services, primary care visits, and factors that influence decisions to use these resources.