



## **A Framework for Social Determinants of Health Integration in Population Health Management Systems**

**Prakash Easwaran\***

Independent Researcher, USA

\* **Corresponding Author Email:** reachprakashaswaran@gmail.com - **ORCID:** 0000-0002-0247-7300

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### **Abstract:**

Traditional models of health care delivery mainly involve health care approaches while overlooking non-health issues that influence health care outcomes and health care expenditures. Social determinants of health relate to poverty, educational attainment, housing status, accessibility of transport, and food availability. Addressing such determinants requires systematic capabilities within population health management platforms. A dual-layer risk assessment framework provides comprehensive identification of social needs across populations. Community-level scoring leverages census tract geography and publicly available socioeconomic data. Six primary domains, including education, employment, income, transportation, housing, and food access, contribute to cumulative geographic risk calculations. Member-level assessments capture individual circumstances through structured screening instruments administered during care management encounters. Individual scores override community-level assignments when documented personal needs diverge from neighborhood averages. Risk stratification algorithms classify populations into tiered categories based on cumulative scores. High-risk individuals receive intensive care management with dedicated program enrollment. Medium-risk individuals receive educational materials and periodic monitoring. Configurable parameters enable organizational customization of scoring weights and threshold boundaries. Integration with community-based organization referral platforms enables closed-loop referral management. Electronic referral transmission and status tracking support regulatory compliance requirements. It translates disparate efforts within social care into structured and trackable interventions within healthcare populations.

## **1. Introduction**

Medical delivery systems also emphasize clinical interventions as the most important way to improve patient outcomes. Medical care only accounts for a small part of the factors and influences that affect the health status of individuals and communities. Socioeconomic factors significantly affect the health status of individuals and communities. They play a crucial role in influencing the health status because they affect the majority. Large numbers of people fall into a certain group based on factors related to economic status, and Marmot and Allen established that health inequities arise from inequities in the conditions of daily life [1]. These conditions include access to education, employment opportunities, income levels, housing quality, and community environments. The circumstances in which people are born, grow, live, and work shape

health trajectories more significantly than clinical encounters [1].

The relationship between social position and health outcomes follows a consistent gradient across populations. People who belong to lower socioeconomic groups have poor health outcomes compared with members of higher socioeconomic groups. This gradient also exists for all groups within a hierarchy, not only the disadvantaged ones [1]. The existence of health inequities indicates the effects of the poor distribution of power, money, goods, and services across societies. Efforts geared toward improving health inequities must go beyond the health systems. Conventional approaches have failed because the patients return to their settings, which are major players in determining their health. Although there has been an increasing awareness of the importance of addressing social determinants, there has been a challenge in integrating effective

strategies into healthcare systems. In their research, Fichtenberg et al. established that substantial gaps exist in the literature regarding the intervention of social needs in a healthcare setting [2]. There has been an increasing trend among healthcare facilities to screen patients concerning their social needs, such as food insecurity, unstable housing, and transportation issues. Yet the connection between identification and resolution remains underdeveloped. Screening activities have expanded substantially, but corresponding intervention strategies lack rigorous evaluation [2]. The translation of social needs identification into meaningful action presents considerable challenges. It has also been noticed that the healthcare sector usually has not developed referral patterns to community agencies. The integration of the health sector and the social agencies is usually not a smooth process. Fichtenberg and colleagues supported the notion that to advance the area, there is a need for a better understanding of the interventions that work and when [2]. Current research provides limited guidance on optimal intervention design, implementation strategies, and outcome measurement approaches.

Value-based care models create new incentives for healthcare organizations to address social determinants. Payment structures increasingly tie reimbursement to health outcomes rather than service volume. Organizations bearing financial risk for population health outcomes recognize that unaddressed social needs drive utilization and costs. This economic reality accelerates interest in social care integration within population health management platforms. Systematic approaches enable organizations to identify social risks across populations and coordinate appropriate responses. Such integration transforms episodic social needs screening into sustained care management workflows. The development of robust frameworks for social determinants assessment and intervention represents a critical advancement in population health strategy.

## 2. Related Work and Methods

Established research has found significant associations between socioeconomic factors and outcomes for various groups. Geographic deprivation scales have made clear links between neighborhoods and mortality. Standardized screening instruments enable systematic identification of individual social needs within clinical settings. Risk stratification tools support population segmentation in primary care contexts internationally. Configurable decision support systems allow organizational customization of

clinical algorithms without technical programming expertise. Closed-loop referral mechanisms address limitations of traditional open-loop referral practices, which lack feedback capabilities.

The framework presented in the current article advances existing knowledge through several distinct contributions. A dual-layer assessment architecture combines community-level geographic indicators with individualized member-level screening results. Census tract geography provides the foundational spatial unit for population-level risk calculation across six socioeconomic domains. Member-level assessments administered during care management encounters generate weighted scores reflecting personal circumstances. The hierarchical scoring structure ensures individual documentation overrides geographic generalizations when divergence exists. Tiered stratification classifies populations into high, medium, and low-risk categories, triggering differentiated care pathways. Configurable parameters enable organizational adaptation of scoring weights and threshold boundaries. Integration pathways connect population health management platforms with community-based organization referral networks. Electronic referral transmission and bidirectional status tracking support closed-loop coordination. The comprehensive architecture transforms fragmented social care delivery into systematic, auditable intervention workflows across healthcare organizations serving diverse populations.

## 3. Dual-Layer Risk Assessment Framework

### 3.1 Community-Level Risk Scoring

Geographic analysis offers a core methodology for evaluating issues of population health inequity. The usage of census tracts gives a standardized unit of geography for evaluating network-degree elements that impact community health. These geographic limitations offer sufficient granularity to seize significant variation in socioeconomic traits throughout neighborhoods. Patel and colleagues demonstrated the utility of geographic information systems in healthcare applications, employing census-based spatial analysis to evaluate population access to healthcare services [3]. Their methodology linked population data to geographic boundaries, enabling systematic assessment of service availability across defined areas [3]. Similar approaches support social determinants assessment by connecting individual addresses to corresponding census tract identifiers.

A census tract is considered to be the “smallest geographic area for which the agencies publish

data.” A census tract usually has between 1,200 and 8,000 persons. It is for this reason that healthcare systems use geocodes to assign census tracts to a patient’s geographic location. Census tracts are bounded by “visible boundaries, such as roads, rivers, and other administrative boundaries.” In this manner, healthcare facilities are able to utilize census tracts to identify patient addresses. The geocoding process assigns each individual to a specific tract based on residential location. This assignment enables automatic application of area-level characteristics without requiring direct member contact.

Community risk scoring draws upon multiple socioeconomic indicators aggregated at the census tract level. Singh developed area deprivation indices that capture the multidimensional nature of socioeconomic disadvantage [4]. The research demonstrated strong associations between area deprivation and mortality outcomes across the United States populations. Communities characterized by concentrated poverty, limited educational attainment, high unemployment, and inadequate housing exhibited substantially elevated mortality rates [4]. These geographic disparities persisted across demographic groups and widened over time during the study period [4].

The scoring framework encompasses six primary domains relevant to health outcomes. Education indicators capture educational attainment levels within the census tract population. Employment indicators evaluate labor participation rates and unemployment. Income indicators evaluate household income, poverty rates, and economic stability. Transportation indicators evaluate vehicle access and access to mass transit. Housing indicators evaluate housing quality, affordability, and stability. Food access measures evaluate access to grocery stores and healthy food options.

Each domain incorporates multiple variables that aggregate into composite domain scores. The domain scores subsequently combine into a cumulative community risk score for each census tract. Higher scores indicate greater socioeconomic hardship and elevated population health risk. Lower scores reflect relative neighborhood advantage. This cumulative scoring enables initial population stratification based on residential geography alone. Organizations can identify high-risk populations without conducting individual assessments. The community-level score serves as a baseline indicator that subsequent member-level assessments may confirm or override based on individual circumstances.

### 3.2 Member-Level Assessment Integration

Community-level risk indicators provide valuable population-level insights but cannot capture individual variation within geographic areas. Residents of the same census tract experience different social circumstances based on personal factors. A neighborhood characterized by aggregate disadvantage may contain individuals with stable employment and secure housing. Conversely, affluent areas may include residents facing food insecurity or transportation barriers. Effective social care requires mechanisms that identify individual needs beyond geographic generalizations.

Standardized screening instruments enable systematic identification of health-related social needs at the individual level. Billieux and colleagues articulated a framework for social needs screening within clinical settings through the National Academy of Medicine [5]. The framework identified core domains requiring assessment across healthcare populations. These domains include housing instability, food insecurity, transportation difficulties, utility assistance needs, and interpersonal safety concerns [5]. Standardized screening approaches ensure consistent assessment across patient populations and clinical sites. The adoption of validated instruments supports comparability of findings and enables aggregation of data for population health analysis [5].

Care managers administer structured assessments during clinical encounters or dedicated outreach contacts. Each assessment contains questions addressing specific social need domains. Response options follow standardized formats that enable scoring and quantification. Affirmative responses indicating unmet social needs generate weighted scores reflecting the severity and urgency of identified concerns. The cumulative score across all domains produces an overall member-level risk assessment. This individualized score captures the specific social circumstances affecting each person rather than relying solely on neighborhood characteristics.

The integration of social risk scoring within electronic health record systems enhances operational feasibility. Hatef and colleagues developed methodologies for calculating social risk scores using data available within electronic health records [6]. Their research focused on identifying social needs among underserved populations through systematic data analysis. The approach combined patient-reported information with administrative data elements to generate comprehensive risk assessments [6]. Electronic integration enables automatic score calculation and supports clinical decision-making at the point of

care. Risk scores become visible to care teams, prompting appropriate intervention planning [6]. The framework establishes a hierarchical relationship between community and member-level scores. Member-level assessments take precedence when both scores exist for an individual. This override mechanism ensures that documented individual circumstances drive care planning decisions. A person residing in a low-risk census tract but reporting significant personal social needs receives appropriate attention. Similarly, an individual in a high-risk area who demonstrates personal stability avoids unnecessary intervention intensity. The hierarchical approach balances efficiency with accuracy. Community scores enable initial population stratification without resource-intensive individual outreach. Member-level assessments refine risk classification for individuals engaged in care management activities. This dual-layer methodology optimizes resource allocation while maintaining personalized care delivery.

#### **4. Risk Stratification and Population Segmentation**

Effective population health management must incorporate tools for systematically identifying individuals most in need of intensive management. Risk stratification represents the analytical underpinning for allocating resources based on the relative level of need that can be identified in given members. Member-level risk scores simplify the process of stratifying whole populations into defined levels of relative social vulnerability based on their collective needs and risks. The calculated member-level risk scores enable classification of entire populations into distinct tiers reflecting relative social vulnerability. This segmentation transforms raw assessment data into actionable categories that guide care management workflows. Risk stratification tools have mushroomed in the health delivery setup as health organizations look to resource allocation optimization. Girwar and colleagues conducted a systematic review of risk stratification instruments employed in primary care contexts internationally [7]. The review identified substantial variation in stratification approaches across different healthcare systems and populations. Most tools incorporated multiple risk factors to generate composite scores reflecting overall patient complexity [7]. The stratification process typically assigns individuals to discrete risk categories based on score thresholds. These categories then determine the intensity and type of interventions offered to each population segment [7]. Effective stratification balances sensitivity in identifying high-risk individuals against specificity in avoiding

unnecessary resource expenditure on lower-risk populations.

The social determinants stratification framework classifies members into three primary tiers. High-risk individuals demonstrate elevated scores indicating substantial unmet social needs across multiple domains. Medium-risk individuals present moderate scores, suggesting some social vulnerability requiring monitoring. Low-risk individuals show minimal scores, indicating relative social stability. Each level is associated with differentiated management paths that involve different levels of intensity. For high-risk levels, it triggers membership in specific management programs for follow-ups. For medium levels, it starts follow-up and education programs. Low-risk classification requires no active intervention beyond continued monitoring. Organizational diversity necessitates configurable stratification parameters. Different healthcare entities serve distinct populations with varying social need profiles. Threshold values appropriate for one population may inadequately segment another. Kleymenova and colleagues examined user-configurable decision support systems that enable organizational customization of clinical algorithms [8]. Configurable systems allow authorized users to modify scoring parameters, threshold boundaries, and rule logic without requiring technical programming expertise [8]. This flexibility supports adaptation to local population characteristics and organizational priorities. Healthcare entities can adjust domain weights to emphasize social factors most relevant to their specific populations [8]. The stratification engine accommodates customization across multiple parameters. Organizations define threshold values that determine tier boundaries between risk categories. Domain weighting adjustments prioritize certain social factors over others based on population needs. Rule configuration enables the incorporation of organizational policies and regulatory requirements. Such flexibility is important because it allows the framework to be applied in various settings, be it geographical or demographic. Rural health organizations may prioritize connectivity with transportation differently compared to their urban organizations. Organizations serving elderly populations may prioritize housing stability and food access. The configurable architecture supports these variations while maintaining methodological consistency in the underlying stratification approach.

#### **5. Community-Based Organization Integration**

Healthcare organizations cannot address social determinants of health in isolation. Effective social care requires partnerships with external entities that provide community-based services. Food banks address food insecurity. Housing agencies assist with shelter stability. Transportation services enable access to medical appointments. Employment programs support economic stability. These resources exist outside traditional healthcare delivery systems. Connecting patients to appropriate community resources demands systematic coordination mechanisms.

The American healthcare system has historically maintained separation between medical services and social support programs. Marmor examined the underlying principles governing social insurance and healthcare delivery in the United States [9]. The analysis revealed persistent tensions between healthcare financing mechanisms and broader social welfare objectives. Healthcare organizations increasingly recognize limitations in addressing patient needs through clinical services alone [9]. Social insurance principles suggest shared responsibility for population welfare extending beyond individual clinical encounters. Integrating community resources into healthcare workflows represents an expansion of organizational responsibility toward comprehensive patient support [9].

Community-based organization referral platforms provide technological infrastructure for cross-sector coordination. These platforms enable electronic transmission of referrals from healthcare settings to community service providers. The referral contains relevant patient information and identified social needs. Community organizations receive referrals through secure channels and initiate service delivery. Platform functionality supports bidirectional communication between referring and receiving organizations. Healthcare entities gain visibility into referral status and service delivery outcomes.

Closed-loop referral management represents a critical advancement over traditional referral

practices. Olson and colleagues investigated patient experiences with community resource referral systems employing closed-loop methodologies [10]. The research utilized community-based participatory approaches to understand how individuals navigate social care connections. Closed-loop systems provide confirmation when patients successfully connect with referred services [10]. This confirmation enables healthcare organizations to document outcomes and identify barriers to service access. Traditional open-loop referrals lack feedback mechanisms, leaving referring organizations uncertain about patient follow-through [10]. Closed-loop architecture addresses this gap through systematic status tracking and outcome reporting.

The integration framework establishes secure pathways connecting population health management platforms with community referral networks. Application programming interfaces enable data exchange between systems. Referral information flows electronically from care management workflows to community organization portals. Status updates return through the same channels. Care managers receive notifications when patients engage with referred services. Documentation of service delivery supports comprehensive care records.

Regulatory requirements mandate referral tracking and reporting for healthcare organizations participating in government programs. State agencies require evidence of social care coordination activities. Federal auditors examine referral documentation during compliance reviews. The integration architecture generates reports satisfying these audit requirements. Referral volumes, connection rates, and service delivery outcomes become reportable data elements. Organizations demonstrate program effectiveness through documented referral outcomes. Compliance with state and federal mandates depends upon systematic tracking enabled through closed-loop integration.

**Table 1.** Risk Assessment Layers and Associated Data Sources in Social Determinants Evaluation [3, 4]

Assessment Layer	Geographic Unit	Data Source	Primary Domains	Score Application
Community-Level	Census Tract	Federal Statistical Agencies	Education, Employment, Income, Transportation, Housing, Food Access	Baseline Population Segmentation
Member-Level	Individual	Structured Screening Instruments	Housing Instability, Food Insecurity, Transportation Difficulties, Utility Needs, and Interpersonal Safety	Personalized Care Planning

**Table 2.** Risk Stratification Tier Classification and Characteristics [5, 6].

Risk Tier	Score Interpretation	Social Vulnerability Level	Intervention Trigger	Resource Intensity
High Risk	Elevated Cumulative Score	Substantial Unmet Needs Across Multiple Domains	Dedicated Care Management Enrollment	Intensive Follow-up
Medium Risk	Moderate Cumulative Score	Some Social Vulnerability Requiring Monitoring	Periodic Outreach Initiation	Moderate Engagement
Low Risk	Minimal Cumulative Score	Relative Social Stability	Continued Monitoring Only	Minimal Active Intervention

**Table 3.** *Intervention Protocols and Care Management Activities Across Risk Categories [7, 8].*

Risk Category	Program Enrollment	Assessment Requirements	Care Plan Components	Follow-up Protocol
High Risk	Dedicated Social Determinants Care Management Program	Comprehensive Detailed Assessment	Problems, Goals, Interventions	Active Care Manager Engagement with Timely Resolution Tracking
Medium Risk	Educational Intervention Program	Periodic Reassessment	Targeted Educational Materials	Scheduled Monitoring to Prevent Escalation
Low Risk	Standard Population Monitoring	No Active Assessment Required	None	Continuous Background Monitoring

**Table 4.** *Community-Based Organization Integration Architecture [9, 10].*

Integration Component	Functional Description	Information Flow Direction	Compliance Support
Electronic Referral Transmission	Secure Transfer of Patient Information and Identified Social Needs	Healthcare Platform to Community Organization	Referral Volume Documentation
Bidirectional Status Tracking	Real-time Updates on Referral Progress and Patient Engagement	Community Organization to Healthcare Platform	Connection Rate Reporting
Service Delivery Confirmation	Verification of Successful Patient Connection with Referred Services	Community Organization to Care Management Team	Outcome Documentation
Audit Reporting Generation	Systematic Production of Compliance Documentation	Internal Platform Function	State and Federal Mandate Satisfaction

## 6. Conclusions

Healthcare organizations face mounting pressure to address nonmedical factors influencing patient outcomes and organizational expenditures. Social care capabilities within population health management platforms represent a fundamental shift in healthcare delivery philosophy. The dual-layer risk assessment framework bridges geographic population insights with individualized member circumstances. Census tract data provides efficient baseline stratification without requiring direct patient contact. Standardized screening instruments capture personal social needs that geographic averages cannot reflect. The hierarchical scoring structure ensures individual documentation takes precedence over neighborhood generalizations. Tiered stratification enables proportionate resource allocation, matching intervention intensity to demonstrated need levels. High-risk populations receive dedicated care

management attention while lower-risk individuals avoid unnecessary organizational expenditure. Configurable architecture accommodates organizational diversity across different geographic regions and population characteristics. Healthcare entities adjust domain weights, threshold boundaries, and rule logic according to specific strategic priorities. Community-based organization integration extends organizational reach beyond clinical service delivery. Closed-loop referral mechanisms provide visibility into service connections and outcomes. Electronic documentation satisfies state and federal audit requirements for social care coordination. The comprehensive framework positions healthcare organizations to systematically identify social needs, coordinate appropriate community resources, and demonstrate measurable program effectiveness across served populations.

### Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
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- **Use of AI Tools:** The author(s) declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

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