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# Solving Homelessness from a Complex Systems Perspective: Insights for Prevention Responses

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## Abstract

Homelessness represents an enduring public health threat facing communities across the developed world. Children, families, and marginalized adults face life course implications of housing insecurity, while communities struggle to address the extensive array of needs within heterogeneous homeless populations. Trends in homelessness remain stubbornly high despite policy initiatives to end homelessness. A complex systems perspective provides insights into the dynamics underlying coordinated responses to homelessness. A constant demand for housing assistance strains service delivery, while prevention efforts remain inconsistently implemented in most countries. Feedback processes challenge efficient service delivery. A system dynamics model tests assumptions of policy interventions for ending homelessness. Simulations suggest that prevention provides a leverage point within the system; small efficiencies in keeping people housed yield disproportionately large reductions in homelessness. A need exists for policies that ensure reliable delivery of coordinated prevention efforts. A complex systems approach identifies capacities and constraints for sustainably solving homelessness.

# 1. HOMELESSNESS AS A COMPLEX PUBLIC HEALTH THREAT

## 1.1. Scope of Homelessness

Homelessness poses an enduring public health challenge throughout the developed world. Although the Universal Declaration of Human Rights declared housing a basic right in 1991, the United Nations continues to identify homelessness as an urgent human rights crisis (109). Definitions vary, but homelessness generally refers to the lack of safe accommodations necessary for respite and connection with people and places (11, 47, 110). Homelessness includes living on the streets or in shelters, as well as patterns of housing insecurity such as overcrowding or excessive cost burden. The most recent global survey of countries estimates that more than 1.5% of the world's population lack basic shelter, while as many as one in five people experience housing insecurity (109).

Trends of homelessness suggest stubbornly stable or expanding rates. Most of Europe has seen large increases in rooflessness as well as housing instability in recent years (80, 110). For instance, the homeless populations of Germany and Ireland have increased by approximately 150% from 2014 to 2016 and from 2014 to 2017, respectively (92). Point-in-time counts of homeless persons in Australia suggest increases in per capita (PC) rates from 2006 (45 per 10,000) to 2016 (50 PC) (3). The United States shows decreases in PC rates of homelessness based on annual point-in-time counts of sheltered and unsheltered persons (47); however, changes have leveled off despite substantial reorganization of homeless assistance.

Housing insecurity represents the much larger problem of hidden homelessness. On average, poor families (earning less than 60% of the median national income) in the European Union spent more than 40% of their income on rent in 2016 (92). More than 80% of US households below the federal poverty line spent at least 30% of their incomes on rent. Frequent moves and doubling up represent additional common indicators of inadequate housing (20). Foreclosure and evictions are endemic in certain communities; estimates suggest that nearly one million US households experienced eviction in 2016, while eviction represents a major challenge across Europe (23, 53). Trends demonstrate the challenges of solving homelessness and the need for innovations.

## 1.2. Impact of Homelessness

Homelessness and associated poverty have life course implications for physical and mental health. Many adverse health and socioemotional outcomes are linked to homelessness in children (26, 117). Homeless adults face increased mortality from all causes, and those with severe mental illness display significantly worse quality of life compared with nonhomeless individuals with mental illness (61). Education levels and employment rates among homeless adults are low compared with the general population (9, 16). In Europe, average life expectancy of people who experience homelessness is 30 years less than nonhomeless populations (11).

In addition to human suffering, public expenditures associated with homelessness are substantial. In the United States, estimated costs (all adjusted to 2018 USD) of a homeless shelter can exceed $7,000 per month per family (19, 45, 98) with additional costs attributed to inpatient hospitalization, incarceration, and public assistance (36, 99). Cost estimates in Europe are limited but suggest substantial expenditures associated with shelter and outside services such as emergency departments, psychiatric care, and jail or prison (78). In Australia, the government estimates spending at $30,000 per homeless person per year (4). Few rigorous studies quantify the additional social losses in productivity and well-being. Communities around the world struggle to manage the human and financial burdens of homelessness.

# 2. COMPLEXITY IN CAUSES AND RESPONSES TO HOMELESSNESS

## 2.1. Complex Causes of Homelessness

Experiences of homelessness depend on a complex interplay between individual, interpersonal, and socioeconomic factors. Research has long identified mental illness and addiction as risk factors for homelessness (37, 47, 48). Personal struggles also strain interpersonal relationships with family, friends, and romantic partners; in a vicious cycle, conflict undermines well-being as well as erodes potential housing supports (21, 77). However, socioeconomic factors often dictate the likelihood of displacement.

Globally, marginalized communities disproportionately experience homelessness. Homelessness is much more common among the poor and minorities in terms of race/ethnicity, sexual orientation and identity, and institutionalization and among those with physical and mental disabilities compared with the general population (105). For instance, members of Aboriginal communities in Australia comprise a quarter of people receiving homeless services, while representing less than 3% of the total population (3). A similar disparity exists in Canada, with Indigenous people 10 times more likely to use homeless shelters than non-Indigenous (37, 91). Due to structural inequalities associated with marginalization, the accessibility of jobs and affordable housing remains constrained; availability of appropriate accommodations is more or less random (11, 74). Household-level shocks to housing stability such as job loss, termination of assistance, or eviction require a scramble for housing that may or may not be available, given market constraints. Homelessness results when other formal or informal housing supports remain inaccessible; lack of supports can reinforce vulnerability to crises that threaten stable housing. Thus, entries as well as exits into homelessness among vulnerable populations become a matter of bad timing and bad luck. The presence of personal and interpersonal barriers exacerbates vulnerabilities but fails to explain homelessness.

## 2.2. Implications of Complexity for Homeless Responses

Complexity underlying housing insecurity carries important implications for systematic responses to homelessness. First, extensive heterogeneity exists in homeless populations and in the types of services needed to address housing instability. Individuals with severe mental illness, for example, may require ongoing intensive supports to avoid falling back into homelessness, whereas pregnant teens with few connections to supportive adults have a different set of needs. This variation requires considerable flexibility and tailoring of resources to promote stability.

A related implication concerns variation in the timing and patterns of homelessness. Some households experience single episodes of homelessness, while chronic homelessness refers to instability for more than two years (one year for families with children) with ongoing barriers to stability [HEARTH Act of 2009 (Pub. L. 112–141)]. Research that investigates patterns of housing insecurity reveals distinct subpopulations based on housing trajectories (18, 31, 33, 106). For instance, studies show that chronic patterns of homelessness affect a relatively small number of persons (33, 34). Homeless assistance continuously interacts with households at different stages of different trajectories, which makes accurate prediction of risk as well as response to interventions exceedingly difficult (5, 38, 44, 58, 95).

The complex causes of homelessness require complex solutions. Homeless assistance typically requires the provision of multifaceted supports that adapt in response to shifting household demands and often includes unique combinations of residential and nonresidential supports. Recurrent constraints on the availability of supports often require further tailoring of homeless

assistance on the basis of resource accessibility. The resulting combinatorial complexity of housing interventions challenges sustained, systematic responses to homelessness (35).

Finally, the complex causes of and responses to homelessness present substantial challenges for screening and resource allocation. Efficient service provision depends on accurate assessments of risk and potential responses to interventions (10, 58, 72). Tools, such as the Vulnerability Index—Service Prioritization Decision Assistance Tool (VI SPDAT), purport to categorize households seeking homeless assistance for appropriate interventions from responses to screening questions; high vulnerability requires supportive housing, moderate requires temporary housing with less intensive supports, and households with low risk are diverted from the system (22). VI SPDAT developers report item reliability and claim use in communities around the world (75). However, little evidence exists on the tool's accuracy, and available research suggests poor sensitivity and specificity with common scoring procedures (7, 15). The VI SPDAT intervention assignments poorly differentiate households, resulting in extensive false positives (false alarms) and false negatives (missed hits) (6, 108). Other screening tools show similar challenges for targeting preventive services (13, 28, 44, 94). The difficulty in prediction reflects the complexity that underlies homelessness (5, 38, 58).
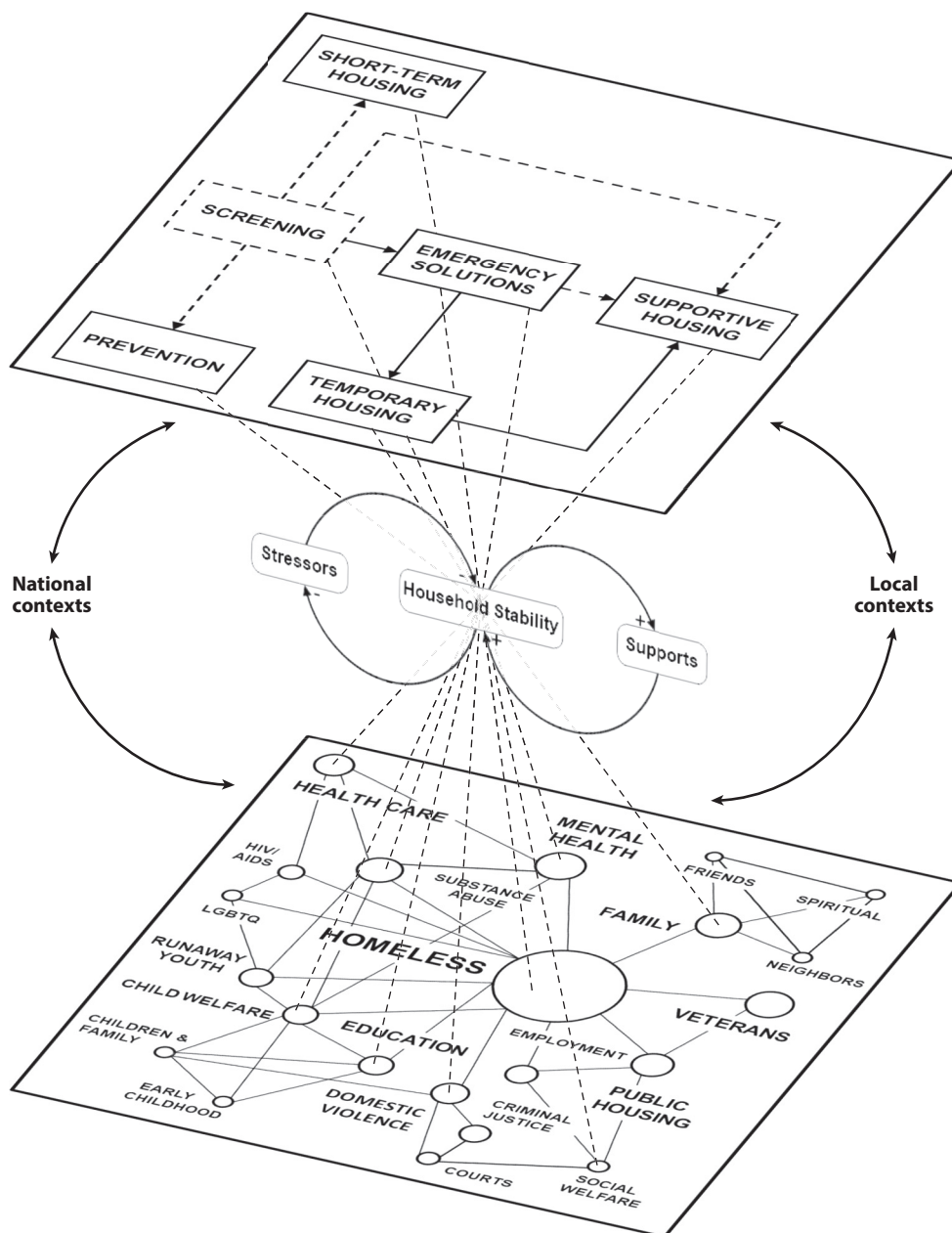
## 2.3. Complex Systems and Coordinated Responses to Homelessness

Nations have adopted various strategies to address homelessness. Responsibility for serving homeless populations in European Union nations generally falls under common social welfare policies, while federal policies and funding structure local responses to homelessness in Australia, Canada, and the United States (11, 116; Pub. L. 112–141). Although communities differ in how supports are organized, a common structure connects the delivery of homeless assistance. Delivery of housing plus supports leverages interorganizational networks composed of governmental and nongovernmental agencies (10, 41, 81, 87). Formal and informal partnerships work together to screen and respond to individuals and families experiencing housing crises.

**Figure 1** illustrates the underlying framework for homeless services from a complex systems perspective. In the center, households experience countervailing supports and strains that influence stability, represented as virtuous and vicious cycles. When strains exceed supports, a need for housing triggers the demand for homeless assistance. Access to homeless services depends on local and national contexts; formal and informal policies determine eligibility, timing, and funding of resources, while socioeconomic conditions influence demand chains for services (27, 74). The resulting dynamics allow homeless services to adapt and evolve over time.

The top layer in **Figure 1** represents the general structure of homeless or residential services. Although heavily based on a North American perspective, the model captures a number of common elements in local and national responses to homelessness (10, 11, 25). Screening aims to identify need and allocate households to the most appropriate and available service. Emergency responses address immediate housing crises; in many countries, this represents homeless shelters that provide short-term accommodations. Temporary housing provides time-limited accommodations with case management and other nonresidential services. Supportive housing refers to permanent connection to housing plus case management to address substantial barriers to stability. Rapid rehousing and homelessness prevention represent efforts to provide immediate access to stable accommodations.

Movement through the system depends on organizing philosophies for solving homelessness. Screening attempts to forecast the level of need, ranging from low (prevention), moderate (rapid rehousing), and high (supportive housing) risk for ongoing homelessness (75). Treatment first assumes people need services to address the underlying barriers that led to homelessness

**Figure 1**

Coordinated responses to homelessness as a complex system. Solid lines reflect a treatment first approach, whereas dashed lines represent housing first philosophy. Circular nodes represent examples of key supports in keeping people housed; ties between nodes generally refer to information exchanges, such as communications, service referrals, or funds. The + and – signs indicate the direction of correlation between variables.

(88, 107). A staircase model structures services so that households progress from shelters to temporary housing in addition to the provision of services to permanent supportive housing. Transitions indicate a need for higher levels of supports that make people more prepared for stable housing. In contrast, housing first considers stable accommodations as a precondition for any treatment needed to reduce homelessness (107). The structure of residential services attempts to place people in stable housing as quickly as possible.

The bottom layer in **Figure 1** illustrates the extensive networks of formal and informal supports engaged in addressing household instability. Conceptually, connections can be informal interpersonal communities or formalized through agreements and contracts. Homeless services at the hub denote efforts to weave a safety net of supports for households. Systems vary in the extent to which nonresidential supports are specific to the residential service or carry over with households as they transition into and out of homelessness (11, 30). Regardless, homeless systems rely on extensive cross-systems collaboration to promote stability and remove barriers that prolong homelessness (10, 19, 90).

Use of interagency networks responds to the complexities of addressing homelessness. Foremost, referral networks allow for quicker access to a wide range of supports, which can handle the extensive heterogeneity of needs among homeless populations. Networks also provide flexibility to expand and contract with shifts in demand for services (10, 19, 73, 87). A timely example concerns displacement due to conflict that triggers surges in refugee populations with various needs within a community or country; Germany, for example, saw a 150% increase in homelessness from 2014 to 2016 composed primarily of refugees (92). In times of greater need such as an influx of refugee families, interagency networks allow for sharing information and resources to respond more quickly. Likewise, collaborative organizations avoid hierarchal approval processes; instead, decision making on service delivery is distributed across providers within agencies that potentially speed up resource allocations (82). A network structure provides a dynamic and adaptive response to homelessness.

Collaborative networks introduce their own complexities for homeless service delivery. Actual efficiencies of the system depend on the mutually agreed upon rules that drive resource allocation (8, 82). Partnerships must continuously devote time toward planning and monitoring mutually agreed upon goals, which shifts resources away from the core service missions of each agency (35). Given the constant pressure for social services, a dynamic emerges that threatens continued investment in collaboration (59). Instability can create oscillations in the quality of network performance toward ending homelessness (35). Virtuous cycles emerge within collaborations that have clear goals, strong leadership, and investments in backbone supports (62). Challenges exist for sustainable efforts.

Taken together, coordinated approaches to homelessness must consider the extensive heterogeneity in the population, as well as in the types and timing of services. Given the multiple pathways into homelessness and the diversity of the homeless population, a one-size-fits-all approach is inadequate. Collaborations represent a flexible strategy to address homelessness. However, system performance toward ending homelessness depends in large part on continuous investments in partnerships.

## 3. TRANSFORMING COORDINATED RESPONSES TO HOMELESSNESS

### 3.1. Housing First as an Organizing Philosophy

The complex systems delivering homeless assistance organize around key theories on ending homelessness. Formal and informal policies operationalize these theories, and structure emerges

to coordinate resource allocation across intersecting networks (8). A paradigm shift has moved homeless systems toward a housing first philosophy (76). Although housing first also refers to a specific case management intervention, the philosophy more generally aligns services to stabilize accommodations quickly and without preconditions. This approach contrasts with the earlier treatment first, or staircase, approach that requires homeless persons to demonstrate housing readiness or compliance with service plans as a condition of obtaining and maintaining housing supports. Fundamentally, the shift in philosophies moves toward a person-centered and recovery-oriented approach that assumes housing serves as a platform for reintegrating into communities.

Housing first interventions provide access to housing plus ongoing supports ranging in duration and intensity (11, 107). Examples include assertive community treatment (ACT), critical time intervention (CTI), and Pathways to Housing. Early experimental studies in the 1980s and 1990s showed that homeless persons experiencing severe mental illness achieved stability more quickly and more consistently when randomly assigned to housing first instead of to treatment first services (87, 102). Moreover, early studies suggested that the delivery of case management yielded savings from avoided costs for shelter, hospitalization, and criminalization (51, 85). The initial evidence challenged assumptions of housing readiness to highlight cheaper and more effective options for homeless service delivery.

Well-designed studies subsequently tested the implementation and impact of housing first models with different homeless populations. Several large experiments in the United States and Canada randomly assigned homeless individuals and families to different housing interventions and carefully monitored the impacts of service delivery on a host of outcomes (2, 45, 87). Evidence from these and other studies generally support permanent housing approaches for improving stability (84). Benefits of permanent housing on well-being and quality-of-life improvements are more elusive; treatment effects are smaller and less consistent across outcomes and populations (32, 45). Additionally, emerging evidence on rapid rehousing interventions providing time-limited rental assistance shows little impact on stability or well-being (14, 45, 58). As a whole, the body of evidence firmly dismisses housing readiness requirements for homeless assistance.

## 3.2. Dissemination and Implementation of Housing First

Numerous rigorous investigations into widespread dissemination and implementation of housing first provide important considerations for complex homeless systems. Studies show that fidelity to specific housing first models promotes household outcomes (2, 40, 87). Yet, model adherence requires substantial investment in training and technical assistance (2, 40, 69). Using the interactive systems framework (115), a national rollout of Pathways to Housing in Canada showed that fidelity diminished in communities with less initial buy-in and support (2, 69).

Similar findings emerged from an initiative to provide housing first to 85,000 veterans across the United States (55, 56). The organizational transformation model (63) directed substantial investment and technical assistance to deliver supportive housing as part of the health care system for veterans. Housing readiness requirements diminished through transformational efforts; however, model fidelity for client-centered supportive services remained inconsistent (54). Both studies emphasize the necessity of strong leadership and buy-in for achieving housing first model adherence (2, 39, 40, 54). The studies show the difficulty in shifting cultures toward housing first principles even in well-resourced initiatives.

Systems integration of services for housing first also proves challenging. An innovative early experiment of supportive housing for homeless individuals experiencing severe mental illness also tested impacts on systems of care (43). The study randomly assigned individuals to receive supportive housing, as well as communities to receive technical assistance for systems transformation

to integrate services. Community-level interagency networks were assessed over time to see if resources for supportive housing triggered new and stronger partnerships for nonresidential services. Findings suggested little change in systems of care, and technical assistance failed to integrate services (73, 86, 88).

### 3.3. Housing First Adoption and Adaptations

Despite implementation challenges, the housing first philosophy has been broadly adopted within homeless services around the world (11, 76). This shift is most apparent in the integration of housing first principles into national strategies for addressing homelessness in Australia, Austria, Belgium, Canada, Denmark, France, Finland, Germany, Great Britain, Greece, Italy, the Netherlands, Portugal, Scotland, Spain, Sweden, and the United States (76). Policies focus on the provision of housing as a platform for connection to other services necessary for ending homelessness (79, 112). However, considerable variation exists in adherence to evidence-based interventions as well as adaptations for system-wide implementation (11, 76).

The United States provides an example of both broad adoption and adaptations of housing first philosophy. The Homeless Emergency Assistance and Rapid Transition to Housing (HEARTH) Act of 2009 (Pub. L. 112–141) introduced federal legislation that required every community across the country to develop and implement coordinated responses to homelessness. Guided by housing first principles, policies focus on procedures for community-wide screening and allocation of homeless assistance based on level of need; resources are prioritized for homeless persons deemed most vulnerable (62, 113). The emphasis on vulnerability coincides with a shift in resources toward the literally homeless and away from the broader demand for supports to maintain housing (10, 19, 94). The housing first tenets were codified in a redefinition of homelessness and eligibility for services, as well as national agendas for ending homelessness (113; Pub. L. 112–141).

**Figure 2** illustrates the implementation of housing first policies through shifts in new and real-located resources. Plotting year-round beds available for homeless persons since 2007, the system has increasingly used housing first rapid rehousing and supportive housing, whereas use of shelters and temporary housing has declined. Trends in total federal funding for homeless assistance also demonstrate increases in capacities. Although annual budgets fail to disaggregate funds by service type, increases in funding correspond with shifts toward rapid rehousing and supportive housing. Decreases in the number of persons served through homeless assistance over the same period further suggest that the homeless systems provide more intensive services (46).

### 3.4. Housing Insecurity and Coordinated Responses to Homelessness

Capacity shifts also signal the role of housing insecurity in the coordinated response to homelessness. Although US policy requires communities to include prevention in coordinated responses to homelessness, the availability and funding for such efforts are not tracked. Moreover, annual assessments of homeless system performance required by federal regulations do not consistently measure successful prevention efforts (Pub. L. 112–141). A similar pattern emerges in countries across the world; European countries that record funding show disproportionate spending on homeless interventions relative to prevention (66, 78). Only Wales systematically monitors the total demand and response to prevention services (66, 68). In the absence of metrics that track the implementation and outcomes of prevention, it is difficult to understand how well-coordinated responses address overall demand for homeless assistance.

Crises in affordable housing throughout the United States and globally suggest widespread unmet demand. **Figure 3**, for instance, presents an indicator of housing insecurity in the United
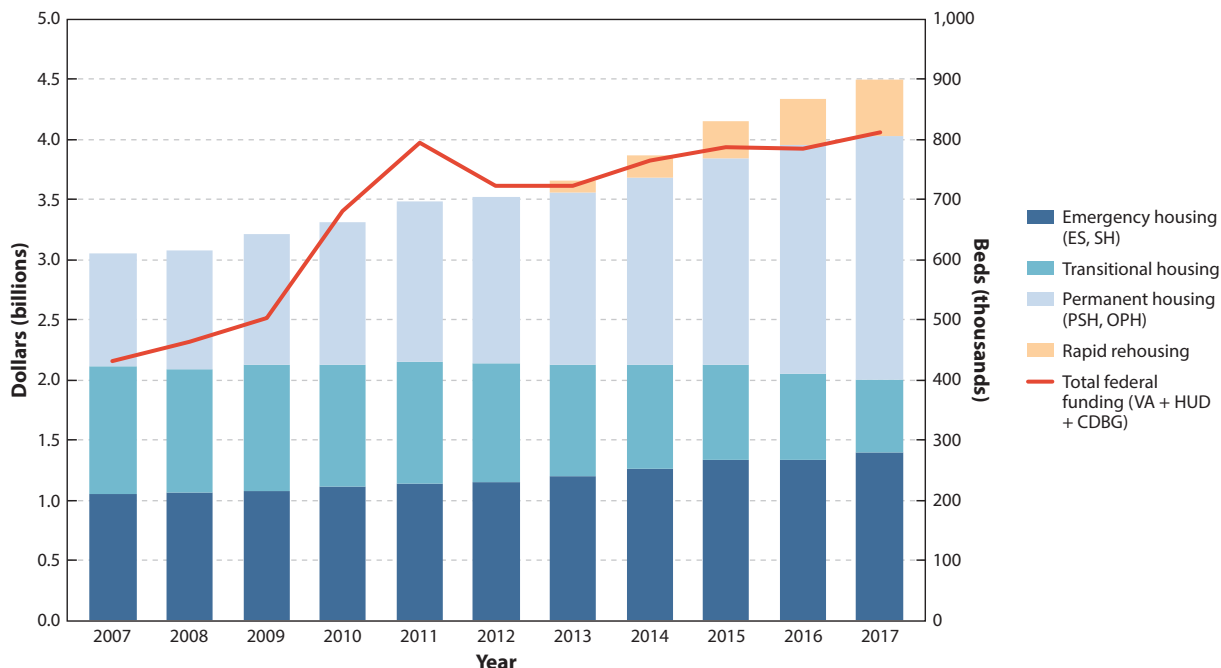
**Figure 2**

Capacity trends of homeless assistance in the United States. Bars indicate the number and type of year-round beds according to Continuum of Care Housing Inventory Counts; the red trend line represents overall federal funding of homeless services through the US Department of Housing and Urban Development (HUD), Veterans Affairs (VA), and Community Development Block Grants (CDBG). Other abbreviations: ES, emergency shelter; OPH, other permanent housing; PSH, permanent supportive housing; SH, safe haven.
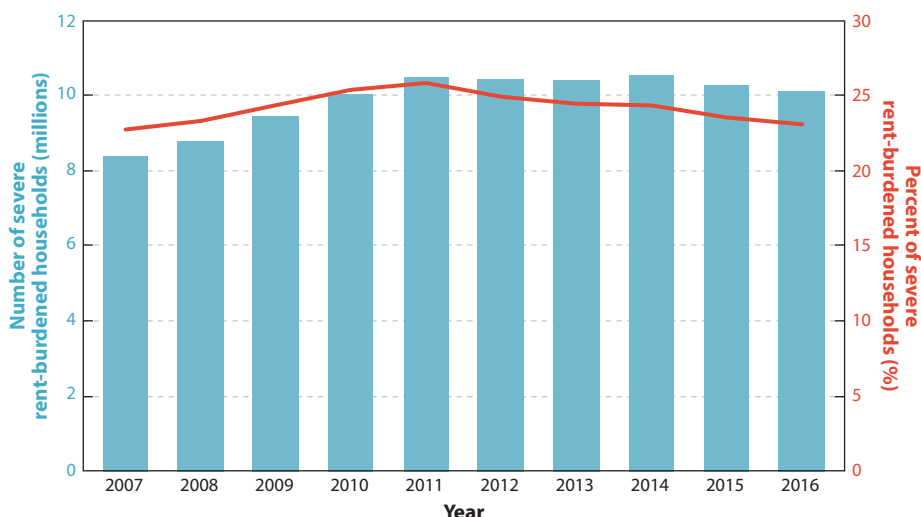


**Figure 3**

Number (*blue bars*) and percent (*red line*) of households in the United States with severe rent burden 2007–2017. Data obtained from the American Community Survey 1-year estimates (111).

States. The figure plots the annual number of renting households paying more than 50% of income toward rent, referred to as severe rent burdened (111). A spike of 10 million households in 2012 has declined in recent years, and the trend line of severely burdened as a proportion of all renting households suggests some relief for the lowest-income households. Yet, reductions have yet to return to prehousing crises levels (52). Markets around the world face similar shortages in affordable housing that create a constant demand for homeless assistance (27, 60, 92).

## 3.5. Prevention in Coordinated Responses to Homelessness

The lack of focus on housing insecurity reflects ambivalence in national policies regarding prevention (67). On one hand, most countries emphasize prevention as a key component of housing first strategies (11, 37, 66, 113). Prevention frameworks are based on a public health conceptualization of homelessness and generally refer to policies and practices that promote connections to stable homes (37, 67, 94). As illustrated in **Figure 4**, prevention efforts target populations at varying levels of risk for homelessness with evidence-based resources that increase in intensity (42, 67, 94). Universal prevention is broadly available to ensure access to housing, such as the right to housing legislation that guarantees access to housing supports, as well as duty to assist policies that require governments to respond to requests for housing supports (11, 67, 103). Selective prevention targets resources toward groups vulnerable for homelessness, for instance families under investigation for child maltreatment, youth aging out of foster care, and veterans returning from combat (14, 32, 33). Indicated prevention focuses on populations demonstrating vulnerability for homelessness, such as households facing evictions and foreclosures and low-income families screening high for housing instability (44, 95, 114). Coordinated prevention initiatives combine multiple intervention types to stem the inflow into homelessness. National policies aspire to avoid human and social costs through timely assistance that addresses housing insecurity.

On the other hand, policy agendas struggle to reconcile aspirations with the feasibility of meeting the broad demand posed by housing insecurity (11, 19, 67). Prevention proves challenging, given the difficulty in predicting whether timely assistance averts homelessness that would have occurred otherwise; inefficiencies in targeting create false alarms that diminish cost-effectiveness (12, 94, 95). Moreover, prevention efforts that fail to address societal determinants of homelessness—including structural poverty, violence, and marginalization—are perceived as misguided (12, 94). In the context of scarcity, persuasive arguments suggest a responsibility to deliver
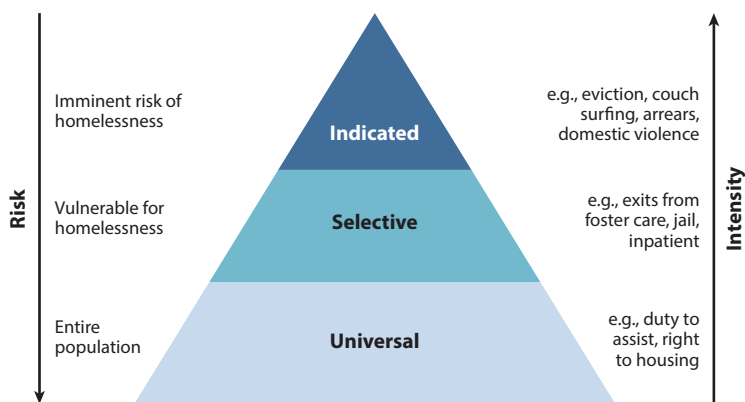


**Figure 4**

Homelessness prevention targets based on population and intensity of housing supports.

services for households most likely to avoid homelessness and associated costs (12, 19, 94). Prevention efforts shift toward avoiding reentry into homelessness instead of promoting connections to housing (14, 67, 104).

Policy ambivalence results in inconsistent applications of prevention across countries (67). Debates over prevention-oriented approaches to homelessness have persisted over three decades (19, 50, 94). Few national strategies currently include structured processes for delivering and monitoring prevention activities, and instead, countries vary considerably in basic definitions on targeting of services (67, 68). In the United States, coordinated responses allow allocation of homeless funds for prevention without guaranteeing access. Even most communities that recognize housing as a basic right ensure only connection with supports (regardless of appropriateness and legality) and not accommodations (12, 67). Homeless assistance relies on diverting demand driven by housing insecurity toward community-based services and other social welfare resources outside of homeless systems (12, 19, 72). If the adage that what gets measured gets done is correct, the lack of accountability reveals the unsystematic role of prevention within coordinated responses to homelessness (67, 68).

# 4. SOLVING HOMELESSNESS FROM A COMPLEX SYSTEMS PERSPECTIVE

## 4.1. Homeless Assistance from a Complex Systems Perspective

Complex systems provide a critical perspective on the delivery of coordinated responses to homelessness. Complex systems are composed of multiple interacting agents that produce nonlinear patterns of behaviors, and they continually adapt and evolve in response to conditions within the system (24, 64, 93, 101). Dynamics emerge from feedback mechanisms, influencing future system behaviors. Reinforcing feedback generates patterns of growth (positive or negative), whereas balancing feedback limits unconstrained growth (homeostasis). Interactions between feedback processes often produce counterintuitive results when trying to change a system. Given the nature of homelessness, complex systems offer a unique tool for evaluating coordinated responses.

Complexity characterizes homelessness and systematic responses. At the household level, transitions between stable and unstable accommodations create oscillations over time that characterize homelessness (83, 89, 96). The patterns challenge accurate predictions and effective responses to homelessness (38, 44, 95). The elaborate ties across persons, agencies, and service systems enable extensive customization to unique and dynamic demands for services (1, 57, 81).

A complex systems perspective offers insights into sustainable solutions to homelessness. Framed as a dynamic problem (49, 100), total homelessness is a function of the initial levels plus the ongoing movement of people in and out of homelessness. Mathematically, the dynamic is described by the differential equation:

$$\mathrm{d}homelessness(t)/\mathrm{d}t = entries(t) - exits(t),$$

where d represents change, *homelessness* represents total persons homeless, *t* represents time, *entries* represents persons entering homelessness at a given time, and *exits* represents persons exiting homelessness at a given time. Homelessness trends depend on the population size plus the rate of entries and exits over time. This stock-and-flow dynamic is analogous to water levels in a bathtub and produces counterintuitive results (100, 101). For instance, to drain a tub, the volume of water from the tap must be less than the volume of outflow after pulling the stopper. Thus, the tub will never completely empty after opening the drain without also closing the tap.

Likewise, closing the tap will not reduce water levels if the drain remains blocked. As anyone who has dealt with an overflowing toilet knows, the complexity can trigger poorly timed and counter-productive reactions.

Community-wide coordinated responses to homelessness attempt to manage stock-and-flow dynamics under conditions of far greater uncertainty. Efficient solutions likely address the net flow of homelessness, as opposed to just one part of the system. However, the interacting processes that respond to the need for homeless assistance (see **Figure 1**) produce nonlinearities that obscure optimal choices for system-wide strategies (71, 100). A number of common results from intervening in complex systems challenge decision making, such as delayed effects, tipping points, and worse-before-better scenarios (100). The dynamics make decisions about resource allocation toward housing first adaptations or prevention approaches difficult.

## 4.2. A System Dynamics Model of Coordinated Responses to Homelessness

A system dynamics model allows investigation into coordinated responses to homelessness. The systems science method uses informal and formal models to represent complex systems from a feedback perspective (49, 64, 100). Computer simulations test assumptions of the system, as well as help identify leverage points that represent places to intervene in the system for maximum benefit (70).

**Figure 5** represents solving homelessness as a dynamic problem. Historical trends present the annual number of persons receiving homeless services in the United States (97). Hoped and feared trajectories represent theorized responses to homelessness. The trajectories define the
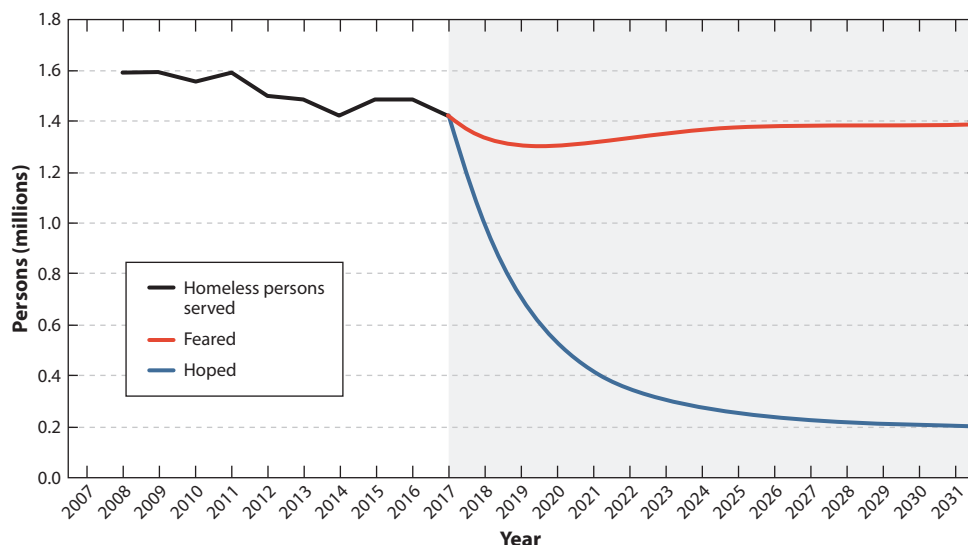


**Figure 5**

Dynamic problem of homelessness in the United States. Historical trends (*black*) present the annual number of persons receiving homeless services. Hoped (*blue*) and feared (*red*) trajectories represent theorized responses to homelessness. Based on trends in the United States, the vertical axis reports the number of persons served by homeless assistance annually, whereas the horizontal axis represents time as 10 years in the past and future. The left half of the graph shows the observed linear decline in homeless, which is interpreted as progress (97). The right half of the graph articulates the hopes and fears of coordinated responses to homelessness.

dynamic problem as a need for innovative policies that disrupt the status quo (49, 67, 100). Although the example uses annual national data on homeless persons served in the United States, similar hopes and fears likely emerge in many local and national contexts (35).

Policy shifts toward housing first adaptations as well as prevention-oriented approaches hypothesize a sharp and sustainable downward trajectory of homelessness. However, the mechanisms underlying the dynamic differ on the basis of philosophy. Housing first adaptations assume moving more homeless persons into stable housing more quickly will drive down demand for homeless assistance, whereas prevention-oriented approaches hypothesize that supports provided before homelessness will reduce demand. A third hypothesis from a complex systems perspective suggests that a combination of approaches disrupt homeless trajectories. Articulating the theories of change allows researchers to model the dynamics.

**Figure 6** presents an informal model of coordinated responses to homelessness. The structure elaborates on the previous formulation to capture stock-and-flow dynamics, and a formal computational model incorporates additional differential equations to capture dynamics (100). Using system dynamics conventions, stocks refer to accumulations of people, whereas flows represent transitions in and out of stocks. People exit stocks into stable housing defined as not needing housing assistance. In addition to homelessness, the model tracks individuals experiencing housing insecurity who are seeking assistance versus hidden homeless, which incorporates the different targets of prevention. Dynamics emerge as people transition in and out of stable housing. The model assumes that the average time in homeless assistance is 3.5 years, and housing
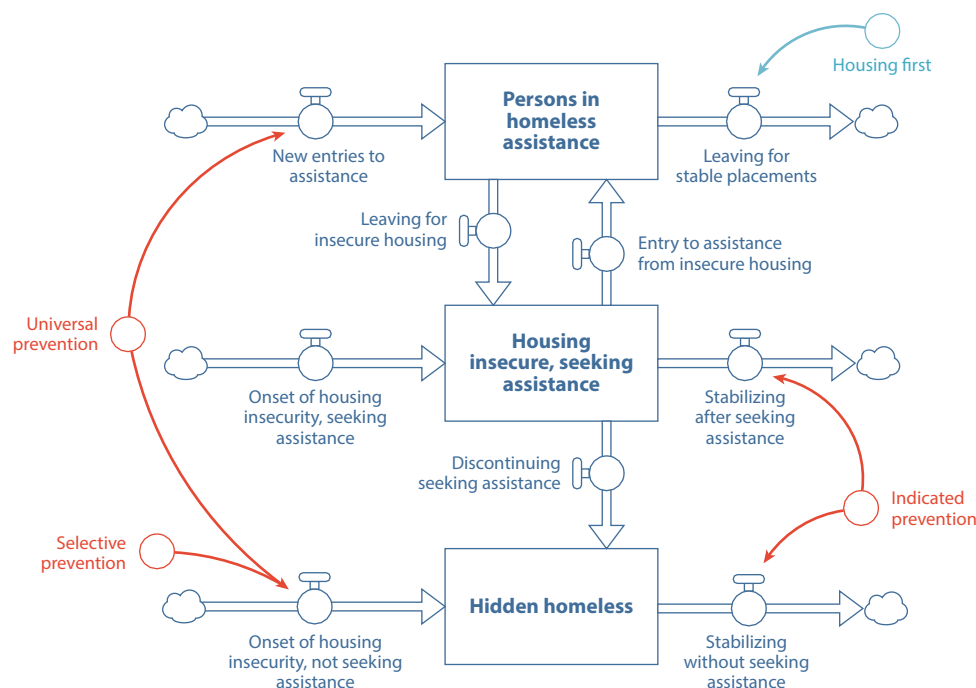


**Figure 6**

System dynamics model of people receiving homeless assistance and those experiencing housing insecurity and hidden homelessness. Boxes represent accumulations of people, arrows represent transitions in and out of stocks, and clouds represent stable housing.

insecurity represents a transitional state through which most exit within two years, loosely based on definitions of chronic homelessness (97).

Computer simulations test a series of policy experiments for solving homelessness. The first experiment tests efforts to improve housing first by decreasing time spent in homeless assistance before exiting to stability. The second experiment expands universal, selective, and indicated prevention by reducing each inflow into homelessness assistance. The third experiment tests combined housing first and prevention strategies. Each experiment improves performance by 50%, and combined interventions do not exceed 50% effects. All analyses were conducted within Stella Architect Version 1.2.1. A web-interface provides access to the model and allows real-time experiments (**https://socialsystemdesignlab.wustl.edu/items/homelessness-and-complex-systems/**).

### 4.3. Simulation Results

Initial analyses assessed confidence in the model. Simulations replicate observed trends in persons seeking homeless assistance (**Figure 3**) and housing insecurity (**Figure 2**) in the United States between 2007 and 2016. Moreover, exploratory analyses suggest that the model is insensitive to initial values; similar patterns emerge when increasing stocks and reducing transition times (100). Different indicators of homelessness and insecurity produce similar results, which further suggests that the model captures the population-level dynamics of homelessness.

**Figure 7** displays results from policy experiments on trends of homeless assistance and total housing insecurity (seeking assistance plus not seeking assistance). Findings demonstrate support for the complex systems perspective. Optimizing housing first approaches results in incremental reductions in the number of persons in homeless assistance with no impact on the rates of housing insecurity; results suggest that the system is already optimized for reducing homelessness quickly, and it currently strains to keep up with the constant demand for homeless assistance. By reducing the demand for homeless assistance, prevention improvements qualitatively shift the trajectory of housing insecurity, while generating similar incremental improvements in homeless assistance trends as housing first optimization. The same shifts occur when experimenting with smaller improvements in efficiencies; prevention always outperforms housing first adaptations. For instance, a 5% improvement in prevention generates a similar decrease on total need for housing as a 50% improvement in housing first adaptations. Thus, prevention represents a leverage point to enhance coordinated responses to homelessness, and tests reveal that universal plus indicated preventions account for the greatest shifts. However, the optimal response to homelessness comes from a multipronged approach that incorporates prevention with housing first, which generates shifts in housing insecurity and homeless assistance. As hypothesized by the complex systems perspective, managing the net flow achieves desired outcomes of moving toward solving homelessness.

Results must be considered in context. Simulations use US national data to build confidence that the model replicates trends; however, the forecasts are not meant as point estimates for planning purposes. Likewise, national data aggregate across communities that may experience different outcomes from coordinated responses. Using local data and different indicators of system performance would improve confidence in the simulation, as well as in the dynamics of homeless assistance. Finally, the simulations fail to provide an oracle; malleability exists in how policy responds and adapts to trends in homelessness that may alter the system dynamics. The models also make no assumptions about the implementation of prevention. Reducing demand by 50% may exceed realistic expectations, and the simulations fail to consider policy resistance generated from current paradigms. Regardless, simulations suggest small improvements in prevention generate qualitative shifts in demand for assistance.
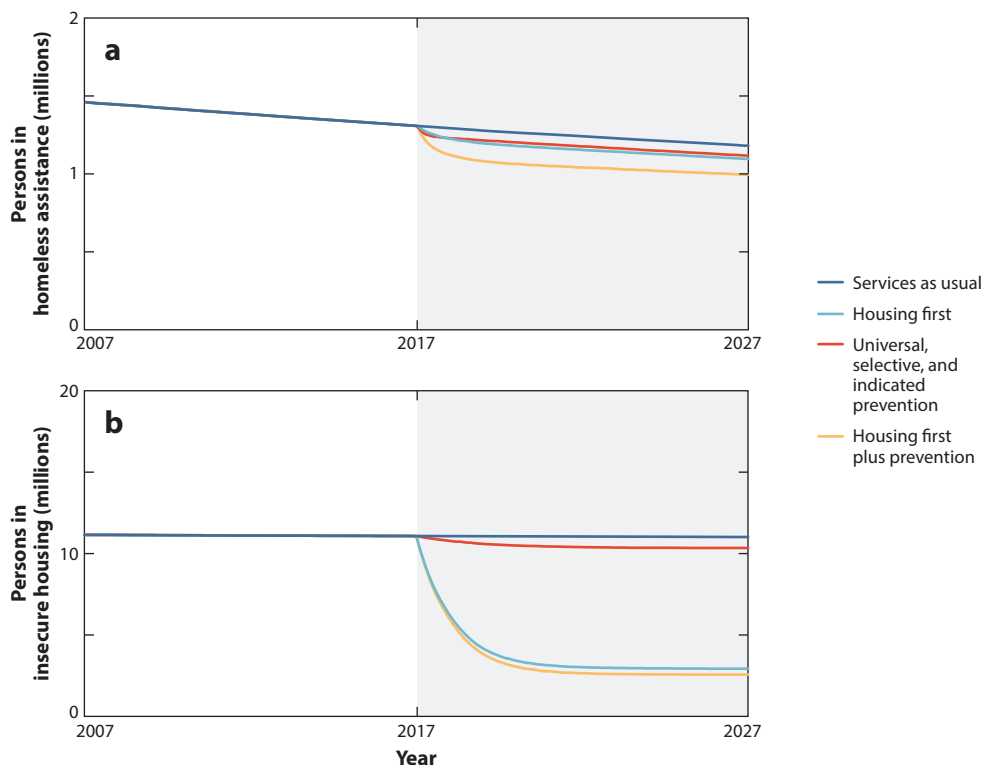
**Figure 7**

Policy experiments showing the impact of housing first and prevention efforts on the number of people in homeless assistance (*a*) and number of hidden homeless (*b*) with services as usual (*dark blue line*); housing first only (*light blue line*); universal, selective, and indicated prevention (*red line*); and housing first plus universal, selective, and indicated prevention (*yellow line*).

## 4.4. Implications for Coordinated Responses to Homelessness

Homeless systems across the world are optimizing policies toward solving chronic homelessness. Resource allocation increasingly prioritizes on the basis of vulnerability and moral preference (e.g., households with children, veterans, seniors). However, simulations warn of unintended consequences that arise from constant pressure for stable housing. Systems that focus on the most vulnerable risk ignoring the unseen needs of the many households unable to access timely supports. Effective responses need to manage both the inflows and outflows to produce intended declines in homelessness rates.

A complex systems perspective presents a number of implications for homeless policies and practices. First, prevention represents a necessary component for sustainable reductions in homelessness. Although declines are achievable and have been demonstrated through coordinated efforts (67), the dynamics of the system challenge population-level reductions in the absence of considerable ongoing investment of resources. Second, the efficiency of prevention questions the fairness of current policies that prioritize on the basis of vulnerability. Not only does accumulating evidence question the reliability of prioritization tools (6, 108), but also simulations suggest that withholding prevention potentially harms a large population of individuals who are unable to access useful services. Policies must consider an equitable distribution of both benefits and harms in resource allocation strategies. Third, history warns of resistance to reorienting systems

toward prevention (17, 19, 94). A shift requires longer-term investment and introduces delays in observing results, which proves challenging in the presence of human suffering associated with current homelessness, as demonstrated by the well-meaning appeal of prioritization on the basis of vulnerability. Policies, and especially system performance goals, need to create incentives for balancing crisis response with upstream interventions. Fourth, an immediate step toward a prevention framework requires communities to track and actively monitor broader demand for housing assistance beyond entry into homeless services. As communities increasingly move toward a coordinated entry into homeless services, existing policies typically emphasize or require a homelessness determination for access and, thus, fail to connect with the delivery of prevention services. The oversight results in limited information being provided to assess and improve prevention responses; for instance, communities may be unable to track demand for prevention beyond those who receive the limited services available. The lack of success of disorganized resources further undermines investments in prevention. System performance metrics contingent on homelessness reductions must also reward prevention successes. Finally, rights-based housing policies provide the most conducive framework for broad-scale prevention (29, 66). Duty to assist legislation enacted in Wales ensures households seeking housing supports receive best effort responses, which include counseling plus short-term housing only if necessary (67, 68). Households that still need assistance and those already homeless enter more intensive interventions. Policies structure services to capture demand for and effectiveness of prevention responses in ways that allow for ongoing system improvements.

## 5. SUMMARY

Homelessness represents a global public health challenge. Coordinated responses leverage flexible networks to deliver a range of services tailored to complex needs. However, current policies that prioritize services on the basis of vulnerability miss opportunities for prevention, thus contributing to overwhelming pressure on the service system. To achieve broad and sustainable reductions in housing insecurity, homelessness prevention must be fully integrated into existing service networks. Prevention-oriented policies that ensure timely responses to housing insecurity extend the housing first philosophy and leverage the considerable capacity of homeless services.

## DISCLOSURE STATEMENT

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## ACKNOWLEDGMENTS

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