

THINK **BIGGER** DO **GOOD**

POLICY SERIES

Using Markov Modeling to Understand the Dynamics of Unhoused Populations Experiencing Serious Mental Illness

Rachel M. Smith, M.P.H., and Sherry Glied, Ph.D.

Fall 2025

Dear Reader,

Now is the time to address the growing behavioral health needs across our country by advancing public policies that transform how mental health and substance use disorder services are delivered—and by modernizing outdated funding systems that stand in the way of progress.

This paper is part of *Think Bigger Do Good*, a series launched in 2017 through the leadership and support of the Thomas Scattergood Behavioral Health Foundation and Peg's Foundation. While the topics have evolved over time, our mission remains constant: to shape a forward-thinking policy agenda that improves health outcomes for all.

In collaboration with national behavioral health experts—including our editors, Howard Goldman and Constance Gartner—we have identified several critical topics for this series of papers. Each paper defines the problem and offers clear, actionable solutions for policymakers, practitioners, and advocates alike.

We invite you to join us in championing stronger behavioral health policies. Please share this paper with your colleagues, community partners, policymakers at all levels, advocacy organizations, and voters. To explore the full *Think Bigger Do Good* series, visit www.thinkbiggerdogood.org.

Sincerely,

Joseph Pyle, M.A.

President
Scattergood Foundation
Founding Partner of Series

Rick Kellar, M.B.A.

President
Peg's Foundation
Founding Partner of Series

Jane Mogavero, Esq.

Executive Director
Patrick P. Lee Foundation

Tracy A. Sawicki

Executive Director
Peter & Elizabeth Tower Foundation

Melissa Beck, J.D.

Executive Director
Sozosei Foundation

We would like to acknowledge the following individuals for their participation in the meeting that led to the conceptualization of the paper series.

Colleen L. Barry, Ph.D., M.P.P.

Cornell University

Cynthia Baum-Baicker, Ph.D.

The Scattergood Foundation

Anita Burgos, Ph.D.

Bipartisan Policy Center

Thom Craig, M.P.A.

Peg's Foundation

Rebecca David, M.P.H.

National Council for Behavioral Health

Kelly Davis

Mental Health America

Lisa Dixon, M.D., M.P.H.

Columbia University, NY State Psychiatric Institute, and *Psychiatric Services*

Sara Dugan, Pharm.D., B.C.P.P., B.C.P.S.

Northeast Ohio Medical University

Peter Earley

Author & Journalist

Alyson Ferguson, M.P.H.

The Scattergood Foundation

Richard Frank, Ph.D.

Harvard Medical School

Rachel Garfield, Ph.D., M.H.S.

The Henry J. Kaiser Family Foundation

Mary Giliberti, J.D.

Mental Health America

Aaron Glickman, B.A.

Perelman School of Medicine, University of Pennsylvania

Sherry Glied, Ph.D.

NYU Wagner School of Public Service

Howard Goldman, M.D., Ph.D.

University of Maryland School of Medicine

Pamela Greenberg, M.P.P.

Association for Behavioral Health and Wellness

Kimberly Hoagwood, Ph.D.

New York University School of Medicine

Michael F. Hogan, Ph.D.

Hogan Health Solutions

Chuck Ingoglia, M.S.W.

National Council for Behavioral Health

Rick Kellar, M.B.A.

Peg's Foundation

Kelly Kelleher, M.D., M.P.H.

The Research Institute at Nationwide Children's Hospital

Jennifer Mathis, J.D.

Bazelon Center for Mental Health Law

Donald Matteson, M.A.

Peter & Elizabeth Tower Foundation

Brian McGregor, Ph.D.

Satcher Health Leadership Institute, Morehouse College

Erik Messamore, M.D.

Northeast Ohio Medical University

Benjamin F. Miller, Psy.D.

Well Being Trust

Jane Mogavero, Esq.

Patrick P. Lee Foundation

Mark R. Munetz, M.D.

Northeast Ohio Medical University

Sandra Newman, Ph.D.

John Hopkins Bloomberg School of Public Health

Joseph Pyle, M.A.

The Scattergood Foundation

Barbara Ricci

Center for High Impact Philanthropy

Cheryl Roberts, Esq.

Greenberger Center

Victoria Romanda

Peg's Foundation

Tracy A. Sawicki

Peter & Elizabeth Tower Foundation

Lloyd Sederer, M.D.

NYS Office of Mental Health/Mailman School of Public Health

Dominic Sisti, Ph.D.

Scattergood Program for Applied Ethics in Behavioral Health Care & Perelman School of Medicine at the University of Pennsylvania

Andrew Sperling, J.D.

NAMI

Kate Williams, J.D.

The Scattergood Foundation

Glenda L. Wrenn, M.D., M.S.H.P.

180 Health Partners

Titles in the Paper Series

Editors Howard Goldman, M.D., Ph.D. and Constance Gartner, M.S.W.

America's Opioid Epidemic

Lloyd I. Sederer, M.D.

Behavioral Health and the Individual Health Insurance Market: Preserving Key Elements of Reform

Richard G. Frank, Ph.D., and Sherry A. Glied, Ph.D., M.A.

Bringing Treatment Parity to Jail Inmates with Schizophrenia

Mark R. Munetz, M.D., Erik Messamore, M.D., Ph.D., and Sara E. Dugan, Pharm.D., B.C.P.P., B.C.P.S.

Coordinated Specialty Care for First-Episode Psychosis: An Example of Financing for Specialty Programs

Lisa B. Dixon, M.D., M.P.H.

COVID-19, Structural Racism, and Mental Health Inequities: Policy Implications for an Emerging Syndemic

Ruth S. Shim, M.D., M.P.H., and Steven M. Starks, M.D.

Employing People with Mental Illness in the 21st Century: Labor Market Changes and Policy Challenges

Richard G. Frank, Ph.D., and Sherry A. Glied, Ph.D., M.A.

Enhancing the Capacity of the Mental Health and Addiction Workforce: A Framework

Benjamin F. Miller, Psy.D., and Anita Burgos, Ph.D.

Fentanyl and the Evolving Opioid Epidemic: What Strategies Should Policymakers Consider?

Colleen L. Barry, Ph.D., M.P.P.

Growing Peer Support: Specialized Services at a Time of Crisis?

Kelly A. Davis and Nathaniel Z. Counts, J.D.

Housing Is Mental Health Care: A Call for Medicaid Demonstration Waivers Covering Housing

Jennifer Mathis, J.D.

How Communities Must Use 988 to Improve Care and Correct Crisis System Disparities

Stephanie Barrios Hepburn, J.D., and Michael F. Hogan, Ph.D.

Improving Outcomes for People with Serious Mental Illness and Co-Occurring Substance Use Disorders in Contact with the Criminal Justice System

Glenda L. Wrenn, M.D., M.S.H.P., Brian McGregor, Ph.D., and Mark R. Munetz, M.D.

Informed Consent: A Policy Prescription for Communicating Benefit and Risk in State Medical Marijuana Program

Erik Messamore, M.D., Ph.D., and Sara E. Dugan, Pharm.D., B.C.P.P., B.C.P.S.

Integrating Mental Health and Addiction Treatment in General Medical Care: The Role of Policy

Emma B. McGinty, Ph.D., M.S., and Gail L. Daumit, M.D., M.H.S.

Investing in Certified Community Behavioral Health Centers to Fulfill Their Promise

Richard G. Frank, Ph.D., and Julia Paris, M.A.

Investing in School Mental Health: Strategies to Wisely Spend Federal and State Funding

Sharon Hoover, Ph.D.

Judicial Threats to Olmstead and the Americans with Disabilities Act

Jean Goetz Mangan, J.D., Esq., Andrea L. Dennis, J.D., Esq.

Medicaid's Institutions for Mental Diseases (IMD) Exclusion Rule: A Policy Debate

Jennifer Mathis, J.D., Dominic A. Sisti, Ph.D., and Aaron Glickman, B.A.

Meeting the Needs of Justice-Involved People with Serious Mental Illness within Community Behavioral Health Systems

Natalie Bonfine, Ph.D., Amy Blank Wilson, Ph.D., L.S.W., and Mark R. Munetz, M.D.

New Opportunities to Improve Mental Health Crisis Systems

Michael F. Hogan, Ph.D., and Mathew L. Goldman, M.D., M.S.

Redesigning Federal Health Insurance Policies to Promote Children's Mental Health

Kimberly Hoagwood, Ph.D., Kelly Kelleher, M.D., M.P.H., and Michael F. Hogan, Ph.D.

Policy and Practice Innovations to Improve Prescribing of Psychoactive Medications for Children

Kelly J. Kelleher, M.D., M.P.H., David Rubin, M.D., M.S.C.E., and Kimberly Hoagwood, Ph.D.

Policy Recommendations to Address Housing Shortages for People with Severe Mental Illness

Sally Luken, M.A.

Preventing Risk and Promoting Young Children's Mental, Emotional, and Behavioral Health in State Mental Health Systems

Kimberly E. Hoagwood, Ph.D., Kelly Kelleher, M.D., Nathaniel Z. Counts, J.D., Suzanne Brundage, M.Sc., and Robin Peth-Pierce, M.P.A.

Preventing Suicide Through Better Firearm Safety Policy in the United States

Jeffrey W. Swanson, Ph.D.

Promoting the Mental Health of Parents and Children by Strengthening Medicaid Support for Home Visiting

Elisabeth Wright Burak, M.P.P., M.S.W., and Vikki Wachino, M.P.P.

Promoting Youth Mental Health through Equity-Centered Trauma-Informed Educational Initiatives in Schools

Ruth S. Shim, M.D., M.P.H., and Alex Shevrin Venet, M.Ed.

Systemic, Racial Justice-Informed Solutions to Shift "Care" From the Criminal Legal System to the Mental Health Care System

Sarah Y. Vinson, M.D., and Andrea L. Dennis, J.D.

Suicide Is a Significant Health Problem

Michael F. Hogan, Ph.D.

The Current Medicaid Policy Debate and Implications for Behavioral Healthcare in the United States

Rachel Garfield, Ph.D., M.H.S., and Julia Zur, Ph.D.

Toward Greater Accountability in Mental Health Care

Richard G. Frank, Ph.D., and Ruth S. Shim, M.D., M.P.H.

What About the Kids? Child and Adolescent Crises, the Pandemic, and 988

Stephanie Barrios Hepburn, J.D..

Youth Suicide Is Increasing: Modest Actions Taken Now Can Save Lives

Michael F. Hogan, Ph.D.

Find the papers online at www.thinkbiggerdogood.org



We are grateful for the partnership that allows this paper and others to appear in Psychiatric Services, a peer-reviewed monthly journal of the American Psychiatric Association. Content can be viewed at ps.psychiatryonline.org.

Using Markov Modeling to Understand the Dynamics of Unhoused Populations Experiencing Serious Mental Illness

Rachel M. Smith, M.P.H.

University of Maryland School of Public Health
rsmith74@umd.edu

Sherry Glied, Ph.D.

Wagner Graduate School of Public Service
New York University
sherry.glied@nyu.edu

1 / Introduction

There are many known strategies for housing unsheltered people with serious mental illness. For decades, literature has demonstrated the efficacy of the “housing first” approach, which entails providing supportive housing before requiring treatment for substance use or mental health (1–8). Yet even cities that have made substantial investments in housing continue to find that addressing chronic unsheltered homelessness among people with serious mental illness is challenging. One reason that homelessness in this group persists despite policy efforts may be the dynamics of homelessness. In all populations, including those with serious mental illness, people move in and out of housing. In a simple model, adding a certain number of housing units, e.g., 2,000, would reduce the chronic unsheltered census by the same number (2,000). However, the presence of these dynamics complicates outcomes and makes it more difficult to estimate the number of units needed to reduce the size of the unsheltered population by a given number. A second challenge is that even when offered housing, some people, particularly those with serious mental illness, are not able to make a sustained transition to stable housing (9). Policies to enhance retention in housing may help this group remain in housing.

One reason that homelessness in this group persists despite policy efforts may be the dynamics of homelessness.

To assess how the dynamics of homelessness and the challenges of keeping people housed affect where people with serious mental illness are living, we developed a Markov model of housing and homelessness.

To assess how the dynamics of homelessness and the challenges of keeping people housed affect where people with serious mental illness are living, we developed a Markov model of housing and homelessness. A Markov simulation model is a stochastic, dynamic simulation that captures transitions across states across different time periods (10). This approach allows us to take into consideration that chronically unsheltered homelessness among people with serious mental illness is not a static condition (11). Over time, some housed people with serious mental illness become homeless; others exit homelessness for shelter (12). We calibrated our model to the population of adults with serious mental illness in New York City and simulated the effects on housing circumstances under alternative options for those in this group who live persistently on the streets for more than 2 years (a state we refer to as chronic unsheltered homelessness).



2 / Prior Research

Although there are many point-in-time (PIT) counts of the homeless population and there is a robust literature on Housing First and similar interventions (1, 12), most of this literature does not address the challenges of transitions into and out of homelessness. Two prior longitudinal studies using Markov models provide information on usual sleeping place over time and the rates at which people enter and exit different types of places—transition probabilities (13, 14). Alexander-Eitzman’s analysis of the SUNCODA study in St. Louis, Missouri, reports on patterns of housing transitions for an urban population experiencing homelessness (13). Lemoine and colleagues uses the French Un Chez Soi d’Abord randomized clinical trial data to assess the cost effectiveness of Housing First combined with assertive community treatment (ACT) compared with usual care (in which housing was typically conditioned on mental health/substance use treatment) for a chronically unhoused population with serious mental illness (14).

Few studies have addressed the capacity of housing services needed to make substantial long-term changes in homelessness.

Few studies have addressed the capacity of housing services needed to make substantial long-term changes in homelessness. One prior study used randomized controlled trial data from the U.S. (HUD-VASH) experiment and the Canadian At Home/Chez Soi study and found, as we do, that although program capacity expansions reduced PIT counts in homelessness, the reduction over time was not one-to-one (15).

3 / Data and Methods

We constructed a Markov simulation model in Microsoft Excel with four states: general housing (housed or in institutions or dead), unsheltered homelessness, sheltered homelessness, and newly provided supportive housing (13, 14, 16). Our analysis population consisted of all individuals with serious mental illness in New York City. We derived our initial baseline transition probability (rates at which people move from one state to another) estimates from the studies by Lemoine and colleagues (14) and Alexander-Eitzman and colleagues (13), using a 1-year cycle length and a 60-year time horizon (13, 14). However, as these studies do not fully correspond to the situations we are considering, we adjusted these probabilities and calibrated the model so that after 60 iterations, it produces baseline estimates consistent with outside evidence about the PIT housing of people in New York. In a sensitivity analysis, we used unadjusted transition probabilities from research in other settings. Our study was conducted from May through September 2022. Institutional review board approval was not obtained because the study did not involve human subjects research.

Population

We assumed, based on a review of the literature, that the New York City population with serious mental illness at risk of losing housing is 45,000 people. This figure is consistent with an underlying prevalence of serious and persistent mental illness that poses a risk of losing housing of 0.85% in nonelderly adults and an adult population of 5.3 million in New York City in 2022 (17–19). Our model conclusions are not substantially changed if we assume a larger (or smaller) initial count of people with serious mental illness at risk of losing housing, because we ultimately calibrate this figure and rate to our estimates of the number of people with serious mental illness who are unhoused.

We assumed, based on a review of the literature, that the New York City population with serious mental illness at risk of losing housing is 45,000 people.

General housing (includes institutions and mortality).

We assumed that most individuals (38,000) with serious mental illness at risk of losing housing are initially housed (for example, living with family or in institutions). This housed population included people living in existing NYC supportive housing (we did not separate out this population). It also included a relatively smaller number of people housed in other institutional settings, including hospitals, jails, or institutions (20–24). Finally, we treated mortality as a transition into the general housing state (although, of course, mortality is an absorbing state); implicitly, we assumed that the increase in the population of people with serious mental illness who become newly at risk for homelessness matches the decline in the population that occurs as people who are homeless die.

Chronic unsheltered homelessness. Based on consultation with a knowledgeable NYC official, we assumed that initially about 2,500 single chronically homeless adults with serious mental illness live on the streets of New York City. We refer to this group as “chronically unsheltered homeless.” The model operationalizes the chronicity of unsheltered homelessness by assigning low transition probabilities of exit to all other states.

Sheltered homelessness. We assumed the sheltered population with serious mental illness lives primarily in shelters and intermittently on the street; for brevity, we refer to this state as “sheltered homelessness.” We assumed, based on NYC PIT counts, that there are 4,500 sheltered people with serious mental illness in this category at baseline. In total, this yields a homeless population with serious mental illness of 7,000 people (24–30).

Interventions

After calibrating the base case to match observed data, we modeled three types of interventions. The initial intervention adds 2,000 units of supportive housing (31). To model this intervention, we adjusted our baseline transition probabilities such that 2,000 people live in new supportive housing in the new steady state. We allowed transitions into supportive housing only from the chronically unsheltered homeless state. This assumption is much more restrictive than the typical experience documented in prior studies, where some people entered supportive housing directly from other states (such as shelter). In our base case analysis, we assumed that the risk of transitioning into the general housing state is higher for those in chronic unsheltered homelessness than for those in (relatively more stable) supportive housing.

We allowed transitions into supportive housing only from the chronically unsheltered homeless state.

Next (intervention 2), we supplemented supportive housing units with complementary services aimed at improving housing retention (32, 33). We did this by increasing the transition probability around remaining in supportive housing.

Finally, we supplemented housing and retention interventions with a hypothetical preventive intervention that also addresses those who are housed at baseline. We present this case to illustrate the interaction between having a fixed number of supportive housing units and reducing the flow into chronically unsheltered homelessness. We modeled this preventive intervention (intervention 3) by increasing the probability of remaining in general housing.

Sensitivity Analyses

We conducted four sensitivity analyses in total. In three one-way sensitivity analyses, we simulated how much our conclusions would change if we modified our transition assumptions in intervention 1 (supportive housing only). A final sensitivity analysis simulated changes to the base case.

In our first sensitivity analysis, we modeled the effects of modifying our very restrictive assumption that new units are targeted only to people who have been in chronically unsheltered homelessness. Instead, we allowed up to 3% of those in sheltered homelessness to transition to supportive housing units.

Next, we modeled the effect of modifying our assumption that, relative to those who are chronically unsheltered, those who live in supportive housing have a lower rate of transition to the general housing state. We did this by increasing the transition rate for those in supportive housing (from 5%) to be the same as the rate for the chronically unsheltered (4).

Third, we modeled the effect of decreasing the fraction who are retained in supportive housing from our base case estimate of 75% down to 50%.

These studies reported much higher rates of exit from homelessness and supportive housing into general housing and institutions than we assume.

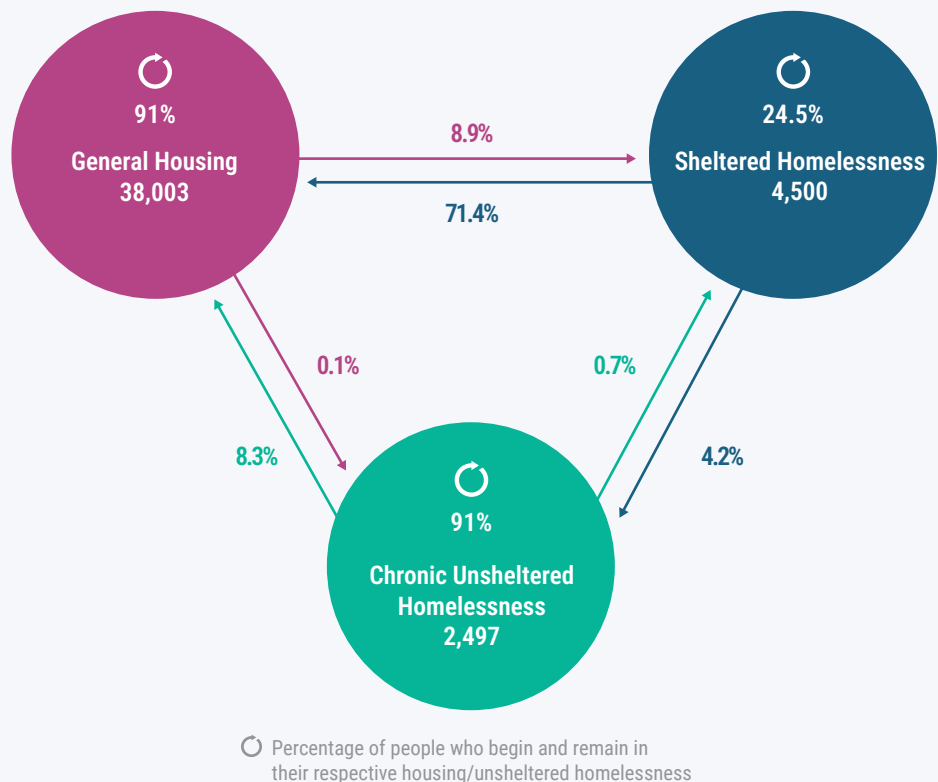
Finally, we separately simulated a model with assumptions across transitions that are closer to those in prior studies of supportive housing (e.g., Lemoine and colleagues [14] and Alexander-Eitzman and colleagues [13]). These studies reported much higher rates of exit from homelessness and supportive housing into general housing and institutions than we assume. These transition rates are so high that we needed to adjust downward (from 45,000 to 22,500) our assumptions about the underlying size of the population at risk for homelessness to generate a steady state of 4,500 people in shelters and 2,500 people experiencing chronic unsheltered homelessness.

4 / Results

Figure 1 provides our base case transition probabilities. These transition estimates are calibrated to generate steady state totals of shelter and chronically unsheltered homeless people corresponding to the assumptions described above.

Figure 1
Base Case Markov Model without Supportive Housing: Transition Probabilities and Steady-State Values¹

¹Figure 1 portrays the base case before any interventions are added. It is assumed that there are approximately 45,000 people aged 18–64 with serious mental illness living in New York City and at risk for homelessness. Transition probabilities (figures beside lines) are drawn from existing literature and calibrated to point-in-time estimates of persons who are chronically unsheltered and intermittently sheltered. Steady-state equilibrium estimates are indicated in bubbles. The general housing category includes people living in supported and standard housing and those in institutions (including jails). Total population size is assumed to be fixed, so that mortality is equal to entry into the at-risk population. Numbers are rounded.



The number in the top left indicates that 91% of people who begin in general housing remain in general housing the following cycle. The figure on the arrow leading from general housing to sheltered homelessness indicates that 8.9% of those who begin in housing transition to sheltered homelessness in the following year. Finally, 0.1% of people who begin in general housing transition to chronic unsheltered homelessness.

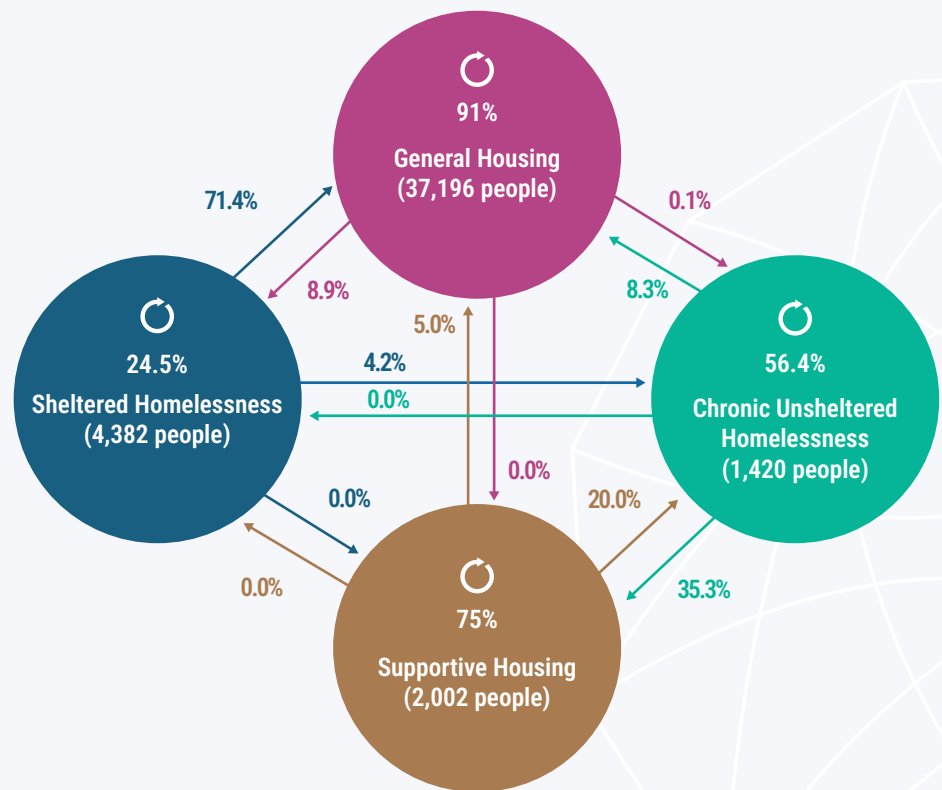
Among those who begin in shelters, 71.4% transition to housing. About 24.5% remain in shelters, and 4.15% move to the streets. Among those who begin in chronically unsheltered homelessness, 8.3% move to housing, die, or become institutionalized; 0.7% move to shelters; and 91% remain in chronic unsheltered homelessness. The figures in the bubbles show the steady-state outcomes after 60 model iterations: 2,497 people are chronically unsheltered and 4,500 are in sheltered homelessness.

Interventions

Next, we modeled the effects of adding 2,000 units of new supportive housing (Fig. 2) and of supplementing that housing with additional interventions (Fig. 3). We modeled the effect of adding housing by modifying our base case transition rates, shifting 2,000 people from chronic homelessness into supportive housing by applying a 35.5% transition rate from chronic unsheltered homelessness into housing. We assumed that among those in these new supportive housing units, 75% remain in supportive housing while 20% return to the street and 5% move to the general housing state. The figures in the bubbles (Fig. 2) show the steady-state outcomes under these assumptions. The intervention reduced the number in chronic unsheltered homelessness in the steady state by approximately 1,077, from 2,497 to 1,420; that is, the reduction in the chronic unsheltered census is a little more than half the number of new units added.

Figure 2
Markov Model
Adding 2,000 Units of
Supportive Housing¹

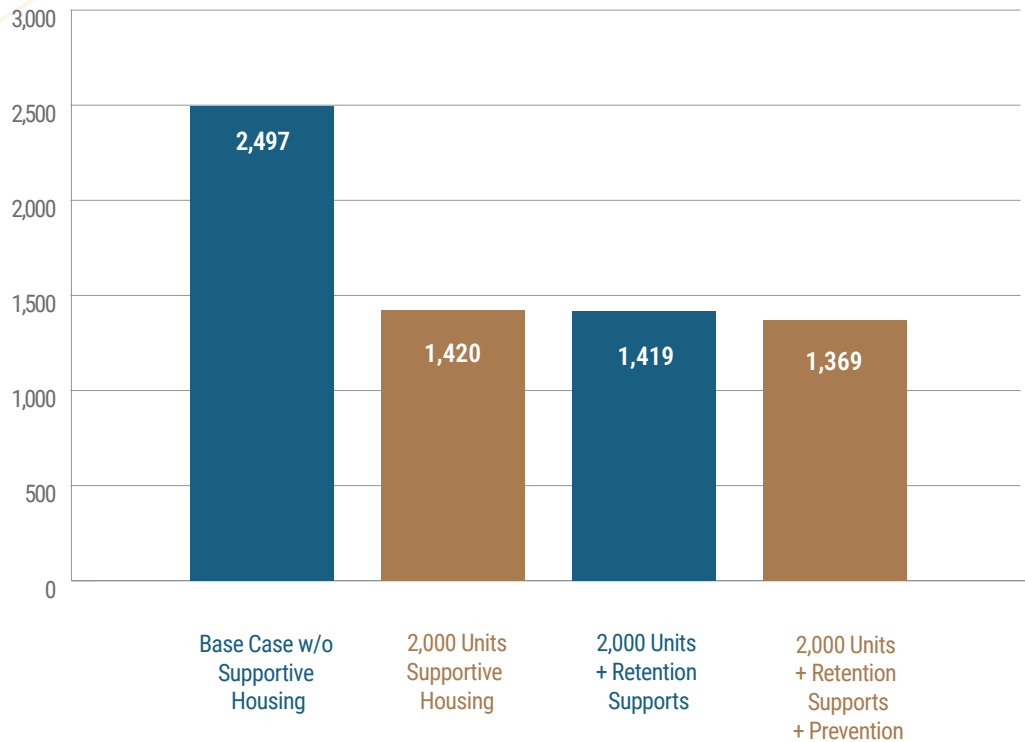
¹Figure 2 portrays the first intervention, which adds 2,000 units of supportive housing that can be entered only by individuals in chronic unsheltered homelessness (see Fig. 1). This intervention is calibrated such that in equilibrium 2,000 people with serious mental illness live in supportive housing.



In Figure 3, we show the effect of this new supportive housing supplemented by two interventions: a retention program that increases the percentage of individuals remaining in supportive housing and a preventive program that reduces the percentage of housed individuals who lose their housing. Table 1 in the Supplement describes the modifications of transition probabilities we used to describe these interventions. We assumed that adding retention supports (intervention 2) increased the share of people who remain in supportive housing from one year to the next by 5%.

Figure 3
Individuals with Serious Mental Illness Experiencing Chronic Unsheltered Homelessness under Alternative Interventions¹

¹Figure 3 reports the chronic unsheltered census for individuals under the base case and three types of subsequent interventions: adding the 2,000 supported housing units, increasing retention in the 2,000 units, and reducing the flow into homelessness (see Fig. 2).



As Figure 3 shows, in the base case, adding 2,000 units of housing reduced the number of people with serious mental illness who are chronically unsheltered by 1,077 to 1,420, a 54-person reduction per 100 permanent supportive housing units added. Adding retention supports serving the same population has a negligible impact on the chronic unsheltered census if the number of supportive housing units is fixed. Adding preventive interventions that keep people from transitioning into chronically unsheltered homelessness, by contrast, is more effective in reducing chronically unsheltered homelessness, because a fixed number of units would be serving a smaller population.

Sensitivity Analyses

In Figure 4, we report the results of varying the stringency of targeting by allowing transitions from shelters into supportive housing. Even a small decline in targeting substantially reduces the number of people who are moved out of chronically unsheltered homelessness for a given supply of supportive housing. Under a slightly less stringent targeting strategy, more than three units of housing are needed to reduce the chronic unsheltered census by one person.

Figure 4
Chronic Unsheltered* Census by Stringency of Targeting¹

¹Unsheltered* refers to "chronic unsheltered homelessness." In this one-way sensitivity analysis, the transition probability from shelters to supportive housing is increased from 0 (base case) to 3%. This shift is accommodated by adjusting retention in supportive housing and shelters, as well as transitions between chronically unsheltered homelessness and supportive housing. The key transition probabilities correspond to initial shares of transitioners into supportive housing drawn from shelters as follows: 0%, 3%, 7%, 11%, 15%, 19%, and 24%.

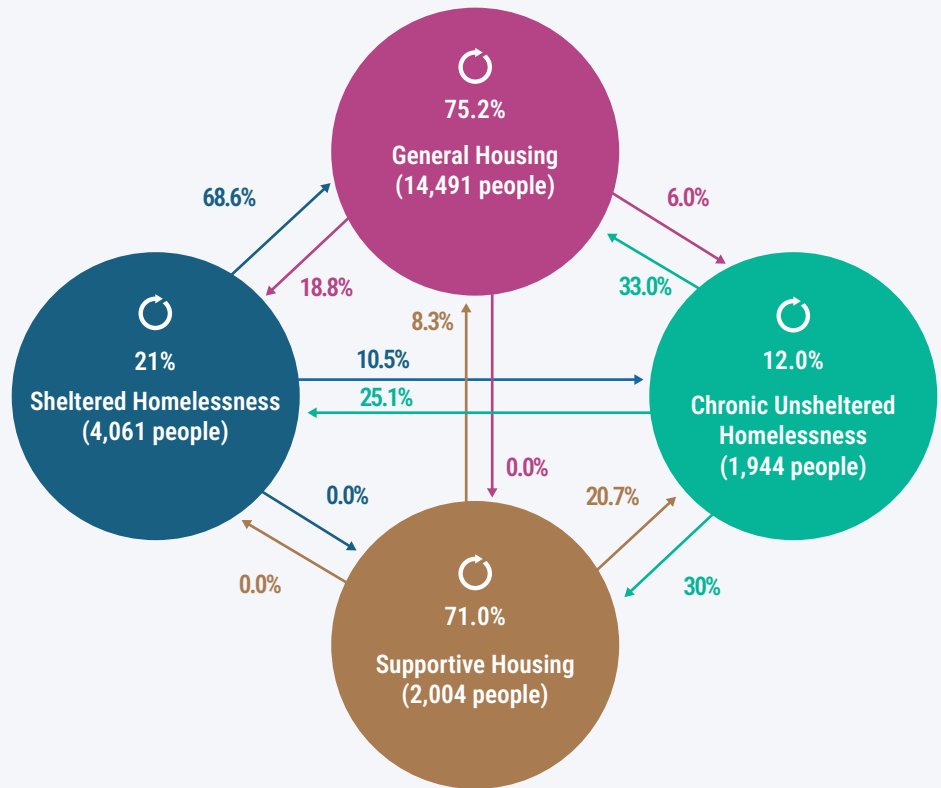


In Panel A in the Supplement we varied the rate of retention in supportive housing from the base case (25% leave supportive housing) to 50% leaving supportive housing each cycle/year. This assumption has little impact on the estimated number of people who are living in chronic unsheltered homelessness at a point in time: more people experience briefer episodes of living in the fixed number of supportive housing units. In Panel B, we varied the rate at which residents of supportive housing move into the general housing state (general housing, institutionalization, or mortality) from the baseline rate of 5% up to the rate for those who remain in chronic unsheltered homelessness (8.3%). Under this assumption, a given number of supportive housing units yields greater reductions in the number of people in chronic unsheltered homelessness. Because this may be due to higher mortality or institutionalization (which are included in the general housing state), however, this result could imply a loss in the well-being of the population.

Finally, we modified all our baseline assumptions about transition probabilities to more closely replicate the rates described in prior studies (Fig. 5). Under the rates of transition into and out of homelessness identified in prior supportive housing studies, four units of supportive housing are needed to reduce the chronic unsheltered census by one person.

Figure 5
Markov Model Using Transition
Probabilities from Prior Housing
Transition Studies¹

¹Figure 5 reports the addition of 2,000 strictly targeted supportive housing units (as seen in Fig. 2) with modified base case transition assumptions (see Fig. 1). A population size of 22,500 people aged 18–64 with serious mental illness living in New York City and at risk for homelessness is assumed (reduced from original 45,000). Transition probabilities are drawn from Alexander-Eitzman and colleagues (13) and Lemoine and colleagues (14).



Limitations

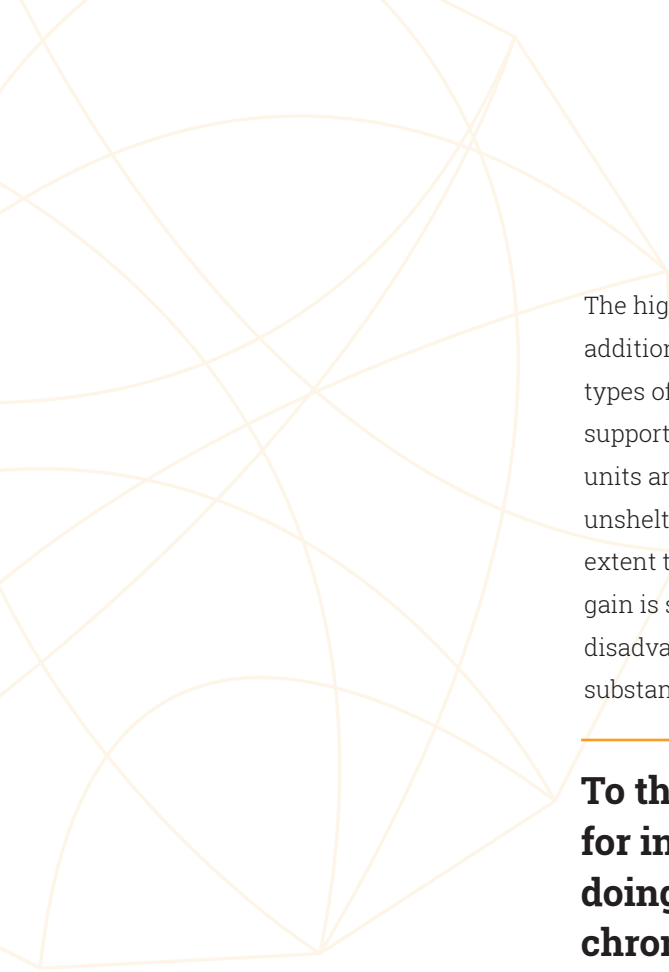
We grounded our transition rate assumptions on estimates of the PIT homeless population and on prior studies. However, the PIT estimates are highly uncertain, and the populations examined in prior studies had lower rates of serious mental illness than in the chronically unsheltered population we focused on. There are no published studies measuring many of the transition probabilities we used. We performed sensitivity analyses, checked for internal consistency, and calibrated to external data where available. The general patterns we observed are robust to substantial changes in the underlying assumptions.

5 / Discussion

Our analysis highlights the importance of accounting for dynamics in addressing the difficult problem of people with serious mental illness who are chronically unsheltered. Our results reinforce the intuition that the most important intervention for getting homeless people into housing is housing. But accounting for dynamics implies that the amount of housing needed to reduce the chronically unsheltered homeless census is much greater than implied by the steady-state (or point prevalence) number of people who need to be housed.

Our model generated three key findings. First, even under very restrictive assumptions, about two new supportive housing units targeted to people who are chronically unsheltered are required to reduce this population by one person in steady state. Even this estimate is more favorable than some prior estimates. O'Flaherty (15) and Corinth (34) estimated a street reduction of just 10–20 individuals per 100 new beds across all unsheltered populations.

Our analysis highlights the importance of accounting for dynamics in addressing the difficult problem of people with serious mental illness who are chronically unsheltered.



The high number of units needed occurs because, inevitably, some share of additional units will house people who would otherwise have found other types of housing, or become institutionalized, or died. To the extent that supportive housing substitutes for institutionalization or mortality, the units are doing a great deal of good, even though the count of chronically unsheltered homeless people does not change very much (35). To the extent that supportive housing substitutes for general housing, the gain is somewhat smaller, though these units nonetheless support very disadvantaged people who might otherwise be living in challenging and substandard circumstances (36).

To the extent that supportive housing substitutes for institutionalization or mortality, the units are doing a great deal of good, even though the count of chronically unsheltered homeless people does not change very much.

Second, adding supplementary services for people in supportive housing or on the streets helps people remain in housing, but if the supply of housing is fixed, it does not have a very big effect on the number of people experiencing chronic unsheltered homelessness. Adding services that improve retention helps reduce the chronic unsheltered census only if more housing units are also made available.

Third, the number of supportive housing units needed to reduce the chronic unsheltered census is highly sensitive to the stringency of targeting. If people experiencing intermittent homelessness (and have higher rates of transition out of homelessness) are permitted to move into supportive housing units, far more units will be needed to reduce the census. In our sensitivity analyses, we found a result similar to that of O'Flaherty (15) and Corinth (34) if approximately 1.5% of those in shelters are permitted to enter supportive housing. This result does not require that people seeking housing behave strategically; it is simply an outgrowth of providing housing to people with higher underlying transition probabilities.

6 / Conclusion

Adding supportive housing targeted to people with serious mental illness who are chronically unsheltered can help a very vulnerable population and reduce the chronic unsheltered census. But failing to account for the dynamics of homelessness can lead to results that disappoint proponents of housing programs. It is important to be realistic about how many units are likely to be needed and how strictly they will need to be targeted and resourced to achieve visible gains.

References

- 1 / Baxter AJ, Tweed EJ, Katikireddi SV, et al: Effects of Housing First approaches on health and well-being of adults who are homeless or at risk of homelessness: systematic review and meta-analysis of randomised controlled trials. *J Epidemiol Community Health* 73:379–387, 2019.
- 2 / O’Flaherty B: Homelessness research: a guide for economists (and friends). *J Hous Econ* 44:1–25, 2019.
- 3 / Lander B: Housing First: A Proven Approach to Dramatically Reduce Chronically Unsheltered Homelessness. New York, New York City Comptroller, 2023. Available here: <https://comptroller.nyc.gov/reports/housing-first/>.
- 4 / Hanson D, Gillespie S: “Housing First” increased psychiatric care office visits and prescriptions while reducing emergency visits. *Health Aff* 43:209–217, 2024.
- 5 / Jacob V, Chattopadhyay SK, Attipoe-Dorcoo S, et al: Permanent supportive housing with Housing First: findings from a community guide systematic economic review. *Am J Prev Med* 62:e188–e201, 2022.
- 6 / McBain RK, Scherling A, Briscoe B, et al: Pima County Housing First Initiative: Final Evaluation Report Fall 2021. Santa Monica, CA, RAND Corp, 2021. Available here: https://www.rand.org/pubs/research_reports/RRA236-1.html.
- 7 / Peng Y, Hahn RA, Finnie RKC, et al: Permanent supportive housing with Housing First to reduce homelessness and promote health among homeless populations with disability: a community guide systematic review. *J Public Health Manag Pract* 26:404–411, 2020.
- 8 / National Academies of Sciences, Engineering, and Medicine: Permanent Supportive Housing: Evaluating the Evidence for Improving Health Outcomes among People Experiencing Chronic Homelessness. Washington, DC, National Academies Press, 2018. Available here: <http://www.ncbi.nlm.nih.gov/books/NBK519594/>.
- 9 / Batko S, Oneto A, Shroyer A: Unsheltered Homelessness: Trends, Characteristics, and Homeless Histories. Washington, DC, Urban Institute, 2020. Available here: <https://www.urban.org/research/publication/unsheltered-homelessness-trends-characteristics-and-homeless-histories>.
- 10 / Leff HS, Chow CM, Graves SC: No magic bullet: a theory-based meta-analysis of Markov transition probabilities in studies of service systems for persons with mental disabilities. *Psychiatr Serv* 68:278–287, 2017.
- 11 / Lee BA, Shinn M, Culhane DP: Homelessness as a moving target. *Ann Am Acad Pol Soc Sci* 693:8–26, 2021.

- 12 / de Sousa T, Andrichik A, Prestera E, et al: The 2023 Annual Homelessness Assessment Report (AHAR to Congress). Washington, DC, US Department of Housing and Urban Development, Office of Community Planning and Development, 2023. Available here: <https://www.huduser.gov/portal/sites/default/files/pdf/2023-AHAR-Part-1.pdf>.
- 13 / Alexander-Eitzman B, North CS, Pollio DE: Transitions between housing states among urban homeless adults: a Bayesian Markov model. *J Urban Health* 95:423–430, 2018.
- 14 / Lemoine C, Loubière S, Boucekine M, et al: Cost-effectiveness analysis of housing first intervention with an independent housing and team support for homeless people with severe mental illness: a Markov model informed by a randomized controlled trial. *Soc Sci Med* 272:113692, 2021.
- 15 / O'Flaherty B: Aggregate-level inferences from individual-level data: the case of permanent supportive housing and Housing First. *J Hous Econ* 59:101913, 2023.
- 16 / Daily Report. New York, New York City Department of Homeless Services. Accessed June 13, 2024. Available here: <https://www.nyc.gov/assets/dhs/downloads/pdf/dailyreport.pdf>.
- 17 / US Census Bureau QuickFacts: New York. Hillcrest Heights, MD, United States Census Bureau. Accessed September 11, 2023. <https://www.census.gov/quickfacts/fact/table/newyorkcitynewyork/PST045222>.
- 18 / Frank RG, Glied SA: Better but Not Well: Mental Health Policy in the United States since 1950. Baltimore, Johns Hopkins University Press, 2006.
- 19 / Zumstein N, Riese F: Defining severe and persistent mental illness—a pragmatic utility concept analysis. *Front Psychiatry* 11:648, 2020.
- 20 / Hospital Inpatient Discharges (SPARCS De-Identified): 2021. New York, Department of Health, Office of Quality and Patient Safety, Center for Applied Research and Evaluation, 2021. Available here: <https://health.data.ny.gov/Health/Hospital-Inpatient-Discharges-SPARCS-De-Identified/tg3i-cinn>.
- 21 / Hospital Homeless Count. New York, Health and Housing Consortium. Accessed June 16, 2023. Available here: <https://healthandhousingconsortium.org/hospital-homeless-count/>.
- 22 / Intensive Mobile Treatment (IMT) Teams. New York, Mayor's Office of Community Mental Health, 2019. Accessed February 7, 2024. Available here: <https://mentalhealth.cityofnewyork.us/program/intensive-mobile-treatment-imt>.
- 23 / Seventeenth Annual Report on Deaths among Persons Experiencing Homelessness. New York, New York City Department of Health and Mental Hygiene, New York City Department of Homeless Services, 2023. Available here: https://a860-gpp.nyc.gov/concern/nyc_government_publications/nc580q435?locale=en.

- 24 / Ayano G, Tesfaw G, Shumet S: The prevalence of schizophrenia and other psychotic disorders among homeless people: a systematic review and meta-analysis. *BMC Psychiatry* 19:370, 2019.
- 25 / Simon GE, Coleman KJ, Yarborough BJ, et al: Incidence and presentation of first-episode psychosis in a population-based sample. *Psychiatr Serv* 68:456–461, 2017.
- 26 / PIT and HIC Data Since 2007. Washington, DC, US Department of Housing and Urban Development. Accessed September 10, 2023. Available here: <https://www.hudexchange.info/resource/3031/pit-and-hic-data-since-2007>.
- 27 / Continuum of Care Homeless Assistance Programs Homeless Populations and Subpopulations. Washington, DC, US Department of Housing and Urban Development, 2022. Available here: <https://www.hudexchange.info/programs/coc/coc-homeless-populations-and-subpopulations-reports/>.
- 28 / What Is Homelessness in America? Washington, DC, National Alliance to End Homelessness, 2023. Available here: <https://endhomelessness.org/homelessness-in-america/what-causes-homelessness/health/#:~:text=In%20contrast%2C%2031.4%20percent%20of,from%20a%20substance%20use%20disorder>.
- 29 / Carroll H: Serious Mental Illness Prevalence in Jails and Prisons. Alexandria, VA, Treatment Advocacy Center. Accessed September 11, 2023. Available here: <https://www.tac.org/reports-publications/serious-mental-illness-prevalence-in-jails-and-prisons/>.
- 30 / Gutwinski S, Schreiter S, Deutscher K, et al: The prevalence of mental disorders among homeless people in high-income countries: an updated systematic review and meta-regression analysis. *PLoS Med* 18:e1003750, 2021.
- 31 / Hoch JS, Trenaman L: Economic Analysis of Options for Helping People Experiencing Homelessness in Sacramento. Sacramento, UC Davis Health Policy and Management, Center for Healthcare Policy and Research, 2020. Available here: <https://health.ucdavis.edu/media-resources/chpr/documents/pdfs/economic-analysis-homelessness-report-2020.pdf>.
- 32 / Roy R, Raman KJ, Raj EA, et al: Outcomes of psychosocial interventions for homeless individuals with mental illness: a systematic review. *Int J Soc Psychiatry* 70:841–849, 2024.
- 33 / Tsemberis S: Housing First Manual: The Pathways Model to End Homelessness for People with Mental Illness and Addiction. Center City, MN, Hazelden Publishing, 2010.
- 34 / Corinth K: The impact of permanent supportive housing on homeless populations. *J Hous Econ* 35:69–84, 2017.
- 35 / Fowle MZ, Routhier G: Mortal systemic exclusion yielded steep mortality-rate increases in people experiencing homelessness, 2011–20. *Health Aff* 43:226–233, 2024.
- 36 / Adamus C, Alpiger J, Jäger M, et al: Independent supported housing versus institutionalised residential rehabilitation for individuals with severe mental illness: a survey of attitudes and working conditions among mental healthcare professionals. *Community Ment Health J* 59:531–539, 2023.

SUPPLEMENT

APPENDIX TABLE 1: Transition Probabilities under Interventions That Improve Retention in Supportive Housing or General Housing

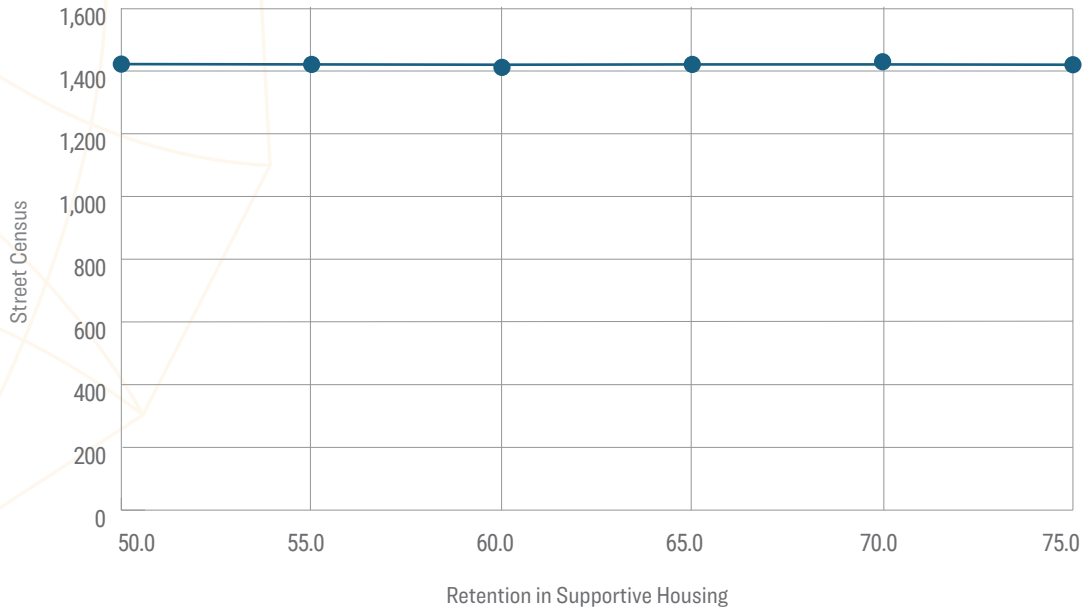
Intervention	From Chronic Unsheltered Homelessness to Supportive Housing (+ change from base case)	Remain in Supportive Housing	Remain in General Housing
Intervention 1: 2,000 Units Supportive Housing	0.353	0.75	0.91
Intervention 2: 2,000 units + Retention supports	0.283 (-0.07)	0.8 (+.05)	0.91
Intervention 3: 2,000 units + Retention supports + Prevention	0.293 (+.01)	0.8	0.9125 (+.0025)

Note: See Figure 1. The base case intervention is calibrated such that in equilibrium 2,000 people with serious mental illness live in supportive housing. In Intervention 2, we add retention supports, which we assume increases the probability of remaining in supportive housing. To accommodate this change while holding the number of people in supportive housing at 2,000, we reduce the probability of transitioning from chronic unsheltered homelessness to supportive housing. In Intervention 3, we add both assertive community treatment teams and a preventive intervention targeted at those in general housing, which we assume reduces the probability of transitioning out of general housing. To accommodate this change while holding the number of people in supportive housing at 2,000, we increase the probability of transitioning from chronic unsheltered homelessness to supportive housing.

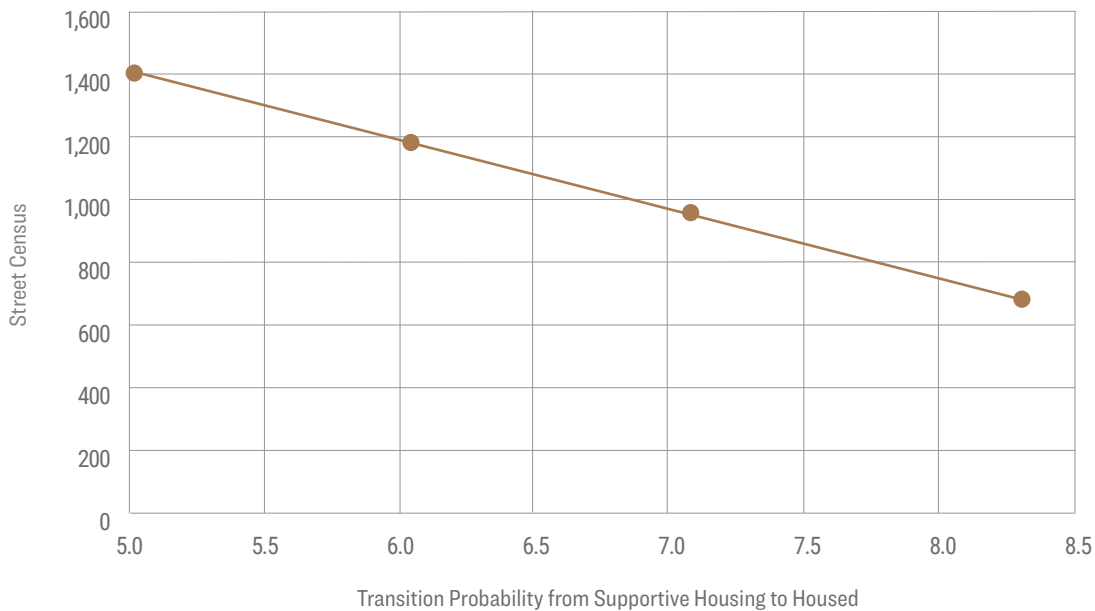
APPENDIX FIGURE 1

Sensitivity analyses are performed below on three key parameters of interest. Transition probabilities are recalibrated to hold the number of supportive housing units at 2,000. Note that transition probabilities across a row must add to one, so all efforts were maintained to keep other parameters as stable as possible.

Panel A. Street Census by Retention Rate in Supportive Housing



Panel B. Street Census by Exits from Supportive Housing



Panel A. In this one-way sensitivity analysis, the rate of retention in supportive housing is reduced from 75% (base case) to 50%. This shift is accommodated by adjusting the transition probabilities between chronic unsheltered homelessness and supportive housing.

Panel B. In this one-way sensitivity analysis, the rate of transition from supportive housing into general housing is increased from the base case of 5% to 8.3% (same as base rate from chronic unsheltered homelessness). This shift is accommodated by adjusting the transition probabilities between supportive housing and chronic unsheltered homelessness.

How to use this paper to “Think Bigger” and “Do Good”

- 1 / Send the paper to your local, state, and federal policy- and decision-makers**
- 2 / Share the paper with mental health and substance use advocates and providers**
- 3 / Endorse the paper on social media outlets**
- 4 / Link to the paper on your organization's website or blog**
- 5 / Use the paper in group or classroom presentations**

As strictly nonpartisan organizations, we do not grant permission for reprints, links, citations, or other uses of our data, analysis, or papers in any way that implies the Scattergood Foundation, Peg's Foundation, Peter & Elizabeth Tower Foundation, or Patrick P. Lee Foundation endorse a candidate, party, product, or business.

SCATTERGOOD THINK|DO|SUPPORT

The Scattergood Foundation believes major disruption is needed to build a stronger, more effective, compassionate, and inclusive health care system — one that improves well-being and quality of life as much as it treats illness and disease. At the Foundation, we THINK, DO, and SUPPORT in order to establish a new paradigm for behavioral health, which values the unique spark and basic dignity in every human.

www.scattergoodfoundation.org



Peg's Foundation believes in relevant and innovative, and at times disruptive ideas to improve access to care and treatment for the seriously mentally ill. We strive to promote the implementation of a stronger, more effective, compassionate, and inclusive health care system for all. Our Founder, Peg Morgan, guided us to “Think Bigger”, and to understand recovery from mental illness is the expectation, and mental wellness is integral to a healthy life.

www.pegfoundation.org



The Patrick P. Lee Foundation is a family foundation with two core funding areas - Education and Mental Health. The Foundation's primary investments in education are through its scholarship programs in science, technology, engineering, and math. In mental health, the Foundation's investments focus on strengthening the mental health workforce, supporting community programs and services, advocating for increased public funding, and building the mental health literacy of the community.

www.lee.foundation



PETER & ELIZABETH
TOWER FOUNDATION

As grantmaker, partner, and advocate, the Tower Foundation strengthens organizations and works to change systems to improve the lives of young people with learning disabilities, mental illness, substance use disorders, and intellectual disabilities.

www.thetowerfoundation.org

Sozosei Foundation® Otsuka

The Sozosei Foundation is the philanthropic arm of Otsuka. The Foundation's primary focus is to increase access to mental healthcare in order to eliminate the inappropriate use of jails and prisons for the diagnosis and treatment of mental illness in the United States. The name Sozosei means “creativity” in Japanese. Our Japanese heritage is manifest in the Foundation's fundamental values and day-to-day operations.

<https://www.sozoseifoundation.org/>