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Housing Intervention For Medically Complex Families Associated With Improved Family Health: Pilot Randomized Trial

ABSTRACT The effects of housing instability and homelessness on child and adult health are well documented. However, few studies have explored health and housing interventions for families with children with the objective of health improvement. Housing Prescriptions as Health Care is a randomized controlled trial that is investigating the impact on physical and mental health of integrating priority placement in affordable housing and the provision of services (case management, financial, and legal), compared to the standard of care (providing resource guides and hospital-based social work or care navigation services). In 2016–19 seventy-eight homeless or housing-unstable families defined as "medically complex"—with a child or adult member who used more health services than usual or had a chronic disease or disability—were enrolled in the trial, and sixty-seven completed a six-month follow-up. A difference-in-differences analysis at six months showed decreases in the share of children in fair or poor health and in average anxiety and depression scores among parents in the intervention group, relative to the control group. Findings suggest that a population-specific model that integrates health, housing, legal, and social services can improve health-related outcomes at the household level.

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Housing instability and homelessness are well-documented predictors of poor health across the life course.[1,2] Children in stable, affordable homes have better health than do children in families who are behind on rent, move frequently, or are homeless.[3] Family homelessness and housing instability are prevalent in the US. In 2013 an estimated 2.5 million children younger than age eighteen experienced homelessness, and 2.8 million renter households were at risk of eviction.[3–5]

Homelessness is associated with poor physical and mental health, as well as increased health care use, for both children and adults.[3,6–8] Even before families experience homelessness, they often show signs of instability, such as moving frequently and being behind on rent—which are associated with increased risk of adverse health and educational outcomes, health care use, and household material hardships.[2,3,9] In families with low incomes, children with special health care needs may be at even greater risk of housing instability or homelessness than children without such needs.[10] Studies have also documented increased health care use and costs associated with housing instability, homelessness, or both.[11–13] Strategies to prevent homelessness and reduce housing instability may improve health and reduce avoidable health care use.[12]

Innovative solutions that provide health and housing resources, commonly known as sup-

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portive housing, may be essential for improving population health. To date, most supportive housing models have focused on homeless adults with chronic physical, mental, or behavioral health conditions. One systematic review that assessed multiple randomized controlled trials on supportive housing for adults who experienced homelessness demonstrated improvements in housing stability and health outcomes among those receiving the intervention.[14] However, findings from cost-benefit analyses of these adult-focused interventions are mixed.[15]

While research has demonstrated the importance of interventions to address family homelessness,[16] there are few models specifically focused on housing-unstable or homeless families with children, adults, or both who have chronic conditions or disabilities or are using more health services than usual—henceforth referred to as "medically complex families."[17] Additionally, we are aware of very few randomized studies that assessed longitudinal housing, child and adult health, and economic outcomes of supportive housing for this population.

To test a supportive housing intervention with the objective of improving family health, the authors, who are researchers with Children's HealthWatch at Boston Medical Center (BMC), designed and implemented a pilot randomized controlled trial (called Housing Prescriptions as Health Care) through a collaborative process with human services agencies, a Medicaid managed care payer, legal experts, and a public housing authority. Medically complex families in particular face challenges associated with health and social needs. Previous research has demonstrated that these families have increased out-of-pocket spending associated with more use of medical and education services and are at risk of losing parental income, both of which are linked to greater economic hardship.[18] Thus, an intervention that responds to families' lack of financial resources as well as time burdens through the coordination of services that address housing, financial, legal, social, and health needs may improve housing and health outcomes.

The objective of this study was to investigate whether Housing Prescriptions as Health Care, an intervention that integrates housing and multifaceted supports, can improve housing stability and positively affect the health of medically complex families with children, when compared with the current standard of care.

Study Data And Methods

STUDY DESIGN AND PARTICIPANTS
Housing Prescriptions as Health Care is a pilot randomized controlled trial[19] that enrolled families in the period October 2016–January 2019. Participant families were recruited at BMC through the pediatric emergency department (ED), primary care practices, and the BMC HealthNet Plan. Eligibility criteria for families included experiencing one or more adverse housing circumstances: being homeless in the previous year, having moved two or more times in the previous year (multiple moves), having been behind on rent in the previous year, and paying more than 50 percent of the family income on rent. Housing instability was identified through parents' reports to either a referring clinician or a Children's HealthWatch research assistant who was collecting data in the ED on family economic hardships. Given previous research that has documented similar independent associations between child and parent health outcomes and frequent moves, lack of ability to afford rent, and homelessness, study eligibility encompassed multiple forms of adverse housing circumstances.[3] Other eligibility criteria included having at least one child younger than age eleven who received primary care at BMC, meeting the income eligibility requirement for Medicaid, having at least one family member who had used ED services three or more times in the previous year, and fluency in English or Spanish. In April 2018, because of low enrollment, having a child with a chronic condition that required two or more specialist providers and enrolled in BMC's patient-centered medical home was added as an eligibility criterion in addition to or in lieu of having a family member with three or more ED visits in a year.

Boston University Medical Campus Institutional Review Board approval was obtained before the start of this study and renewed annually. Families were randomly assigned to the intervention or control group using a 1:1 allocation ratio, stratified by eligibility criteria meant to ensure balance across these groups (for more details on sample distribution, see online appendix exhibit A).[20] Data were collected every six months for two years, with surveys administered over the phone and health information abstracted from the index child's electronic health record (EHR) at each time point. During the period we studied (October 2016–June 2019), seventy-eight families were enrolled in the trial, with seventy-six providing complete data at baseline and sixty-seven providing complete data at six months (for a description of the analytic sample, see appendix exhibit B).[20]

INTERVENTION GROUP The intervention was delivered through cross-sector partnerships that assessed and addressed housing instability in a standardized way through intensive case management and wraparound services designed to meet the relevant needs of participant families.

Providing services designed to maximize family income may set families on a positive trajectory toward stability.

Families received services as needed—including housing search, eviction prevention, legal services, financial services, and a public housing unit if they were eligible. These services were provided through external partnerships in the communities where the families lived. Project Hope, a local housing services agency not affiliated with Project HOPE, the publisher of *Health Affairs*, provided case management and served as a central point of contact for families. Financial services were provided by Nuestra Comunidad, a local community development corporation. Families with legal needs received legal support through MLPB (formerly the Medical-Legal Partnership, Boston). Families eligible for public housing received application assistance from and waitlist priority at the Boston Housing Authority. These services, which are currently not easily accessible for all patients, were delivered in coordination with health care providers—who were made aware of the intervention through a note in the patient's EHR and who provided letters of medical necessity and requests for reasonable accommodations as well as other health-related services as needed.

CONTROL GROUP Families assigned to the control group received the standard of care: a list of resources detailing housing services available in the community, in addition to hospital-based social work and care navigation services.

DEMOGRAPHICS Parents reported on their race/ethnicity, primary language, education, employment, number of current jobs held, monthly household income, marital status, number of people in the household, country of birth, and health insurance type for the child and the parent.

OUTCOME MEASURES Child and parent health status was obtained using questions from the National Health and Nutrition Examination Survey. Parents rated their own health and the health of their children as excellent, good, fair, or poor. Health status was dichotomized as ex-

cellent/good and fair/poor.[21]

Parental mental health was assessed using the Patient Health Questionnaire–2 (PHQ-2) for depression and the Generalized Anxiety Disorder two-item (GAD-2) scale for anxiety. The PHQ-2 score ranges from 0 to 6, and a positive depression screen is a score of 3 or higher. The GAD-2 has the same range and cutoff point for a positive anxiety screen.[22,23]

Child developmental risk was measured using the Parents' Evaluation of Developmental Status (PEDS) for children ages 4–48 months.[24] Children were categorized as at risk for developmental delays if their parent reported two or more concerns.

Body mass index for children older than twenty-four months was calculated based on height and weight recorded in the child's EHR at their most recent medical visit.

Parents reported on their children's health care use by service (ED visits, urgent care visits, and hospitalizations). Health care use was subsequently verified in the EHR for Boston Medical Center visits.

Housing status was reported by parents. *Homelessness* was defined as having no steady place to sleep; needing to rely on family or friends; or sleeping in a car, motel, or emergency shelter for one or more nights in the previous year.

Families were categorized as having multiple moves if they reported moving two or more times in the previous year for economic reasons. Families were categorized as being behind on rent if they reported having been unable to pay rent on time in the previous year.

STATISTICAL ANALYSIS Changes from the baseline interview to the six-month interview were first examined separately within the intervention and control groups, using paired sample *t*-tests for measurement scaled outcomes and McNemar's paired sample chi-square tests for categorical outcomes. For our primary analyses we conducted a difference-in-differences analysis to compare changes from baseline to six months in the intervention versus the control group. Measurement scaled outcomes were analyzed using mixed-effects linear regression models for longitudinal data with a compound symmetric correlation structure. In this approach each participant provides observations at baseline and follow-up. Independent variables included time, intervention group, and the interaction between time and intervention. The intervention effect, which measured the differential change over time in the intervention versus the control group, was estimated by the interaction term. For dichotomous outcomes we used generalized estimating equation linear binomial regression models for longitudinal bi-

nary outcomes, with independent indicator variables for time, intervention group, and the interaction between time and intervention.

All analyses that we performed used a significance level of 0.05 and were completed with SAS, version 9.4.

LIMITATIONS AND STRENGTHS Our study had several limitations. The main limitations were, first, the study's sample size and, second, its single-site nature, both of which limited its external validity. Because of the small sample size and the tailored nature of the intervention, it was difficult to analyze the effect of each component of the intervention alone. Therefore, as has been done in other studies,[25] this study examined outcomes associated with all components of the intervention combined.

Third, there was some loss to follow-up (12 percent; $n = 9$). However, when we compared participants who did not complete the six-month survey to those who did, we found no difference across nearly all outcomes at baseline (appendix exhibit C).[20]

The study's major strength was its randomization. Another strength was its focus on the household as a unit. Examining both child and adult outcomes and health care use is critical for estimating the benefits associated with household-level interventions that affect all family members.

Study Results

There were no significant differences at baseline between the intervention and control groups for the variables included in the study, including the age of the index child and the mean number of children in the household (exhibit 1). At baseline, twenty families reported multiple forms of adverse housing circumstances (see appendix exhibit A).[20]

Exhibit 2 presents baseline and six-month outcome data for both groups. At baseline, the most prevalent forms of housing instability in both groups were homelessness (71 percent in the intervention group and 64 percent in the control group) and being behind on rent (58 percent and 55 percent, respectively). Both groups had high rates of unemployment (64 percent and 65 percent, respectively). The mean PHQ-2 score was 2.86 in the intervention group and 2.52 in the control group, and the mean GAD-2 score was 3.78 in the intervention group and 3.00 in the control group.

Unadjusted results demonstrated significant decreases between baseline and six months in homelessness and multiple moves in both groups. Being behind on rent decreased significantly in the intervention group but not the con-

> **Without policy changes in the housing sector, it will be difficult for health systems to adequately respond to housing needs.**

trol group. Both groups demonstrated significant reductions in their health care use. There were no significant differences in either group for child body mass index, child developmental risk, or parent overall health.

Within the intervention group but not the control group, there were significant changes in child health status, PHQ-2 score, and GAD-2 score. Compared to baseline, there was a 21.5-percentage-point decrease in fair/poor child health, a 1.81-point decrease in mean GAD-2 score, and a 1.37-point decrease in PHQ-2 score in the intervention group at the six-month follow-up.

Further investigation within the intervention group found that the eleven families that moved into public housing apartments at six months had a significantly better mean GAD-2 score than those that had not moved (0.70 versus 2.48) (appendix exhibit D).[20] Children who were housed at six months also had a lower prevalence of developmental risk than those who were not (0.0 percent versus 62.5 percent).

Our difference-in-differences analysis demonstrated significantly greater improvements in child health status and parental anxiety and depression scores among those in the intervention group, compared to the control group (exhibit 3). Over the six-month study period, the share of children with fair/poor health decreased by 32 percentage points more in the intervention group than in the control group. In the same period, the average GAD-2 score declined by 1.38 points more in the intervention group, and the average PHQ-2 score declined by 1.04 points more. There were no significant differences in homelessness; multiple moves; being behind on rent; or numbers of child urgent care visits, ED visits, or hospitalizations.

Demographic characteristics of the intervention and control groups in the Housing Prescriptions as Health Care intervention in Boston, Massachusetts, at baseline

Characteristics	All (N = 67)	Intervention (n = 36)	Control (n = 31)
Mean age of index child, years (SD)	2.8 (2.8)	3.3 (2.9)	2.3 (2.5)
Mean no. of people in household (SD)	3 (1)	3 (1)	3 (1)
Mean no. of children ages 11 years or younger in family (SD)	2 (1)	2 (1)	2 (1)
Child's biological mother's country of origin			
US	37.3%	30.6%	45.1%
Other country	59.7	66.7	51.6
Don't know or refused to answer	1.5	2.7	0.0
No response	1.5	0.0	3.2
Child's birth country			
US	88.1%	88.9%	87.1%
Other country	11.9	11.1	12.9
Parent Hispanic, Latinx, or Spanish			
Yes	40.3%	47.2%	32.3%
No	59.7	52.8	67.7
Parent race			
White	17.9%	22.2%	12.9%
Black or African American	52.2	52.8	51.6
Other	13.4	11.1	16.1
No response	16.4	13.9	19.4
Child Hispanic, Latinx, or Spanish			
Yes	44.8%	47.2%	41.9%
No	55.2	52.8	58.1
Child race			
White	17.9%	22.2%	12.9%
Black or African American	55.2	55.6	54.8
Other	11.9	8.3	16.1
No response	14.9	13.9	16.1
Language spoken most at home			
English	58.2%	58.3%	58.1%
Spanish	26.8	36.1	16.1
Cape Verdean Creole	1.5	0.0	3.2
Haitian Creole	10.4	5.6	16.1
Other	3.0	0.0	6.5
Parent level of education			
8th grade or less	4.5%	0.0%	9.7%
Some high school but did not graduate	23.9	33.3	12.9
High school graduate or GED	35.8	27.8	45.2
Some college or vocational or technical school	26.9	27.8	25.8
Graduated from college or graduate school	9.0	11.1	6.5
Parent marital status			
Single (living alone)	55.2%	52.8%	58.1%
Married	19.4	22.2	16.1
Cohabitating (living together)	11.9	8.3	16.1
Separated, divorced, or widowed	13.4	16.7	9.7
Mean monthly household income (SD)	$918 (713)	$916 (705)	$920 (736)

source Authors' analysis of data for 2016–19 from Housing Prescriptions as Health Care. **notes** Baseline is the baseline interview timepoint. SD is standard deviation.

Discussion

The preliminary findings of our study of Housing Prescriptions as Health Care suggest improvement in child health and parental mental health over six months of this supportive housing intervention tailored for medically complex families in Boston that experienced homelessness and housing instability.

This work builds upon evidence-based interventions that addressed social needs among

EXHIBIT 2

Housing, employment, insurance, physical and mental health, and health care use at baseline and six months, by intervention or control group, among participants in Housing Prescriptions as Health Care in Boston, Massachusetts

	Intervention		Control	
	Baseline	6 months	Baseline	6 months
HOUSING				
Currently homeless	71.0%	30.3%****	64.0%	37.9%**
Behind on rent in previous year	58.3%	29.4%***	54.8%	44.8%
Mean no. of moves in previous year (SD)	0.83 (1.18)	0.34 (0.64)**	1.00 (1.26)	0.39 (0.63)***
2 or more moves in previous year	19.4%	2.9%**	32.3%	7.1%**
EMPLOYMENT				
Parent not employed	63.9%	57.1%	64.5%	55.2%
Mean no. of parent jobs currently (SD)	1.15 (0.38)	1.20 (0.41)	1.09 (0.30)	1.00 (0.00)
INSURANCE				
Parent on public health insurance	97.2%	97.1%	100.0%	100.0%
Child on public health insurance	100.0%	100.0%	100.0%	96.6%
PARENT HEALTH				
Fair/poor health	47.2%	42.9%	45.2%	55.2%
Good/excellent health	52.8%	57.1%	54.8%	44.8%
Mean GAD-2 score (SD)	3.78 (1.96)	1.97 (1.90)****	3.00 (1.95)	2.59 (2.31)
Mean PHQ-2 score (SD)	2.86 (1.73)	1.49 (1.67)****	2.52 (1.81)	2.21 (2.24)
CHILD HEALTH				
Fair/poor health	47.2%	25.7%**	32.3%	42.9%
Good/excellent health	52.8%	74.3%**	67.7%	57.1%
Mean child BMI (SD)	18.17 (6.71)	16.88 (1.77)	17.22 (2.21)	21.05 (16.56)
Child developmental risk	37.0%	25.0%	34.5%	22.7%
HEALTH CARE USE				
In past 6 months, mean no. of:				
Urgent care visits (SD)	1.58 (1.63)	0.51 (0.89)****	1.75 (2.25)	0.89 (1.45)**
ED visits (SD)	2.39 (1.61)	0.71 (1.02)****	2.43 (3.29)	1.14 (1.25)***
Hospitalizations (SD)	0.36 (0.8)	0.09 (0.28)***	0.71 (1.22)	0.34 (0.77)**

SOURCE Authors' analysis of data for 2016–19 from Housing Prescriptions as Health Care. **NOTES** Baseline is the baseline interview timepoint. Sample sizes are in exhibit 1. SD is standard deviation. BMI is body mass index. GAD-2 is Generalized Anxiety Disorder two-item scale for anxiety. PHQ-2 is Patient Health Questionnaire–2 for depression. ED is emergency department. **$p < 0.05$ ***$p < 0.01$ ****$p < 0.001$

families with children. The National Academies of Science, Engineering, and Medicine report that multiple studies have demonstrated that the combination of housing assistance and case management is more effective in promoting housing stability among families exiting homelessness than either intervention alone.[26] One randomized controlled trial showed improvements in parents' reports of child health status, and another qualitative study showed improved parental mental health as a result of pediatric social needs navigation programs.[27,28] Our study underscored and extended these findings.

Our data are also consistent with the results of previous studies that targeted families. One study that used quasi-experimental methods showed that providing case management and public housing to high-risk pregnant women who experienced homelessness resulted in improvements in maternal depressive symptoms and social and mental functioning over twelve months among those receiving the intervention, compared to a similar cohort of nonparticipants.[29] Another study found improved housing stability among homeless families with mothers who had mental or behavioral health conditions and received housing assistance and intensive case management, compared to families that received housing assistance and less intensive case management.[17] Both groups showed improvement in maternal mental health and children's school outcomes.

In Housing Prescriptions as Health Care, services offered to families were not one-dimensional but rather a combination of coordinated services that were tailored to address families' needs. In addition to case management, legal advocacy and pro bono legal services were provided to families with specific legal needs. Medical-legal partnership models offer an innovative, evidence-based approach to addressing families' social needs, and research has shown that they

may also decrease families' use of ED services.[30,31] The intervention also provided financial services—including financial counseling, credit repair, homeownership classes, and benefit maximization—designed to help families become and remain financially stable. Given the robust research that has linked financial stress and family economic instability with health outcomes,[32–34] providing services designed to maximize family income may set families on a positive trajectory toward stability.

Even though only eleven families moved into public housing during the first six months of the intervention, it is notable that coordinating social, legal, and financial services from community agencies resulted in health benefits in a relatively short period of time. Positive parental mental health may also improve parents' ability to foster positive health and development among their children.[35]

In addition to the direct benefits of improving child physical health and parent mental health, the services offered in this intervention may also yield a cost benefit. Though this intervention is resource intensive, its codesigned and coordinated nature, which leveraged community-based expertise and health care administrative infrastructure, may have created cost efficiencies within each system.

Fair/poor health status is associated with increased medical expenditures nationally as a result of higher health care use, compared to use by people in excellent/good health.[36] Also, anxiety and depression are strongly associated with avoidable costs for adults.[37] Further analysis is necessary to define the cost benefits associated with the specific intervention we studied.

Notably, the outcomes identified in this study were achieved at the household, not the individual, level through an intervention that was holistic in design. By examining the potential cumulative effect of the intervention on health outcomes of adults and children within a family, this study was able to more accurately reflect the benefits of the intervention. This approach is critical for understanding the ways in which tailored housing and health interventions may be able to produce a positive return on investment within pediatric populations.

Additional research is needed to assess the long-term effects of the Housing Prescriptions as Health Care intervention on health and health care use. While this study did not demonstrate any difference between the intervention and control groups in health care use in the first six months, more follow-up time may be needed to allow an examination of these trends. Data collection is ongoing, and further analyses will be conducted.

EXHIBIT 3

Difference-in-differences in changes from baseline to 6 months between intervention and control groups, among participants in Housing Prescriptions as Health Care in Boston, Massachusetts

	Difference	95% CI
Behind on rent in past year	19[a]	(−2, 40)
Two or more moves in past year	−9[a]	(−11, 28)
Homeless in past 6 months	15[a]	(−11, 40)
Child in fair or poor health	−32[a]**	(−59, −06)
In past 6 months, mean no. of child:		
Urgent care visits	−0.51	(−1.54, 0.51)
ED visits	−0.41	(−1.66, 0.83)
Hospitalizations	0.05	(−0.38, 0.49)
Mean GAD-2 score	−1.38**	(−2.46, −0.31)
Mean PHQ-2 score	−1.04**	(−1.95, −0.13)

SOURCE Authors' analysis of data for 2016–19 from Housing Prescriptions as Health Care. **NOTES** Difference is the estimated intervention effect, which represents the difference in the change from baseline (the baseline interview timepoint) to six months between the intervention and control groups, calculated from the time and intervention interaction term in longitudinal data models. CI is confidence interval. ED is emergency department. GAD-2 is Generalized Anxiety Disorder two-item scale for anxiety. PHQ-2 is Patient Health Questionnaire–2 for depression. [a]Percentage points. **$p < 0.05$

Policy Implications

As health care systems transition to value-based care models (such as accountable care organizations), there may be greater opportunities to address the root causes of poor health outcomes (such as housing instability and homelessness). Medicaid Section 1115 waivers, which enable states to test new or existing ways to deliver or pay for health services, have authorized the creation of programs that provide Medicaid funding for nonmedical services that address social needs such as housing.[1] However, the majority of services currently financed by health care target high-cost adults as a way to reap the largest return on investment. As other researchers have claimed and this study found, social needs interventions for children will require a paradigm shift in estimating the impact of the resource investment.[38] Instead of using more traditional calculations of per member costs and benefits, pediatric interventions need to develop methods for understanding the household-level benefits of providing social services and housing supports to all members of a family.

While Section 1115 waivers and other opportunities for health systems to reduce homelessness and housing instability offer promising opportunities,[39] these models will be unable to effectively meet the needs of patients and families without substantial increases in public financing for affordable housing. There is a shortage of housing available for families with the lowest incomes in the US:[40] Only a quarter of households with low incomes that are eligible for rental assistance receive a subsidy.[41] Given

this shortage, it is critical to expand government resources to build more affordable homes, increase rental assistance, and provide emergency assistance for families and individuals. Concrete policy solutions in these domains are necessary. Without policy changes in the housing sector, it will be difficult for health systems to adequately respond to the housing needs of patients and families.

Conclusion

Housing instability and homelessness affect the health of children and adults and result in excess health care use. Family-oriented models for integrating health, housing, legal, and social services may be effective in improving physical and mental health outcomes. Findings from the first six months of the Housing Prescriptions as Health Care intervention—which was specifically designed to respond to the housing and health needs of medically complex families in Boston that experienced homelessness and housing instability—demonstrate improvements in child health status and parental mental health. Further research is necessary to assess the long-term impacts of this model, but current findings indicate promising results for reducing future health care use and costs for multiple family members affected by the intervention. As health care institutions and policy makers continue to examine models to address health-related social needs, it is necessary to consider household-level impacts when assessing interventions that target families with children. Creating and expanding supportive housing models across the life span that reduce family homelessness and housing instability as well as promoting efforts to increase resources for more affordable housing solutions may not only increase housing stability but also improve health for children and adults. ∎

NOTES

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