A Data-based Re-design of Housing Supports and Services for Aging Adults who Experience Homelessness

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I. INTRODUCTION

This report examines health services use and population dynamics among the aging homeless population in Los Angeles. Evidence suggests that adverse health outcomes lead to homelessness, and the conditions related to homelessness lead to or exacerbate a range of health problems (Hwang, 2001). In addition, the barriers to accessing preventative and primary care while homeless lead to receipt of healthcare only when morbidities are more acute, (Reid, Vittinghoff, & Kushel, 2008; Kushel, Gupta, Gee, & Haas, 2006; Lim, Andersen, Leake, Cunningham, & Gelberg, 2002) meaning that there is a disproportionate use of inpatient hospitalization and other costly medical and behavioral health services among persons experiencing homelessness (Doran et al., 2013; Hwang, Weaver, Aubry, & Hoch, 2011; Kushel, Perry, Bangsberg, Clark, & Moss, 2002; Salit, Kuhm & Hartz, 1998). As a result, homelessness is expensive for healthcare systems and for society as a whole (Latimer et al., 2017; Flaming, Burns, & Matsunaga, 2009; Culhane, 2008). Given this, interest in using healthcare systems as a platform to address homelessness has grown in recent years. Strategies include efforts to identify homeless patients in healthcare settings in order to link them with housing and social services (Garg, Toy, Tripodis, Silverstein, & Freeman, 2015; Gottlieb, Hessler, Long, Amaya, & Adler, 2014); the creation of accountable care organizations that seek to coordinate healthcare and social services for persons experiencing housing instability (Mahadevan & Houston, 2015); and the development of new financing mechanisms geared towards using healthcare dollars to support housing stability (Burt, Wilkins, & Locke, 2014).

Here we focus on healthcare use among older homeless individuals, a group that is particularly vulnerable to adverse health outcomes. Recent evidence has shown a cohort effect in the single adult homeless population, where persons born between 1955 and 1964 have faced a disproportionate risk of homelessness over the past two decades (Culhane, Metraux, Byrne, Stino, & Bainbridge, 2013). As a result, studies have documented substantial increases in the size of the older adult homeless population, such that they represent an increasing share of all homeless adults (U.S. Department of Housing and Urban Development, 2016). Persons in this cohort are now between the ages of 49 and 60, and, given current trends, there is likely to be substantial growth over the next decade in the number of older adults experiencing chronic homelessness.

Prior research demonstrates that older homeless adults have medical ages that far exceed their biological ages. Indeed, they experience geriatric medical conditions at rates that are on par with those among their housed counterparts who are 20 years older (Brown et al., 2017; Brown, Kiely, Bharel, & Mitchell, 2012). This means that older homeless adults are likely to be heavy users of healthcare services in general, especially long-term care services such as nursing homes. Moreover, with homeless persons having an average life expectancy of 64 years (Metraux, Eng, Bainbridge, & Culhane, 2011), the current cohort of older homeless individuals will experience old-age related mortality prematurely, and will reach their life expectancy over the next 5–15 years. The effects of premature morbidity and mortality, coupled with increases in the size of the older adult homeless population, will mean pronounced further increases in the high healthcare costs already linked with homelessness.

Addressing the healthcare needs that accompany these trends means shifting the current focus on remedial healthcare services to one more oriented toward social determinants of health. This would

mean an increased role for housing that could preserve functional independence among members of this population. Studies show that placement of individuals experiencing chronic homelessness in permanent supportive housing (PSH)—a housing model that provides subsidized housing matched with supportive services—can lead to substantial and sustained improvements in housing stability (Goering et al., 2014; Tsemberis & Eisenberg, 2000), and large reductions in their utilization of costly acute healthcare services (Byrne & Smart, 2017; Ly & Latimer, 2015; Larimer et al., 2009). This has created growing interest in ways to use Medicaid funds to help finance housing interventions for this population. States have, in recent years, sought Medicaid waivers to pay for supportive services for PSH tenants (Burt, Wilkins, & Locke, 2014), and there have been increasing calls for using healthcare dollars to pay directly for housing costs (Bamberger, 2016).

This report uses Los Angeles County as a case study to examine future trends in healthcare use among an older homeless population through combining analyses of current healthcare use with projected aging trends among Los Angeles County's homeless population. In doing so, we address the following objectives:

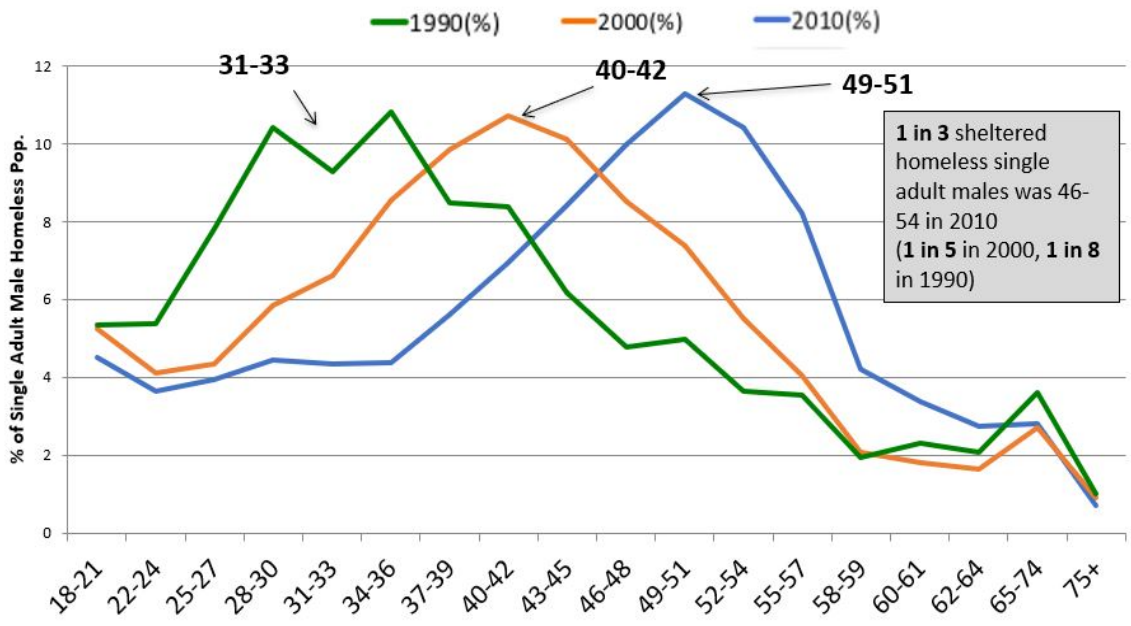
1. Project aging dynamics for sheltered homeless population using LAHSA HMIS data (2009-15) and demographic forecasting methods
2. Apply age-group specific healthcare and shelter cost estimates to population projections for likely future cost dynamics
3. Use cluster analysis to match sheltered sub-populations to different housing interventions and estimate related service costs
4. Draw upon prior research to estimate potential cost offsets associated with housing under different scenarios
5. Compare costs of housing interventions to cost offsets

This is one of three studies, with companion projects in Boston and New York City, that describe the aging trends in local homeless population, healthcare utilization by homeless persons, and the potential returns on investment associated with identifying and intervening with this population.

II. AGING DYNAMICS AMONG THE LOS ANGELES SHELTERED HOMELESS POPULATION

Aging among both national and selected local homeless populations is, by now, a well-documented trend. Figure II-1 illustrates how the single adult homeless population has been aging over the past three decades. Using Census data from the last three decennial censuses, Culhane et al. (2013) show a distinct cohort effect whereby the age distribution becomes noticeably older over time. Figure II-2 presents a similar trend, this time among changes in the age distribution for the sheltered single adult homeless population in LA County over a seven-year span (2009-2015).

In this section, we use data on the single adult sheltered population, collected by the Los Angeles Homeless Services Authority (LAHSA), to extend these findings into the future. Just extending the aging trends from Figures 1 and 2 into the future would portend more and more homeless persons aging into their sixties, seventies, and beyond in the upcoming years. This conjecture will be more systematically assessed based upon applying demographic methods to age specific shelter data over time to forecast aging dynamics among the homeless population through 2030.



Source: Culhane et al. (2013)/ U.S. Census Bureau Decennial Census Special Tabulation

Figure II-1 – Age Distributions of Male Shelter Users

Data for this forecasting comes from two different data sources, both maintained by the Los Angeles Homeless Services Authority (LAHSA). LAHSA administers a homeless management information system (HMIS) database which provides records of shelter stays by adults over age 30 in the years 2008 through 2015, as well as aggregate age distributions of unsheltered homeless persons based upon their 2017

point-in-time (PIT) count and survey. The PIT is an annual event in which LAHSA systematically seeks to assess the size of the homeless population, including hard-to-count populations such as the unsheltered homeless. A sizeable majority of LA County's single adult homeless population is unsheltered, and the unsheltered tend to be substantially younger than the sheltered, perhaps due to greater need or incumbency advantages

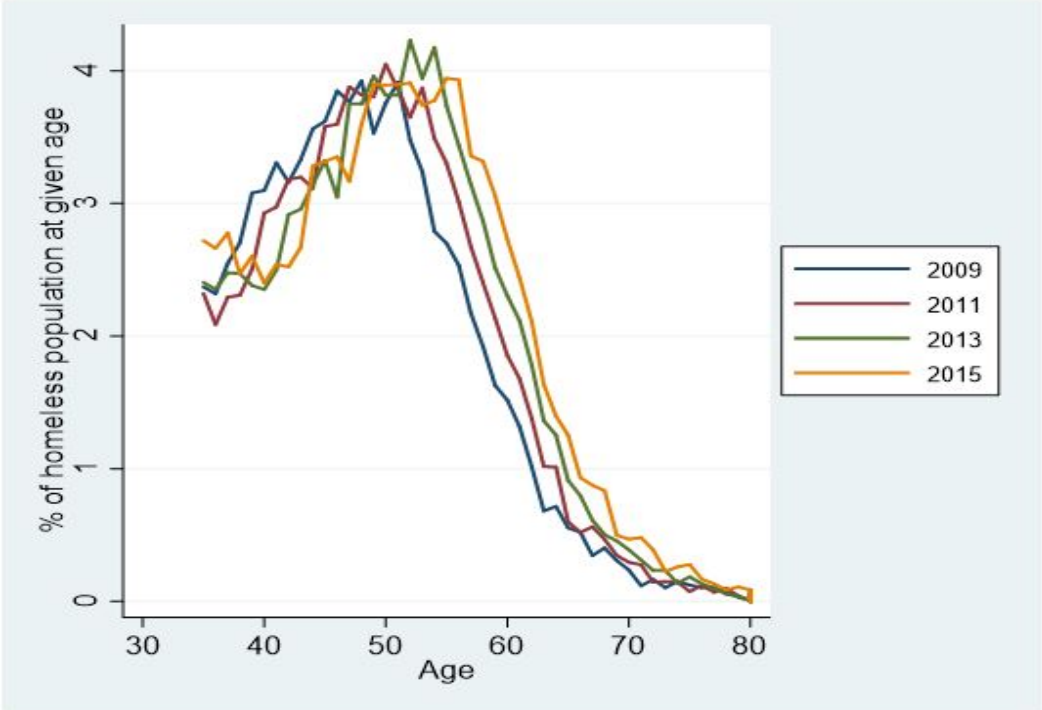


Figure II-2 – Age distribution of the sheltered population in Los Angeles County: 2009-2015.

The analytic approach employed for forecasting uses the HMIS data to develop population-level estimates. This entailed separately developing population-level estimates of the expected trajectory of health care costs for persons age 55 and above for the 2016-2030 period for the sheltered population. PIT data were then used to adjust these estimates for the entire homeless population.

In order to forecast changes in the size and age composition of the older homeless adult population, an age-period-cohort model of year-to-year persistence in the shelter was employed. These analyses were performed on the sheltered population using the HMIS data, as it contained information both on individuals' ages and their entries into and exits from shelter. The persistence is defined as the ratio of stock of homeless individuals in a single-year age cohort (i.e., adults born in 1960) who are present in year n+1 divided by the number present in year n (i.e. those remaining in 2018 as a share of those present in 2017). The ratio is analogous to the individual probability of persistence or exit, though in this case persistence may reflect a combination of individuals who remain in the shelter as well as new entries. An extensive exploratory analysis of prior trends in homeless shelter persistence by age, period and cohort was conducted. Following this, age-period-cohort spline Poisson regression models were conducted using the apcspline procedure in Stata 15. These models were then used to predict the

annual probability of persistence for each single-year age group controlling for age and period for 2016 to 2030. To account for uncertainty in the true nature of the age-period-cohort pattern and test the sensitivity of our results to different assumptions, we developed an ensemble of possible statistical models in which we varied a range of model assumptions including 1) the shape of the age effect, 2) the shape of the period effect, 3) the shape of the cohort effect, 4) the base year of the model, 5) model estimation based on all ages or only ages under 69, and 6) models based on raw population counts or population shares.

The final step involved taking the existing age-specific homeless population for the base year 2015, and applying single-year age-specific persistence rates for each year from 2017 to 2030 to extend the trend of shelter population change, extending the observed trend from 2009 to 2015. We produced estimates based only on the sheltered population, but we report estimates that adjust to also account for the unsheltered population. We took the simple approach of adjusting the base year population in 2015 to include the unsheltered by adjusting the population to account for the unsheltered-to-sheltered ratio in each five-year age group. In addition to capturing the full extent of homelessness in LA where ¾ of homeless individuals are sheltered on any given night, it also accounts the relatively younger unsheltered population. As a result, the current LA age distribution more similar to distributions observed in parallel forecasts in New York and Boston. We report central estimates of the aged homeless population from 2016 to 2030.

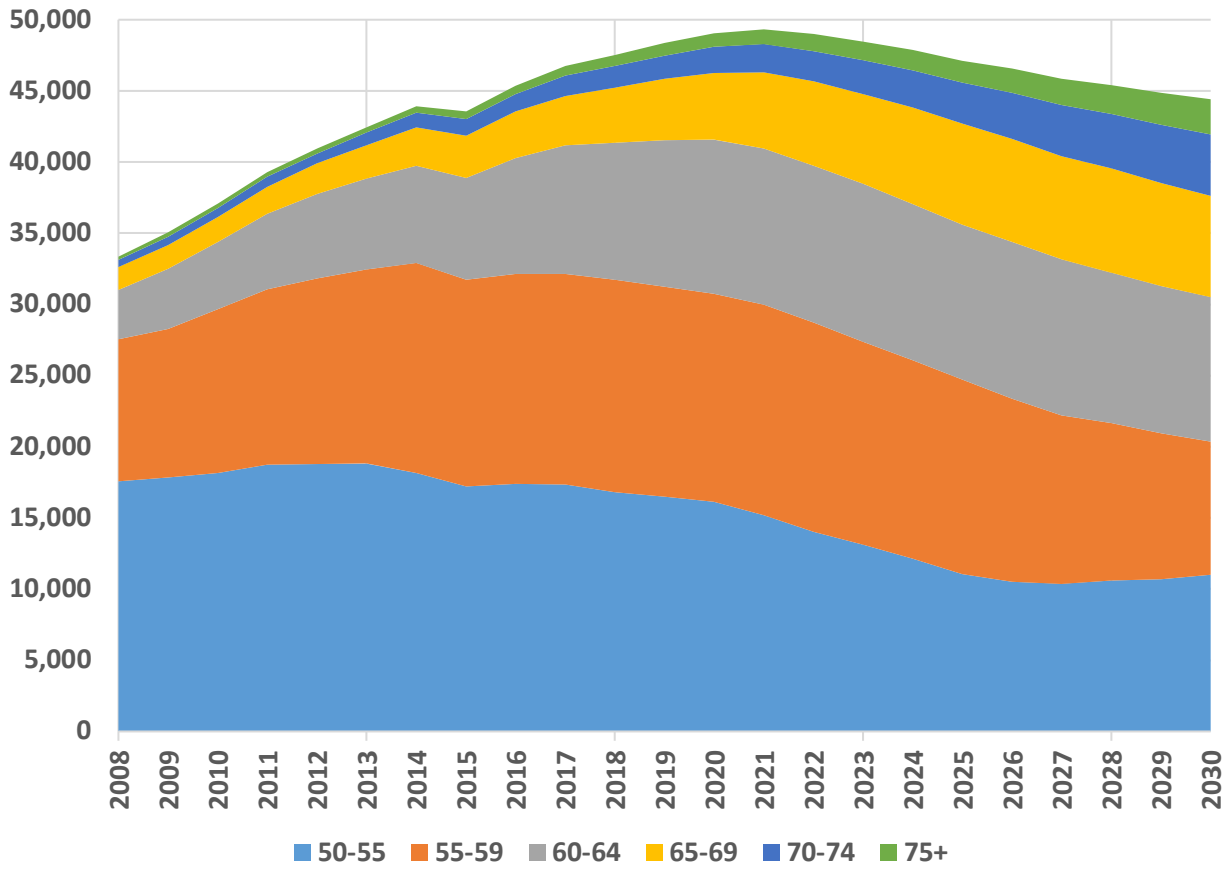


Figure II-3 – Total homeless (shelter and unsheltered) population forecast; age 50+: Actual counts (2009-2015) and forecast (2016-2030)

Figure II-3 illustrates findings (2009-2015) and forecasts (2016-2030) for five-year age groups, starting at age 50, among the total homeless population. The actual projections are available in Appendix A. The youngest age group has declined somewhat and is expected to shrink substantially after 2016, the 50-55-year age group is forecast to maintain a roughly steady number, and the older cohorts are expected to increase more dramatically, though their relatively small sizes will limit their absolute growth. This growth among the over-65 population is shown on Figure II-4, both for the overall homeless population and only the sheltered population. The former is expected to triple in the 22-year period covered here, while the sheltered population over age 65 would grow 2.3-fold.

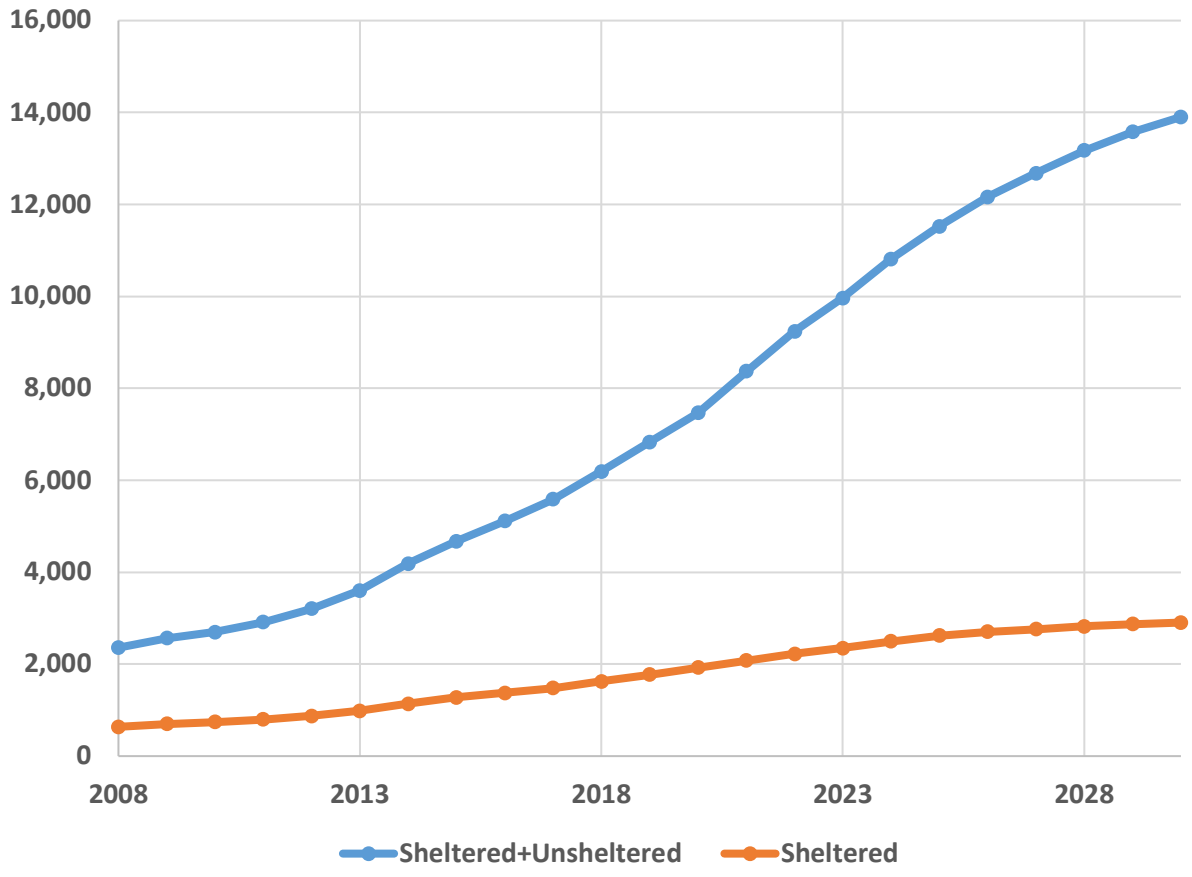


Figure II-4 - Forecast growth in total and sheltered homeless population age 65+, Los Angeles, 2008-2015 (actual) and 2016-2030 (forecast)

To summarize, the demographic forecast for LA County's homeless population, both sheltered and overall, predicts substantial aging through 2030, with the largest amount of proportional growth occurring among persons over age 65. These projections, based upon LAHSA data on both sheltered and unsheltered individuals, are consistent with observations that the homeless population is aging. These forecasts provide more specific data on what that aging might look like. Age-specific estimates from

these forecasts will be applied to historic age-specific health care utilization measures to provide parameters on the health care costs that are expected to be incurred by this aging population.

III. AGE-GROUP SPECIFIC HEALTHCARE AND SHELTER COST ESTIMATES

This section estimates the use of and corresponding costs associated with six different types of health services, as well as shelter costs, for sheltered persons age 55 and over. Individuals that meet these criteria are selected from shelter records in the HMIS database maintained by LAHSA. These records are matched based on personal identifiers to an array of health services records. Depending upon the data source, these records were available for different years and the analyses vary based on the data source and the time periods covered. For each type of health service, summary statistics are provided on the mean use and cost of services.

Demographic and Disability Statistics

Table III-1 – Demographic and Disability Characteristics of the Study Group

CATEGORY	2009	2010	2011	2012	2013	2014	2015
Number in Cohort	20,970	23,453	21,139	18,446	16,103	16,259	16,203
Age in 2011							
Under 55	80.6	78.1	75.7	73.3	70.4	66.7	64.8
55-59 (%)	10.7	12.2	13.4	14.4	15.5	17.5	17.6
60-64 (%)	5.3	5.9	6.8	7.8	8.8	9.4	10.3
65-69 (%)	2.1	2.2	2.5	2.9	3.2	3.9	4.4
70+ (%)	1.3	1.5	1.7	1.7	2.1	2.6	3.0
Median Age (years)	46	47	48	48	49	50	51
Sex							
Male (%)	72.0	70.6	70.3	70.8	71.9	71.8	71.4
Race							
Black (%)	47.7	46.5	47.7	49.3	48.0	47.5	47.1
White (%)	42.2	44.1	43.9	43.9	45.0	45.6	45.2
Other/Multi/Unk. (%)	10.1	9.3	8.5	6.9	7.0	7.0	7.7
Ethnicity							
Hispanic (%)	26.6	26.4	24.6	23.1	23.4	24.5	24.5
Disability Status							
Disability Indication (%)	45.0	44.4	47.5	48.1	47.8	46.9	47.5

Table III-1 presents an overview of demographic characteristics and a disability indicator for annual prevalence cohorts of the sheltered population between 2009 and 2015. The findings are for the entire sheltered population, and, in the descriptions that follow we also provide corresponding findings for the subpopulation of interest, those age 55 and over (which are not shown on the table). The source for these statistics is LAHSA HMIS records that were provided for this study and described in the previous section.

The key findings from Table III-1 include:

- A clear aging trend in the shelter population over the seven years covered by these data. The median age increased just under one year of age per prevalence year (from 46 to 51 over the seven years included). Whereas over four-fifths (80.6%) of the sheltered population was under age 55 in 2009, this proportion was under two-thirds (64.8%) in 2015. The two oldest subgroups on the table, those age 70 and over and those aged 65 to 69, had their shares of the shelter population more than double, from 1.3% to 3.0% and from 2.1% to 4.4%, respectively, over this time period.

- The overall cohorts were consistently around 71% male. The age 55 and over subgroup was proportionately somewhat more male at around 75%.

- Racial proportions between Black and White did not change much over time with the prevalence population being consistently slightly more of Black race.

- Persons of Hispanic ethnicity made up between 23% and 27% of the overall prevalence populations while comprising about 18% of those in these populations that were age 55 and over.

- Persons in the overall prevalence populations with a positive disability indicator in the HMIS records ranged between 44% and 48%.[1] Not surprisingly, among the age 55 and older subpopulation, the corresponding proportion was higher, fluctuating around 57%.

Health and Shelter Services Use

The remainder of this section examines various types of health and shelter services use, and corresponding costs, among sheltered cohorts of those aged 55 and older. Findings for each type of service will be presented in separate subsections, which will also contain brief descriptions of the data used to determine these use and cost estimates. For each service and only for years that services records were available, records for individuals who were in shelter in a given calendar year were matched to service records for that same calendar year.[2] The resulting service use findings are grouped into discrete calendar year units for each person that are referred to throughout this report as "person-shelter years." An individual who was sheltered during multiple years would contribute multiple person-shelter years to the data used here.

This allows service use to be grouped by age, and to be so grouped across different calendar years. To illustrate, if a person had a record of shelter stay during 2011 when he was age 57 then any service stays (inpatient hospital, emergency department, outpatient, etc.) that occurred in 2011 would be associated

[1] No further details on the nature, extent or determination of these disabilities were available.

[2] For all services but nursing homes, services in a particular calendar year will be linked to individuals who were in a shelter at some point during that calendar year. For nursing homes, since such placements usually follow shelter stays, a nursing home placement will be linked to an individual if it occurs in a 365-day period following the individual's first day in a shelter in a given year.

with this person-shelter year unit, and would be grouped with all other person-shelter years with ages between 55 and 59 to assess services use. If he also was in shelter during 2012 (at age 58) then that person-shelter year (with any service use) would also be aggregated into the same age group. Aggregated results for each age group will be shown for various services.

Nursing Home Stays subsequent to shelter stays were derived from a match between the Minimum Data Set (MDS) of nursing home stays and persons with LAHSA shelter stay records. MDS contains data from a standardized resident assessment instrument that is collected on residents of Medicare- and Medicaid-certified nursing homes. The LAHSA data cover 80,188 adults who were recorded in the HMIS as having stayed in a shelter sometime between 2009 and 2015. Data were matched based upon common personal identifiers (name, social security number, and date of birth).

MDS data are a collection of patient assessments and do not have specific dates that demarcate entries and exits from nursing home care. As a result, estimates of stay durations were created based upon the dates of MDS assessments. A set of pre-determined decision rules were applied to the assessment records, and stays were estimated for all persons identified as having stayed in nursing homes. The start and end dates for these stays covered only the time for which there was a reasonable certainty that the person was staying in the nursing home. Thus, these records were conservative, almost certainly underassessing the actual lengths of stay for the study population.

Once the stay dates were estimated, the methodology was similar to that of the other services, which is briefly described in the beginning of this subsection (also see footnote #2). Complete data coverage is available for the years 2011 through 2015. Table 2 presents data on nursing home use by the previously described shelter year metric for persons in shelter during this time period. A per diem cost of $206[3] is applied to the mean inpatient days to estimate the corresponding cost.

Table III-2 – Nursing home days (2011-14) for persons over age 55 who used shelters: 2009-2011

Age	% Person-Shelter Years with Nursing Home Placements	Mean Annual Nursing Home Placements (all person-shelter years with at least 1 inpatient day)	Mean Annual Nursing Home Placements (all person-shelter years)	Estimated Mean Annual Nursing Home Cost (all person-shelter years)
55-59	3.8%	76.33	2.93	$603
60-64	5.4%	88.60	4.76	$980
65-69	14.0%	86.86	12.16	$2503
70+	19.0%	106.60	20.23	$4164

Table III-2 shows that the proportion of person-shelter years that included a nursing home stay increased substantially by age group, from 3.8% (ages 55-59) to 19.0% (ages 70+). The mean number of nursing home days per person-shelter year also increases with age. Thus, as would be expected, the use of nursing homes increases with age, both in the proportion of sheltered persons using nursing homes and the number of days in which they use nursing homes. The mean cost per person-shelter year

[3] Based upon a 2015 estimated Medi-Cal per diem reimbursement rate of $205.87 as reported by the California Association of Health Facilities (2017).

(regardless of whether it included an actual nursing home stay) increased from $603 for the age 55-59 group to almost seven times that ($4,164) for the age 70+ group.

Figure III-1 illustrates how nursing home use among persons in shelter increases with age. The mean number of nursing home days per person-shelter year is tracked for individual years of age from 31 to 75. The increase shown in the figure is a result of increases in both the proportion of users and the number of nursing home days used as age increases. This pattern of increase closely fits an exponential trend line, meaning that the increase in mean days is gradual in the younger years and then increases much more sharply from about age 55 on.

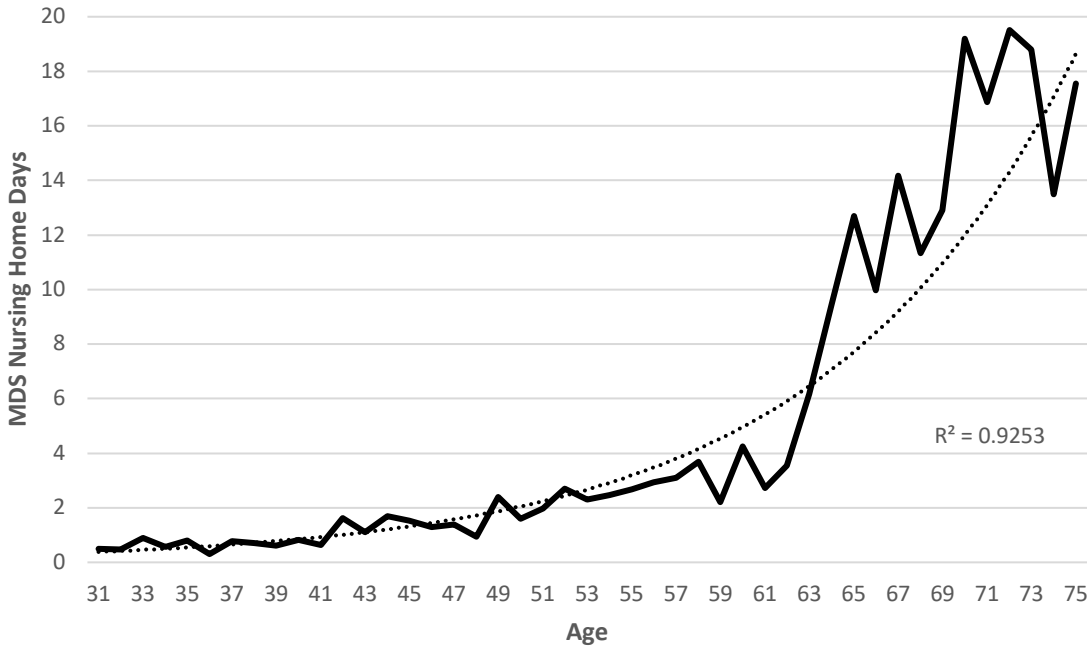


Figure III-1 – Average number of nursing home days per person-shelter year broken down by individual years of age

Inpatient Hospital Services received by individuals while they stayed in a shelter in the years 2009 through 2011 were derived from matched records of two administrative data sources: Los Angeles County's Department of Health Services (DHS) and the State of California's Office of Statewide Planning and Development (OSHPD). DHS is the County's publicly funded health care provider and offers an array of health services across a network of hospitals and other facilities. OSHPD collects records and maintains databases of healthcare use from more than 5,000 California Department of Public Health-licensed healthcare facilities. As such, OSHPD draws upon health service providers beyond the DHS system. Records that are both in the DHS and OSHPD databases were unduplicated prior to the analyses. Per diem rates for inpatient stays are the DHS rate for all inpatient stays ($3,849), a rate based upon Los Angeles County documentation (Wei & Stevens, 2016) and adjusted to 2017 dollars.[4]

[4] The DHS per diem inpatient rate ($3,849) is based upon findings from the LA County Chief Executive's Office (Wu & Stevens, 2016) that report total costs and total inpatient days consumed by 3,940 homeless persons in fiscal year 2014-15, and adjusted for inflation to 2017 dollars.

Table III-3 – Annual inpatient hospital days, per year in shelter and broken down by age group, for persons over age 55 who used shelters: 2009-2011

Age	% Person-Shelter Years with Inpatient Stays	Mean Annual Inpatient Days (all person-shelter years with at least 1 inpatient day)	Mean Annual Inpatient Days (all person-shelter years)	Estimated Mean Annual Inpatient Cost (all person-shelter years)
55-59	11.9%	15.6	1.85	$7,121
60-64	12.6%	16.2	2.04	$7,852
65-69	14.7%	16.0	2.35	$9,045
70+	17.3%	13.2	2.28	$8,776

Table III-3 shows that as the age groups got older, the proportions experiencing inpatient hospital stays increased, and mean inpatient days (and corresponding costs) also increased, except among the oldest (70+) age group. This decline in the 70+ age group reflects an increase in the proportion of persons using inpatient care annually that was offset by a sharper decrease in the mean number of inpatient days per person. This corresponds to mean inpatient cost per person that increased from $7,121 per year for the youngest age group (55-59) to $9,045 per year for the 65-59 age group and then, for the oldest age group (70+), decreased somewhat to $8,776.

Figure III-2 shows the mean annual inpatient hospital days per person-shelter year for each individual year of age, starting at age 31. The increase adheres reasonably close to a linear trend line and indicates a steady rise of inpatient hospital use based upon age.

Emergency Department (ED) Services received by individuals while they stayed in a shelter were based upon the same OSHPD and DHS databases and covered the same years (2009 through 2011) as the use of inpatient hospital days. Cost data for ED use were unavailable, and costs were estimated by applying an average per ED visit rate of $1,370.[5]

[5] This cost estimate was based upon Los Angeles County documentation (Wu & Stevens, 2016) and adjusted to 2017 dollars.

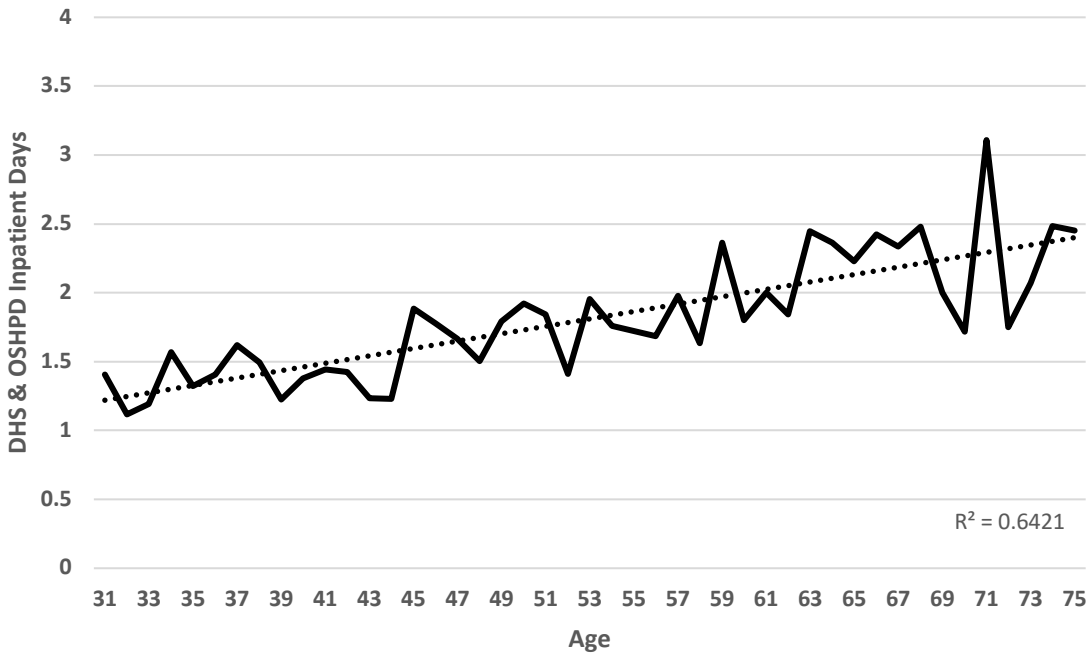


Figure III-2 – Average days of inpatient hospital use per person-shelter year broken down by individual years of age

Table III-4 shows ED visits by age group. There were not substantial variations between the four over-55 age groups, with roughly 30% of all person-shelter years containing at least one ED visit. For those person-shelter years where there was an ED visit, the mean number of visits was between four and five. This led to an overall mean number of ED visits per person-shelter year of roughly 1.4, and an associated cost of around $2,000.

Table III-4 – Annual emergency department visits, per year in shelter and broken down by age group, for persons over age 55 who used shelters: 2009-2011

Age	% Shelter Years with ED Visits	Mean Annual ED Visits (all shelter years with at least 1 inpatient day)	Mean Annual ED Visits (all shelter years)	Estimated Mean ED Visits Cost (all shelter years)
55-59	29.3%	4.82	1.41	$1,934
60-64	29.5%	4.97	1.46	$2,007
65-69	31.2%	4.66	1.45	$1,991
70+	32.0%	4.34	1.39	$1,901

The relative lack of fluctuation among these age groups belies the gradual increase found in ED use as age increased from 31 shown on Figure III-3. While the increase is steady with earlier ages and reasonably holds to a linear trend, the variation becomes more pronounced in later years and, as indicated in Table III-4, a smoothed trend for these later years would not show substantial differences in ED use past age 55.

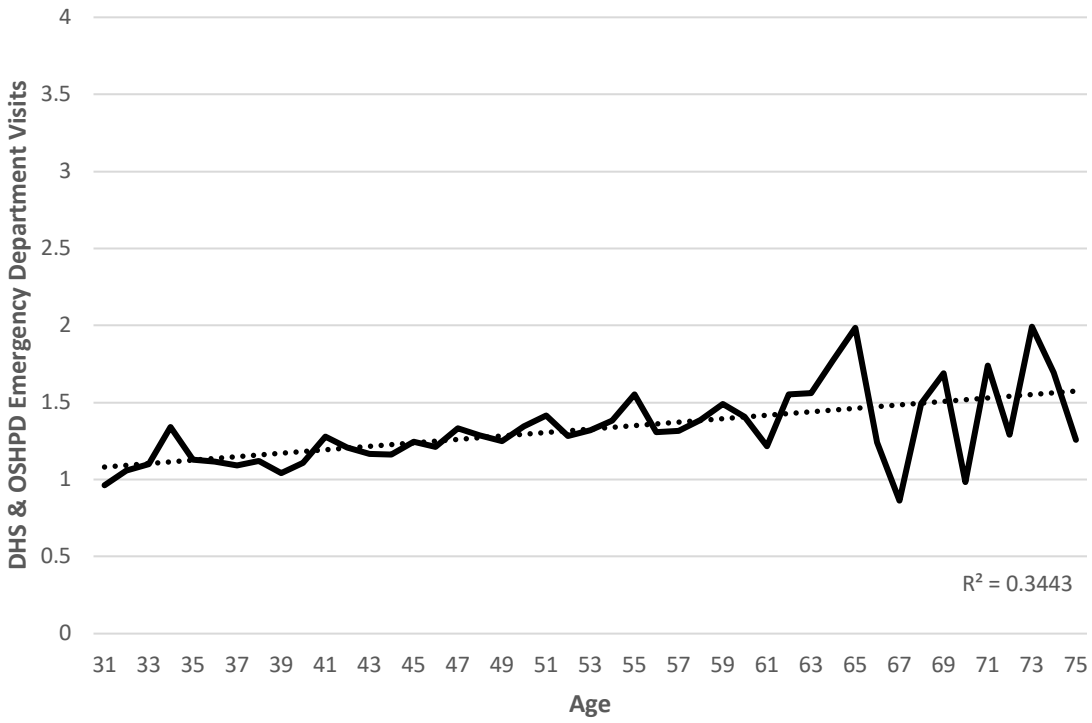


Figure III-3 – Average number of emergency department visits per person-shelter year broken down by individual years of age

Outpatient Health Care Services used by individuals while they were in shelter in the years 2009 through 2011 were available only through DHS records (i.e., not OSHPD). Otherwise, the data source is the same as that for the inpatient and ED services. L.A. County's DHS system, by itself, would have provided a substantial though undetermined proportion of total outpatient services for those in the homeless population. Estimated mean per visit costs, adjusted to 2017 dollars, were $862 per visit (see footnote 5).

Table III-5 – Annual outpatient visits, per year in shelter and broken down by age group, for persons over age 55 who used shelters: 2009-2011

Age	% Person-Shelter Years with Outpatient Visits	Mean Annual Outpatient Visits (all person-shelter years with at least 1 inpatient day)	Mean Annual Outpatient Visits (all person-shelter years)	Estimated Mean Outpatient Visits Cost (all person-shelter years)
55-59	17.9%	15.54	2.78	$2,392
60-64	18.1%	18.88	3.41	$2,943
65-69	12.5%	14.71	1.84	$1,582
70+	8.3%	4.35	0.36	$312

Looking at Table III-5, the proportion of sheltered persons with outpatient visits, as well as the mean number of outpatient visits per person using this service, both dropped in the 65-69 age group and dropped more precipitously in the 70+ age group. Figure III-4 depicts the average visits per person-

shelter year from age 31 on, showing a trend that best fits an exponential distribution, where outpatient use increased from age 31, peaked among persons aged in the mid-50s, and then declined with increased age after that.

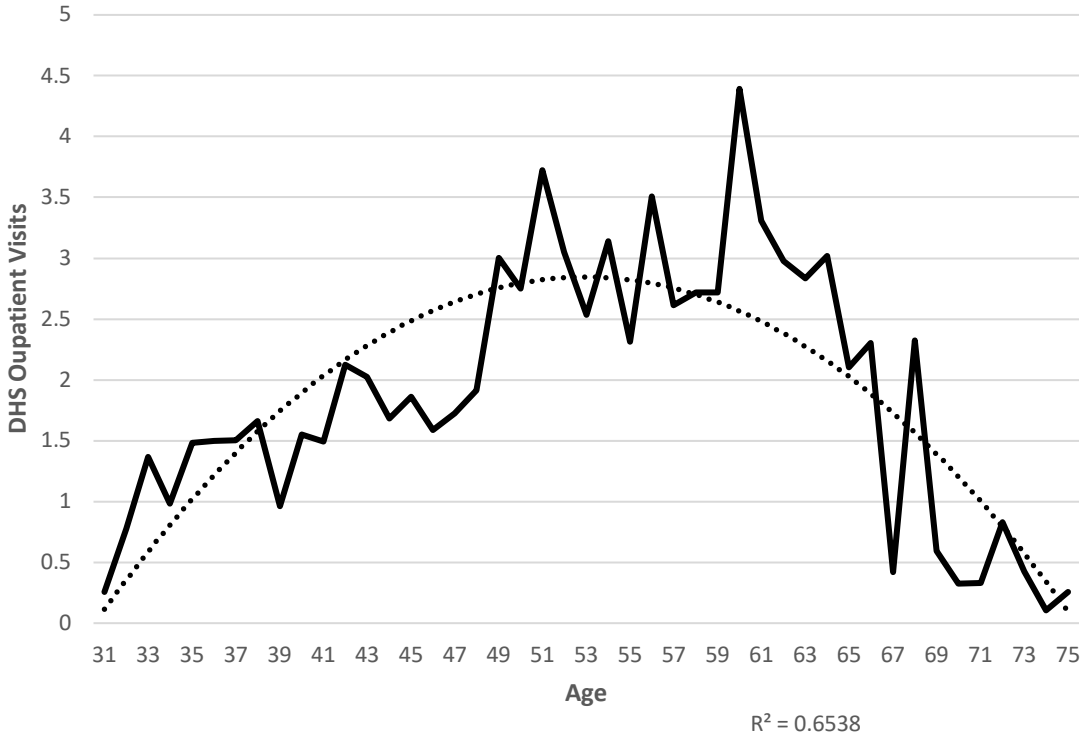


Figure III-4 – Average number of outpatient visits per person-shelter year broken down by individual years of age

Substance Abuse Treatment Services were examined based upon records from the LA County Department of Public Health's (DPH) Substance Abuse Prevention and Control division. This study looks at the three services most widely provided by this division between 2009 and 2014—residential, inpatient drug treatment, and detoxification services. Mean residential and inpatient services costs, on a per diem basis, were set at $121 in 2017 dollars (Wei & Stevens, 2016), while the corresponding rate for detox services was $55 (United Way of Greater LA, 2009). Both per diem rates were adjusted for inflation to 2017 dollars. The costs for residential, inpatient drug treatment, and detox services will be combined into one measure of DPH substance abuse treatment services.

As shown in Table III-6, the proportion of sheltered adults that use these DPH services is small: 2.5% among those in the 55-59 group and declining thereafter to where virtually no one among the over age 70 group used these services. Days used per person also declined somewhat with age. All totaled, the average cost per person-shelter year becomes minimal when spread over the whole over-age 55 group, ranging from $151 for the age 55-59 group to $22 for the over age 70 group. Figure III-5 illustrates the trends shown in Table III-4 cast over a broader age group. Here the average days per person-shelter year declined in a linear fashion with age.

Table III-6 – Annual use of substance abuse services (Residential Treatment, Inpatient Drug Treatment, and Detoxification) provided by the LA County Department of Public Health per year in shelter and broken down by age group, for persons over age 55 who used shelters: 2009-2014

Age	% Shelter Years with SA Service Days	Mean Annual DPH SA Services days (all shelter years with at least 1 SA service day)	Mean Annual SA Service Days (all shelter years)	Estimated Mean SA Service Days Cost (all shelter years)
55-59	2.5%	50.85	1.29	$151
60-64	1.7%	45.41	0.77	$89
65-69	1.6%	38.93	0.62	$74
70+	0.4%	43.80	0.17	$22

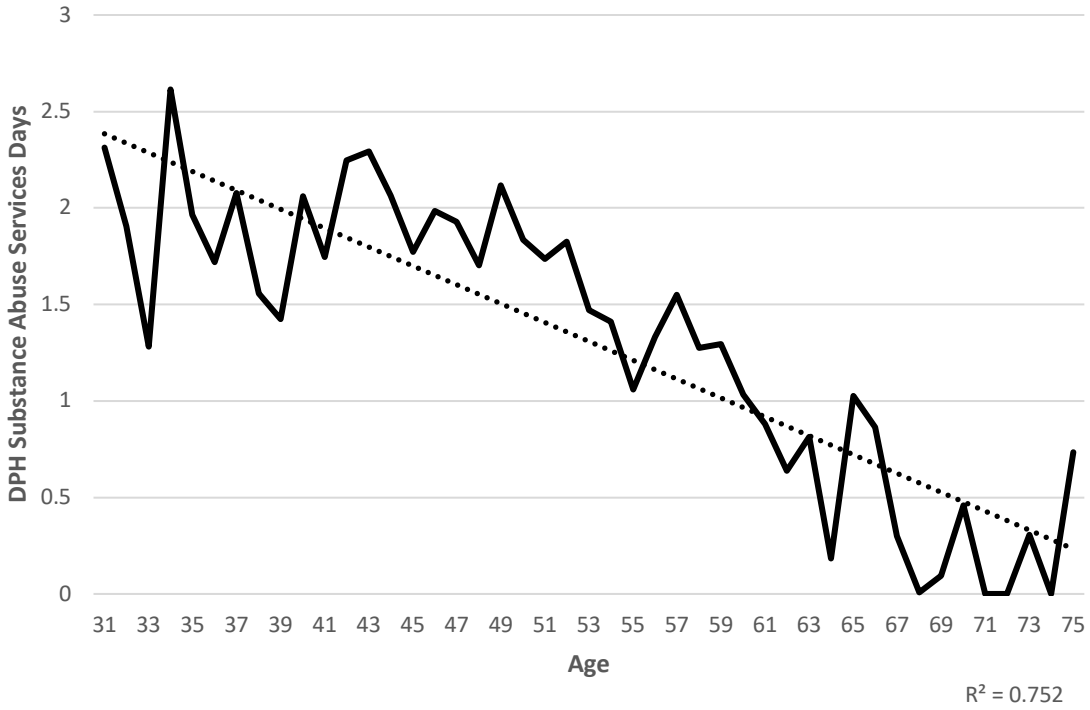


Figure III-5 – Average days of DPH substance use per person-shelter year broken down by individual years of age

Outpatient Mental Health Services were from records provided by the LA County Department of Mental Health (DMH). Psychiatric inpatient care, other than what was shown in the OSHPD and DHS inpatient records, was not available. The per visit cost of outpatient services was $202 in 2017 dollars (Wei & Stevens, 2016; see footnote 4). The DMH data covers the years 2011 through 2014.

Table III-7 – Annual use of mental health outpatient services provided by the LA County Department of Mental Health per year in shelter and broken down by age group, for persons over age 55 who used shelters: 2011-2014

Age	% Shelter Years with SA Service Days	Mean Annual DPH SA Services days (all shelter years with at least 1 SA service day)	Mean Annual SA Service Days (all shelter years)	Estimated Mean SA Service Days Cost (all shelter years)
55-59	7.0%	25.78	1.81	$383
60-64	6.4%	26.37	1.68	$371
65-69	4.3%	16.52	0.71	$169
70+	4.1%	18.56	0.76	$253

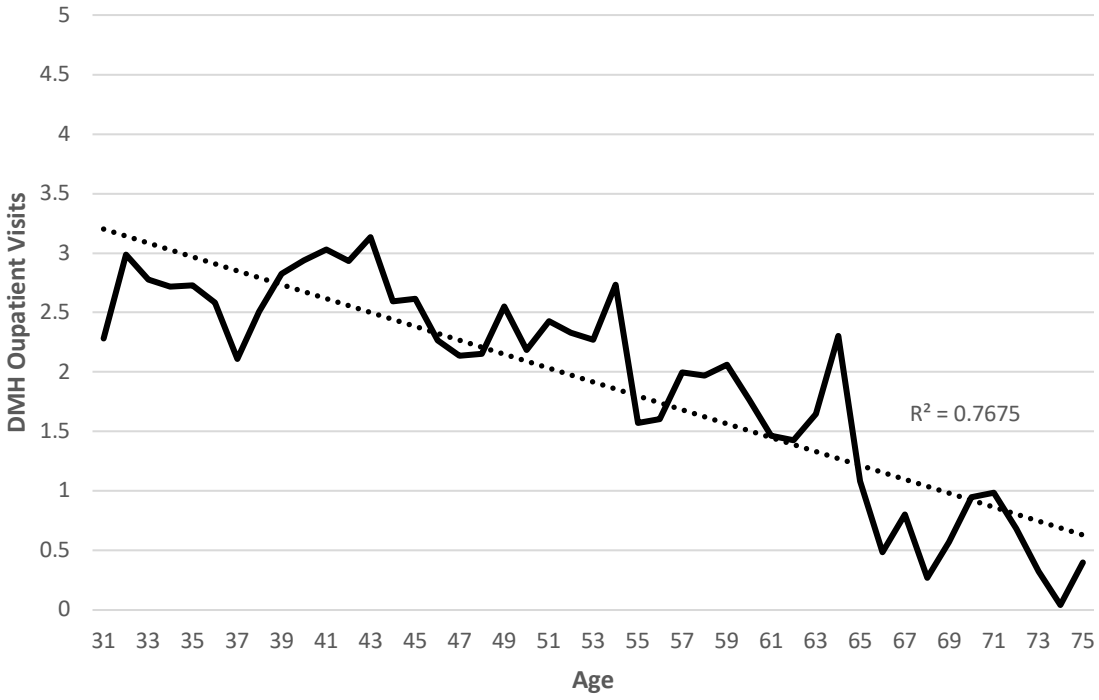


Figure III-6 – Average number of DMH outpatient visits per person-shelter year broken down by individual years of age

Table III-7 illustrates that usage patterns for DMH outpatient mental health services also generally decline with age. It shows low and declining proportions of sheltered individuals over age 55 receiving services, and demonstrates that use for people receiving services declines inconsistently across age groups. This leads to a mean cost per person-shelter year for all shelter users that declines from $383 (55-59 age group) to $169 and then rises somewhat to $253 for those in the 70+ age group. Figure III-6 is consistent with these findings as it shows a declining linear trend as age increased from age 31.

Shelter Use, the final service tracked, was assessed through LAHSA data for 80,188 adults who were recorded in the HMIS as having stayed in a shelter sometime between 2009 and 2014. Shelter use represents the number of days, on average, that persons stayed in a shelter in a one-year period during time periods starting between 2009 and 2014. For each of these years, the total number of shelter days is tallied in the 365-day period starting with the initial day spent in a shelter. Stays beginning in previous

years were set to commence on January 1 of the year in question. This approach is similar to the tracking of nursing home days that is described in footnote 2. Cost of shelter is estimated by applying the per diem cost of a shelter bed to the mean days stayed which, in 2017 dollars, was $40 (LAHSA, 2017).

Table III-8 – Annual use of LAHSA shelter days in a year broken down by age group, for persons over age 55 who used shelters: 2009-2014

Age	Mean Annual LAHSA Shelter Days	Estimated Mean Annual Shelter Days Cost
55-59	135.0	$5,400
60-64	140.0	$5,600
65-69	131.4	$5,256
70+	127.5	$5,100

Table III-8 shows the mean number of shelter days used per person-shelter year broken down by age groups. This table differs from previous tables in that all persons in the study group stayed in shelters. Mean days increased up to age 65 and then declined for the older two age groups. As seen in Figure III-7, the table shows the end of a more general increase in shelter days used with advancing age, which peaks between ages 60 and 65 and then declines in the older age groups. As such, this pattern roughly follows an exponential distribution.

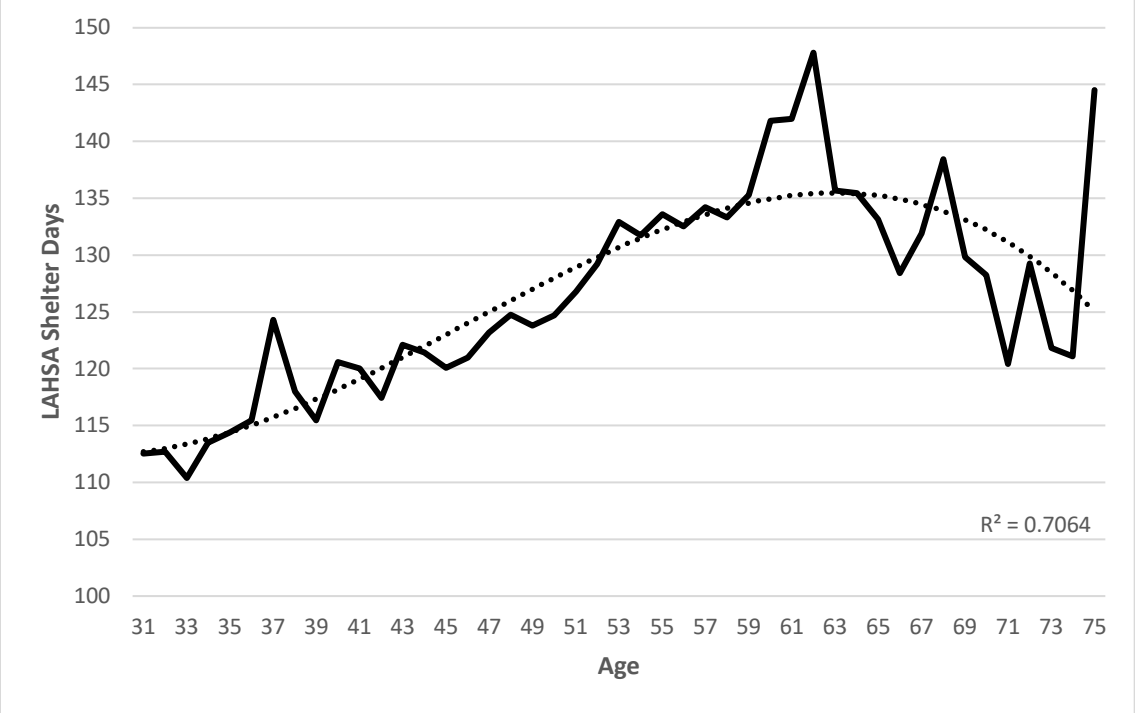


Figure III-7 – Average number of LAHSA shelter days per person-shelter year broken down by individual years of age

Summary of costs. Table III-9, the final table of this section, summarizes the costs accrued across the healthcare service types that were just reviewed. Combined with shelter use, the cost of homelessness

across the systems tracked here, for a year in which a person used at least some shelter, was $17,984 in the 55-59 age group, and increased to where the combined costs exceeded $20,000 among the 65-69 and 70+ age groups.

The health care costs tracked with the data available for this study, when combined, increased as the age groups got older. The largest proportion of the costs across all age groups was from inpatient care. However, considerably higher nursing home costs among the 70+ group offset declines in some other types of health care costs, most notably outpatient services costs. Inpatient and nursing home use and costs rose steadily. Other health services that were used much less across the population (DPH substance abuse and DMH outpatient services) declined with increased age, while DHS outpatient use and LAHSA shelter use increased up to around age 65 and then declined. Taken together, the substantial increase in nursing home use among the older age groups might have supplanted use of other health care services.

Figure III-8 shows the differences in average cost per person across age groups. This figure also highlights the proportions represented by each different service in making up the whole, and the differences in the mix of service costs that make up the total cost for each age group.

Table III-9 – Combined cost of health care and shelter services per year in which shelter was used for sheltered individuals aged 55 and over, grouped into four age groups

Service	55-59	60-64	65-69	70+
MDS – Nursing home	$603 (2.93 days)	$980 (4.76 days)	$2,503 (12.16 days)	$4,164 (20.23 days)
DHS & OSHPD – Hospital Inpatient	$7,121 (1.85 days)	$7,852 (2.04 days)	$9,045 (2.35 days)	$8,776 (2.28 days)
DHS – Outpatient	$2,392 (2.78 stays)	$2,943 (3.41 stays)	$1,582 (1.84 stays)	$312 (0.36 stays)
DHS & OSHPD – Emergency Dept.	$1,934 (1.41 visits)	$2,007 (1.46 visits)	$1,991 (1.45 visits)	$1,901 (1.39 visits)
DPH – Drug & Alcohol (Residential , Tx, & Detox)	$151 (1.29 days)	$89 (0.77 days)	$74 (0.62 days)	$22 (0.18 days)
DMH – Mental Health (Outpatient)	$383 (1.81 visits)	$371 (1.68 visits)	$169 (0.71 visits)	$253 (0.76 visits)
COMBINED HEALTH COSTS	**$12,584**	**$14,242**	**$15,364**	**$15,428**
LAHSA Shelter Days	**$5,400** (135.0 days)	**$5,600** (140.0 days)	**$5,256** (131.4 days)	**$5,100** (127.5 days)

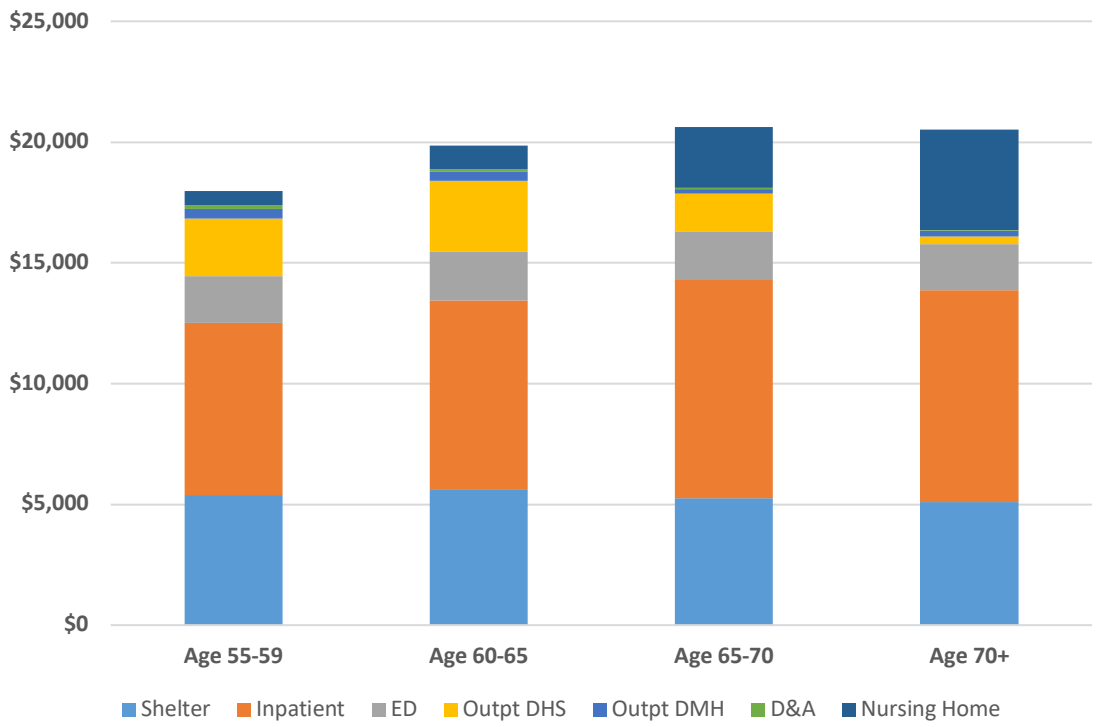


Figure III-8 – Total average services cost per person among four age groups in LA County shelter population, as well as proportional representations of each health care and shelter service included in the total

IV. MATCHING SHELTERED SUB-POPULATIONS TO DIFFERENT HOUSING INTERVENTIONS AND ESTIMATED SERVICE COSTS BASED UPON CLUSTER ANALYSIS

Even after they are broken down by age group, older adults experiencing homelessness remain a heterogenous population with respect to their housing, health care, social, and other needs. While there is an elevated level of health care need among older, homeless adults compared with both their younger homeless and their contemporary housed counterparts, there remains substantial variation in their need for and use of health care services within this subpopulation (Flaming, Burns & Matsunaga, 2009). Also, homeless persons in general have different patterns of shelter use, with most people's total homeless experience lasting for one or two short episodes, but with substantial minorities experiencing longer and more frequent periods of homelessness (Kuhn & Culhane, 1998). Given this information, it was hypothesized that similar variation would be seen in this study group in both health care and shelter service utilization. This means that, to address both housing and health care needs, different individuals will require different types of housing interventions in order to obtain housing stability and promote health. This section uses a cluster analysis technique to place a large cohort of elderly adults who were in LA shelters during 2011 into subgroups based upon health and shelter measures. After assessing if these cluster-based subgroups are sufficiently distinct, each group was then matched to a suitable housing model based upon aggregate housing and health needs.

For the 4,495 individuals who had a shelter record in 2011 and who were over age 55, LAHSA shelter data were used to compute the number of days spent in shelter and episodes of shelter stay (delimited by at least a 30-day absence from a shelter). These were calculated over a three-year period starting with the first recorded day of shelter beginning in 2011. Those whose first day was prior to 2009, meaning that they had been in shelter for over three years, were taken out of the study group. This reduced the total to 3,985. The other criterion used to sort the study group was the complexity of treated health conditions. Medical complexity was assessed using a combined comorbidity score from an algorithm developed by Gagne et al. (2011) based on ICD-9 codes to identity 20 different medical conditions; each of these were assigned a weight based on their estimated association with risk of mortality. This medical comorbidity score was developed specifically for an older adult population. In following the approach used by Gagne et al. (2011), the comorbidity score was calculated based on the full year of 2011 claims data.

These criteria–the number of emergency shelter episodes and shelter days and the medical comorbidity score–served as the basis for conducting *k*-means cluster analysis to identify distinct sub-groups based on health conditions and shelter use. Similar methods have been used to designate typologies among homeless populations (e.g., Lee et al., 2016; McAllister, Lennon, & Kuang, 2011; Kuhn & Culhane, 1998). Different cluster solutions were tested, and it was determined that the 3-cluster solution provided the most clearly delineated groups.

Table IV-1 summarizes the results of this cluster analysis. In addition to presenting summary information on the variables used in the cluster analysis (i.e., comorbidity score, days in shelter, and shelter episodes), and also presents average annual health care costs for each cluster and the share of persons

in each cluster with a nursing home stay. Clusters #1 and #3 have very similar shelter usage (means of 237 and 250 days; 1.7 and 1.4 episodes, respectively, over three years) but have very different comorbidity scores (7.62 and 0.38, respectively) and health care costs ($46,317 and $10,639, respectively). Cluster #1 is the smallest cluster (7% of total), while cluster #3 is by far the largest (82%). Cluster #2, with 11% of the study group, has more extensive shelter stays (means of 392 days and 3.7 episodes) than the other two groups, and a comorbidity score of 1.28 that is higher than cluster #1 but still relatively low and close to the comorbidity score of 1.23 observed in a general population sample of adults age 65 and above (Gagne et al., 2011). In line with their comorbidity scores, persons in cluster #1 had substantially higher levels of nursing home records (55%) than clusters 2 and 3 (20% and 14%, respectively).

Table IV-1 – Cluster designations for 2011 prevalence cohort of individuals age 55 and older

Cluster	Cohort Share	Gagne Index Comorbidity Score (mean)	Shelter days	Shelter episodes	Mean 2011 Health Services Cost	Nursing Home Records (2011-15)	Population Summary
1	7%	7.62	237	1.7	$46,317	55%	Highest comorbidity & lower shelter use
2	11%	1.28	392	3.7	$14,598	20%	Low/Mid-level comorbidity & highest shelter use
3	82%	0.38	250	1.4	$10,639	14%	Lowest comorbidity & lower shelter use

The housing and health care use patterns for each of the three cluster groups correspond to three widely used housing assistance approaches. Each of these approaches have been implemented in practice with older adults experiencing homelessness, although the degree of evidence of their impact on housing stability and health care costs varies.

The largest and (comparatively speaking) healthiest group, cluster #3, has modest levels of shelter use and relatively low health care use. This cluster has the highest proportion of individuals with low to moderate health needs who would likely be able to live in independent housing in the community with limited supports. Housing interventions, if any were needed, would be "light touch" approaches that might include rapid rehousing or short-term, shallow rental subsidies plus stabilization services. Medicaid funds might cover certain housing transition and stabilization services. The housing needs of this group would be addressed using a 4-tiered progressive engagement approach as follows:

- **Tier 1:** One third of this cluster would presumably self-resolve their lack of housing. Housing research consistently determines that up to 80% of the homeless population are "transitionally homeless" and stay homeless for relatively short periods of time (Kuhn & Culhane, 1998). Therefore, in any homeless population, a substantial proportion will exit homelessness with minimal to no assistance. People who self-resolve would most likely be from this cluster, and the

estimated size of this cluster subgroup is conservative. There would be no added cost associated with this tier.

- **Tier 2:** 22% of the cluster would benefit from rapid re-housing (RRH). The goal of RRH is to provide supports necessary to help individuals quickly exit homelessness and move back into stable community housing. This entails case management and a variety of services such as move-in and other initial rent and moving costs; linking clients with community services; and ongoing, short or medium-term rental and housing subsidies to facilitate stabilization. This study assumes that, on average, it will cost $3,872 per person to provide RRH to persons in this tier, which is the average cost per household served by the VA's Supportive Services for Veterans and Families (SSVF) program, the nation's largest RRH provider (U.S. Department of Veterans Affairs, 2017).

- **Tier 3:** Another 22% of the cluster would benefit from shallow rent subsidies accompanied by moderate case management supports. These subsidies are time-limited rental assistance that help stabilize households and gives them time and support to develop the means for maintaining housing self-sufficiency. The level and duration of this shallow subsidy varies; here a $500 monthly subsidy (approximately half of fair market rent in LA County for an efficiency apartment) is assumed for twelve months. Case management services would cost an additional $125 per month. The annual cost per person for this tier of assistance would be $7,500.

- **Tier 4:** The final 22% of this cluster would fare best under an ongoing, more traditional housing voucher structure such as what is provided through HUD's Housing Choice vouchers. The cost for such vouchers is estimated by subtracting the tenant contribution from the cost of rent. Based on this formula, the rent for an efficiency apartment ($1,067 is fair market rent in 2018 in LA County) minus the tenant rent contribution (benchmarked at one-third of the maximum monthly individual SSI amount of $911, or $304) leads to an estimated monthly cost of $764, or $9,168 annually (HUD Economic and Market Analysis Division, 2018).

The weighted average of the costs for these four tiers is $4,580, which represents the average cost of housing people in this cluster under one of the housing models described here.

Cluster group #2 (11% of the total) was also relatively healthy but had high levels of shelter use. Based primarily on the latter, persons in this group could benefit from permanent supportive housing (PSH). PSH provides ongoing subsidized housing with flexible health, behavioral health, social, and other supportive services. PSH, as a flexible means to provide housing while accommodating a range of disability and health needs, is well-suited for elderly homeless adults (Corporation for Supportive Housing, 2011). There is strong evidence demonstrating its effectiveness at improving housing stability and reducing shelter, health care, and other public service costs. Furthermore, PSH provides housing in the community and can function as an alternative to more costly and unnecessary institutional options such as nursing homes and assisted living (Goldberg, Lang, & Barrington, 2016). Nonetheless, PHS is a relatively high cost intervention, though the cost can vary depending on the intensity of supportive services needed. Medicaid funds can be used to pay for the supportive services component of the intervention. The PSH cost estimate is based on prior research in LA County. Adjusted to 2017 dollars,

the annual housing, operating, and service costs after tenant contribution would be $15,800 per person (Hunter et al., 2017; Flaming et al., 2013; Flaming, Burns, & Matsunaga, 2009).

Finally, those in the smallest group (cluster #1 at 7%) had the most extensive medical needs. The literature on PSH shows that this housing intervention has the capacity to provide a "high-quality and cost-effective option" for older homeless adults in place of assisted living arrangements (Bamberger & Dobbins, 2015) and as an alternative to skilled nursing facilities for elderly homeless persons who have significant health issues. Details on PSH were described for the previous cluster and estimated to cost $15,800 per person annually—$10,400 for the housing component and $5,400 for operating and service costs. Here, in recognition of the increased service needs that this population is likely to incur in conjunction with their increased level of comorbidity, the estimated operating and services costs[6] were doubled for those in this cohort, thereby increasing the total annual cost per year of housing for people in this cluster from $15,400 to $21,200.

These interventions do not represent an exhaustive list of suitable and available housing models for older persons experiencing homelessness. Rather, they were selected as exemplars likely to correspond with the general level and intensity of housing and other needs of different segments of the older homeless adult population.

Table IV-2 – Cluster groups, corresponding housing models, and related costs

Cluster	Intervention	Overall need	Overall average housing and service cost
1 - Highest comorbidity & lower shelter use	Nursing home and assisted living (tier 1) and PSH (tier 2)	7%	$21,200
2- Low/Mid-level comorbidity & highest shelter use	Permanent Supportive Housing (PSH)	11%	$15,800
3 - Lowest comorbidity & lower shelter use	Self-resolve (tier 1); rapid rehousing (tier 2); shallow rent subsidy (tier 3); subsidized housing (tier 4)	82%	$4,580
Total		100%	$6,978

To recapitulate, based on the relative size of each cluster group and the housing intervention assumed to be most appropriate for each, overall, a total of 7% of older homeless adults are estimated to require medical respite/hospice/palliative care or PSH; 11% are estimated to require PSH; and 82% are estimated to need short term/shallow subsidies plus stabilization services. Table IV-2 summarizes this, and presents a total estimated weighted average housing cost, per person in 2017 dollars of $6,978. These clusters and housing designations, along with the estimated health care costs related to homelessness as well as housing costs related to ending homelessness, will be addressed in the next

[6] Operating and services costs are taken from Flaming et al. (2013) and adjusted to 2017 dollars for a cost of $5,400, and are doubled for this high medical needs cluster.

section as the bases for projecting how much health care and shelter services costs could be offset by these housing placements.

V. POTENTIAL COST OFFSETS ASSOCIATED WITH HOUSING MODELS, BASED ON PRIOR RESEARCH

This section focuses on estimating the likely impact on the projected future health care and emergency shelter costs of providing these housing interventions at scale to all older homeless adults in LA County. In doing so, we sought to mirror the conceptual approach of a meta-analysis, which is a statistical procedure for combining data from multiple studies that have examined the impact of the same intervention to arrive at an overall estimate of the effect of that intervention. In the present context, information was aggregated from 15 previously published studies that have examined the impact of permanent supportive housing interventions for persons experiencing homelessness on healthcare and emergency shelter utilization and costs. This analysis is based solely on studies that have examined permanent supportive housing, as there is a fairly robust body of literature in this area, whereas the number of studies examining the impact of other housing interventions for persons experiencing homelessness on health services use and costs remains highly limited.

The studies that were included in constructing these scenarios varied in terms of their methodological rigor, the locations in which they were conducted, the populations and specific interventions that they considered, and the type of health care costs that they considered. They also varied in terms of whether, and, if so, by how much they were able to reduce health care costs for participants. As such, the cost reduction scenarios used in this study, as well as the resulting estimates of future reductions in costs, should be interpreted somewhat cautiously and be considered rough estimates of what might be expected.

The cost reductions scenarios were constructed based on studies that were included in a systematic review of studies examining the relationship between permanent supportive housing and public service costs (Ly & Latimer, 2015) as well as those summarized in another recent study (Richter & Hoffman, 2017). Additional, relevant studies that were not included in either of the two previously mentioned sources were also identified by the study team for consideration. In constructing the cost reduction scenarios presented in this paper, only studies that conducted tests of statistical significance when examining the relationship between placement in permanent supportive housing and healthcare costs/services utilization were included. Additionally, studies were excluded that did not disaggregate healthcare cost by treatment modality. For example, if a study reported the impact of permanent supportive housing on mental healthcare costs, but did not distinguish between inpatient and outpatient mental health service use or costs, it was not included in our analysis. As a result, a total of 15 studies were used to construct the cost reduction scenarios described in this paper. Additional information on these studies is listed in Appendix B.

After identifying these 15 studies, the percent change in healthcare and shelter utilization and costs associated with PSH were extracted from each study. In some cases, this information was reported directly in the study report. In other cases, changes were calculated based on information reported in the study. Information was extracted separately for each category (e.g., mental health, substance abuse) and/or type (e.g., inpatient, outpatient, emergency department) of cost reported in the study, and only included service categories/types for which the change in cost or service use could be calculated (or

approximated) based on information reported in the study. Where possible, information about percent change was extracted based on units of service utilization (e.g., number inpatient hospitalization days, number outpatient visits), rather than cost to account for potential variation in healthcare costs across regions/counties and time. Finally, each study was assigned a weight based on its methodological rigor. Studies using an experimental design were assigned a 3; those involving a quasi-experimental design with a comparison group were assigned a 2; and those involving a quasi-experimental design with a single group pre/post comparison were assigned a 1. These weights were subsequently used in developing pooled estimates of the relationship between housing placement and healthcare costs under the different scenarios.

After extracting the information described above from each of the 15 studies, information from across the studies was combined to develop pooled estimates of potential cost reductions associated with housing placement for two different scenarios:

- **Scenario 1 (More conservative):** Scenario 1 is considered more conservative in terms of its estimates of healthcare cost reductions. It was constructed by calculating a weighted average of the percentage change in healthcare utilization/costs associated with housing placement observed in all prior studies considered for inclusion, which encompasses studies that did not identify a statistically significant change and those that identified statistically significant increases in utilization/costs. In calculating this average, studies that did not identify a significant change were assigned a "0" and studies were weighted based on their methodological rigor score.

- **Scenario 2 (Less conservative):** Scenario 2 is considered less conservative in terms of its estimates of healthcare cost reductions. It was constructed by calculating a weighted average of the percentage change in healthcare utilization/costs associated with housing placement that were observed in all studies that identified a significant reduction in healthcare costs. In other words, this scenario represents cost reductions that might be expected should the implementation of the housing interventions described above have an effect more in line with what studies identifying relatively larger impacts have found. Once again, in calculating this average, studies were weighted such that those with stronger methodological rigor were assigned a larger weight.

Separate pooled estimates were then developed under each of these scenarios for the cost categories and types (e.g. inpatient medical, inpatient behavioral health, nursing home) considered in this study. Because the cost categories and types used in the previous research differed from the cost categories in the present study, the cost categories had to be aligned. Table A4 summarizes how the cost categories included in Table A3 were matched with the cost categories considered in the present study.

Given that prior studies have consistently identified a large effect of housing interventions for persons experiencing homelessness on emergency shelter utilization and costs, it was assumed that reductions in emergency shelter costs would be consistent across both cost reduction scenarios. To determine the estimated reduction in shelter costs, the pooled average was calculated across all studies that reported information on shelter costs. Table V-1 shows the resulting estimates for cost offsets that, taken

together, provide a range between the more and less conservative assessments of the results provided by the research literature.

Table V-1 - Summary of health care and shelter cost reduction scenarios

Cost Category	Scenario 1 (more conservative)	Scenario 2 (less conservative)
Inpatient medical	-18%	-33%
Emergency Department	-6%	-45%
Outpatient medical	-6%	-45%
Outpatient behavioral health	+48%	-29%
Inpatient behavioral health	-35%	-56%
Nursing home	-42%	-90%
Shelter	-71%	-71%

These estimates of cost offset proportions will be used as a basis for the offsets incurred with the provision of housing services to homeless individuals that are estimated in the following section. Estimates are now complete for four factors: population change, costs of services use, mix of housing types (and associated costs) needed for the age 55+ homeless population, and (now) offsets to health and shelter services costs associated with housing. Combining these will allow an assessment of the potential impacts that the provision of different configurations of housing and services could have on the costs of providing selected health care and shelter services to this population.

VI. COMPARING COST OFFSETS TO COST OF HOUSING INTERVENTIONS, RESULTS AND DISCUSSION

This section builds upon the previously described analyses for a comparison of the costs and cost-offsets related to providing various housing and service configurations to homeless adults aged 55 and over. These findings contribute to a discussion on the possible economic feasibility of making housing and related support services a more available resource to address the homelessness of elderly adults. As such, the implications of these findings will follow the presentation of the offset results.

Individual Cost Offsets

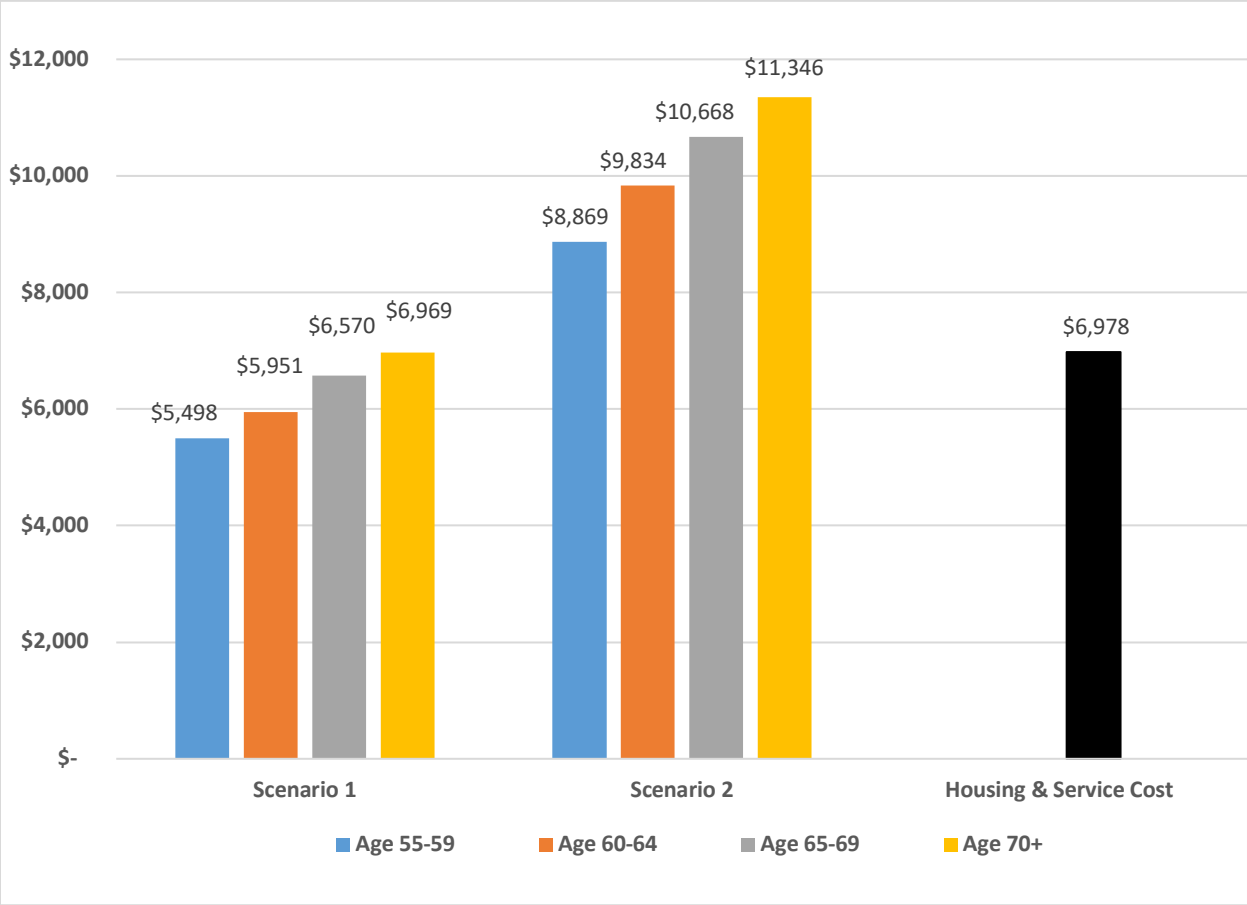


Figure VI-1 – Estimated average individual cost offsets associated with permanent housing placement for use of health and shelter services, for four age groups

Individual cost offsets for services used by an average shelter-using person over one year in each of the four age groups examined are provided in Figure VI-1. These offsets are based on the estimated individual costs presented in Table III-9 and the estimated cost reduction scenarios presented in Table V-1. The estimated offsets are compared to the weighted average cost of $6,978 for providing the three

types of housing discussed in Section IV (weights and costs are shown in Table IV-2). Figure VI-1 shows how the estimated housing and services cost is just above the estimated cost offsets using the more conservative estimates, and substantially below the estimated cost offsets using the less conservative estimates. This means that the cost of the housing and services falls within the range of potential cost offsets estimated here and, depending on the estimate used, could either mostly or completely be recouped by corresponding reductions in shelter and healthcare systems included here. Put more simply, the housing costs fall within the range of plausible offset assumptions.

Discussion

The key finding of this study is that reductions in the use of shelter and healthcare services costs stand to substantially, if not completely, offset the cost of providing housing and related services for shelter-using, elderly homeless adults (i.e., adults age 55 and older). Study results show that the elderly homeless incur greater costs in conjunction with their use of health care services (mostly inpatient services and nursing home use) as they age, and when shelter costs supplement these healthcare costs in the systems available for this study then these combined costs can potentially offset the costs related to providing housing and related services costs.

This role of shelter cost in estimating the offsets of housing has potential implications for expanding this analysis to an unsheltered elderly homeless population. Roughly 20% of elderly individuals experiencing homelessness access any shelter services at some point over a year. For the remaining—unsheltered homeless persons—living homeless outside of a shelter would obviate shelter costs. For the offsets that we use here, this would mean taking out the shelter expenses. Without any shelter costs to discount, the offsets would be lower, and would appear to weaken the economic case for providing housing to this population.

However, there are almost certainly substantial extra costs that go along with being homelessness in unsheltered circumstances that are not captured in this study. This includes a range of public costs including but not limited to law enforcement, emergency services, and social services. Additionally, subsisting in unsheltered circumstances has been associated with excess morbidity, meaning that the health care costs found here would likely be higher for the unsheltered portion of Los Angeles's elderly homeless population (Montgomery et al., 2016; Nyamathi Leake & Gelberg 2000; Gelberg & Siecke 1997). Taken together, the differences in services use costs between the sheltered (examined here) and unsheltered (not examined here) subpopulations is unknown, but we would posit them to be similar, if not higher for the unsheltered portion of this population.

The assessment of healthcare costs measured here are not comprehensive, and the estimated cost offsets would likely have been higher if more systems were involved. A particular example is inpatient behavioral health, which is only partially covered with the DHS and OSHPD records. It is impossible to capture all health services, and this limitation keeps healthcare costs on the conservative side.

Other cost dimensions involved in this study were inexact, though based upon the best data available. Limitations on the MDS (nursing home) data required some estimation of the number of days consumed, and the calculation erred on the side of being conservative when estimating lengths of stay.

Per diem and per service estimates were also used to estimate costs, which is less exact than billing data but was all that was available. Some assumptions involving housing costs and extent of offsets were also limited to available data and research, and so were estimated conservatively whenever possible.

While these results are estimates, at least for the unsheltered population, the cost of providing housing and related services for elderly homeless individuals appears to fall roughly into the range of shelter and health care expenditure offsets. Costs and cost offsets should not be the primary justification for providing housing. However, when combined with other arguments for housing people in the study group, effectively reducing the cost of housing is a powerful tool for scaling up the availability of this housing, especially when the alternative is high health and nursing home costs and continued homelessness.

Examining healthcare costs in conjunction with providing housing also has implications for financing services in both these domains. Various states have services related to housing as potentially reimbursable under Medicaid, as well as options for using Medicaid for nursing home avoidance, and reduced acute care. Managed care providers may also consider investing in housing as a means to realize savings in healthcare costs while also facilitating improved quality of life.

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APPENDIX A: Forecast of total (sheltered and unsheltered) homeless population by five-year age group, Los Angeles 2008-2015 (actual) and 2016-2030 (forecast)

Year	50-55	55-59	60-64	65-69	70-74	75+	Total
2008	17559	9991	3444	1632	505	222	33353
2009	17822	10467	4206	1682	569	313	35058
2010	18171	11512	4713	1750	615	330	37092
2011	18729	12332	5305	1880	707	326	39277
2012	18793	13018	5934	2185	666	358	40956
2013	18817	13621	6412	2347	868	390	42455
2014	18163	14755	6804	2702	1043	442	43909
2015	17211	14527	7130	2990	1153	534	43546
2016	17402	14750	8108	3300	1194	622	45377
2017	17364	14776	9015	3493	1423	667	46738
2018	16805	14949	9582	3879	1544	768	47527
2019	16477	14750	10305	4332	1620	878	48362
2020	16153	14590	10829	4703	1809	952	49035
2021	15191	14769	10992	5353	1995	1023	49324
2022	14008	14730	11003	5948	2113	1178	48982
2023	13118	14237	11122	6314	2349	1303	48442
2024	12118	13951	10976	6787	2622	1408	47860
2025	11071	13668	10855	7121	2846	1555	47115
2026	10522	12861	11004	7226	3242	1699	46553
2027	10361	11847	10968	7229	3600	1852	45857
2028	10592	11071	10582	7303	3818	2054	45421
2029	10716	10228	10363	7208	4103	2267	44885
2030	11005	9357	10147	7127	4301	2475	44413

APPENDIX B: COST OFFSET STUDIES

INPATIENT SERVICE USE								
Study	**Population**	**Design**	**Weight**	**Substance use**	**Mental health/ Psychiatric**	**Physical / Medical**	**Behavioral health**	**Total**
Aubry et al. (2015)[1]	Homeless individuals with mental illness and high needs	Experimental	3		-	-		
Basu et al. (2012)	Homeless individuals with chronic medical conditions	Experimental	3	-68%				-23%
Rosenheck et al. (2003)[a]	Homeless Veterans with mental illness	Experimental	3		NS	NS		NS
Stergiopoulous et al. (2015)[1]	Homeless individuals with mental illness and moderate needs	Experimental	3					NS
Byrne et al. (2017)[a,2]	Chronically homeless individuals	Quasi-experimental (w/comparison group)	2			-22%	-56%	
Culhane et al. (2002)	Homeless individuals with severe mental illness	Quasi-experimental (w/comparison group)	2		-49.2%			-24%[5]
Gilmer et al. (2009)[a,2]	Homeless individuals with serious mental illness	Quasi-experimental (w/comparison group)	2					-46%[6]
Larimer et al. (2009)[a,3]	Chronically homeless individuals with serious alcohol disorders	Quasi-experimental (w/comparison group)	2	~-90%				
Martinez & Burt (2006)	Homeless individuals with two of following: serious mental illness, substance abuse disorder or HIV/AIDS	Quasi-experimental (w/comparison group)	2		NS	NS		-44%
Seligson et al. (2013)	Various populations	Quasi-experimental (w/comparison group)	2		-94%			
Srebnik et al. (2013)	Chronically homeless adults with medical illness and high prior acute service use	Quasi-experimental (w/comparison group)	2	-86%				NS
Byrne et al. (2017)[a,4]	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1			-12%	-13%	
Hunter et al. (2017)	Homeless individuals with complex medical and behavioral health issues	Quasi-experimental (pre/post no comparison group)	1	NS	NS	-61%		
Mares & Rosenheck (2009)	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1					-53%
Thomas et al. (2015)	Chronically homeless adults with behavioral or health issues	Quasi-experimental (pre/post no comparison group)	1					-62%

Wright et al. (2016)[a]	Homeless individuals with complex medical and mental health issues	Quasi-experimental (pre/post no comparison group)	1			NS		-84%		
OUTPATIENT SERVICE USE										
Study	**Population**	**Design**	**Weight**	**Substance use**	**Mental health/ Psychiatric**	**Physical/ Medical**	**Behavioral health**	**Primary Care**	**Other**	**Total**
Aubry et al. (2015)[1]	Homeless individuals with mental illness and high needs	Experimental	3	+155%	+59%					+76%
Basu et al. (2012)	Homeless individuals with chronic medical conditions	Experimental	3		+32%	NS				
Rosenheck et al. (2003)[a]	Homeless Veterans with mental illness	Experimental	3							+
Stergiopoulous et al. (2015)[1]	Homeless individuals with mental illness and moderate needs	Experimental	3			-19%	-29%			
Byrne et al. (2017)[a,2]	Chronically homeless individuals	Quasi-experimental (w/comparison group)	2							+76%
Culhane et al. (2002)	Homeless individuals with severe mental illness	Quasi-experimental (w/comparison group)	2							+14%
Gilmer et al. (2009)[a,2]	Homeless individuals with serious mental illness	Quasi-experimental (w/comparison group)	2							
Larimer et al. (2009)[a,3]	Chronically homeless individuals with serious alcohol disorders	Quasi-experimental (w/comparison group)	2							
Martinez & Burt (2006)	Homeless individuals with two of following: serious mental illness, substance abuse disorder or HIV/AIDS	Quasi-experimental (w/comparison group)	2							
Seligson et al. (2013)	Various populations	Quasi-experimental (w/comparison group)	2							
Srebnik et al. (2013)	Chronically homeless adults with medical illness and high prior acute service use	Quasi-experimental (w/comparison group)	2			-36%	-7%			
Byrne et al. (2017)[a,4]	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1	NS	-44%	47%				
Hunter et al. (2017)	Homeless individuals with complex medical and behavioral health issues	Quasi-experimental (pre/post no comparison group)	1							-34%
Mares & Rosenheck (2009)	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1							+53%
Thomas et al. (2015)	Chronically homeless adults with behavioral or health issues	Quasi-experimental (pre/post no comparison group)	1				NS	NS	-42% (Outpat. speciality care)/ -53% (outpat.	

									labs & radiolog)	
Wright et al. (2016)[a]	Homeless individuals with complex medical and mental health issues	Quasi-experimental (pre/post no comparison group)	1	+155%	+59%					+76%
OTHER SERVICES										
Study	**Population**	**Design**	**Weight**	**Emergency Dept.**	**Pharmacy**	**Nursing home**	**LTSS**	**Other**		**Emergency Shelter**
Aubry et al. (2015)[1]	Homeless individuals with mental illness and high needs	Experimental	3							-
Basu et al. (2012)	Homeless individuals with chronic medical conditions	Experimental	3	-33%		-42%[7]				NS
Rosenheck et al. (2003)[a]	Homeless Veterans with mental illness	Experimental	3							-50%
Stergiopoulous et al. (2015)[1]	Homeless individuals with mental illness and moderate needs	Experimental	3	NS						
Byrne et al. (2017)[a,2]	Chronically homeless individuals	Quasi-experimental (w/comparison group)	2		NS		NS	NS		
Culhane et al. (2002)	Homeless individuals with severe mental illness	Quasi-experimental (w/comparison group)	2							-61%
Gilmer et al. (2009)[a,2]	Homeless individuals with serious mental illness	Quasi-experimental (w/comparison group)	2	-46%[6]						
Larimer et al. (2009)[a,3]	Chronically homeless individuals with serious alcohol disorders	Quasi-experimental (w/comparison group)	2							~-90%
Martinez & Burt (2006)	Homeless individuals with two of following: serious mental illness, substance abuse disorder or HIV/AIDS	Quasi-experimental (w/comparison group)	2	-56%						
Seligson et al. (2013)	Various populations	Quasi-experimental (w/comparison group)	2							-97%
Srebnik et al. (2013)	Chronically homeless adults with medical illness and high prior acute service use	Quasi-experimental (w/comparison group)	2	-53%						
Byrne et al. (2017)[a,4]	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1		NS		+9%	NS		
Hunter et al. (2017)	Homeless individuals with complex medical and behavioral health issues	Quasi-experimental (pre/post no comparison group)	1	-80%						-59%
Mares & Rosenheck (2009)	Chronically homeless individuals	Quasi-experimental (pre/post no comparison group)	1							
Thomas et al. (2015)	Chronically homeless adults with behavioral or health issues	Quasi-experimental (pre/post no comparison group)	1	-81%						
Wright et al. (2016)[a]	Homeless individuals with complex medical and mental health issues	Quasi-experimental (pre/post no comparison group)	1	-40%	NS			-61%		

Notes: NS = not statistically significant;
-/+ = study reported significant decrease/increase, but it was not possible to calculate exact magnitude of decrease/increase from available data;
a-Percent reduction based on reported change in costs, not units of service use;
1-Based on cross-site results from At-Home/Chez Soi study;
2-Based on difference-in-difference analysis reported in study. For difference in difference analysis percent change in costs calculated by comparing observed cost in "post" period for intervention group with assumed counterfactual post period cost (i.e. observed post period cost + observed pre/post cost difference for comparison group);
3-Cost reduction estimates are approximate and based on rate ratios displayed in Figure 2 in study, as exact reductions were not reported.
4-Based on fixed effects models using log-transformed cost as dependent variable (reported in study Appendix)
5-Based on Medicaid inpatient days
6-Study groups together inpatient and emergency department costs; same estimate is used for both categories
7-Statistically significant at p <.01 level