King County Data Across Sectors for Housing and Health, 2018

King County Housing Authority

Seattle HOUSING AUTHORITY

Public Health
Seattle & King County

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Please note that figures created in the report are subject to change as new data are added or data are amended. See the online dashboard for the most up-to-date data.

Executive summary

Although housing is an essential component of the social determinants of health, the relationship between subsidized housing and health is only minimally understood. This limited understanding of how health and housing are linked has been fueled in part by data siloes that limit comprehensive insights into whole-person health. In an effort to overcome such limitations and to provide a stronger foundation for a growing regional (and national) focus on health and housing intersections, in 2016, the King County Housing Authority (KCHA), Seattle Housing Authority (SHA), and Public Health – Seattle and King County (PHSKC) joined to form the Data Across Sectors for Health and Housing (DASHH) partnership, focused on creating a unique and sustainable dataset containing linked health and housing administrative data.[1] Key goals for DASHH were to use linked data to inform and measure future interventions, including policy, outreach, and programming to improve the health of King County residents, as well as to share this actionable data with key health and housing stakeholders.

Approach

Housing data provided by KCHA and SHA were matched with Medicaid enrollment and claims data to create a longitudinal dataset of housing and healthcare utilization data from 2012-2016.[2] This merged dataset allows exploration of population overlaps between the Medicaid and Public Housing Authority (PHA) service systems. To ensure that linked data was easily accessible and interpretable for cross-sector users, the DASHH dataset was built into a dynamic, web-based dashboard that allows exploration by condition, housing subpopulation, and time period. This platform is designed to be a sustainable (and updatable) resource, and new health and housing data will be incorporated into the dataset as it becomes available.

Key Findings

Preliminary DASHH analyses highlight broad patterns in the health of PHA residents relative to Medicaid enrollees who are not living in subsidized housing. Data only indicates the number of times an individual interacted with the health service system. Additional examination is needed to understand the driving factors behind varying levels of service utilization, in part to identify if patterns are due to the prevalence of a given condition, differences in care-seeking behaviors, or for other reasons.

High levels of overlap between the PHA and Medicaid populations in King County

In 2012, 74% of PHA residents were enrolled in Medicaid; by 2016, this enrollment rate had increased to 83%, largely due to the expansion of Medicaid in 2014 under the Affordable Care Act. Enrollment rates vary by PHA population groups, with children (ages 0-17) having the highest enrollment (91%) and young adults (ages 18-24) having the lowest enrollment (77%). Overall, **PHA residents represent 11% of the Medicaid population within King County**. Given this magnitude and the unique and ongoing relationships PHAs have with residents, there is significant potential for cross-sector efforts to improve population health and lower health care costs by targeting education, resources, and supports to PHA residents.

PHA residents are more likely to receive care for chronic conditions than the non-PHA Medicaid population

Across all years, **PHA residents were more likely to engage with the healthcare system than the non-PHA Medicaid population for all chronic conditions** included in this analysis (e.g., hypertension, asthma, diabetes). For example, in 2016, the rate of service utilization for hypertension among people aged 45-61 years was 2.0 times higher in the KCHA population and 1.6 times higher in the SHA population as compared to the non-PHA Medicaid population. Further analyses will explore whether these patterns are due to higher chronic disease prevalence in the PHA population and if more frequent chronic care service utilization is due to prevention, condition management, or acute/emergency purposes.

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[1] This effort was supported by funding from the Robert Wood Johnson Foundation (RWJF) Data Across Sectors for Health (DASH) grant; for more information, see www.dashconnect.org.
[2] Both KCHA and SHA provided data for residents living in Housing and Urban Development (HUD) funded subsidized housing programs including Public Housing and the Housing Choice Voucher Program.

PHA residents are more likely to seek acute care than the non-PHA Medicaid population

Rates of emergency department (ED) visits dropped dramatically among non-PHA population adults aged 25–64 following Medicaid expansion in 2014, likely due to changes in who was enrolled in Medicaid. However, a corresponding drop was not seen among the PHA population where rates remained similar before and after expansion. For all years, **PHA women had higher rates of both ED and avoidable ED visits compared to non-PHA women** suggesting opportunities for targeted innovation pertaining to health systems navigation among PHA residents.

Well-child visits are more frequent among PHA residents than non-PHA Medicaid enrollees

Well-child checks for children ages 3-6 are a crucial aspect of early child health. **A higher proportion of PHA resident children had well-child checks than non-PHA Medicaid enrollees** (61–64% among PHA children compared to 57% among non-PHA Medicaid children).

Demographic differences may explain some service utilization patterns

This project allows for the identification of trends and discrepancies in enrollment and service engagement within both PHA and non-PHA Medicaid populations. **Some patterns may be due to demographic differences across PHAs or in comparisons between PHA and non-PHA Medicaid enrollees**. The DASHH **interactive dashboard**[3] supports more detailed subpopulation comparisons in order to discern whether population characteristics or other factors may be underlying these differences.

Medicaid data alone cannot provide insights into the health of elderly residents

Though a majority (79%) of PHA residents aged 65 and older are enrolled in Medicaid, almost all (over 98%) are also enrolled in Medicare. Most health encounters in the 65+ age group are covered by Medicare and do not appear in the Medicaid claims data. **Integrating Medicare data is a high priority future project** in order to gain insights into health and housing patterns among older adults in King County.

Data regarding behavioral and mental health among the Medicaid population is limited

While depression and mental health conditions are included in the DASHH analysis and are critical health conditions to consider in health and housing intersections, Medicaid claims data alone provides an incomplete picture of behavioral health service utilization, and therefore limits the utility of these indicators. Results from just Medicaid claims indicate that **rates of service utilization for depression and other mental health conditions are higher for PHA than non-PHA populations**. However, additional data integration efforts are necessary to gain a better understanding of mental and behavioral health within both of these groups.

Next steps

Additional years of Medicaid and PHA data will be added to the current dataset as they become available, improving the ability to examine time trends. Given that service utilization does not necessarily equate to poorer health outcomes or higher condition prevalence (but rather may reflect regular engagement with the healthcare system for positive reasons), future analyses will also focus on gaining a better understanding of the causes and nature behind service utilization. As noted above, subsequent DASHH data integration will focus on adding Medicare and behavioral health data to provide a more comprehensive picture of health for all PHA residents.

This continued development and expansion of the DASHH dataset and dashboard will serve as a critical resource for strengthening cross-sector partnerships in pursuit of a better understanding of how housing plays a role in health, how policy and system changes impact health, and how linked and actionable data can be used to improve the health of vulnerable King County residents.

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[3] www.kingcounty.gov/health-housing

Key findings

Demographics and Medicaid enrollment

Most public housing authority (PHA) residents are enrolled in Medicaid

In 2012, approximately 74% of Seattle Housing Authority (SHA) and King County Housing Authority (KCHA) residents were enrolled in Medicaid at some point during their time at the PHA. By 2016, this increased to around 83%, largely due to expansion of Medicaid in 2014 under the Affordable Care Act (Figure 1).

Among the PHA resident population, Medicaid enrollment rates (as of 2016) are:

- Highest among youth (under 18 years of age) (91%)
- Lowest among young adults (18-24) (77%)
- Similar between genders
- Varied by race/ethnicity, ranging from around 65% enrolled among multiple-race residents to 88% among American Indians/Alaskan Native residents

Medicaid data alone cannot tell us much about the health of elderly PHA residents

Though a majority (79%) of PHA residents aged 65+ are enrolled in Medicaid, the vast majority of this group (over 98%) are also enrolled in Medicare (people enrolled in both programs are termed dual eligible). As Medicaid is the payer of last resort, most health encounters in the 65+ age group are covered by Medicare and do not appear in the Medicaid claims data. This limits the ability to identity health outcomes for elderly housing residents so they are not included in this report or accompanying dashboard.

PUBLIC HOUSING AGENCIES HOUSE A SIGNIFICANT NUMBER OF LOW-INCOME PEOPLE WHO ARE ALSO RECEIVING MEDICAID. LINKING HOUSING AND MEDICAID DATA SETS ALLOWS PHAS TO BETTER UNDERSTAND THE HEALTH CONDITIONS AND SERVICE UTILIZATION OF THEIR CLIENTS.

Figure 1: Medicaid expansion substantially increased the proportion of PHA residents enrolled in Medicaid
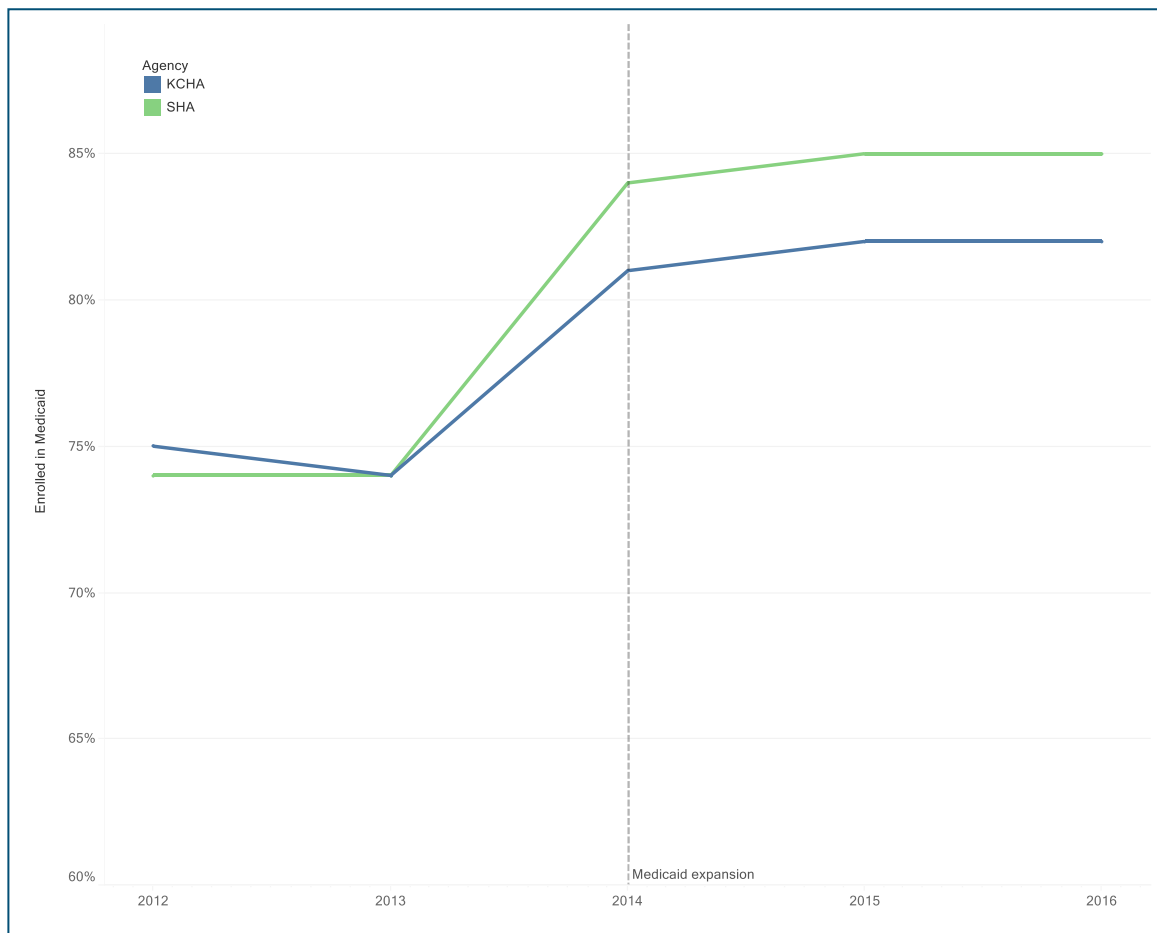
Housing authority residents make up a substantial proportion of King County Medicaid recipients

In 2012, approximately 14% of all Medicaid recipients in King County were supported by the Seattle or King County Housing Authorities. By 2016, despite Medicaid expansion increasing the number of adults on Medicaid by over 100,000, PHA residents still accounted for over 1 in 10 of all Medicaid enrollees in King County. The overlap between the Medicaid and PHA service systems suggests that efforts to improve the health of PHA residents could have a noticeable impact on the overall health of the low-income King County population, many of whom live in areas with high prevalence of chronic conditions.

Figure 2: Enrollment in Medicaid, including concurrent enrollment in Medicare (dually eligible), among KCHA and SHA residents combined, 2016 (note that people may be counted in multiple categories of enrollment)
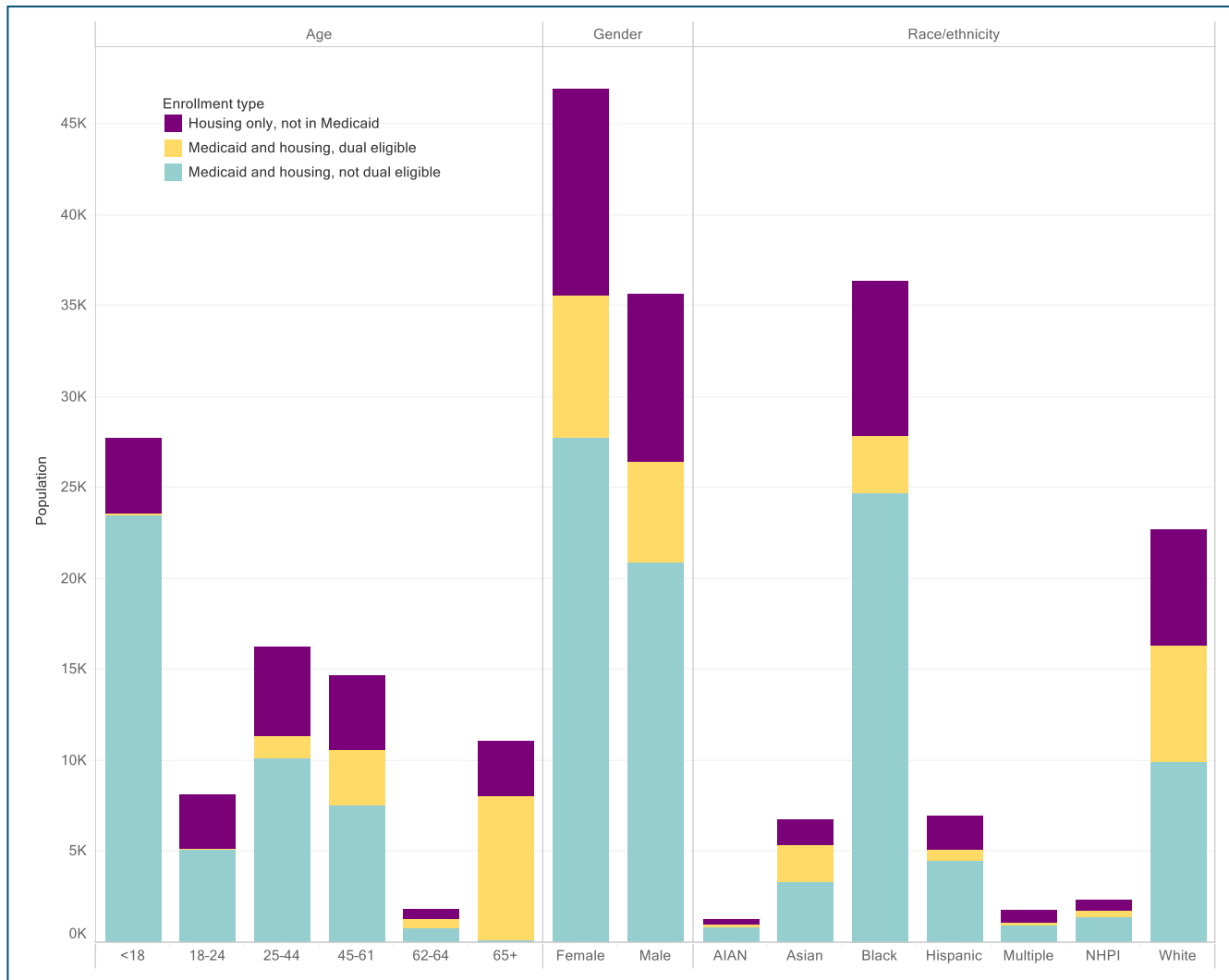
Medicaid recipients in PHA housing are younger, more likely to be female, and less likely to be White than the rest of the Medicaid population

In 2016, Medicaid recipients in KCHA and SHA housing who were not also receiving Medicare (i.e., not dual eligible) compared to the rest of the Medicaid, non-Medicare population were:

- More likely to be younger than the rest of the Medicaid, non-Medicare population
- More likely to be female
- More likely to identify as Black or African American
- Less likely to be White or Latino/Hispanic
- More likely to be dually enrolled in Medicaid AND Medicare than the non-PHA Medicaid population

Table 1: Demographics of Medicaid recipients (enrolled at any time in this group in 2016 and not also enrolled in Medicare (dual eligible))

	KCHA	SHA	non-PHA
	N = 27,616	N = 21,000	N = 446,302
Gender			
Female	58.7%	55.1%	51.7%
Male	41.3%	44.9%	48.3%
Race/ethnicity*			
American Indian/Alaska Native	1.6%	1.9%	1.6%
Asian	4.7%	9.5%	10.5%
Black/African American	45.1%	58.4%	12.5%
Latino/Hispanic	10.9%	7.1%	16.8%
Multiple race	2.4%	1.4%	1.2%
Native Hawaiian or Pacific Islander	3.2%	2.5%	4.8%
White	25.2%	14.2%	37.1%
Other/unknown	7%	5.1%	15.5%
Age			
Median	17.8 years	19.9 years	23.7 years
Mean	23.6 years	26.4 years	25.5 years
<17	50.5%	45.6%	40.6%
18–24	11.2%	9.6%	10.1%
25–44	21%	20.7%	29.7%
45–61	13.4%	18.1%	14.1%
62–64	1.3%	2.3%	1.5%
65+	0.3%	0.4%	0.7%
Unknown	2.4%	3.3%	3.4%
Dual eligibility (also enrolled in Medicare)	18.7% (n = 33,976)	25.0% (n = 27,993)	9.4% (n = 492,357)

* Latino/Hispanic was collected as a separate field. If a person indicated Hispanic ethnicity they are only included in that group regardless of other race/ethnicity groups selected. All other race/ethnicity groups are non-Latino.

Understanding health conditions using Medicaid data
Higher rates of care for chronic conditions are not necessarily a negative outcome

Medicaid claims are the first block in building a broader, more holistic understanding of PHA resident health. Medicaid claims are best used as one measure of health service utilization—i.e., what types of health care people are accessing. Medicaid claims data provide useful insight into a person's health care service interactions, but it is important to remember that medical claims data for chronic conditions such as asthma and diabetes are only defined by a person accessing health care and receiving a particular diagnosis. Individuals who seek care but don't find it, or who choose not to seek care, cannot be counted using this data source. While the rates of chronic conditions seen in this data may reflect a higher prevalence of certain conditions among PHA residents, it might also be due to a higher level of engagement with the health care system due to supports provided by PHAs.

Acute events such as emergency department (ED) visits, hospitalizations, and injuries are less susceptible to care-seeking biases. Higher rates are more likely to be indicative of a conditions that could be managed through preventive care and environmental conditions that lead to more injuries.

PHA residents were more likely to receive care for most conditions compared to non-PHA Medicaid enrollees

Compared to the non-PHA Medicaid population, PHA residents on Medicaid had higher rates for many of the chronic and mental health conditions analyzed. For example, in 2016, hypertension (high blood pressure) among people aged 45–61 years was 2.0 times higher in the KCHA population and 1.6 times higher in the SHA population compared to the non-PHA Medicaid population. Even accounting for demographic differences between the PHA and non-PHA Medicaid populations, PHA residents showed higher levels among many conditions. The reasons for higher rates of health conditions between PHA and non-PHA Medicaid recipients is unclear. Previous studies have found that health care utilization may increase when a person is able to obtain stable housing but further investigation is required to determine whether that explanation applies to King County's PHA residents.

KCHA residents seem to have higher rates of most conditions than SHA residents but this is often driven by differences in demographic composition

Overall, KCHA residents have higher rates of health conditions than SHA residents. For example, across most age groups, a higher proportion of KCHA-housed Medicaid recipients met the definition for ischemic heart disease than SHA-housed Medicaid recipients. However, drilling into the rates and looking at specific PHA populations (e.g., black males, white females), the differences largely disappear and sometimes reverse. This highlights that an apparent difference in rate of a condition between the overall PHA populations can be driven by the demographic composition of each PHA. Future analyses will need to adjust for these differences when comparing residents' health statuses between PHAs.

Acute conditions

Hospitalization rates were similar between non-PHA Medicaid enrollees and PHA residents on Medicaid

There was no notable difference in rates of overall hospitalization when comparing non-PHA, KCHA, and SHA Medicaid enrollees. Within specific sub-populations where an agency's rate did appear substantially different from the others in that group, the sample size of residents with a hospitalization was typically small, making it difficult to draw firm conclusions. For all three groups, hospitalization rates increased with age, from around 10 per 1,000 person-years (p-y) among minors (<18year olds) to between 90 and 138 per 1,000 p-y among 62–64-year-olds. Rates were slightly higher among males for SHA and non-PHA enrollees, but lower for male KCHA residents. Hospitalization also varied by subsidy type: residents in units where the housing subsidy was tied to the property (hard units) had higher hospitalization rates than residents who received a voucher subsidy (soft units) at SHA (33.6 vs. 22.6 per 1,000 p-y), while the reverse was true at KCHA (20.1 per 1,000 p-y in hard units vs. 28.2 in soft units).

Rates of hospitalizations remained static among minors (<18 year olds) across all three population groups from 2012 to 2016. Rates for the 18–24 and 25–44-year-old groups were fairly consistent among KCHA residents, but showed signs of increasing among SHA residents and non-PHA Medicaid recipients. Among older adults (62–64-year-olds), Medicaid expansion in 2014 resulted in a substantial decrease in hospitalization rates.

Emergency department (ED) visit rates were largely unchanged over time for PHA residents but decreased substantially among non-PHA Medicaid recipients after Medicaid expanded

Rates of ED visits were higher among PHA residents than non-PHA Medicaid recipients in 2016, particularly for females. However, this gap between PHA and non-PHA Medicaid recipients was largely a result of a substantial decrease in ED visit rates among older non-PHA Medicaid recipients after Medicaid expanded in 2014. For example, among non-PHA 45–61-year-olds, the rate of ED visits was 1,222.5 per 1,000 p-y in 2013 but decreased to 667.9 per 1,000 p-y in 2016. Similar drops were recorded for 25–44-year-olds and 62–64-year-olds, while younger groups had static or increasing rates. Among KCHA and SHA residents on Medicaid, rates fluctuated but tended to remain flat over time (Figure 3). ED utilization rates did not show major differences between subsidy types at either PHA.

A similar pattern emerged for *avoidable* ED visits; there was an initial large drop in the non-PHA group from 2013 to 2014 but no obvious change among PHA residents (though in both groups, rates increased again from 2014 to 2016). Avoidable ED visits are costly, and are considered to be signs of poor care management or inadequate access to primary health care. Rates of avoidable ED visits were higher in both KCHA and SHA across all age groups when compared to the non-PHA Medicaid population, with the highest rates seen in KCHA females. Rates were slightly higher among KCHA females in soft units than those in hard units but there was no difference by gender among SHA residents.

Figure 3: Rates of emergency department visits by age for SHA and KCHA combined (top panel) vs. non-PHA Medicaid recipients (lower panel)
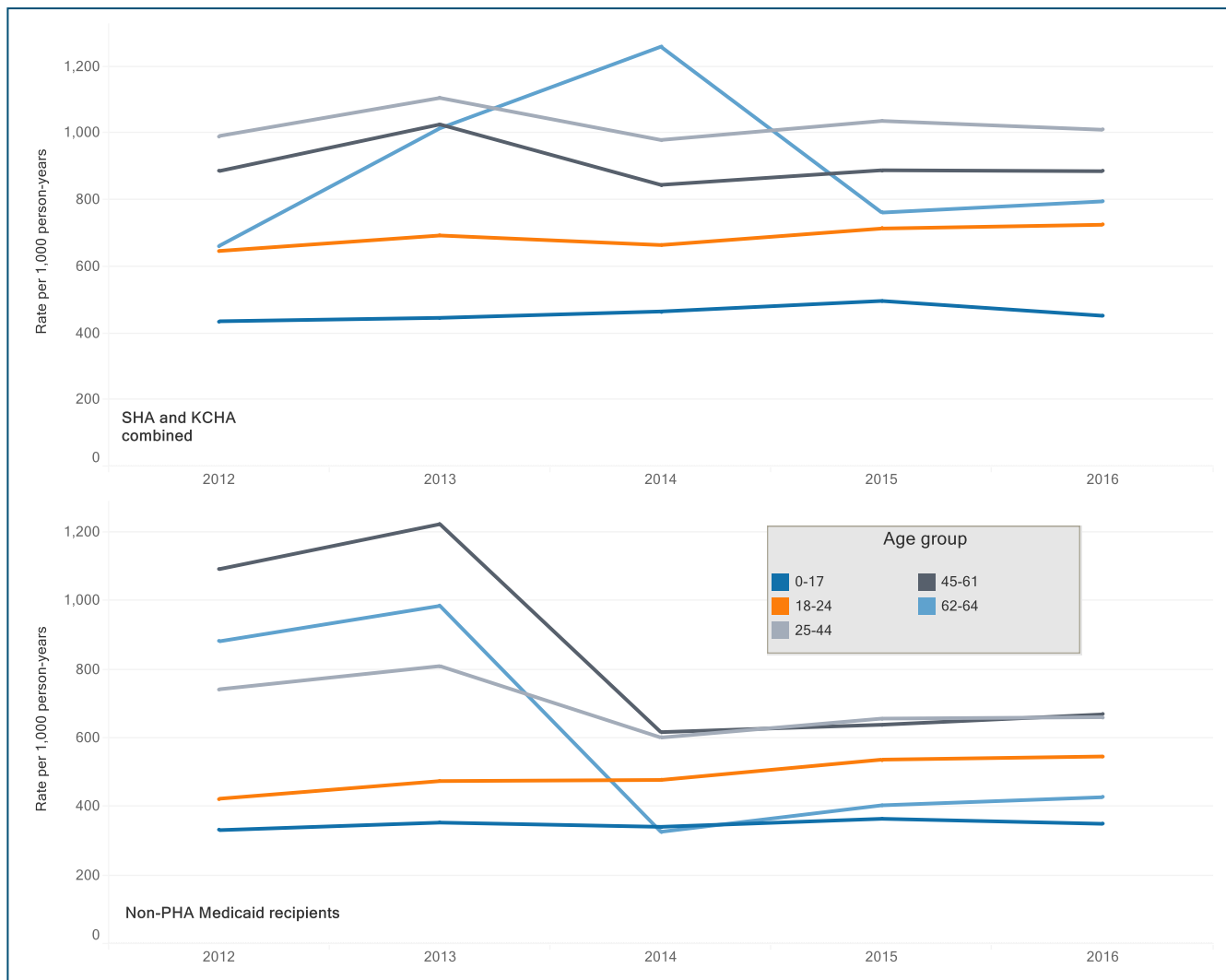
There was a strong age gradient for rates of unintentional injuries among SHA residents but not so among KCHA residents and non-PHA Medicaid recipients

Among SHA residents, rates of unintentional injuries were nearly three times higher for men aged 62–64 than males aged under 18 (292.5 vs. 111.2 per 1,000 p-y), and over four times higher for women (384.6 vs. 87.4 per 1,000 p-y). This strong age gradient was not evident among KCHA residents or non-PHA Medicaid recipients.

Like hospitalizations and ED visits, rates of unintentional injuries declined substantially between 2013 and 2014 among non-PHA Medicaid recipients aged over 45 but remained static or increased among younger age groups and PHA residents of all ages. Though there appeared to be a sharp increase in rates

of injuries starting in 2015 and continuing in 2016, this is likely driven by a change in the diagnostic coding system used in claims data that took place in October 2015.[4]

Chronic conditions

PHA residents were much more likely to receive care for asthma than non-PHA Medicaid recipients

PHA residents of all ages, genders, and races/ethnicities were much more likely to have met the definition for asthma than non-PHA Medicaid recipients. The proportion was consistently 2–3 times higher in PHA residents when looking across age and gender. It is unclear whether the higher proportion seen represents greater prevalence of asthma among PHA residents or higher levels of care seeking. The proportion also increased with age among both PHA and non-PHA Medicaid enrollees.

White individuals were more likely than Black/African American individuals to meet the definition for chronic obstructive pulmonary disorder (COPD) for both PHA and non-PHA Medicaid recipients

As expected, the proportion of people meeting the definition of COPD increased with age. Even accounting for age, there were some differences in proportions by race/ethnicity. The proportion for Black/African American individuals aged 45–61 ranged from 12.9 per 1,000 in the non-PHA group to 31.1 per 1,000 at KCHA. For white individuals in the same age group, rates ranged from 18.5 per 1,000 (non-PHA) to 58.8 per 1,000 (SHA). The difference was less pronounced among the 62–64-year-old group.

KCHA residents were more likely to meet the definition for diabetes than SHA residents

For most demographic subgroups, a higher proportion of KCHA residents met the definition for diabetes than SHA residents. This was particularly true for males aged 62–64 (169.2 vs. 111.6 per 1,000), Black/African American individuals aged 45–61 (134.5 vs. 108.1 per 1,000), and tenant-based voucher residents aged 62–64 (189.7 vs. 124.0 per 1,000). Both PHAs had a higher proportion of people meeting the definition for diabetes than non-PHA Medicaid recipients (1.5–3 times higher).

More detailed analyses may be viewed online

The best way to explore the health status of PHA residents is to use an [interactive visualization](http://www.kingcounty.gov/health-housing)[5] hosted by King County. The online tool allow users to navigate between viewing conditions by demographics and housing types, looking at time trends, and looking at specific housing portfolios or ZIP codes. Any new analyses will be updated.

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[4] The switch from the ninth revision of the International Classification of Diseases, Clinical Modification (ICD-9-CM) to the tenth revision (ICD-10-CM) makes it difficult to compare across time for conditions that are defined by ICD codes, like unintentional injuries. Work is underway nationally to create mappings between the two systems for specific conditions. Though the provisional mapping was used in the analysis for injuries, the approach has not yet been fully validated caution should be taken when comparing over time.
[5] http://www.kingcounty.gov/health-housing

Background

Housing profiles/types
Federally subsidized housing

PHAs administer federal, state and locally funded long-term affordable rental housing and rental assistance that serve low-income people and their families. Subsidized housing is important for avoiding poor housing conditions that impact health, such as unsafe living conditions, high rent burdens, frequent moves and displacement of communities, and overcrowding. There are 3 main types of housing assistance:

- Housing Choice Vouchers (HCV, formerly called Section 8)—used by voucher recipients to rent a unit on the private housing market.
- Public housing properties and units that are managed and owned by PHAs
- Project-based vouchers (voucher): Housing units that are subsidized by PHAs.

Throughout this report and online dashboard[6], subsidy types are categorized as either "hard" or "soft" units. A "hard" unit refers to subsidies that are tied to specific housing units, which include subsidies administered through both the Public Housing and Project-based voucher programs. A "soft" unit refers to a subsidy administered through the HCV (Section 8) program, which is used by the voucher holder to lease a unit on the private housing market.

SHA and KCHA are the largest affordable housing providers in King County. Collectively, KCHA and SHA provide access to decent, safe, and sanitary housing for 26,000 households (57,000+ individuals) in the county. They do so primarily through two federally funded programs—low-income public housing (LIPH) and voucher (Section 8)—where households generally pay 30%-40% of their income for rent.
SHA owns and operates more than 8,000 apartments and single family homes at nearly 400 sites throughout Seattle through LIPH, Seattle Senior Housing Program, and additional housing. SHA also administers over 6,900 tenant-based HCV (Section 8), and subsidizes 3,700 units operated by local providers ("collaborative units")

KCHA provides rental housing and rental assistance to more than 19,000 households across 33 cities in King County, excluding Seattle and Renton. KCHA owns and manages 4,269 units of federally funded housing for families, the elderly, and people with disabilities. An additional 6,000 units of low- and moderate-income housing are financed through tax credits or tax-exempt bonds. KCHA also administers housing assistance through the HCV (Section 8) program to over 12,000 households who rent affordable housing on the private market.

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[6] http://www.kingcounty.gov/health-housing

Housing as a platform for health, well-being and success

Intergenerational poverty, where children of low-income parents become low-income adults, also can result in a cycle of vulnerability for poor health outcomes. In order to break these cycles, a comprehensive, cross-sector response is needed to understand the relationship between social factors that create the best opportunities for improved health. No sector can create effective and lasting changes in a vacuum and this has brought a call to break down policy and programmatic siloes. For affordable housing providers, "housing as a platform for health" is an outgrowth of this perspective shift on poverty alleviation. This view expands the role of housing providers beyond the development and maintenance of buildings and rental subsidies. Instead, it reframes housing assistance as providing the stability that serves as an essential springboard for engagement and success in other sectors including education, health, employment, and longer-term asset building.

Both PHAs recognize that housing is only one component in a constellation of necessary supports and have looked to systems-level partnerships to improve the stability and well-being of residents and the broader community. Over the past five years, both KCHA and SHA have prioritized the use of housing as a platform to improve quality of life, including

AS AN EXAMPLE OF HOUSING AS A PLATFORM FOR HEALTH, THE MERCY HOUSING NORTHWEST COMMUNITY HEALTH WORKER INITIATIVE FOUND INCREASED RESIDENT ENGAGEMENT WITH HEALTHY BEHAVIORS, PARTICULARLY IN NON-ENGLISH SPEAKING RESIDENTS. [5]

enhancing programming and services that impact the health of residents. Good behavioral and physical health are necessary for people to move towards stability and self-sufficiency, and roughly 60 percent of health is determined by social factors, including housing and neighborhood resources (i.e., social determinants of health).7

Concurrently, there has been an increased focus on health system transformation nationally and locally; specifically using cross-sector, systems-level partnerships to improve service delivery, improve population health and address health inequities while driving down health care costs. PHAs are the primary affordable housing providers for people eligible for Medicaid—including seniors, people with disabilities and families with children. PHAs have unique, ongoing relationships with residents that offer various opportunities to engage people around health, particularly in those areas of King County that have high rates of chronic health conditions.

With continued and expanded cross-sector opportunities to link housing data to other datasets, health and housing systems have an opportunity to improve the health and well-being of the broader community through the ACH, and to design data-driven integrated policy and program design. This

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[7] https://www.mercyhousing.org/file/1570_MHNW_FinalHealthHousingReport_v7.pdf, accessed 2/2017

requires a clear understanding of what the specific health needs are within and across different resident populations and programs.

Data to drive decision-making towards policy/program design, evaluation and impact

Both the PHAs and the broader health system have made a commitment to design, implement and evaluate policies/programs based on sound information. Historically, PHA and health partnerships have relied on an incomplete picture, relying primarily on anecdotal understandings and assumptions of specific health conditions and baseline service engagement among and across different PHA populations or programs. Data comes from separate programs or agencies, such as administrative datasets or ad-hoc surveys; and integrated data across programs, agencies and sectors have remained elusive. Without effective cross-sector data integration efforts, it remains difficult to accurately define and identify issues and service gaps, understand the interconnectedness of service systems, and measure returns on investments in system changes. Additional work toward achieving integrated data systems is needed to address the large inequities in our county through innovative cross-sector initiatives, and align health, housing and social services systems to address multiple determinants of health. Phase I of the Medicaid and PHA data integration will:

1. Provide the PHAs and partners with baseline understanding of health conditions and service utilization among and across different PHA populations or program.
2. Inform current and future cross-sector efforts aimed at eliminating health inequities among low income residents of PHAs

More broadly, this project provides a scaffold on which to build a broader integrated data system with additional data from other sectors and agencies. More data and more comprehensive information will allow capacity for more rigorous and precise evaluation of the programs and policies, measure costs and savings associated with initiatives, identify disparities, and inform new initiatives and partnerships.

Primary questions

A growing national evidence base shows that high quality, stable housing improves health; permanent supportive housing is an effective strategy to end homelessness, improve mental health and substance use. Does King County have the same experience? With linked data, health and housing policy makers can examine questions about service utilization and engagement, health conditions, and can design programs to reduce illness and accidents. How do housing clients fare? How frequently do PHA residents use Medicaid? Is the pattern of health conditions or health care utilization different from non-PHA housed Medicaid clients? Are there ways that a PHA can provide programs or services that can maintain or improve health among their residents? There is a need to verify the anecdotal stories heard by PHAs and to add to the evidence of how housing impacts health.

Who is included?

In the analysis and report, population and counts of conditions or events numbers are restricted to individuals under the age of 65 who were on Medicaid from 2012 forward, in the PHA at some point between 2004 and 2016, and who were not dual enrolled in Medicare. Medicaid is considered to be the "payer of last resort," meaning that individuals or families who have other medical coverage would have claims go to the other coverage first, so the claim may not appear in Medicaid data. Adults over age 65 are almost all covered by Medicare, which would pay before Medicaid.

What conditions are currently examined?

The primary focus of this report allows each PHA to look at their data, and compare patterns to the overall non-PHA Medicaid population and to the other PHA. It provides descriptive statistics on Medicaid claims data and service utilization. The focus is on conditions and service utilization patterns where there are opportunities for a policy, system, or environment change that can support the health of PHA residents. Are there conditions where PHA residents seem to be doing better or worse than non-PHA assisted Medicaid enrollees? Questions that are relevant to the policies and programs within the PHAs also help to inform the Accountable Community of Health triple aim goal of improving health care quality, reducing health care costs, and improving population health.

Future questions

This pilot study provides many rich insights about the PHA and non-PHA population. It also leads to other important questions that may not be able to be answered using the current data sources, including: How did resident usage patterns change after moving into public housing? Does integrated data support the idea that stable housing can reduce costs within the health care system? How do demographic and health patterns vary for those who are dual eligible for Medicaid and Medicare? How does the health status of residents in federally funded (HUD) housing compare to residents in other forms of subsidized housing? What is the interaction of behavioral health with housing? These are all areas for future exploration.

Methods

Overview

This section provides a brief overview of the steps taken to produce a linked PHA and Medicaid dataset that could be analyzed to identify health needs among PHA residents. Additional details are located in the technical appendix. Most code used is publicly available on PHSKC's GitHub page[8].

Data sources

Housing enrollment data came from data reported to the US Department of Housing and Urban Development (HUD) on the Moving to Work version of the 50058 form (50058)[9]. This data source was used because it is common to both PHAs, contains the majority of desired data elements, and creates the potential for this work to be expanded to other PHAs around the country also using the form. While the data elements and basic data collection procedures were similar across the PHAs, the PHA data needed

USING HUD 50058 DATA SIMPLIFIED COMBINING DATA FROM TWO PHAS AND MAKES IT EASIER FOR OTHERS TO ADAPT THIS WORK TO THEIR REGION.

substantial understanding and manipulation before linking to Medicaid data. This clean-up process, as well as limitations within the data sources, are described further in this section, the *Limitations* section, and the technical appendix.

Medicaid enrollment and claims data were supplied by the Washington Health Care Authority (HCA), which administers the Medicaid program for Washington State. Enrollment data provided details on who was enrolled in Medicaid at a given time and the claims data showed services for which Medicaid paid.

Data processing and linkage

Housing data came in the form of cross-sectional records from 2004 to 2016. Data from each PHA was consolidated into a single longitudinal file and then joined into a combined PHA file. We used probabilistic linking to clean identifying information and a series of logic rules to create a longitudinal record for each individual.

The Medicaid enrollment data were also processed to produce a single row per individual per contiguous time enrolled in Medicaid. The longitudinal PHA data were joined with the Medicaid enrollment data in two stages. First, linkages were made by matching on Social Security Number (SSN), name, and date of birth. For PHA residents without a recorded SSN, probabilistic matching used name and date of birth.

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[8] https://github.com/PHSKC-APDE/Housing
[9] https://www.hud.gov/program_offices/public_indian_housing/systems/pic/50058/mtw

Medicaid claims data were coded to conditions based on procedure, place, or diagnosis code, based on standard definition sets. One major caveat is that in October 2015, the diagnosis code system changed and added many more codes. This means that many conditions can't be compared across time until crosswalks have been developed to account for the impact of additional codes. Even for indicators where we are presenting rates across time, caution is advised when interpreting this data. More detailed information is available in the technical appendix.

Analyses

Descriptive statistics were produced for the PHA demographic data. This consisted primarily of assessing the number of PHA residents for each month broken down by factors of interest such as PHA, type of housing program, age, gender, race, disability, and location. Health outcomes were displayed as incidence rates or prevalence, depending on the condition.

How are conditions calculated?

People may not stay in one place through the course of the year, and may have situations that change their eligibility/enrollment in Medicaid. Since this project is looking at data over time, and not just a snapshot of one period, circumstances where an individual's housing and/or Medicaid enrollment status changed at some point during the covered time period needed to be addressed. Details of the variation of these calculation can be found in the technical appendix.

Limitations

It is important to note some limitations to the conclusions that can be drawn from the current Medicaid-PHA linked dataset. The claims data are derived from reimbursement information from when a provider billed and Medicaid paid that bill. Conditions must be diagnosed to be billed; some diseases such as hypertension, depression, and diabetes might be underdiagnosed and therefore underrepresented in the Medicaid claims dataset. Medicaid is the last payer of medical bills; people with Medicaid plus another insurance may not have their claims represented in this data. This is particularly relevant for the PHA population over age 65, which are likely covered exclusively by Medicare or by Medicaid AND Medicare (dual enrolled). Dual enrolled individuals are not included in these analyses. More detailed limitations are included in the technical appendix.

Rates of health conditions shown cannot be considered to be the prevalence, or the number of people who have an existing condition, because claims data only reflects instances where someone seeks and receives treatment for their condition. For example, if a person with asthma did not seek care for their condition during a given calendar year, or they were treated by someone who did not bill to Medicaid, that person will not appear in the results. When someone is identified in the claims file as having a chronic disease, such as asthma or diabetes, there is no information about how long they have had that condition. Claims data also do not include care that is needed but not received, even if a patient was seen by a medical provider and diagnosed with a particular health condition. Services that providers know may be denied for payment may also be inconsistently submitted. The current data set may also miss services for which claims are not submitted (for example, immunizations from a grocery store clinic). Having a higher rate of care utilization may not be a negative outcome; for chronic diseases that are well-managed, more primary care visits and medication adherence result in better health care outcomes.

HAVING A HIGHER RATE OF CARE UTILIZATION MAY NOT BE A NEGATIVE OUTCOME; FOR CHRONIC DISEASES THAT ARE WELL-MANAGED, MORE PRIMARY CARE VISITS AND BETTER MEDICATION ADHERENCE RESULTS IN IMPROVED HEALTH OUTCOMES

In 2014, the Affordable Care Act (ACA) expansion for adult eligibility for Medicaid began in WA State. In addition to increasing adult coverage in King County, the number of adult PHA residents on Medicaid also increased. Newly enrolled individuals may have different health care utilization patterns than ones with previous coverage.

At this time, conditions cannot be compared across time. On October 1, 2015, health care providers switched to a new system of coding when billing Medicaid for services; definitions for a condition have changed and expanded. So while there are questions about how utilization changed after expansion of the ACA, those cannot yet be answered. This report and dashboard, only include conditions over time

for health outcomes that appear not affected by the transition. Future work will include a focus on understanding the impacts of coding changes for the ability to look at patterns over time.

PHA data systems changed a number of times over the time period reflected in this data set, and varying data structures led to some data quality issues that required decision rules on how to address the issues, which were amplified in more historical data. PHA recertification[10] dates were not routinely captured until more recently, potentially inflating the number of individuals who appeared to be in the PHA programming. In addition, individuals and families may move between PHAs (called a "port"), which can occur during a calendar year. This movement can impact the count of individuals within each PHA population, as well as where a health condition might be assigned.

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[10] The recertification process is used at PHAs to update and confirm key program data for each subsidized household. The certification timeline varies by PHA and as policies change over time, but occurs regularly anytime between a one-three year cycle. Households can submit interim certifications, as circumstances (such as income and household composition) change between regularly scheduled certifications.

Impact and next steps

The information contained in the dashboard are the beginning steps to start examining patterns that are seen. Through continued conversations to promote additional understanding, the data could enhance the PHA and health system ability to use sound information to design, implement and evaluate policies/programs. PHA residents on Medicaid are demographically different and are experiencing a different set of health conditions and utilization patterns compared to non-PHA Medicaid residents. PHA staff can explore the data to see whether it fits the anecdotal stories they have heard, and if it measures up to resident experience. When 2017 housing data and Medicaid data become available, the dashboard will be updated, keeping it timely and relevant.

When data show unexpected events, such as a high rate of avoidable ED utilization, a more detailed look into the data might be able to shed light on the "why." In some cases, it might be a condition impacting a specific population that could be an opportunity for outreach and education. Some data points may not be answered with a deeper dive into the existing information; it may require additional analysis, qualitative data, community feedback, or different data points.

Beyond the PHAs and Public Health, it is also an opportunity for the ACH to consider leveraging the partnership to be able to reach target goals and to potentially reach a large number of the Medicaid population. National discourse talks about the potential for catapulting the housing as a platform for health by leveraging Medicaid dollars for investment in affordable housing or related services. One example of this could be to add to the increasing evidence base of Community Health Workers (CHW) or Resident Service Coordinators (RSCs) impact on improved health outcomes.

While this baseline linkage enhances knowledge, it brings up additional data gaps that still need to be addressed. How conditions are changing over time is a key variable to measure progress: additional work around how to interpret data over code changes will continue. Since we lack information about health care utilization for people age 65 and older as well as the dual eligible population, obtaining identified Medicare data would greatly add to the picture and bolster evidence-based *Aging in Place* programs. Outside of HUD-funded housing, King County also has other major non-profit housing assistance programs that report to the Finance Commission and Department of Commerce using the Web-Based Annual Reporting System (WBARS). Together, WBARS and identified Medicare data provide a much more robust picture of health and housing in low-income King County residents. Behavioral health is a key factor in stable housing, and PHAs are interested in leveraging other on-going data integration work to expand knowledge of the relationships of behavioral health and homelessness on health. These cross-sector partnerships could result in rich information that allows for understanding of how housing plays a role in health; how policy, system, and environment change impacts health; and provide actionable data to help improve the health of some of the most vulnerable King County residents.

Appendices

Appendix I: Technical documentation

This appendix delves into the nuances of the PHA enrollment, Medicaid enrollment and claims, limitation of the PHA and Medicaid data and the methods used for processing and linking the datasets. As new methods are developed or applied to the health-housing linked data, this appendix will be updated.

Data sources

PHA data came from the Housing and Urban Development (HUD) 50058 Moving to Work form (50058). However, data structures and systems changed in the PHAs. The King County Housing Authority (KCHA) 50058 data were stored in two different databases with slightly different structures (one spanning data from 2004–2015 and the other with data from 2016 onward). Data were in a wide format with one row per household. Seattle Housing Authority (SHA) 50058 data also originated from multiple systems: one covering public housing data from 2004–2012, one for public housing data from 2012 onward, and a final one with housing choice voucher data from 2006 onward. Data were structured with one row per individual and the method for identifying household members varied by system.

Medicaid enrollment data were structured as a single row per person per month of enrollment and was available from 2012 onward. Medicaid claims data contained elements such as diagnosis codes that were necessary to identify acute events and chronic conditions. Claims data were linked to Medicaid enrollment by a unique Medicaid ID number.

All data sets contained individual identifying information such as name, date of birth, and Social Security Number (SSN), which was essential for linking data from each source.

PHA data processing and joining

The 50058 data consists of point-in-time records of who lives where but does not consistently provide records of when individuals move in and out of housing. The goal of processing the PHA data was to produce a combined, longitudinal record of each person's time as a PHA resident. The following steps were taken to achieve this (each step has a link to the specific code used on a GitHub repository but note that code may have been updated since this report was written):

1. Combine KCHA data into a single file and reshape to have one row per individual per time point.
2. Combine SHA data into a single file.
3. Process KCHA and SHA data to have the same variable names and formats.
4. Combine into a single PHA file.
5. Deduplicate records and fix inconsistencies in demographic data.
6. Set up demographic groups of interest.
7. Clean addresses and geocode data.

8. Address conflicting data (e.g., people appearing in multiple PHA programs simultaneously) and apply rules for people who move between PHAs (port in and port out).
9. Set up final elements to be used in analyses.

Steps 1–4 are outlined in Figure 1 below. The end result for data from 2004–2016 was 162,377 unique individuals in 65,466 distinct households. The deduplication and demographic standardization process (step 5) used a six phases of probabilistic linking based on SSN, name, date of birth, and PHA-given ID. We used the RecordLinkage package in R for the linking process[11]. After the deduplication process, there were 152,420 unique individuals in 65,934 distinct households at 91,300 addresses. After address cleaning (step 7), there were 71,967 unique addresses.

A series of unique rules was derived to address conflicting information. For example, when a person or household moved from one PHA to another, data often continued to be entered in the original PHA's database. In order to avoid double counting these people, they were assigned to the PHA they had moved to. Other data issues included households appearing in multiple programs within a PHA, no record of a household exiting a program or PHA, and auto-generated recertifications that obscured when a household exited a program. After addressing these issues, there were 147,914 unique individuals in 62,283 households and 360,100 records (Figure 2).

Medicaid data processing

Medicaid enrollment data were reshaped to have the same format as the PHA data, with a single from- and to- date per contiguous coverage period per individual. The code used to complete this is also available online[12]. After consolidating the data, there were 864,843 unique individuals on Medicaid with 1,150,021 records (Figure 2).

PHA and Medicaid linkage

We used two rounds of probabilistic matching to link the PHA and Medicaid datasets[13]. Of the 103,494 individuals in the PHA with data from 2012 onward, 88,351 (85.3%) were successfully linked to the Medicaid data, though not everyone had housing and Medicaid coverage simultaneously. The Medicaid recorded value for age, gender, and race/ethnicity fields was used as the default as it was deemed to be more reliable and it allowed for comparisons to the non-PHA Medicaid population. There was a very high degree of concordance between the PHA and Medicaid data for age and gender when the field was non-missing in both datasets (96.6% and 98.7% matched, respectively). Race data were more variable, but 74.0% of non-missing records still matched (35.9% of the mismatched data could be explained by the presence of an 'other' option in the Medicaid data that was not available in the PHA data).

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[11] https://cran.r-project.org/web/packages/RecordLinkage/index.html
[12] https://github.com/PHSKC-APDE/Medicaid/blob/master/eligibility%20cleanup/elig_overall_process.sql
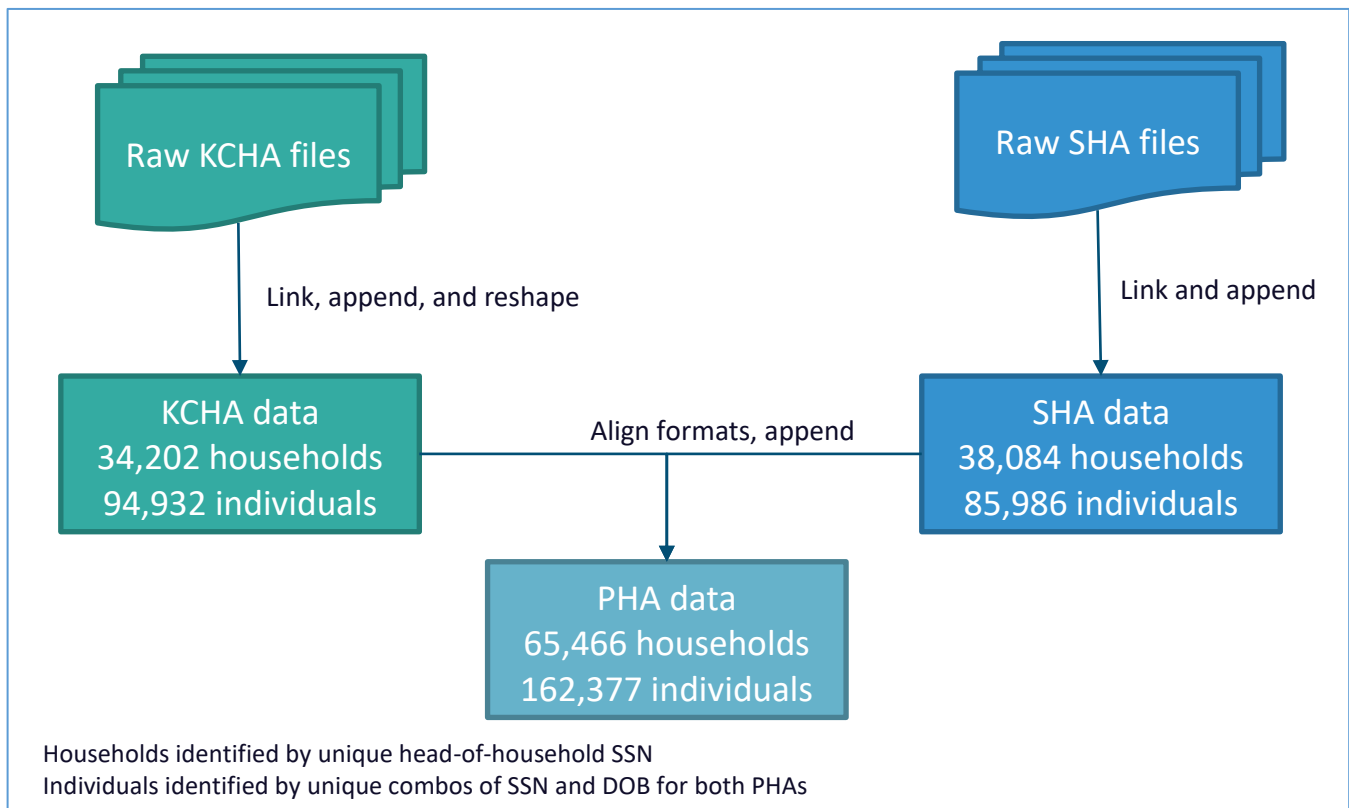[13] https://github.com/PHSKC-APDE/Housing/blob/master/processing/pha_medicaid_join.R

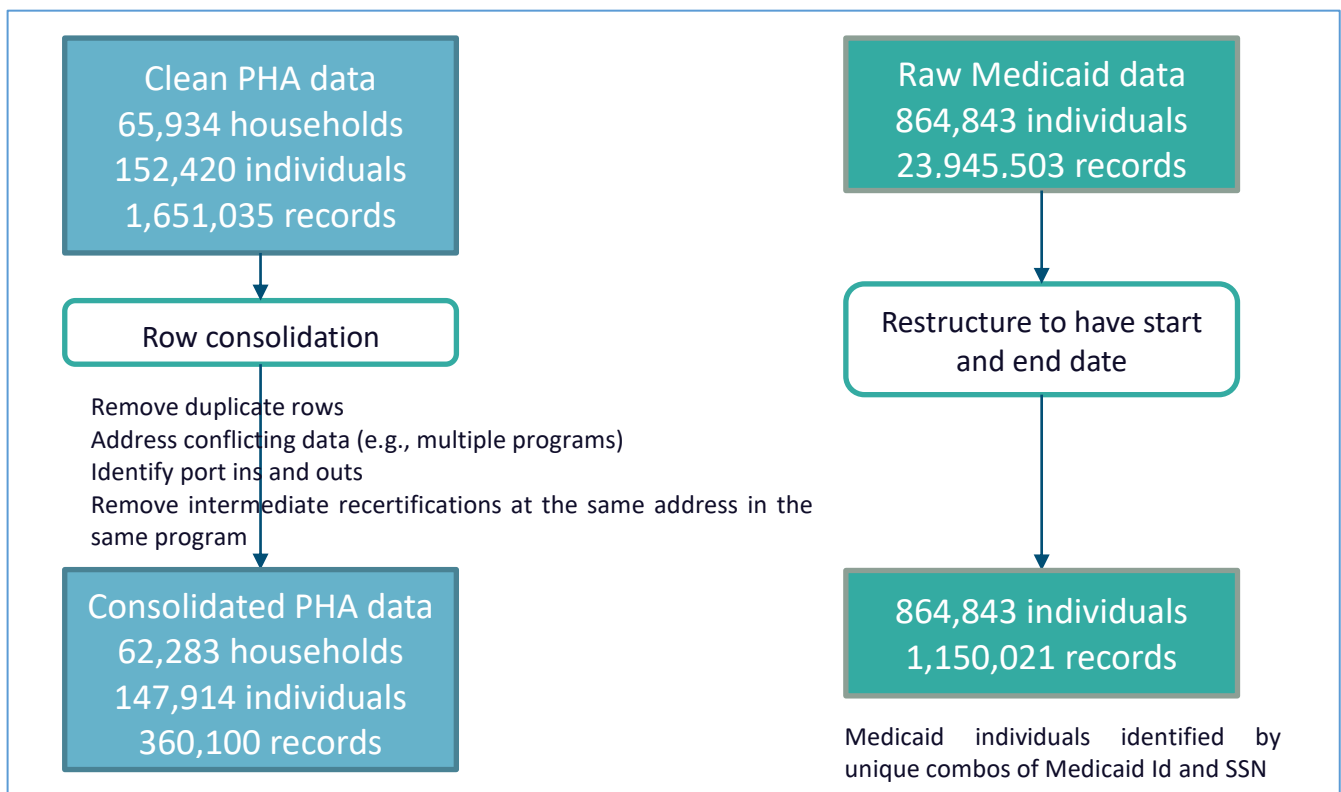**Figure 1: Processing and combining PHA data**

Figure 2: PHA and Medicaid data consolidation

Calculating rates and proportions

Definitions for urgent health care utilization and chronic condition measures in the Medicaid and public housing populations involve looking at both the numerator (counts of events) and the denominator (the number of potential people impacted, or person-time).

Denominators

People move in and out of different housing situations (e.g., someone may move from Seattle Housing Authority (SHA) to King County Housing Authority (KCHA), or from being supported by a tenant-based voucher to living in public housing). People also move on and off Medicaid as their circumstances change. When calculating rates of health outcomes for a calendar year, it is necessary to assign people to a particular combination of PHA and other demographics.

For acute events (ED visits, hospitalizations, and unintentional injuries), people were allocated to a given group in proportion to the number of days spent in that combination (person-time). For example, if a Medicaid recipient was not in public housing from January through March of 2015, moved into a public housing program on April 1 and remained both there and on Medicaid for the remainder of 2015, they would contribute 90 days to the non-PHA (Medicaid only) group and 275 days to the PHA group.

For chronic conditions (e.g., asthma, hypertension), people are allocated to the housing group they spent the most time in for that calendar year. Using the example above, the person would be included only in the public housing group for 2015. The exception to this is if the person spent time in both KCHA and SHA, in which case they are counted in both agencies. If a person was only enrolled in Medicaid and not housing that year, they are included in the non-PHA group.

Numerators

Claims data have a variety of definitions that could be used to describe conditions. Depending on the definition, the number of individuals with the condition could vary wildly; in some cases, definitions rely on exclusion or having coverage for a certain length of time. This section tries to illuminate how much a single definition can impact counts (and therefore, rates). While there may be other sources for King County Medicaid population conditions, the numbers presented in this report will not exactly match those as we are using different definitions. Comparisons among groups in this report are valid. Conditions are diagnosed using claim type, procedure information, and International Classification of Disease, Clinical Modification (ICD-CM) diagnosis codes.

Hospitalizations:
1. Total number of hospitalizations.
2. Persons with 1+ hospitalizations.

Hospitalizations are identified by the inpatient claim type (claim type 31 or 33). Based on the Health Plan Employer Data and Information Set (HEDIS) inpatient utilization measure, the following hospitalizations were excluded:
1. Where mental health or chemical dependency is the principal diagnosis

2. A principal diagnosis for infant delivery
3. A principal diagnosis for maternity care
4. A DRG code in the maternity MS-DRG value set
5. A non-acute inpatient stay revenue code

In addition, based on the Agency for Health care Research and Quality's (AHRQ) Prevention Quality Indicators (PQIs), the following hospitalizations were excluded:

6. Transfers from another hospital or health care facility (based on admission source field).
7. If the patient died (discharge status) during the hospitalization.

For example, in 2015, without applying any of the exclusion criteria, 18,396 distinct persons had 1+ hospitalizations, for a total of 22,899 hospitalizations. If we implemented the exclusion criteria, the number of persons excluded would be: (1) 493 (3%), (2) 3,658 (20%), (3) 3,364 (18%), (4) 125 (1%), (5) 0 (0%), (6) 2,243 (12%), and (7) 151 (1%), respectively. When all seven exclusion criteria are applied, 10,027 (55%) were excluded. For this report, hospitalizations were defined with all exclusions applied.

Emergency department (ED) visits:

1. Total number of ED visits.
2. Persons with 1+ ED visits.
3. Total number of avoidable ED visits.

We defined ED visits using an adaptation of the definition provided by the Healthier Washington Medicaid Transformation project (https://www.hca.wa.gov/assets/program/mtp-measurement-guide.pdf):

- Claim or encounter is a outpatient claim type (including hospital outpatient) AND
- One or more of the following criteria is met:
  - Revenue code in the set ('0450', '0451', '0452', '0456', '0459', '0981')
  - Procedure code in the set ('99281' ,'99282' ,'99283' ,'99284' ,'99285', '99288')
  - Place of service code = emergency department AND procedure codes in the set from 10021 to 69990.

We did not exclude any conditions based on diagnosis codes.

Potentially avoidable ED visits are based on a list of 174 ICD-9-CM and 140 ICD-10-CM codes for the principal diagnosis identified by the Medi-Cal Statewide Collaborative Quality Improvement Project specifications[14] and adopted by the Washington Health Alliance. Potentially avoidable ED visits excludes members younger than 12 months.

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[14] http://partnershiphp.org/Providers/Quality/Documents/PCPQIP1516Spec2.pdf, last accessed 3/2018

Unintentional injuries:
Unintentional injury is based on the Clinical Classifications Software (CCS) classification of ICD-CM codes.[15] We used a provisional mapping of ICD-9-CM to ICD-10-CM codes produced by the Council of State and Territorial Epidemiologists to account for the switch in ICD systems in October 2015.

Chronic conditions (diabetes, asthma, chronic obstructive pulmonary disorder (COPD), depression, hypertension, ischemic heart disease (IHD), and mental health conditions):
The chronic conditions are based on algorithms developed for the Centers for Medicare and Medicaid Services (CMS) Chronic Conditions Data Warehouse (CCW).[16] In general, they are based on certain types of claims with a defined list of ICD-CM codes either for any diagnosis or the first and second diagnoses during a reference period. For mental health conditions, the ICD codes selected are based on the HEDIS mental health diagnosis value set.

For asthma, for example, an eligible claim is defined as having at least one inpatient, skilled nursing facility, or home health agency claim or at least two hospital outpatient claims or "carrier" claims with an asthma diagnosis.

Rate calculations
For the rate of acute events such as hospitalizations or injuries, rates were calculated as the total number of events that occurred while people were in that subgroup divided by the total amount of time people spent in that subgroup **while they were also enrolled in Medicaid**. The rate is expressed as X per 1,000 person-years, which can be interpreted as the number of events one would see if 1,000 people were in that subgroup for one year.

For the proportion of persons with ED visits or hospitalizations, the numerator was again the total number of events that occurred while people were in that subgroup and the denominator was the total number of people who spent any time in that subgroup in the year. The proportion is expressed as X per 1,000 people.

For chronic conditions where we are describing an individual rather than an event (e.g., an asthmatic person), people were placed in one or two subgroups based on the following rules:
- If a person was not in a PHA at any time during their Medicaid enrollment that year, they are placed in the non-PHA Medicaid recipient group. This is regardless of whether or not the person was enrolled with a PHA that year when they were NOT on Medicaid.
- If a person spent time enrolled in both a PHA and Medicaid simultaneously, they were placed in the PHA group, even if that person also spent time that year only enrolled in Medicaid.
- If a person spent time in both PHAs in a year, while also enrolled in Medicaid at both PHAs, they are counted twice, once under each PHA.

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[15] https://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp
[16] https://www.ccwdata.org/web/guest/condition-categories., last accessed 2/2018

Chronic conditions are expressed as the number of members who met the definition for that condition during a calendar year per 1,000 members who were allocated to that group for that year.

The following people were excluded from both the denominator and numerator when calculating rates:

- People who were in public housing but not on Medicaid at any point during a year, because data on their health measures do not exist in the Medicaid claims data.
- People with Medicaid/Medicare dual eligibility.

Note: some measures are only or more meaningful when they are restricted to certain age groups. For example, cardiovascular disease (CVD) is rare among children and young adults; comparison between the PHAs who have different populations (SHA tends to have an older population than KCHA) may create the illusion of major differences in rates. Instead of looking at the total population, restricting the analysis to the population over age 45 would provide a more accurate comparison.

Data suppression

In the Tableau visualization, the rate for a measure is suppressed if the numerator or denominator is less than 5 but greater than 0. This is to protect confidentiality as well as provide sufficient numbers to report data.

Health data interpretation limitations

Compared to traditional population health survey measures, such as the Behavioral Risk Factor Surveillance Survey, chronic disease rates based on Medicaid claims data are lower. Rather than interpreting the Medicaid claims information as a prevalence (number of individuals with a given condition), these are best viewed as the service utilization rate for the chronic condition. Even for service utilization, the rate may be under-reported if the member had dual or third party coverage. This is a major issue for individuals who are dual covered by Medicaid and Medicare, and so those were excluded from many of the analyses. See below for more information.

Trends over time: One major question about all data is whether it is getting better or worse over time. Complicating that answer is the ICD-CM switch. Starting in October 1, 2015, the diagnosis and procedure codes in the Medicaid claims data switched from ICD-9 CM to ICD-10 CM. For many conditions, ICD-9-CM and ICD-10-CM do not have an exact match in terms of diagnostic codes. As a result, when examining data across years, starting from 2014, a change in the rate could be due to, at least partially, the ICD code transition.

Comparing results to other studies/publications: Even for the same type of service utilization or chronic disease, multiple definitions may exist with different algorithms for coding and different inclusion and exclusion criteria. A measure that was defined based on a particular data source may not be application to another data source. Therefore, the results of this study may not be comparable to those from other studies or publications. Careful examination of the definitions between two rates are needed before making comparisons.

Other measures that are not included: For this project, we only included a limited number of measures for urgent care utilization and health conditions that we think are most applicable to the public housing population. Nevertheless, there are a wide array of measures that can be included in the future such as those developed or presented by the HEDIS, the chronic disease data warehouse, and the Healthier Washington Medicaid Transformation project.

PHA data limitations

Longitudinal data system changes

While household and subsidy information is collected and submitted to HUD using a standard form across all PHAs (HUD Form 50058), the data systems used to store data changed multiple times at both SHA and KCHA during the time period of interest for this report. Each data system stores and exports variables in slightly different ways, creating the need for a standardization process in order to achieve any longitudinal data set. These differences in data structure led to data quality and consistency issues that required the creation of relevant decision-rules and code to address.

Missing data

Due to the longitudinal nature of the data set, there were cases of missing data in the PHA records, in particular among the earlier extracts. Subsidized households complete a regular certification process to re-confirm a number of characteristics, including household composition and income, which occur either annually or every two to three years (depending on the time period and PHA). In order to identify households that exited subsidized housing, but did not have the expected 'end of participation' certification, it was necessary to create a decision-rule and corresponding code to estimate a move-out date for what were **labeled "inactive" households.**

In addition to missing end-of-participation data, it was also necessary to create estimated move-out dates for household members who exited subsidized housing while the remainder of the household remained housed. If a household does not complete an interim certification to inform the PHA that a member has moved out, the only way to identify the exited individual is to compare the household composition lists between the two most recent certifications. In order to estimate a move-out date for a household member who exited at some point between the two certification dates, code was written to calculate the mid-point between the certification dates. This mid-point was then used as the estimated move-out date for the individual(s) who left the subsidized household.

Port households

A household receiving a subsidy through the Tenant-Based Voucher program at most PHAs has the option to use their voucher to "port" to another PHA's jurisdiction (specific port rules and regulations vary by PHA). There are a number of indicators used by PHAs to identify (1) a household that has ported in or out of a given PHA's jurisdiction, (2) the "originating" and "receiving" PHAs associated with the port household, and (3) the dates the port was active. Due to data quality issues, particularly in the older data sets, it was necessary to develop code to identify port households and the effective

date range of any port activity. It was also necessary to develop code to identify subsidized households that were absorbed by the receiving PHA.

Property categorization

In previous data systems used by the PHAs, the name of the PHA owned and/or managed properties were not recorded (no longer an issue in later data systems). For households missing property names, address data was used to match and identify relevant property information for categorization purposes.

Data structure

For a majority of PHA operations, subsidies are categorized, identified, and tracked on the household level, as opposed to the individual level. While individual data is collected for household composition and subsidy determination purposes, the longevity and activity of the subsidy is attached to the household (as are any unique subsidy and/or household identifiers). Since health data is collected on an individual level, it was necessary to be able to accurately and consistently identify an individual as they interacted with both the PHA and Medicaid systems. In the newer data systems used at both SHA and KCHA, the data system automatically generates unique individual/member identifiers, in addition to the traditional unique household/subsidy identifier. This was not the case in previous data systems, creating a need to develop an individual level unique identifier within the PHA data using other methods. Since name, date of birth, and SSN are collected from all household members, the unique identifier of SSN could be used for a majority of PHA affiliated individuals. For individuals who did not have a SSN recorded, a combination of name and date of birth was used to identify unique individuals. Confidence in an individual level unique identifier was necessary not only for the matching process with Medicaid data, but also to accurately track an individual's experience within the PHA system (especially for individuals who may have moved between households/subsidies/PHAs).

Appendix II: Process evaluation

KING COUNTY-DATA ACROSS SECTORS
FOR HOUSING AND HEALTH (KC-DASHH)
PROCESS EVALUATION SUMMARY

November, 2017

Introduction

Housing is an important component and determinant of health, but little is known about the health conditions experienced by individuals who are living in subsidized housing. Connecting data across health and housing has the potential to improve the health of residents living in low-income housing in King County through providing Public Housing Authorities with information to target programming and policy decisions for healthier outcomes. Public Health – Seattle & King County (PHSKC) and local housing authorities (King County and Seattle Housing Authorities) partnered to link housing data (Housing and Urban Development (HUD) 50058 form) with Medicaid enrollment and claims records to create de-identified data that provide important information about health issues residents might be facing. This approach is part of King County's Accountable Community of Health (ACH)—a regional partnership committed to working in new ways to improve health and health care. The King County Data Across Sectors for Housing and Health (KC-DASHH) was a Robert Wood Johnson Foundation grant in the Data Across Sectors for Health (DASH) national portfolio. This document summarizes the process evaluation conducted during the project. The evaluation's objective was to document and describe what worked for the cross-sector partnership around data integration. The evaluation sought to identify factors contributing to success, how barriers were addressed, whether activities proceeded as intended, provide key takeaways, outline next steps following the end of the grant, and provide a "lessons learned" document for others interested in pursuing similar work.

The data included in this report are based on a series of group and one-on-one discussions with core members of the KC-DASHH team over the course of this project, with a focus from April through November 2017, to document lessons learned throughout this project. The questions asked were based on those asked by the DASH National Program Office and questions the KC-DASHH team determined as important for historical documentation and potential replication by others. This information was collected by an internal evaluator staffing the KC-DASHH team, who synthesized the feedback to identify overarching key themes or takeaways, which were summarized by the team.

Key takeaways

Champions for change

Cross-sector partnerships are never an easy endeavor, even with enthusiastic and interested partners. It takes willingness at multiple levels of the organizations to find the time and funds to work together to share data and develop shared language around the data. In addition to data access, other people inside and outside the organization are needed to drive change and handle barriers. In some cases, those champions are needed in order to gain access to the data and facilitate progress when data sharing agreements might get stalled. When people can bridge sectors (have experience and/or trust in multiple sectors), they enhance the capacity of the team to move work forward. These facilitators for change can also be instrumental in the dissemination of the work as well. If an outside, independent party is involved, like the King County Accountable Community of Health (ACH) was for this project, it provides another avenue to impact change and address issues that may arise. Placing this project under the ACH brought further local attention and visibility to the project, in addition to

providing vision for the potential to tap into Medicaid transformation work. In the background, the increasing narrative around housing as a platform for health also continues to drive interest in how to get the right data to drive action.

Factors that were essential to success

Cross-sector partnerships can be difficult to get off the ground when relationships are in their infancy. Having a trusted housing advocate on board was instrumental; since she spanned health and housing realms and was able to make cross-sector connections where they were needed. PHSKC and the PHAs have a history of partnering together on asthma-reducing homes (e.g., the Breathe Easy project) and prohibiting tobacco use in PHA residences. But all the previous work had been a one-time or one-off project as compared to the focus of the KC-DASHH work, which is designed to be an ongoing data exchange. The PHAs had a history of developing data sharing agreements (DSAs) with other partners, which facilitated the data-sharing partnership with PHSKC. PHSKC also has an experienced Grants and Contracts group that routinely works with DSAs as well, and a Privacy Officer who helps review and consider issues that might arise. The Research and Data Analysis unit in the state Department of Social and Human Services had also performed some one-time linkages that spurred additional questions the PHAs wanted to answer. Funding the PHAs for some FTE/staff time (although they spent more in-kind time) helped bring the PHA analysts to the data table to work through the nuances of the PHA data. Both PHAs were "Moving to Work" (MTW) agencies, which gave them additional funding for looking at policy change opportunities. Having regular team meetings for feedback and to work through data issues kept partners engaged and on the right track. The Medicaid DSA was in place prior to the inception of the project with the Health Care Authority (HCA), the state agency in charge of the program.

To accomplish the work, some basic assets are needed:
1. DSAs – between the PHAs; between PHAs and PHSKC; and between PHSKC and HCA;
2. Understanding data risks and mitigating privacy concerns and accidental disclosure
3. Including language in lease forms for residents that clarify the potential for the data to be shared
4. Right tools for the analysts: understanding linking methodology; statistical programs and capacity for data cleaning; technical ability (staff and software) to link data;
5. Documentation of datasets
6. Tools for data visualization and reporting out of information.

Barriers

At this time, the relationship between DASHH partners is informal, brought together by the RWJF funding opportunity. It lacks a formal governance structure, which is a risk to future work as it may rely too heavily on specific individuals engaged in the work versus institutional commitment for data sharing and participation. When the grant ends, there is no contractual obligation to share data, although all partners have expressed a continued willingness and commitment to advancing this work.

Although our grant award included some funding for FTE at the PHAs, we did not request funding for the HCA, who holds the Medicaid data. In retrospect, it would have been beneficial to have some FTE support from HCA to help elevate the priority of our questions, help understand the data, or request additional data pulls. The quality of the data pulls would have benefitted from more PHSKC and HCA project management and documentation of issues and resolution of those issues.

Sharing housing data can be a gray area; the PHAs modified their leases to add clarification of how data collected from residents would be used. The newness of the datasets provided challenges to the analysts. In addition, even though the Medicaid enrollment, claims, and the HUD 50058 (PHA) forms are considered to be standardized datasets, respectively, both the PHA and Medicaid datasets required a fair amount of cleaning and restructuring of the data, beyond what was originally anticipated. A key lesson learned was not to underestimate the amount of time it might take for data preparation of large datasets. Since the data cleaning and integration piece took so long, we fell behind on the dissemination piece for results, missing out on some stakeholder feedback.

Lessons learned through the data

Medicaid data cover a large proportion of individuals in the public housing data. For those who are covered only by Medicaid, it provides a fairly comprehensive view of their health care utilization. However, solely using Medicaid claims paints an incomplete picture for residents who are dual covered, i.e., covered by more than one health insurance, such as Medicare, TriCare, or private insurance. Since Medicaid is the payer of last resort, we are missing some claims information if other insurance paid for the utilization. About 20% of the PHA population are over age 65, and are likely to be covered by Medicare (or dual covered). Since our linkage would be missing data on the majority of those individuals, analyses should be limited to those under 65, and those who are not dual covered. We also found that prevalence data of chronic conditions such as asthma or diabetes as measured by population health surveys is higher than the estimates of those same conditions in our Medicaid population, so the data provided through this project are likely an undercount of the actual conditions. Related to that, claims data applies only to people who have sought or utilized health care. Therefore, we are unable to discern people who are experiencing health issues but not seeking care. This is a limitation of using health claims data as a proxy for health status, as any analyses based on claims data will omit those experiencing health issues but not seeking care. More will be discovered as we delve further into the health data. Even so, the data provide an interesting and robust glimpse of health care utilization for this population.

What is needed to sustain KC-DASHH

A one-time linkage provides only enough information to whet appetites. **Regular data sharing and linkage on a routine and expected basis must occur,** in order for the project to be useful for monitoring trends or evaluating the impact of programs, policies, or services. Without a mandate to create an integrated system, it will be key for the analysts at PHSKC and PHAs and for DASHH partners to prioritize carving out time, political will, and dedicated analyst staff to pull and analyze data. In addition, having a data sharing agreement (DSA) that lasts for a few years vs one that needs to be renewed every year is helpful, as well as having the support of privacy officers and legal staff. Ideally,

continued advocacy for housing funding that elevates the importance of housing as a platform for health can continue driving things forward. Beyond sustaining this current effort, all partners have an interest in seeing the data linkage options grow (e.g., education, Medicare, and work force development).

Usefulness and application of data linkage

A pilot project linking health and housing data together provides a good framework for PHAs to think about how to prioritize or use limited funds for policy or program implementation. With the right narrative, it also provides a vehicle to make connections (and data linkages) with other stakeholders and sectors, such as education. In addition, if the data linkage methods are well documented, they can be transferred to other partnerships who are also working with housing data. However, concern remain around whether there is enough understanding about the caveats of using Medicaid claims data, what conclusions are appropriate based on Medicaid claims data, and if that language is approachable by non-analysts. In addition, some residents may feel the data findings do not represent their health scenario (e.g. population 65 and older or dual covered residents).

Lasting changes/outcomes

There are some anticipated infrastructure changes that will remain to sustain this work: Both PHAs and PHSKC are planning for 2018 and beyond; tapping into other King County work and data cross-sector pieces and looking for additional funding. Tableau visualizations will be shared to help others see the value of this partnership between health and housing around data sharing. Telling the story about the connection between health and housing helps maintain the momentum and buy-in so that this remains a priority among leadership across sectors.

Dissemination

When others hear about the DASHH project, it generates a lot of individual and organizational interest and excitement. Crafting the story from the data depends on getting the framing right for each type of stakeholder. Any data visualizations and associated narratives need to be easy enough for people who are not data savvy to understand and will ideally address "deeper dive" questions as well. It's important to have narratives and interpretation of the data so that key takeaways and caveats don't get lost. This can be challenging when both datasets (Medicaid and housing administrative data) are new to an organization, and underscores the importance of having the data providers and analysts at the table to help develop the analytics, which drive the messaging. Additional documentation needs to be developed and disseminated for others to adopt the methods used. We have a GitHub account that contains the R code for processing the PHA data, and Tableau dashboards will allow for some interactive exploration of the data. However, champions are needed to maintain momentum at both the PHA and PHSKC leadership levels to continue to connect the dots between health and housing, recognize emerging opportunities, and take action.

Appendix III: Anticipated outcomes

Short term	Intermediate	Long term
PHAs gain understanding about health	Increase datasets being linked	Decreased health inequities
PH gains understanding about housing	Use for program planning and evaluation	Potential for care coordination
Integrated system for regular and routine linkage	Share programming across ACHs	Return on investment
Health status of PHA resident report	Elucidation of housing-health relationships	Triple Aim
Participation in King County Accountable Community of Health	Partnership structure to build on for other cross-sector work	