

HEALTHY HOUSING MAP

Technical Documentation

ACKNOWLEDGMENTS

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List of Abbreviations

CLC	Children’s Law Center
CNH	Children’s National Hospital
D.C.	District of Columbia
DCHA	District of Columbia Housing Authority
DC Health	District of Columbia Department of Health
DCRA	District of Columbia Department of Consumer and Regulatory Affairs
ED	Emergency Department
GIS	Geographic Information System
IMPACT DC	Improving Pediatric Asthma Care in the District of Columbia
MAR	District of Columbia Master Address Repository
OCTO	District of Columbia Office of the Chief Technology Officer
SSL	Square, Suffix, and Lot

Introduction

Housing has long been identified as a significant social determinant of health. People living in poverty are more likely to suffer from housing insecurity, which is defined as spending more than one-half the household income on rent. In the District of Columbia (D.C.), Wards 7 and 8 have the highest cost burden of housing at 49% and 53%, respectively (DC Health, 2018). These wards also have higher rates of poverty and unemployment, and lower median household income than the rest of the city (DC Health Matters, 2020). Not coincidentally, these wards also have higher rates of chronic diseases, particularly asthma (DC Health Matters, 2019). Low-income housing in the District contains significant environmental hazards associated with diseases such as asthma and lead poisoning. These hazards include pest infestations, water intrusion, lead-based paint, lead pipes, poor ventilation, and environmental tobacco smoke (Kelleher, 2018) and exemplify the unhealthy housing conditions from which low-income housing residents suffer disproportionately. However, there has not been a specific examination of the role of housing in DC as a contributor to health outcomes, such as asthma or lead poisoning; health outcomes we know are associated with deferred or absent maintenance and with environmental housing triggers, such as mold, moisture intrusion, pest infestations and poor indoor air quality. In addition, asthma is a leading cause of school absenteeism and is more likely to impact young people of color and young people living in poverty due to health-harming housing conditions and underuse of control medications (CDC, 2017). According to the Office of the State Superintendent of Education for D.C. and the Child Health Advocacy Institute, schools report asthma as the top reason D.C. students are chronically absent.

With support from Fannie Mae, Children's National collaborated more robustly with housing and public health organizations in the D.C. region such as Yachad, the Institute for Public Health Innovation and Local Initiatives Support Corporation, to develop and implement a novel virtual home visiting program in 2020. This pilot proved highly effective and successful particularly during the COVID-19 pandemic, as it allowed D.C. area children and families to receive asthma home visiting services during the pandemic. The pilot intervention correlated with high patient satisfaction, high patient show rates and decreased healthcare utilization in patients who received the virtual home visit intervention and home remediation.

Despite the success of our pilot program, our pilot team did experience limitations in our model, particularly because a majority (~90%) of the families recruited into our program lived in rented units within multi-family buildings. While our pilot team attempted to address the asthma triggers in these rented units through some remediation measures (i.e., completing pest management services or providing new air filters, HEPA vacuums and air purifiers), we remained limited in our capacity to truly improve the quality of these homes due to their ownership by a landlord. Furthermore, our pilot team recognized that many sources of asthma home triggers within multi-family buildings, such as pest infestation, water intrusion and poor ventilation, could not be adequately addressed by remediating a single unit, and our team unfortunately lacked the resources to tackle building-wide remediation projects. While unit-by-unit remediation can lead to improved health outcomes, our team recognizes the need for a more cost efficient and effective approach to improve the quality of multi-family buildings in D.C., which continue to be a large source of the unhealthy housing experienced by our patient population.

Children's National, DC Health, and Children's Law Center were previously part of the BUILD Health Challenge, a project in which our team collaborated to begin addressing the asthma disparities experienced by children in Wards 7 and 8 by leveraging data on housing conditions and asthma outcomes. As part of this work, our team began to gather data and map the properties most frequently reported with unhealthy housing conditions and asthma exacerbations. With additional support in

mapping and data analytics from the Child Health Data Lab at Children’s National, our team developed interactive maps to leverage the resulting data analysis and map insights to promote increased access to healthy housing in D.C.

The data derived from our healthy housing maps will have immense downstream impacts in both the short and long term. The maps will help identify large-scale problematic regions where there is an intersection between health and housing conditions that requires larger-scale interventions, including outreach to landlords for training opportunities around health and remediation or referral to the Office of the Attorney General for large-scale enforcement efforts if the owners are not amenable to taking corrective actions voluntarily. Additionally, our team plans to work with the D.C. government to rethink how to proactively inspect properties more effectively, and this data can be an important driver in reshaping other housing policies in the District. Finally, this data can be further leveraged to highlight which properties and neighborhoods are most in need of remediation, and how remediation could impact future health outcomes of D.C. residents. Ultimately, we hope this project can inform a long-term effort to explore how public and private funds can be leveraged to promote the building and maintenance of healthy properties, both in the District and nationally.

Data and Sources

This application pulls data from multiple sources. These sources fall within three main domains: asthma data, housing conditions data, and residential property data. More detailed information for each source is available below the table.

Data Domain	Source	Accessibility
Pediatric Asthma Data	CNH Asthma Registry	Not publicly available
Housing Conditions Data	DCRA Landlord Violations Tool	Publicly available
	CLC Client Referral Database	Not publicly available
	Yachad Client Information Database	Not publicly available
	IMPACT DC Social Determinants of Health Database	Not publicly available
Residential Property Data	Urban Institute Housing Insights Tool	Publicly available
	DC GIS Office Master Address Repository Geocoder	Publicly available
	Integrated Tax System Extract	Publicly available

Pediatric Asthma Data Source

Children's National Hospital Asthma Registry

With multi-year funding from the DC Health, IMPACT DC developed a novel, population-health pediatric asthma registry. This registry contains data on all pediatric patients diagnosed with asthma who interact with any Children's National inpatient or outpatient resources. This includes our hospital's affiliated and clinically integrated primary care practices. The registry leverages Children's National electronic medical records to identify more than 16,000 children living in D.C. who have asthma. This one-of-a-kind population health tool enables IMPACT DC to view real-time trends in the demographics, healthcare utilization and gaps in asthma care for more than 85% of children with asthma in the city.

Housing Conditions Data Sources

District of Columbia Department of Regulatory and Consumer Affairs (DCRA) Landlord Violations Tool

DCRA released a publicly available tool that allows residents to search for outstanding housing violations cited in properties in which they live. For more information about this tool and to access it, visit <https://eservices.dcradepartment.gov/DCRAAgencyDashboard/index>.

Children's Law Center (CLC) Client Referral Database

CLC maintains a database of self-reported client housing conditions as well as whether anyone in the house has asthma. CLC provided data to this project. Public access to this database is restricted.

Yachad Client Information Database

Yachad's Healthy Housing Remediation program provides comprehensive repair services to lower income homeowners and tenants to address substandard housing conditions that impact a family's health. The nonprofit organization has worked with hundreds of residents to remediate substandard housing conditions over the past 30 years. Yachad, which means "together" in Hebrew, and works in partnership with other community-based organizations, houses of worship, and community stakeholders to revitalize housing and reinvest in communities. Yachad provided data about their clients' housing conditions. Public access to this database is restricted.

IMPACT DC Social Determinants of Health Database

IMPACT DC maintains a database of patients who screen positive for housing needs. These patients are referred to partnering agencies such as CLC or the Department of Energy and Environment or they are provided a letter to give to their landlord. Public access to this database is restricted.

Residential Property Data

Urban Institute Housing Insights Tool

This tool provides data about subsidized and affordable housing projects in D.C. This information includes the name of the project, ownership, the total number of units, types of subsidies attached to

each project, and the list of addresses associated with each project. This is a publicly available tool that can be accessed here <http://housinginsights.org/>.

The Office of the Chief Technology Officer (OCTO) for the District of Columbia maintains an open data portal at <https://octo.dc.gov/service/dc-gis-services>. This catalogue contains many useful datasets about residential properties. The following were accessed for this project:

Master Address Repository (MAR) Geocoder

The MAR geo-enables the address data. Street addresses are translated into latitude and longitude coordinates which can then be placed on a map. In addition to verifying and correcting addresses, the MAR provides important information about the address including the Square, Suffix, and Lot (SSL), type of property (residential versus non-residential), alias (name of buildings, if available), and more. Additionally, the SSL is an important identifier which links the address to other data sources such as tax information.

Integrated Tax System Public Extract (ITS)

This database is used for sending tax bills. ITS stores comprehensive tax information such as ownership and use codes of record lots, tax lots, parcels, and condominiums. The ITS database also processes notices and tax bills. The dataset is publicly available through this link: <https://opendata.dc.gov/datasets/DCGIS::integrated-tax-system-public-extract/about>.

Methodology

This mapping application allows the user to access clinical asthma data (emergency department utilization) and housing conditions (housing code violations) data, either independently of each other or at the same time. Slightly different methodologies were used for asthma patient data compared to housing conditions data. The asthma data requires additional safeguards to ensure HIPAA compliance and to protect patients and families from disclosure. Conversely, the bulk of the housing violations data comes from DCRA and is open to the public, and so does not require the same level of censoring. CLC and CNH established a data sharing agreement, which allowed CLC to share housing client referral data. All clients for whom data was shared consented to inclusion in this project. Similarly, all records from the CNH Asthma Registry were deidentified and consent was given for inclusion in this work. The Institution Review Board at CNH approved this work.

Pediatric Asthma Data Methodology

All patient addresses were geocoded using the District of Columbia MAR. This process verifies and corrects addresses as well as assigns a physical location (geographic coordinates) on a map. It also provides important property information such as the SSL. The SSL is a critical identifier that allows

properties to be linked to many publicly available datasets to obtain information on ownership, property management, and land use codes.

Inclusion Criteria

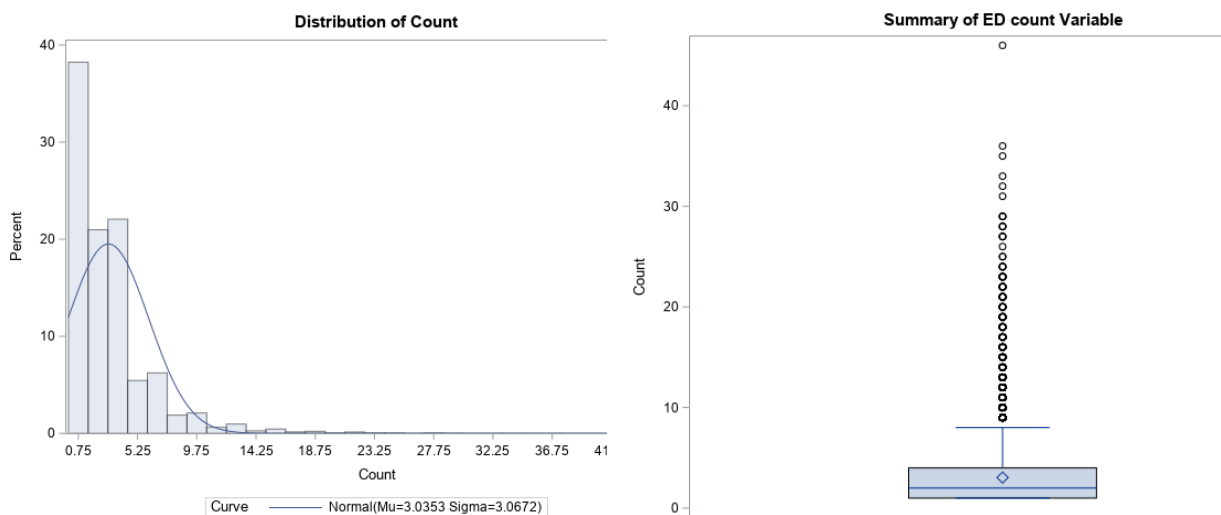
To protect patient privacy, no single-family dwellings (unless in public housing, in which cases addresses were aggregated to the development level) or condominium units were mapped. Only properties with the following land-use codes were included:

Land Use Code	Definition
Residential Apartment Elevator	Structure with 12 or more units; 1 owner; elevator, more than 3 floors; may have accessory uses (parking, laundry, etc.). Owner's motivation is investment income.
Residential Apartment Walk-up	Structure of 6 or more units; 1 owner; owner's motivation is to earn net investment income; no units higher than 3rd floor; no elevator; may have accessory uses.
Residential Conversion More than 5 Units	Structure with more than 5 units, usually not self-contained but under 1 roof; with few accessory uses; 1 unit may be owner-occupied; original primary use not multi-family
Residential Conversion 5 Units	Structure with 5 units, usually not self-contained but under 1 roof; with few accessory uses; 1 unit may be owner-occupied; original primary use not multi-family.
Residential Cooperative Horizontal	Structure with more than 1 unit of 1 or more rooms; 1 corporate ownership accounts for benefit of all tenant-shareholders, or lease from shareholders; entrance no higher than 3 floors; may have accessory uses.
Residential Cooperative Vertical	Structure with more than 1 unit, each with 1 or more rooms; 1 corporate ownership accounts for benefit of all tenant-shareholders; lease from shareholders; elevator; more than 3 floors; may have accessory uses.
Residential Multifamily Miscellaneous	All other residential multi-family uses not otherwise noted.
Residential Row Single Family*	Single family dwelling with 2 walls built as common walls with another structure, 2 exposed walls; primarily used as a place of abode.
Residential Detached Single Family*	Free-standing dwelling with open space around it and in all exterior walls; primarily used as abode.
Residential Semi-Detached Single Family*	Structure with 1 dwelling place, 1 wall built as common wall with another structure, 3 exposed walls; primarily used as abode.
Residential Single Family Miscellaneous*	All other residential-single family uses not otherwise coded.

* Single family homes are only mapped if they are publicly owned and are part of a housing project.

Exclusion Criteria—Statistical Outliers

The statistical distribution of asthma ED visits show that these data are not normally distributed. Any patient who had more than eight emergency department visits were excluded. Additionally, any addresses that could not be mapped or failed to meet the 95% MAR match threshold were excluded.



Housing Conditions Data Methodology

Data were exported from the DCRA Landlord Violations Tool and all addresses were geocoded using the District of Columbia MAR. This process verifies and corrects addresses as well as assigns a physical location (geographic coordinates) on a map. It also provides important property information such as the Square, Suffix and Lot (SSL). The SSL is a critical identifier that allows properties to be linked to many publicly available datasets to obtain information on ownership, property management, and land use codes.

Subject matter experts from CLC, CNH, and Yachad agreed on a categorization scheme to standardize hazardous housing conditions across these organizations. Since each organization captures slightly different information, this process allows the aggregation of many housing conditions as seen in the table below. This scheme was also applied to the data from DCRA.

Self-Reported Housing Condition	Category	Asthma Trigger
Mice/rodents	Mice/Rodents	Yes
Bedbug infestation	Insect infestation	No

Other insect infestation	Insect infestation	No
Inadequate/Broken heating	HVAC	Yes
Inadequate/Broken air conditioning	HVAC	Yes
Broken Windows	Other Hazardous Conditions	No
Broken/missing window screens	Other Hazardous Conditions	No
Plumbing/leaks	Plumbing/Leaks; mold	Yes
Broken flooring	Other Hazardous Conditions	No
Broken shower/bathtub	Plumbing/Leaks; mold	Yes
Broken toilet	Plumbing/Leaks; mold	Yes
Broken kitchen sink	Plumbing/Leaks; mold	Yes
Broken doors/locks	Security Hazard	No
Broken kitchen appliances	Other Hazardous Conditions	No
Broken cabinets	Other Hazardous Conditions	No
Cracks, holes, or sagging ceilings	Potential Lead Hazard	No
Cracks, holes, or crumbling in wall	Potential Lead Hazard	Yes
Mold or mildew	Mold	Yes
Non-functioning/missing smoke and carbon monoxide detectors	Life and Safety Violations	No
Electrical issues	Life and Safety Violations	No
Inadequate hot water	Plumbing/Leaks	No
Peeling paint	Potential Lead Hazard	No
Sewage leak	Plumbing/Leaks	Yes
Smoking entering the home	Unclassified	Yes
Broken stairs/handrail	Other Hazardous Conditions	No
Exterior plumbing/exterior leaks	Plumbing/Leaks	No
Garbage or filth in common areas	Other Hazardous Conditions	No
Inadequate garbage storage	Other Hazardous Conditions	No
Broken or missing windows	Security Hazard	No
Broken or missing locks	Security Hazard	No
Broken or blocked fire escapes	Life and Safety Violations	No
Broken or damaged elevators	Other Hazardous Conditions	No
Broken steps/walkway in disrepair	Other Hazardous Conditions	No
Roof needs repair	Roof Repair	Yes

Geospatial Information Software and Web-Based Application

The Child Health Data Lab at CNH holds a license for Esri GIS software. All geocoding and mapping were performed in ArcGIS Pro 2.0 and statistical analyses were performed using SAS 9.4. Esri also provides the web-based infrastructure for the web map application.