# Disparities in Preventable Hospitalizations Among Public Housing Developments

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**Introduction:** This study assesses preventable hospitalization rates among New York City residents living in public housing developments compared with all New York City residents and residents in low-income areas. Additionally, preventable hospitalization rates by development (one or multiple buildings in close proximity and served by the same management office) were determined.

**Methods:** The 2010−2014 New York City hospital discharge data were geocoded and linked with New York City Housing Authority records using building-level identifiers. Preventable hospitalizations resulting from ambulatory care−sensitive conditions were identified for public housing residents, citywide, and residents of low-income areas. Age-adjusted overall and ambulatory care−sensitive, condition−specific preventable hospitalization rates (11 outcomes) were determined and compared across groups to assess potential disparities. Additionally, rates were ranked and compared among public housing developments by quartiles. The analysis was conducted in 2016 and 2017.

**Results:** The age-adjusted rate of preventable hospitalization was significantly higher among public housing residents than citywide (rate ratio [RR]=2.67, 95% CI=2.65, 2.69), with the greatest disparities in hospitalizations related to diabetes (RR=3.12, 95% CI=3.07, 3.18) and asthma (RR=4.14, 95% CI=4.07, 4.21). The preventable hospitalization rate was also higher among residents of public housing than low-income areas (RR=1.33, 95% CI=1.31, 1.35). There were large differences between developments ranked in the top and bottom quartiles of preventable hospitalization (RR=1.81, 95% CI=1.76, 1.85) with the largest difference related to chronic obstructive pulmonary disease (RR=3.38, 95% CI=3.08, 3.70).

**Conclusions:** Preventable hospitalization rates are high among public housing residents, and vary significantly by development and condition. By providing geographically granular information, geocoded hospital discharge data can serve as a valuable tool for health assessment and engagement of the healthcare sector and other stakeholders in interventions that address health inequities.
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## INTRODUCTION

Ambulatory care−sensitive conditions (ACSCs) are conditions for which high-quality primary care and early intervention can potentially prevent the need for hospitalization.[1] Nationally, the rate of preventable hospitalization resulting from ACSCs was 1,236 per 100,000 in 2013,[2] and disparities by race/ethnicity and SES are widely reported.[3−7] For example, Pappas et al.[7] found that preventable hospitalization rates were higher for people living in lower-income areas than higher-income areas, and were higher among blacks than among whites. Additionally, Feng and colleagues[5]

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reported higher preventable hospitalization rates among Hispanics compared with non-Hispanic (NH) whites, especially in areas with predominantly Puerto Rican and Cuban-American populations. The substantially higher rates of preventable hospitalization among people of color and residents in low-income areas may indicate a lack of access to quality primary care among these groups and warrant additional investigation into similar populations at a local level.

One such group of individuals are those receiving housing assistance from the U.S. Department of Housing and Urban Development (HUD), many of whom are low-income and people of color.[8] Housing assistance is generally provided in one of three ways: public housing; tenant-based; or privately owned, project-based. Studies have shown that HUD-assisted individuals have greater health risks and worse health outcomes than non−HUD-assisted individuals.[9−14] However, few, if any, analyses have focused on preventable hospitalization. This study attempts to fill this gap by focusing on residents living in public housing developments owned and operated by the New York City Housing Authority (NYCHA), the largest housing authority in the U.S., with approximately 400,000 residents. Specifically, hospital discharge data are geocoded and linked with NYCHA records using building-level identifiers to determine preventable hospitalization rates for individuals living in NYCHA developments. In order to contextualize and underscore the extent of disparities among residents in public housing, comparisons to preventable hospitalization rates citywide and among individuals living in low-income areas are made. Finally, preventable hospitalization rates by NYCHA development are examined to assess potential variation among developments. Because public housing residents constitute a large and diverse population spread over NYC, cross-development variation in preventable hospitalizations provides valuable information for targeting potential interventions to reduce health inequies.

## METHODS

### Study Sample
A number of data sources were used for this study. The January 1, 2015 NYCHA Resident Data Book and 2010−2014 American Community Survey 5-year estimates were used to examine differences in demographic and socioeconomic characteristics between individuals living in NYCHA developments and all NYC residents, as well as NYC residents in the lowest-income areas.[15,16] To identify preventable hospitalizations rates, 2010−2014 hospital discharge data from the New York Statewide Planning and Research Cooperative System (SPARCS) were geocoded and linked with the 2016 NYCHA Property Directory Development Guide using building identification numbers (BIN), a unique identifier assigned by the Department of City Planning to buildings in NYC.[17,18]

SPARCS is a comprehensive data reporting system maintained by the New York State Department of Health and comprises outpatient and inpatient data from all hospitals covered by Article 28 of the New York State Public Health Law. Psychiatric, federal, and long-term care hospitals in the state are not included in SPARCS. SPARCS has information on a patient's age, sex, and address; physician and hospital identifiers; diagnoses and procedures; charges; dates of service; and sources of payment. All inpatient hospitalizations from 2010 to 2014 among NYC residents aged ≥18 years were included (*n*=4,392,548).

SPARCS data were geocoded by the NYC Department of Health and Mental Hygiene (DOHMH). Records within NYC (based on the patient's reported city, county, or ZIP code) were first geocoded using the NYC Department of City Planning's Geosupport Desktop software, version 2016C.[19] Geosupport Desktop returns spatial coordinates, standardized address, BIN, tax-lot identification number (Borough-Block-Lot), census geographies (such as census block and census tract), administrative boundaries (such as police precinct and community district), and other property-specific fields (such as land use and zoning designation). In order to ensure that the underlying data are up-to-date, Geosupport Desktop is released on a quarterly basis. Addresses that failed to geocode were processed through IBM Information Server WebSphere QualityStage software and a regular expression file of common errors to correct errors and then re-geocoded using Geosupport Desktop. This geocoding and address verification process was automated using the R statistical computing language, version 3.3.1. This process successfully geocoded 95% of discharge records included in the 2010−2014 SPARCS. All of the fields, including BIN, provided by Geosupport Desktop were included in the geocoded discharge records. The non-geocoded records were excluded from the analysis. The automated geocoding routine is publicly available on Github, including information on the packages utilized.[20]

The NYCHA Property Directory Development Guide provides information on all NYCHA developments, including the address, buildings, and facilities located at the development.[18] Development addresses were geocoded with Geosupport Desktop to ensure consistency. NYCHA developments were then linked with hospital records in SPARCS based on the BIN obtained from geocoded SPARCS patient addresses. Data on NYCHA development residents' demographic and socioeconomic characteristics were obtained from the January 1, 2015 NYCHA Resident Data Book, which provides a summary of resident characteristics in each of NYCHA's programs, including public housing.[15] NYCHA provided the number of residents by age in each development.

The DOHMH IRB reviewed the study and determined that the activity is exempt from the federal regulation under 45 CFR §46.101 (b)(4).

### Measures
The primary outcome of interest was preventable hospitalizations, defined using the Prevention Quality Indicators created by the Agency for Healthcare Research and Quality (AHRQ).[1] Prevention Quality Indicators measures include both chronic (asthma, diabetes, congestive heart failure, chronic obstructive pulmonary disease [COPD], hypertension) and acute (bacterial pneumonia,

dehydration, urinary tract infection) conditions. Per the AHRQ guidelines, all measures were calculated among individuals aged ≥18 years, with the exception of COPD, which was calculated only among those aged ≥40 years. Specific ACSCs and composite measures (chronic, acute, and all conditions) were identified based on ICD-9-CM diagnosis and procedure codes, with technical specifications provided by AHRQ (version 6.0). Approximately 97% of preventable hospitalizations had a geocoded address.

Demographic measures included sex, age (18−24, 25−39, 40−54, 55−64, and ≥65 years), and race/ethnicity (Hispanic, NH black, NH white, NH Asian, and other NH). Household income among individuals living in NYCHA development was calculated as the annual gross sum of all reported income sources for all members of a household,[15] whereas the citywide household income and the household income in the lowest-income areas included all reported income sources from household members aged ≥15 years.[21]

### Statistical Analysis

The number of preventable hospitalizations among NYC residents from 2010 to 2014 by ACSC and the proportions attributable to individuals living in NYCHA developments and those living in the lowest-income census tracts were determined. Preventable hospitalization denominators for residents in NYCHA were provided by NYCHA; NYC overall came from NYC DOHMH intercensal population estimates[22]; and comparison census tracts with lowest income from the American Community Survey.[16] Lowest-income census tracts (*n*=106) were determined to be those in the bottom 5% of the average household income (range, $12,191−$33,187). All rates were age-adjusted to the 2000 U.S. standard population using the previously stated age categories. Additional variables of interest, such as income and race/ethnicity, were not available or reliable in SPARCS. Note that because public housing residents were included in the determination of preventable hospitalization rates for the comparison groups, the estimated disparities would be biased downward if residents in public housing had higher preventable hospitalization rates than the comparison groups.

To assess potential variation among NYCHA developments, age-adjusted rates of preventable hospitalizations were calculated by development. For each ACSC, developments were grouped into quartiles based on rank, and the age-adjusted rate was recalculated for every quartile. Developments with the lowest rates (i.e., those in first quartile) were assigned as the reference population in the determination of RRs. For this development-level analysis, the 40 senior-only developments were excluded to ensure that age-adjusted rates were comparable across quartiles, leading to a loss of ≅3% of the adult NYCHA population. Additionally, developments missing age data were excluded (5% of all developments), resulting in a loss of <1% of the adult public housing population. The analysis was further restricted to developments with a sufficiently large number of annual adult residents (>360 residents) to improve development-level data reliability, resulting in an additional loss of 96 developments and 6% of adults living in NYCHA developments. Housing assistance that targets people with disabilities typically involves programs outside the domain of public housing developments and was not included in the analysis.

The analysis was performed in 2016−2017 using SAS, version 9.4. The 95% CIs for age-adjusted hospitalization rates and RRs were derived using the Keyfitz formula for SE and the Rothman Greenland method, respectively.[23,24]

## RESULTS

The total number of adult residents in NYCHA developments in 2014 was 291,466, representing 4.4% of NYC's adult population (Table 1). Compared with NYC overall, a higher proportion of individuals living in NYCHA developments were in the youngest (18−24 years) and oldest (≥65 years) age groups, and a higher proportion were Hispanic (44.8% vs 27.3%) or NH black (44.2% vs 22.0%). Additionally, the average household income among residents in NYCHA developments ($23,311) was about a quarter of the citywide average ($85,356) and less than half the citywide median ($52,996). It was also lower than the average household income among those living in the lowest-income census tracts ($28,901).

Maps of NYC highlighting NYCHA developments and the census tracts included in the low-income comparison group are included in Appendix Figures 1 and 2 (available online). From these maps, there are clusters of NYCHA developments in East and Central Harlem, the South Bronx and Central Brooklyn, which are also the neighborhoods with the lowest-income census tracts.

From 2010 to 2014, there were 520,489 preventable hospitalizations among NYC residents. One in eight (12.8%, *n*=66,374) were attributable to individuals living in NYCHA developments. The age-adjusted rate of all preventable hospitalizations among residents in NYCHA development was 4,323 (95% CI=4,290, 4,356) per 100,000, which is 2.67 (95% CI=2.65, 2.69) times the citywide rate of 1,621 (95% CI=1,616, 1,625) per 100,000, and 1.17 (95% CI=1.16, 1.18) times the rate of 3,688 (95% CI=3,658, 3,718) per 100,000 among residents in the lowest-income census tracts (Table 2). RRs between residents in NYCHA developments and NYC overall for chronic and acute ACSCs were 2.97 (95% CI=2.94, 3.00) and 1.98 (95% CI=1.95, 2.01), respectively. For specific ACSC, RRs between residents in NYCHA developments and NYC ranged from 1.90 (95% CI=1.85, 1.96) for urinary tract infection to 4.14 (95% CI=4.07, 4.21) for asthma.

Figure 1 depicts the rate of all preventable hospitalizations by NYCHA development. Wide variation in preventable hospitalization rates existed among NYCHA developments, with a sevenfold difference between the highest and lowest rates. Grouped by quartile, the rate of all preventable hospitalizations per 100,000 population ranged from 3,107 (95% CI=3,048, 3,167) in the first quartile to 5,615 (95% CI=5,530, 5,701) in the fourth quartile (Table 3). Compared with developments in the

**Table 1.** Demographic Characteristics of Public Housing Residents and Comparison Groups, 2014

| Characteristic | Public housing residents | All NYC residents | Low-income census tract residents |
|---|---|---|---|
| Population, n | 291,466 | 6,696,284 | 330,522 |
| Age, % (95% CI) | | | |
| 18−24 years | 18.8 | 12.2 (11.8, 12.6) | 18.2 (17.7, 18.8) |
| 25−39 years | 21.6 | 31.6 (31.0, 32.2) | 27.5 (27.0, 28.1) |
| 40−54 years | 22.4 | 25.4 (24.8, 26.0) | 26.7 (26.2, 27.3) |
| 55−64 years | 14.8 | 14.4 (14.0, 14.8) | 12.9 (12.4, 13.3) |
| ≥65 years | 22.4 | 16.4 (16.0, 16.8) | 14.6 (14.1, 15.1) |
| Race/ethnicity,[a] % (95% CI) | | | |
| Hispanic | 44.8 | 27.3 (26.7, 27.9) | 54.6 (53.4, 55.9) |
| Non-Hispanic black | 44.2 | 22.0 (21.5, 22.5) | 36.0 (34.9, 37.0) |
| Non-Hispanic white | 4.5 | 34.1 (33.5, 34.7) | 5.4 (5.0, 5.9) |
| Non-Hispanic Asian | 5.9 | 14.2 (13.8, 14.6) | 2.5 (2.1, 2.8) |
| Other non-Hispanic | 0.6 | 2.4 (2.2, 2.6) | 1.5 (1.2, 1.8) |
| Annual household income, $[b] (95% CI) | | | |
| Mean household income | 23,311 | 83,994 (83,405, 84,583) | 28,901 (28,643, 29,158) |
| Median household income | — | 52,737 (52,435, 53,040) | — |

[a]The American Community Survey data for race and ethnicity were not available by age at the census-tract level. Hence, among low-income census tract residents, each race/ethnicity category represents a percentage of the total population instead of the population aged ≥18 years.
[b]Annual gross sum of all reported income sources for all household members; citywide estimates based on household members aged ≥15 years. Median household income among public housing residents and low-income census tract residents was not unavailable.
NYC, New York City.

first quartile, RRs for all preventable hospitalizations among developments in the second, third, and fourth quartiles were 1.30 (95% CI=1.27, 1.33), 1.50 (95% CI=1.46, 1.54), and 1.81 (95% CI=1.76, 1.85), respectively. For specific ACSCs, there were even greater disparities across NYCHA developments. RRs between developments in the highest and lowest quartiles ranged from 2.54 (95% CI=2.39, 2.69) for congestive heart failure to 3.38 (95% CI=3.08, 3.70) for COPD among chronic conditions, and 2.07 (95% CI=1.91, 2.24) for bacterial pneumonia to 2.65 (95% CI=2.39, 2.94) for dehydration among acute conditions. A map of NYCHA developments by quartile of preventable hospitalization rate is included in Appendix Figure 2 (available online).

## DISCUSSION

This analysis showed that adult residents in NYCHA developments had double the rates of preventable hospitalization compared with the average for NYC residents. The greatest disparities were for chronic conditions, including hospitalizations related to diabetes and asthma. These results are consistent with previous studies in NYC that demonstrated worse health outcomes among lower-income residents and people of color in general,[4,25] and public housing residents in particular.[9,10] The finding that residents in public housing had a higher preventable hospitalization rate than residents in the lowest-income areas further underscores the need to

focus on public housing residents and potential challenges they may have in addressing health issues.

There are multiple potential drivers for the higher rates of preventable hospitalization among residents of public housing. First, residents of public housing may have limited access to quality health care and prevention services.[26] Second, higher smoking rates and indoor and outdoor environmental factors may contribute to poor health outcomes among individuals living in public housing.[12,27−29] Finally, residents in public housing have a higher prevalence of chronic disease conditions,[13,30] which could increase preventable hospitalization rates. However, because the disparities in preventable hospitalization among public housing residents are larger than the disparities in chronic disease conditions, a higher prevalence of chronic disease conditions may not fully account for the substantially higher preventable hospitalization rates among public housing residents.

Building-level information was also leveraged to assess variation in preventable hospitalization rates by public housing development. The average rate among the top quartile of developments was determined to be approximately twice as high as the average rate among the bottom quartile of developments. Disparities were even larger for specific conditions; for COPD the difference between the top and bottom quartiles of developments was more than threefold. This development-level analysis can be used for focusing interventions, including place-based initiatives, to promote community health.
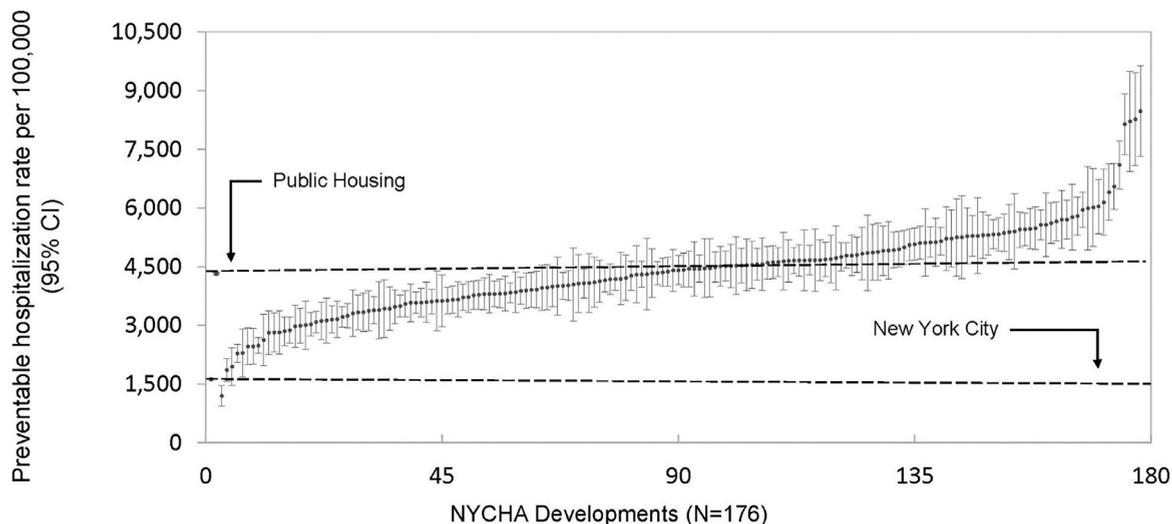
**Table 2.** Preventable Hospitalization Rates and RRs Among Public Housing Residents and Comparison Groups, 2010−2014

| Variable | Public housing residents | All NYC residents | Low-income census tract residents | Public housing/ NYC | Public housing/ low-income census tracts |
|---|---|---|---|---|---|
| Hospitalizations, *n* | 66,374 | 520,489 | 56,998 | — | — |
| Hospitalizations, AAR/RR (95% CI) | | | | | |
| All | 4,323 (4,290, 4,356) | 1,621 (1,616, 1,625) | 3,688 (3,658, 3,718) | 2.67 (2.65, 2.69) | 1.17 (1.16, 1.18) |
| Chronic conditions | 3,347 (3,317, 3,376) | 1,128 (1,124, 1,131) | 2,790 (2,763, 2,816) | 2.97 (2.94, 3) | 1.20 (1.18, 1.22) |
| Asthma | 992 (976, 1,009) | 240 (238, 241) | 758 (744, 771) | 4.14 (4.07, 4.21) | 1.31 (1.28, 1.34) |
| Diabetes | 916 (900, 931) | 293 (291, 295) | 742 (728, 755) | 3.12 (3.07, 3.18) | 1.23 (1.2, 1.26) |
| Congestive heart failure | 847 (833, 861) | 342 (340, 344) | 730 (717, 744) | 2.48 (2.44, 2.52) | 1.16 (1.13, 1.19) |
| COPD[a] | 592 (577, 607) | 266 (264, 268) | 576 (560, 592) | 2.23 (2.17, 2.29) | 1.03 (0.99, 1.07) |
| Hypertension | 248 (240, 256) | 99 (98, 100) | 226 (218, 233) | 2.40 (2.32, 2.48) | 1.10 (1.05, 1.15) |
| Acute conditions | 977 (961, 992) | 493 (491, 495) | 898 (884, 913) | 1.98 (1.95, 2.01) | 1.09 (1.07, 1.12) |
| Bacterial pneumonia | 398 (388, 407) | 196 (194, 197) | 360 (350, 369) | 2.03 (1.98, 2.08) | 1.10 (1.06, 1.14) |
| Urinary tract infection | 324 (315, 333) | 170 (169, 172) | 304 (296, 313) | 1.90 (1.85, 1.96) | 1.07 (1.03, 1.11) |
| Dehydration | 255 (248, 263) | 127 (126, 128) | 234 (226, 242) | 2.01 (1.95, 2.08) | 1.09 (1.04, 1.14) |

*Note*: Age-adjusted rates per 100,000 population were calculated using NYC Housing Authority resident data, NYC Department of Health and Mental Hygiene intercensal population estimates, and American Community Survey 5-year Estimates for 2010−2014 and rounded to the nearest whole number. Preventable hospitalizations were defined using the Prevention Quality Indicators, version 6.0, created by the Agency for Healthcare Research and Quality and include acute (bacterial pneumonia, dehydration, urinary tract infection) and chronic (asthma, diabetes, heart failure, COPD, hypertension) conditions.
[a]Rates among adults aged ≥40 years.
AAR, age-adjusted rate; COPD, chronic obstructive pulmonary disease; NYC, New York City; RR, rate ratio.

**Figure 1.** Age-adjusted preventable hospitalization rates among New York City public housing developments, 2010−2014.
*Note*: Excludes senior-only developments, developments with missing age data, and developments with an annual adult population fewer than 360.
*Source:* New York State Department of Health, Statewide Planning and Research Cooperative System (SPARCS), 2010−2014 (Data updates: June 2015 and March 2017).
NYCHA, New York City Housing Authority.

For example, DOHMH collaborated with NYCHA and other partners to launch a pilot project that paired community health workers with health advocates to address chronic diseases within several public housing developments in the East Harlem neighborhood, which has high rates of chronic disease.[31] The NYCHA development-level data on preventable hospitalizations could inform a potential expansion of similar programs to additional public housing development sites. It could also identify NYCHA developments that are potentially in greatest need of environmental control measures, such as mold remediation, integrated pest management, and reduction of exposures to fine particulate matter.[28,32]

As an understanding of the crucial links between population health and healthcare costs has emerged in the healthcare sector,[33] the geographically granular data on preventable hospitalization can be used to engage the healthcare sector to address ACSCs, which are costly to the healthcare system and to individuals. Traditional healthcare delivery tends to focus on individual instead of community health. This analysis has the potential to help payers and providers alike to invest in place-focused interventions to tackle the underlying causes of persistent inequities concentrated in public housing developments as a potentially cost-effective approach to reducing unnecessary utilization. Additionally, the implications of this study may extend to other HUD-assisted individuals and other settings where community-related factors reduce healthcare access and drive preventable utilization.

## Limitations

This study has several limitations. First, although the preventable hospitalization algorithm has been evaluated and used widely in health services research, the codes used are primarily recorded in SPARCS for billing purposes, creating the potential for misclassification.[1] Additionally, inclusion of a large number of outcomes may introduce errors in the estimates. The SPARCS database was also limited in the number, type, and quality of variables collected; as a result, the analysis could not account for relevant factors, such as race/ethnicity, family income, and disease management.

Fourth, the comparison to low-income census tracts was limited by the fact that NYCHA resident data are only available at the development level and many NYCHA developments cross census tract boundaries. Therefore, the number of non-public housing residents in each census tract who would have been a more relevant comparison could not be precisely estimated. However, as the primary purpose of comparisons was to underscore the disparities in preventable hospitalization among public housing developments, it is appropriate to focus on all residents in low-income areas in the analysis.

Fifth, there is uncertainty over NYCHA development population estimates, used as a denominator in the analysis, because they only captured residents listed on the lease. If there were residents not on the lease who reported an NYCHA address upon hospital admission, the estimated preventable hospitalization rates could be

**Table 3.** Preventable Hospitalization Rates and RRs Among Public Housing Developments by Quartile, 2010−2014[a]

| Variable[b] | Public housing developments by quartile | | | | | | |
| | AAR (95% CI) | | | | RR (95% CI) | | |
| | Q1 | Q2 | Q3 | Q4 | Q2/Q1 | Q3/Q1 | Q4/Q1 |
|---|---|---|---|---|---|---|---|
| All | 3,107 (3,048, 3,167) | 4,039 (3,976, 4,102) | 4,657 (4,584, 4,731) | 5,615 (5,530, 5,701) | 1.30 (1.27, 1.33) | 1.50 (1.46, 1.54) | 1.81 (1.76, 1.85) |
| Chronic conditions | 2,246 (2,195, 2,296) | 3,066 (3,010, 3,122) | 3,686 (3,623, 3,750) | 4,476 (4,398, 4,553) | 1.37 (1.33, 1.41) | 1.64 (1.60, 1.69) | 1.99 (1.94, 2.05) |
| Asthma | 552 (526, 577) | 823 (793, 853) | 1,089 (1,055, 1,123) | 1,550 (1,503, 1,596) | 1.49 (1.41, 1.58) | 1.97 (1.87, 2.09) | 2.81 (2.66, 2.97) |
| Diabetes | 510 (485, 535) | 784 (755, 813) | 980 (948, 1,011) | 1,334 (1,291, 1,378) | 1.54 (1.45, 1.64) | 1.92 (1.81, 2.04) | 2.62 (2.47, 2.77) |
| Heart failure | 487 (463, 510) | 755 (728, 783) | 952 (922, 982) | 1,235 (1,195, 1,276) | 1.55 (1.46, 1.65) | 1.95 (1.84, 2.07) | 2.54 (2.39, 2.69) |
| COPD[c] | 300 (277, 324) | 470 (443, 498) | 632 (598, 665) | 1,013 (967, 1,059) | 1.57 (1.42, 1.73) | 2.11 (1.92, 2.32) | 3.38 (3.08, 3.70) |
| Hypertension | 134 (120, 147) | 212 (198, 226) | 269 (252, 286) | 385 (362, 408) | 1.58 (1.40, 1.78) | 2.01 (1.78, 2.26) | 2.87 (2.56, 3.23) |
| Acute conditions | 742 (712, 771) | 887 (857, 916) | 1,015 (982, 1,048) | 1,284 (1,244, 1,324) | 1.20 (1.13, 1.26) | 1.37 (1.30, 1.44) | 1.73 (1.65, 1.82) |
| Bacterial pneumonia | 274 (256, 292) | 342 (323, 361) | 422 (401, 443) | 566 (539, 592) | 1.25 (1.15, 1.36) | 1.54 (1.42, 1.67) | 2.07 (1.91, 2.24) |
| Urinary tract infection | 201 (184, 217) | 278 (261, 294) | 341 (323, 359) | 462 (438, 486) | 1.38 (1.25, 1.53) | 1.70 (1.54, 1.87) | 2.30 (2.09, 2.53) |
| Dehydration | 145 (132, 158) | 225 (209, 240) | 276 (259, 293) | 384 (362, 405) | 1.55 (1.39, 1.73) | 1.90 (1.71, 2.12) | 2.65 (2.39, 2.94) |

*Note*: Age-adjusted rates per 100,000 population were calculated using New York City Housing Authority resident data for 2010−2014 and rounded to the nearest whole number. Preventable hospitalizations were defined using the Prevention Quality Indicators, version 6.0, created by the Agency for Healthcare Research and Quality and include acute (bacterial pneumonia, dehydration, urinary tract infection) and chronic (asthma, diabetes, heart failure, COPD, hypertension) conditions.
[a]Refer to Appendix Figure 2 (available online) for the locations of the developments in each quartile.
[b]*n*=176 developments (44 per quartile). Excludes senior-only developments, developments with missing age data, and developments with an annual adult population fewer than 360.
[c]Rates among adults aged ≥40 years.
AAR, age-adjusted rate; COPD, chronic obstructive pulmonary disease; Q, quartile; RR, rate ratio.

inflated. However, even if the actual number of residents exceeded the official number by as much as 25%,[34] the preventable hospitalization rate among residents in public housing would still be more than twice as high as NYC overall. Finally, if there was turnover among residents, the estimated preventable hospitalization rates could be biased if there were systematic differences in preventable hospitalization rates between incoming and departing residents.

## CONCLUSIONS

Despite the concentration of risk factors for poor health among public housing residents, there have been no studies to date that examined preventable hospitalizations, an important measure of the quality and accessibility of health care, in this population. By linking geocoded hospital discharge data and administrative records from NYCHA, this study was able to identify preventable hospitalizations among residents of public housing and demonstrate the high burden of preventable hospitalization in this population, as well as variation by condition and by development. Geocoded hospital discharge data can serve as a valuable tool for health assessment and engagement of the healthcare sector and other stakeholders in interventions that address health inequities.

## SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2018.08.019.

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