# Disaggregating Socioeconomic Determinants of Preventable Hospitalisation Rates in Urban Low-Income Populations: A Multilevel Geospatial Analysis Framework

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**Abstract.** Preventable hospitalisations (PHs) impose a disproportionate burden on urban low-income populations, yet their socioeconomic determinants remain poorly disaggregated at the sub-district level. This study applied a multilevel negative binomial regression model integrated with kernel density geospatial analysis across 214 census-defined urban tracts in three metropolitan areas (2019–2023). Primary care access indices, housing deprivation scores, and health literacy metrics were operationalised as explanatory variables. Results revealed that inadequate primary care accessibility (IRR = 1.47; 95% CI: 1.31–1.65) and severe housing deprivation (IRR = 1.39; 95% CI: 1.24–1.56) were the strongest independent predictors of elevated PH rates. Health literacy mediated approximately 28% of the housing deprivation–hospitalisation pathway. Targeted ambulatory care strengthening in high-vulnerability clusters could reduce avoidable inpatient admissions by an estimated 19–24%, offering actionable guidance for municipal health system planners.

**Keywords:** preventable hospitalisation, ambulatory care sensitive conditions, socioeconomic health determinants, multilevel geospatial analysis, urban health equity, primary care accessibility, housing deprivation index, health literacy, avoidable admissions

## Introduction

Preventable hospitalisations (PHs), operationally defined as inpatient admissions for ambulatory care sensitive conditions (ACSCs) that could have been averted through timely, effective outpatient care, represent one of the most persistent and costly inefficiencies within contemporary urban health systems. As of 2024, the global economic burden attributable to avoidable inpatient admissions is estimated to exceed USD 320 billion annually, with the heaviest toll concentrated in lower-income urban neighbourhoods

characterised by fragmented primary care infrastructure and compounding social disadvantage (WHO, 2024). Despite decades of policy attention, the mechanisms by which upstream socioeconomic determinants translate into downstream hospitalisation events remain inadequately resolved at the granular, sub-district spatial scales necessary to guide targeted municipal intervention. The intersection of housing instability, food insecurity, limited health literacy, and constrained access to primary and preventive care constitutes a syndemic environment that systematically elevates ACSC hospitalisation risk among urban low-income cohorts. Existing literature has largely examined these determinants in isolation or at aggregate administrative levels, obscuring the heterogeneous vulnerability profiles that exist within ostensibly uniform urban geographies. This methodological gap is consequential: without precise spatial disaggregation of risk strata, public health resource allocation remains suboptimal, and high-need micro-clusters continue to receive inadequate ambulatory care coverage relative to their burden. Furthermore, the post-pandemic reorganisation of urban primary care networks — including the accelerated adoption of telemedicine, care coordination platforms, and community health worker programmes — has introduced new structural variables that modulate ACSC hospitalisation trajectories in ways not captured by pre-2020 analytical models. Accounting for these evolving system-level exposures demands an updated, integrative analytical framework capable of simultaneously handling individual-level social risk factors, neighbourhood-level deprivation composites, and health system capacity indicators within a coherent inferential architecture. In response to these empirical and methodological gaps, the present study develops and applies a multilevel negative binomial regression model coupled with kernel density estimation to characterise the independent and interactive socioeconomic drivers of preventable hospitalisation rates across 214 census-defined urban tracts. The paper proceeds as follows: Section 2 details the data sources, variable operationalisation, and statistical modelling procedures. Section 3 presents the principal findings, including spatial distribution maps of high-burden clusters and stratified incidence rate ratios for each determinant domain. Section 4 situates these results within the broader health equity and primary care strengthening literature, critically appraising policy implications for municipal health system planners. Section 5 concludes with recommendations for evidence-based reorientation of urban ambulatory care investment priorities and outlines a prospective research agenda addressing remaining uncertainties in ACSC determinant pathways.



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