Primary Care Spatial Density and Nonurgent Emergency Department Utilization: A New Methodology for Evaluating Access to Care

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Abstract

Objective: To determine the spatial and demographic characteristics of pediatric patients who make nonurgent visits (NUVs) to an urban pediatric emergency department (ED). We hypothesized that the rate of NUVs would be inversely associated with the spatial density of primary care providers (PCPs).
Methods: A retrospective, cross-sectional analysis was conducted for all visits to Washington, DC's principal pediatric ED between 2003 and 2006. NUVs were defined by a unique algorithm combining resource allocation, ambulatory-sensitive diagnoses, and billing data. Multivariate linear regression analysis was used to determine the association of PCP density and demographic variables on the spatial rate of NUVs.
Results: Over the 4-year period, 35.1% (52,110) of the 148,314 ED visits by Washington, DC, residents were nonurgent. NUVs were most associated with neighborhood median household income <$40,000 and low spatial density of PCPs. For every 1-unit increase in PCP density, the spatial rate of NUVs decreased by 9%. The odds of a visit being nonurgent were significantly higher for African Americans and Hispanics than for whites (odds ratio [OR] 2.4, 95% confidence interval [CI] 2.19–2.64; and OR 2.6, 95% CI 2.36–2.86, respectively), for patients using public insurance versus private (OR 1.46, 95% CI 1.42–1.50), and for patients age <5 years (OR 2.66, 95% CI 2.60–2.72).
Conclusions: Low spatial density of primary care is strongly associated with nonurgent ED utilization. Improving spatial distribution of primary care may decrease ED misuse and improve access to the medical home.

Keywords: emergency department use; geographic information systems; health care delivery/access; health disparities; pediatrics

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What's New

Low density of pediatric primary care is associated with increased nonurgent emergency department (ED) utilization. Spatial analysis determines residential areas where patients frequently use EDs for nonurgent reasons. Resource planning to improve spatial access to primary care may decrease nonurgent ED utilization.

Low-acuity, nonurgent emergency department (ED) visits by children account for 37% to 60% of the 30 million ED visits made by children in the United States annually.[1–6] These visits contribute to ED overcrowding and increased costs to the health care system.[7] Patients with frequent nonurgent visits (NUVs) have less continuity of care with primary care providers (PCPs),[8,9] which conflicts with the purpose of the primary medical home.[10]

The reasons commonly attributed to seeking nonurgent care at an ED rather than a PCP are multi-factorial and include: lack of health insurance,[11,12] PCP inaccessibility,[13] proximity to emergency care,[12,14] communication/language barriers,[15] difficulty scheduling an appointment,[4] perceived differences in quality of care,[4,5,15,16] frequent parental ED use,[17] living in a single parent family,[12] and lack of parental health education.[18,19] It is unclear which of these factors are independently most predictive of the social and logistic reasons to seek nonurgent care in an ED. Furthermore, some authors have found that the majority of patients who make NUVs to EDs actually have a PCP,[12] have insurance,[20] and seek care during regular office hours when PCP care is available.[21,22]

Spatial accessibility to medical care affects decision making about health care utilization. For emergency care, ED utilization varies with spatial organization,[23,24] decreasing as the patients' distance from the hospital increases.[14,25] Up to 20% of caretakers bring their children to the ED rather than the PCP simply because

the ED is closer.[12] Although spatial proximity to the ED is associated with ED utilization, it is unclear if location relative to primary care alternatives is associated with nonurgent ED utilization—care that could otherwise be offered in ambulatory settings.

We performed this study to explore the spatial determinants of ED use for pediatric NUVs among residents of the District of Columbia. Our primary hypothesis was that nonurgent utilization would be inversely associated with spatial density of PCPs.

METHODS

STUDY DESIGN

This study was a retrospective, observational, cross-sectional analysis of all ED visits presenting to Children's National Medical Center (CNMC) from January 1, 2003 to December 31, 2006. We identified patients using the Logicare ED tracking system (Logicare, Inc., Eau Claire, WI), which records both visit-level data and patient-level demographic data for each ED visit. Each visit was cross-referenced against the Children's National billing system (HBOC, McKesson Corp, San Francisco, CA) to determine physician billing levels (complexity of care), the use of medications, and procedures performed.

Geographic information system (GIS) software (ArcGIS v10, ESRI, Redlands, CA) was used to geocode (ie, determine the latitude and longitude of) the residential address of all patient visits meeting inclusion criteria. To decrease the potential for selection bias from incomplete geocoding,[26] we used Google Maps to increase the overall match rate when addresses were unmatched with ArcGIS.

STUDY SETTING AND POPULATION

CNMC is an urban, academic, tertiary care pediatric medical center in Washington, DC. The ED is the principal pediatric emergency center in Washington, DC, with a mean annual ED census exceeding 80,000 visits. The ED serves a population largely composed of families with low socioeconomic status, 70% of whom were publicly insured in 2008, compared to 33% nationwide.[27] Although there are other options for acute medical care in Washington, DC, and the surrounding areas, the delivery of pediatric emergency care is concentrated primarily at CNMC. This emergency center accounted for 79% of ED visits for residents of Washington, DC, aged 0 to 13 years in 2006.[27] A map of the other regional emergency centers is provided in Figure 1. There are few other pediatric acute care services in Washington, DC, and no accredited urgent care centers according to the American Academy of Urgent Care Medicine.

This analysis was restricted to residents of Washington, DC, because accurate PCP locations (and capacity) extended only to the immediate surrounding area, as described in previous publications.[28,29] Visits with address errors or addresses outside Washington, DC, were excluded.

Patient inclusion was determined by a specific algorithm to characterize NUVs (Table 1). This algorithm expands on previously described methodologies for defining pediatric NUVs,[30] primarily incorporating resource utilization, disposition, and chief complaint. Patient visits were additionally excluded for discharge diagnoses inconsistent with ambulatory-sensitive care or for acute problems that may have required needs beyond the capability of a primary care office (ie, subspecialty consultation or perceived distress). Billing data were used as a validation tool for resource utilization and to ascertain physician charges and need for medications.

MEASUREMENTS AND KEY OUTCOMES

Demographic data included race/ethnicity, gender, age, residential address, and insurance type. In addition to patient-level data, we added a previously collected database of local primary care physician (PCP) density as a layer for analysis.[28,29] This database was last updated in December 2004 (midpoint in study period) and includes the location of each pediatric primary care facility, as well as the actual pediatric provider full-time equivalents (FTE) at each location. PCP density is defined as the number of FTE PCPs in a 3 mile radius per 100,000 children (using child population data from the 2000 US census). A map of both PCP density and the acute care facilities in the Washington, DC, area is provided in Figure 1.

Additional raster layers for median income and race/ethnicity were generated using block group level census data from the 2000 Census. To achieve consistency with the unit of analysis, the median income data were regenerated as a raster with 0.1 mi^2 cells.

Each variable was represented spatially as a raster map layer. A raster is a GIS data type that consists of a matrix of identically sized square cells, each of which contains a measured or estimated value for a specific variable. A density raster of all NUVs was generated using the kernel density estimation technique, which calculates the number of point features per area within a specified search radius distance (neighborhood) of each raster cell. The output cell size and search radius distance is chosen by the analyst, and the final product is then represented as a smoothed contour map.[31,32] Conceptually, a smoothly curved surface is fitted over each point. The surface value is highest at the location of the point and diminishes with increasing distance from the point, reaching 0 at the search radius distance from the point.[28] The volume under the surface equals the population field value for the point. For this analysis the density of visits was calculated within 0.1 mi^2 cells and smoothed with a Gaussian kernel density function to a distance of 1 mi. The PCP density was calculated within 0.1 mi^2 cells and smoothed with a Gaussian kernel density function to a distance of 3 mi, consistent with previously published studies and surveys of Washington, DC, residents indicating how far they would travel to a clinic.[29,33]

The functional unit of analysis was a rate raster, which represented NUVs as a function of child population for a given geographic location. More specifically, this rate equals the number of NUVs in a 0.1 mi^2 cell (ie, density) divided by the 2000 US census child population and