Non-emergent Hospital Emergency Department Use and Neighborhood Poverty in Rhode Island, 2008–2012

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The hospital emergency department (ED) becomes the ultimate destination for vulnerable populations without primary care.[1] Researchers from the New York University (NYU) Center for Health and Public Service Research and the United Hospital Fund of New York jointly developed a profiling algorithm for ED use, which is well known as the NYU ED classification algorithm. Based on the patient's age, symptoms, complaint, vital signs, medical history, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes, the NYU algorithm identifies nine categories of patients: non-emergent, emergent/primary care treatable, emergent/ED care needed, but preventable/avoidable; emergent/ED care needed, not preventable/avoidable; injury, mental health related, alcohol related, drug related (excluding alcohol), not in a special category, and not classified.[2,3] If immediate medical care would not be required within 12 hours, an ED visit was classified as non-emergent.[4]

The NYU algorithm provided us with an opportunity to study the quality of ED care to improve health care efficiency. Non-emergent ED visits unnecessarily crowd ED use and compromise the efficacy and quality of ED services.[4] Previous findings have shown that people at low-income level and who are without a regular source of primary care are more likely to visit the ED compared to those with higher incomes.[2,4-6] Our objective was to determine who uses hospital ED for non-emergent visits, which is an indicator of primary care-sensitive ED services. By using the NYU ED classification algorithm, Rhode Island ED database and American Community Survey (ACS) data, we describe characteristics of patients in Rhode Island who use ED for non-emergent visits and examine whether ED non-emergent use is associated with neighborhood poverty, how those patients are distributed geographically, and how the distribution is correlated with neighborhood poverty status.

METHODS

We analyzed data from the 2008–2012 Rhode Island ED database and 2008–2012 ACS.

Data source

Rhode Island's ED data include demographic information, patient residence at the time of admission coded at the census tract level, ICD-9-CM codes, insurance type, and hospital charges. We included only 11 acute care hospitals' ED visits with a specified ICD-9-CM diagnosis code. In the dataset one patient may have multiple visits. The population was non-emergent ED use at the visit level, which was constructed by using the NYU ED classification algorithm. Age-adjusted percentages of non-emergent ED visits were calculated to allow comparability across census tracts. Using 5 age groups (i.e., 00–14, 15–24, 25–44, 45–64, and ≥65), non-emergent ED visit percentages were age-adjusted to the 2010 U.S. population.

The ACS is conducted by the U.S. Census Bureau and consists of a nationally representative sample of housing units, both occupied and vacant, and institutionalized and non-institutionalized populations of the United States.[7] The ACS is used to provide annual estimates at the national, state and local level on the demographics and socio-economic characteristics of the United States population.[7] In this study, census tract was used as a proxy of neighborhood. Census tracts include 2,500 to 8,000 residents.[8] The authors used ACS data at the census tract levels to characterize neighborhood poverty level.

Data analyses

We used descriptive statistics to summarize the characteristics of patients with non-emergent ED visits. We analyzed the correlation of non-emergent ED visits with the neighborhood poverty status at the census tract level by constructing scatter-plots. The Pearson correlation coefficient was calculated to examine the strength of the relationship. If values are between 0.00-0.29, it indicates a weak relationship; if 0.30-0.69, moderate; and if 0.70-1.00, strong. The coefficient of determination (the squared correlation coefficient) is another way for evaluating the strength of a relationship. This is the proportion of variance in non-emergent ED use percentages that can be accounted for by knowing census tract poverty levels or vice versa.[9] We conducted all analyses with the SAS 9.2 statistical package (SAS Institute, Inc, Cary, North Carolina).

Aggregating features into classes allows us to spot patterns in the data more easily. We created a four-level poverty census tract variable that has consistently detected socio-economic gradients in health across a wide range of health outcomes in the total population: 0 to <5% residents in poverty; 5% to < 10% of residents in poverty; 10 to < 20% of residents in poverty; and 20% or more of residents in poverty.[10]

We use the Quantile Classification method to create the value ranges of non-emergent ED use. The number of values is the same in each class. We used ArcGIS 10.2 (Environmental Systems Research Institute, Inc, Redlands, California) to map poverty percentage and non-emergent ED visit percentage by census tracts of Rhode Island.

RESULTS

A total of 402,013 (20.3%) of 1,985,240 ED visits were for non-emergent use. Other ED visits included 18.5%, emergent/primary care treatable; 4.8%, emergent/ED care needed, but preventable/avoidable; 10.4%, emergent/ED care needed, not preventable/avoidable; 26.5%, injury; 4.4%, mental health related; 2.9%, alcohol related; 0.3%, drug related (excluding alcohol); and 11.8%, not in a special category, and not classified.

Individuals 20-39 years of age were the most frequent non-emergent ED users. The majority of non-emergent ED users were females. Hispanic and non-Hispanic black patients were more likely to use the ED for non-emergent diagnoses than other ED use. The residents of the four core cities including Central Falls, Pawtucket, Providence and Woonsocket have a higher percentage of ED visits for non-emergent use compared to other ED visits. Overall, almost half of the non-emergent ED users were charged less than $1,000. Non-emergent ED visitors had higher self-pay and Medicaid insurance than other ED users. (**Table 1**)

Non-emergent ED users had a higher percentages from all top 10 diagnosis groups than did other ED visits. The total percentage for the top 10 diagnosis groups for non-emergent (51.7% of total non-emergent ED use) exceeded that for other ED visits (26% of total other ED visits). Other symptoms referable to back, the leading diagnosis of non-emergent for

Table 1. Characteristics of ED Visits in Rhode Island, 2008-2012

Characteristic	Non-emergent ED visits		Other ED visits	
	n	%	n	%
Total (N=1,985,240)	402,013	20.3	1,559,554	79.7
Age group (years)				
0-19	92,454	23.1	377,967	24.2
20-39	160,333	39.9	516,925	33.1
40 and over	149,226	37.1	664,664	42.6
Sex				
Male	149,061	37.1	729,908	46.8
Female	252,949	62.9	829,627	53.2
Race/Ethnicity				
White, non-Hispanic	265,561	66.9	1,127,589	73.0
Black, non-Hispanic	46,512	11.7	148,168	9.6
Hispanic	71,150	17.9	216,736	14.0
Other	13,731	3.5	51,343	3.3
City of residence				
Core city	178,467	44.9	606,449	39.3
Non-core city	199,952	50.3	852,732	55.2
Out of state	19,467	4.9	85,817	5.6
Total charges ($)				
<$1,000	199,502	49.6	600,036	38.5
>=$1,000	202,511	50.4	959,519	61.5
Insurance				
Self pay	71,374	18.2	264,744	17.4
Medicaid	129,167	33.0	398,170	26.2
Medicare	59,736	15.2	269,856	17.8
Private	125,618	32.1	537,908	35.4
Other	5,945	1.5	47,704	3.1

ED: Emergency Department

Table 2. Ten Leading Diagnosis Groups of Emergency Department Visits in Rhode Island, 2008-2014

#	Non-emergent Emergent Department visits (402,013)				Other Emergent Department visits (2-9) (1,559,554)		
	Diagnosis Group	n	%		Diagnosis Group	n	%
1	724.8 - Other symptoms referable to back	36,779	9.1		789.0 - Abdominal pain	102,586	6.6
2	784.0 - Headache	33,471	8.3		466.0 - Acute bronchitis	55,776	3.6
3	648.93 - Other current conditions classifiable elsewhere of mother, antepartum condition or complication	29,233	7.3		303.90 - Other and unspecified alcohol dependence, unspecified	39,510	2.5
4	462 - Acute pharyngitis	21,933	5.5		682 - Other cellulitis and abscess	34,795	2.2
5	787.0 - Nausea and vomiting	19,662	4.9		847.0 - Sprain of neck	33,807	2.2
6	691.8 - Other atopic dermatitis and related conditions	15,572	3.9		920 - Contusion of face, scalp, and neck except eye(s)	30,353	1.9
7	525.9 - Unspecified disorder of the teeth and supporting structures	14,970	3.7		845.00 - Sprain of ankle, unspecified site	27,601	1.8
8	599.0 - Urinary tract infection, site not specified	13,597	3.4		493 - Asthma	27,004	1.7
9	719.46 - Pain in joint, lower leg	11,398	2.8		786.50 - Chest pain, unspecified	26,827	1.7
10	780.4 - Dizziness and giddiness	11,287	2.8		873.20 - Open wound of nose, unspecified site, without mention of complication	26,162	1.7
	Total from the top 10 diagnosis groups	207,902	51.7		Total from the top 10 diagnosis groups	404,421	26.0

ED visits, accounted for 9.1% of non-emergent ED service. Headache (8.3%), other current conditions classifiable elsewhere of mother, antepartum condition or complication (7.3%), acute pharyngitis (5.5%), and nausea and vomiting (4.9%), dominated the list of major diagnosis in non-emergent group. (**Table 2**)

The Pearson correlation coefficient between non-emergent ED use and census tract-level poverty was 0.5711, which indicated a moderate positive linear relationship. The coefficient of determination (the squared correlation coefficient) was 0.3262. Thus, 32.62% of high-poverty census tracts had high ED visit percentages for non-emergent use or vice versa. (**Figure 1**)

Each census tract code is shaded based on the percentage of neighborhood poverty. Neighborhood poverty status varies by census tract, from less than 0.8% in the lowest category to 63.6% in the highest category. The darkest color represents the census tract codes with 20% or more of residents in poverty. Each census tract code has a circle based on the percentage of total ED visits for non-emergent use (first through fourth quantile). Non-emergent ED visits varies by census tract, from less than 0.1% in the lowest quantile of census tracts up to 51.2% in the highest quantile. The biggest circle represents the census tract codes with non-emergent ED visit percentages in the highest quantile. The highest percentages of poverty status and non-emergent ED use are in the census tract codes of four core cities, Central Falls, Pawtucket, Providence, and Woonsocket. The figure shows that census tract codes with a high-poverty percentage tend to have a higher percentage of non-emergent ED visits. (**Figure 2**)

DISCUSSION

Rhode Island data reveal that 1 of every 5 ED visits (20.3%) in 2008-2012 was non-emergent. ED use for non-emergent conditions was higher for Hispanics and non-Hispanic blacks than other ED visits. Non-emergent ED users were especially common among self-pay patients or Medicaid beneficiaries. Non-emergent ED visit percentages were moderately correlated with neighborhood poverty level. ED use for non-emergent care by census tracts displays substantial variations across Rhode Island neighborhoods. The highest percentages of ED visits for non-emergent conditions were in four core-city census tract codes.

These findings are consistent with other research on the ED Algorithm.[5] Socio-demographic characteristics were predictors of non-emergent ED service use.[4] ED visits for non-emergent were found to be strongly correlated with poverty and un-insurance.[5]

Figure 1. The correlation between poverty level and non-emergent Emergency Department visit percentage, data from the 2008–2012 American Community Survey and the 2008–2012 Rhode Island Emergency Department Data.
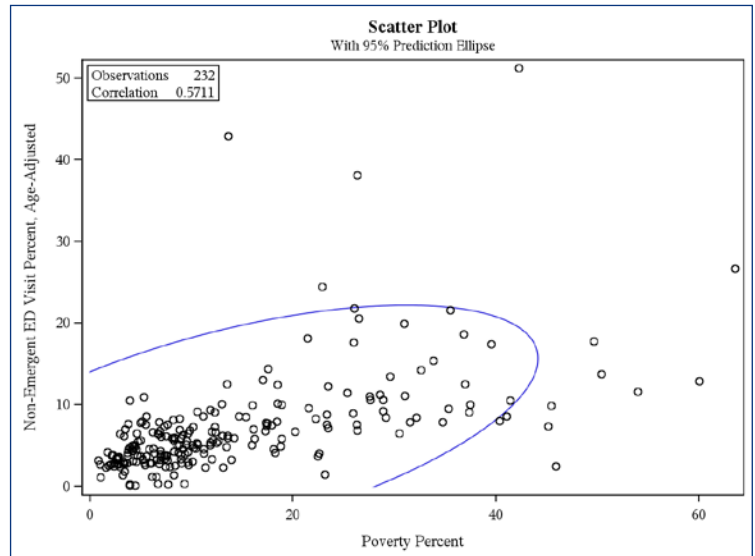
Figure 2. Poverty level and age-adjusted non-emergent Emergency Department visit percentage by census tracts, data from the 2008-2012 American Community Survey and the 2008-2012 Rhode Island Emergency Department database.
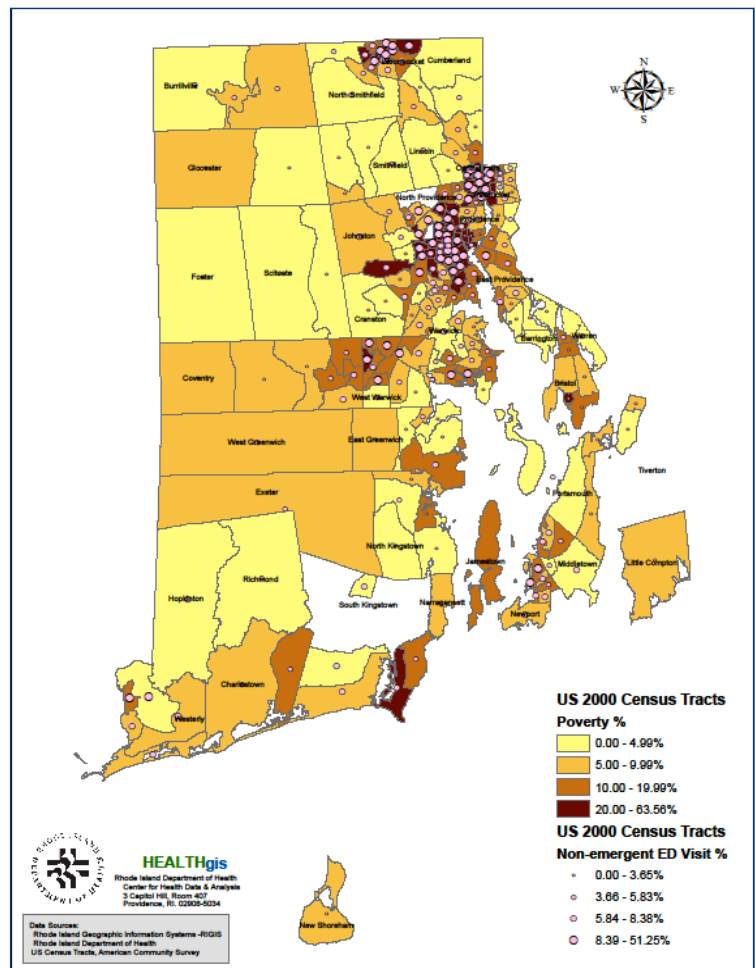
Low-income status and no insurance or underinsurance holders usually delay seeking treatment until their medical condition has worsened.[3] The Begley et al study displayed that people living below poverty are less likely to have a regular source of care, more likely to report fair or poor health, and more likely to have ED visits than people not living below the federal poverty level.[5] Previous studies show that most patients know their condition is not an emergency and an ED is the convenience service.[1] Low-income Rhode Island residents may depend on ED care even more since physician reimbursement rates for Medicaid patients are being cut.[2]

The findings revealed notable geographic differences by census tracts of residence. Areas of the four core-cities with particularly high ED use for non-emergency conditions may lack primary care resources. The maps generated by the Office of Primary Care and Rural Health at the Rhode Island Department of Health showed that the low-income population group and four core-cities had been designated by the Federal government as having a shortage of primary care health professionals, which are consistent with our results.[11] Some neighborhoods of the high-use ED for non-emergent have a high density of immigrants, which may be indicate a lack of a connection to the primary care delivery system. High percentages of ED use for non-emergent conditions may demonstrate that patients have no access to the primary care, are dissatisfied with the primary care provider, or lack knowledge of symptoms and disease self-management. The findings provide support for providing urgent care center alternatives to the ED, and access to high quality primary care, particularly in the Hispanic and non-Hispanic black community. Billings et al[2] also raised a number of ways to reduce reliance on ED and improve primary care: 1) Increasing night time and weekend hours for health care providers; 2) Extending health care providers' telephone consultation capacity; 3) Identifying patients with high use of the ED for primary care, and establishing links to primary care for patients who lack them; and 4) Educating patients about how to manage chronic conditions.

There are at least four limitations to this study. 1) Approximately 14.5% of census tracts were missing or incorrect in the 2008-2012 Rhode Island ED Data. 2) It would have been very helpful to have the length of ED stay hours. But Lifespan including Rhode Island Hospital, Miriam Hospital, and Newport Hospital, which provide 44.8% of total ED services in Rhode Island, did not provide the time of patient's registration in the ED. 3) The authors chose to use defined interval classification developed by Harvard University to create the ranges of poverty level. However, we did not have the criterion for the classification of non-emergent ED use percentage, so we chose to use the Quantile Classification method to create the value ranges of non-emergent ED use percentage depicted on the GIS maps. 4) We only utilized the 11 acute care hospitals' Emergency Department data in Rhode Island, and we did not have "walk-in" ED use data. The Rhode Island health information exchanges (HIE),

also called CurrentCare, collect administrative, clinical, laboratory data, and medication data, and track the full spectrum of healthcare utilization, regardless where of care is sought. In the future when the CurrentCare data are available, we can also include "walk-in" ED visits, which are a part of a big picture.

Despite the limitations, there is some strength to this study as well. 1) Rhode Island state law requires hospitals to submit ED visit records, so this was a statewide study on ED visits that includes all acute care hospitals in Rhode Island. 2) Neighborhood-level poverty was assessed by the population-based survey, not by patients themselves. 3) We found that the ED Algorithm is a useful tool for bringing attention to poverty status at the neighborhood level. The Affordable Care Act may change low-income families' insurance problems and can affect their ED visits for non-emergent conditions. In the near future, it is hoped the Rhode Island Primary Care Trust will fund "Neighborhood Health Stations" across the state, which will provide primary care, dental care, and mental health care service to 75 neighborhoods of approximately 10,000 individuals each. Hospital administrators and neighborhood planners may use the findings to determine the need for and location of "neighborhood health station" in a Rhode Island healthcare system.

SUMMARY

In summary, we need to find specific personal, economic, or systematic barriers to the primary care system in future studies. The high percentage ED service use for non-emergent in Rhode Island indicates it is necessary to improve the access to primary care services or delivery of the primary care services; for instance, to change inconvenient hours, to reduce long waits for appointments, to eliminate treatment inequality, etc. The community planners can reduce the ED use for non-emergent conditions by eliminating health professional shortage areas in Rhode Island, increasing nurse advice lines, and promoting chronic condition management programs.

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