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TECHNICAL
R E P O R T



Cellulitis-Associated Hospitalizations in Baltimore City

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Supported by the Aaron and Lillie Straus Foundation

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Preface

This report describes hospitalizations associated with cellulitis, a skin infection frequently linked to methicillin-resistant *staphylococcus aureus* (known as MRSA), in Baltimore City. The study was conducted within RAND Health, a division of the RAND Corporation, and was funded by the Aaron and Lillie Straus Foundation. The report should be of interest to policymakers in Baltimore City, as well as to individuals concerned with issues related to hospitalizations associated with cellulitis more generally. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health

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Executive Summary

This report describes hospitalizations associated with cellulitis, a skin infection frequently linked to methicillin-resistant *staphylococcus aureus* (known as MRSA), in Baltimore City. From 2000 to 2006, the number of cellulitis-associated inpatient hospitalizations increased by 74 percent, from 1,456 to 2,539—an increase of over 1,000 hospitalizations. The corresponding increase in the rate of cellulitis-associated hospitalizations was from 2.2 to 4.0 per thousand population per year. Rates increased among all age groups and among the insured and uninsured. Rates of cellulitis hospitalizations fell from 2006 to 2007 among adults, but increased among children. Cellulitis-associated hospitalizations varied substantially across different locations within Baltimore City, with a three- to fourfold difference in the highest and lowest rates. Zip codes 21223 and 21225 had the largest number of cellulitis cases in 2007. Zip code 21225 had the greatest increase in number of cases between 2000 and 2007. Overall, rates of cellulitis-associated hospitalizations in 2007 were twice as high in Baltimore City as in the District of Columbia and Maryland as a whole.

Acknowledgments

We gratefully acknowledge financial support from the Aaron and Lillie Straus Foundation. We thank Jeffrey Wasserman at RAND for his review of the report and are grateful to Michael Dalesio for his help preparing the final document. We also thank Cindy Saunders at the Maryland Health Services Cost Review Commission (HSCRC) for assistance with the data.

Abbreviations

DCHA	District of Columbia Hospital Association
HSCRC	Maryland Health Services Cost Review Commission
MRSA	methicillin-resistant <i>staphylococcus aureus</i>
PUMA	public use microdata area

1. Overview

Monitoring and assurance are core public health department functions. A continual challenge is finding appropriate and comprehensive data for tracking indicators of health care access, health conditions and health outcomes. Hospital discharge data can be a valuable tool in detecting trends in certain diagnoses. This report analyzes hospital discharge data and focuses specifically on hospitalizations associated with cellulitis, a skin infection frequently linked to methicillin-resistant *staphylococcus aureus*—known as MRSA. A study of 2005 data found significant levels of community-based MRSA infections throughout the US, with especially high MRSA rates in Baltimore City in 2005.¹

2. Data and Methods

2.1 Hospital Discharge Data

We analyze the Maryland Health Services Cost Review Commission (HSCRC) inpatient discharge data which contain the universe of inpatient discharges from Maryland hospitals. The inpatient data span 2000-2007. The data contain hospital identifiers as well as information on the zip code of the patient's residence.

We also analyze inpatient discharge data from the District of Columbia, provided to us by the DC Hospital Association (DCHA). DCHA inpatient data are available from 2000 forward. We use these data to capture inpatient hospitalizations among Baltimore City residents to District hospitals. While there are relatively few, including them improves the accuracy of our results. In addition, we use the DCHA to create comparison statistics for Washington, D.C.

2.2 Population Data

To construct cellulitis-associated hospitalization rates, we divide the number of hospitalizations among a certain population by the number of individuals in the appropriate population. We use population estimates for particular age groups (0–17, 18–39, 40–64, 65+) for Baltimore City from the County Characteristics Resident Population Estimates File produced by the U.S. Census Population Division.

We would also like to analyze trends in cellulitis-associated hospitalizations for different neighborhoods, or proxies for neighborhoods, such as those defined by zip code. But reliable population estimates at the neighborhood or zip code level, and particularly for various subpopulations defined by age within each neighborhood or zip code, are not available. Thus, at the zip code level we are only able to examine numbers, and not rates, of cellulitis-associated hospitalizations.

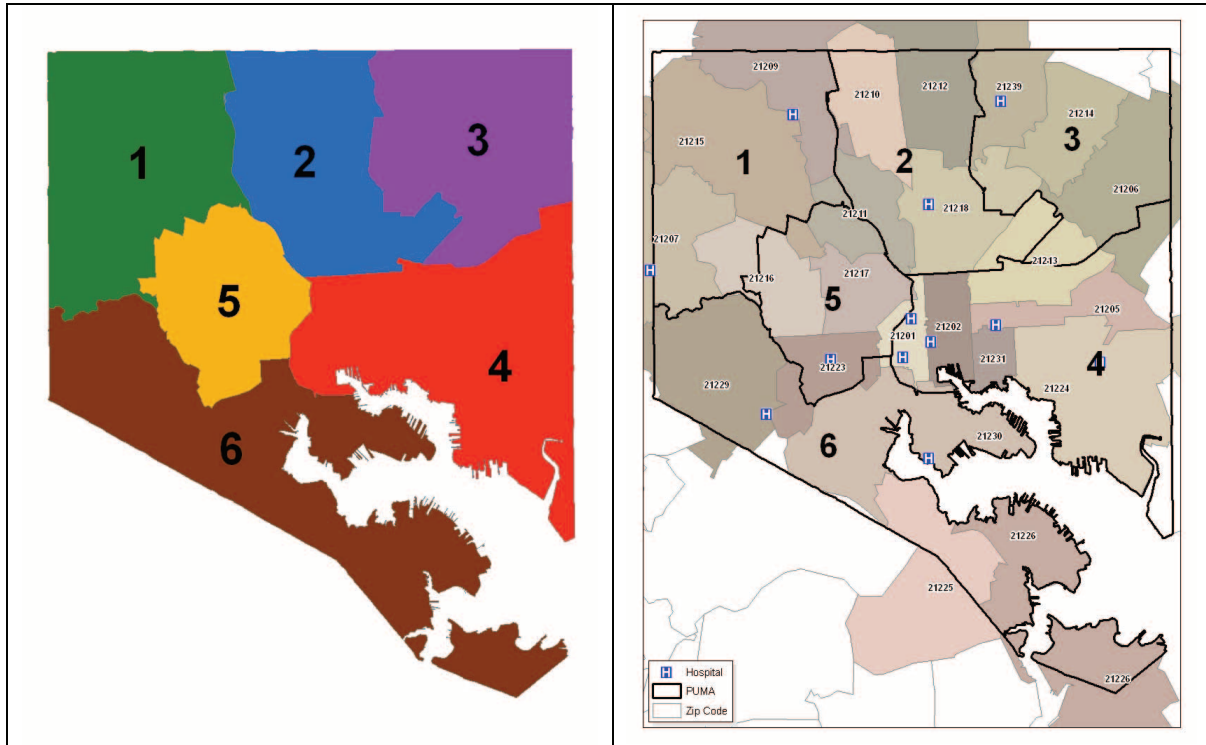
The American Community Survey, which collects data on samples of people each year between the decennial censuses, provides sub-city population estimates for different age groups at the

¹ Klevens RM, Morrison MA, Nadle J, Petit S et al, Invasive Methicillin-Resistant *Staphylococcus Aureus* Infections in the US, JAMA, October 17, 2007, Vol 298, No 15, 1763-1771.

“public use microdata area” (PUMA) level. A PUMA is a catchment area of about 100,000 people. Baltimore comprises six PUMAs (see Figures 1 and 2). We use the American Community Survey for Baltimore City PUMA population estimates for 2007 and the 2000 U.S. Census for PUMA population estimates for that year. For 2001–2006, we linearly interpolate between the Census and American Community Survey estimates.

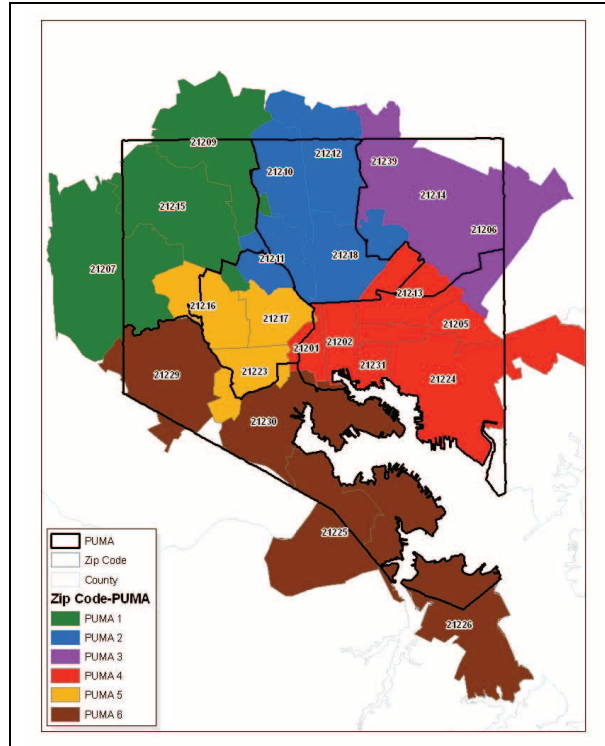
Figure 1: Baltimore City PUMAs

Figure 2: Baltimore City PUMA–Zip Code Crosswalk



The PUMA rates we construct are approximate because zip codes do not map perfectly into PUMAs (see Figure 2). For zip codes that fall into more than one PUMA, we assign the zip code to the PUMA in which the largest percentage of the population resides (see Figure 3). By using information on individuals’ county of residence, we are able to exclude observations from individuals whose zip code is partially in Baltimore City but who live in the part of the zip code that falls outside of the city limits.

Figure 3: Zip Code–Defined PUMA



3. Cellulitis-Associated Hospitalizations

In 2007, there were nearly one thousand more cellulitis hospitalizations in Baltimore than in 2000. Table 1 portrays the numbers and rates of cellulitis-associated hospitalizations.

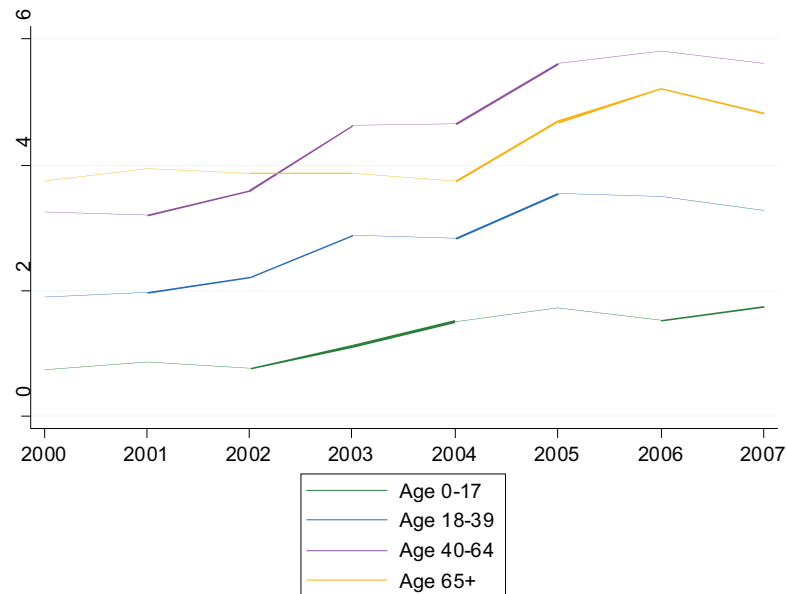
Table 1: Hospitalizations and Hospitalization Rates Associated with Cellulitis Among Residents of Baltimore

	2000	2001	2002	2003	2004	2005	2006	2007
Number of hospitalizations for cellulitis								
0–17	118	137	120	175	238	270	237	272
18–39	405	413	457	596	577	719	714	667
40–64	612	614	697	918	931	1137	1187	1144
65+	321	331	314	312	295	366	401	366
All ages	1,456	1,495	1,588	2,001	2,041	2,492	2,539	2,449
Cellulitis hospitalization rate per 1,000 population								
0–17	0.7	0.9	0.8	1.1	1.5	1.7	1.5	1.8
18–39	1.9	2.0	2.2	2.9	2.8	3.5	3.5	3.3
40–64	3.2	3.2	3.6	4.6	4.6	5.6	5.8	5.6
65+	3.8	3.9	3.9	3.9	3.7	4.7	5.2	4.8
All ages	2.2	2.3	2.5	3.1	3.2	3.9	4.0	3.8

Among residents of all ages, the cellulitis-associated hospitalization rate was 3.8 per thousand population (per year), with a range from 1.8 (ages 0–17) to 5.6 (ages 40–64).

Figure 4 graphs the rate of cellulitis-associated hospitalizations over time by age group.

Figure 4: Rate of Cellulitis-Associated Hospitalizations Among Baltimore Residents by Age



Cellulitis-associated hospitalization rates increased on net for all age groups between 2000 and 2007. For adults (18–39, 40–64 and 65 and over), cellulitis-associated hospitalization rates declined in 2007, but rates continued to rise among children.

Figure 5 compares the cellulitis-associated hospitalization rates in Baltimore with rates in comparison areas. These figures show not only that hospitalizations involving cellulitis are higher in Baltimore in each year compared with other locations in Maryland and the District, but also that the trajectory of cellulitis hospitalizations in Baltimore City is steeper than in other areas. Overall, rates were twice as high in Baltimore City as in the District of Columbia and Maryland as a whole, and rates were higher in Baltimore City for every age group (0–17, 18–39, 40–64).

Figure 5: Rates of Cellulitis-Associated Hospitalizations in Baltimore City and Comparison Locations (2000–2007)

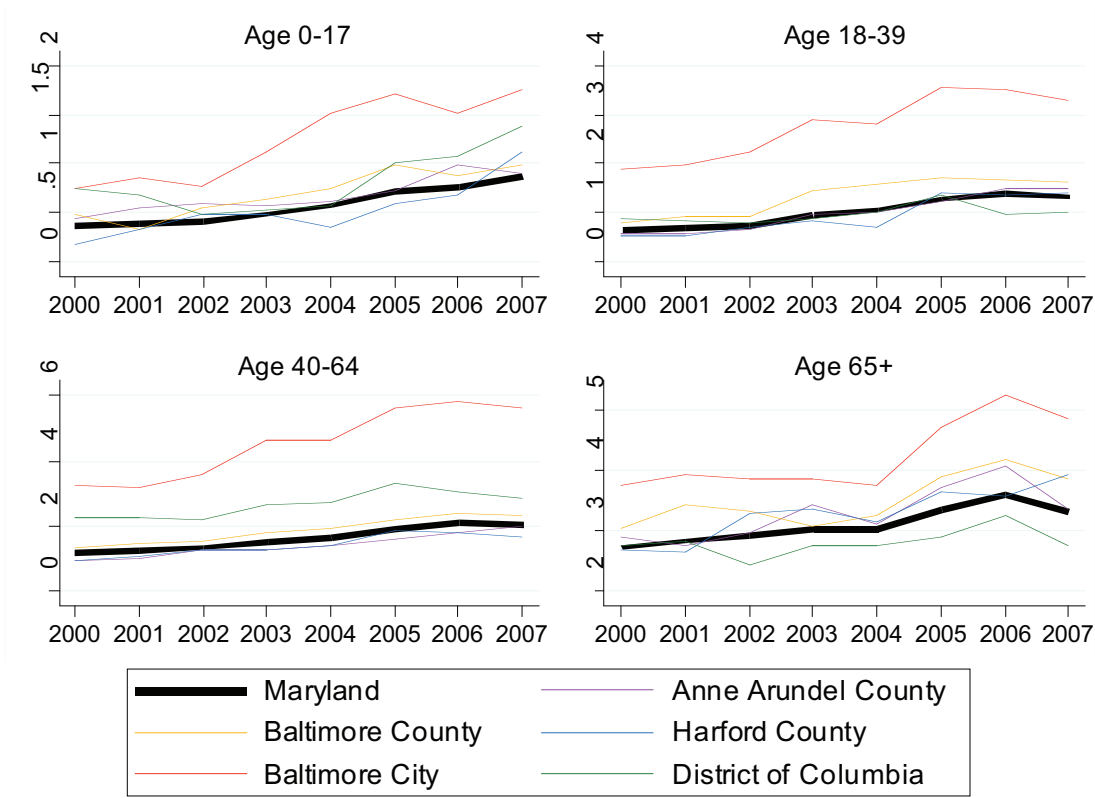


Figure 6 compares rates of cellulitis-associated hospitalizations across PUMAs within Baltimore. The highest rates in 2007 occurred in PUMAs 4 and 5, and the lowest rates for most age groups were in PUMA 3, with a three- to fourfold difference in the highest and lowest PUMA rates. Across all age groups, the steepest increases occurred in PUMAs 4 and 5.

Figure 6: Rate of Cellulitis-Associated Hospitalizations by PUMA

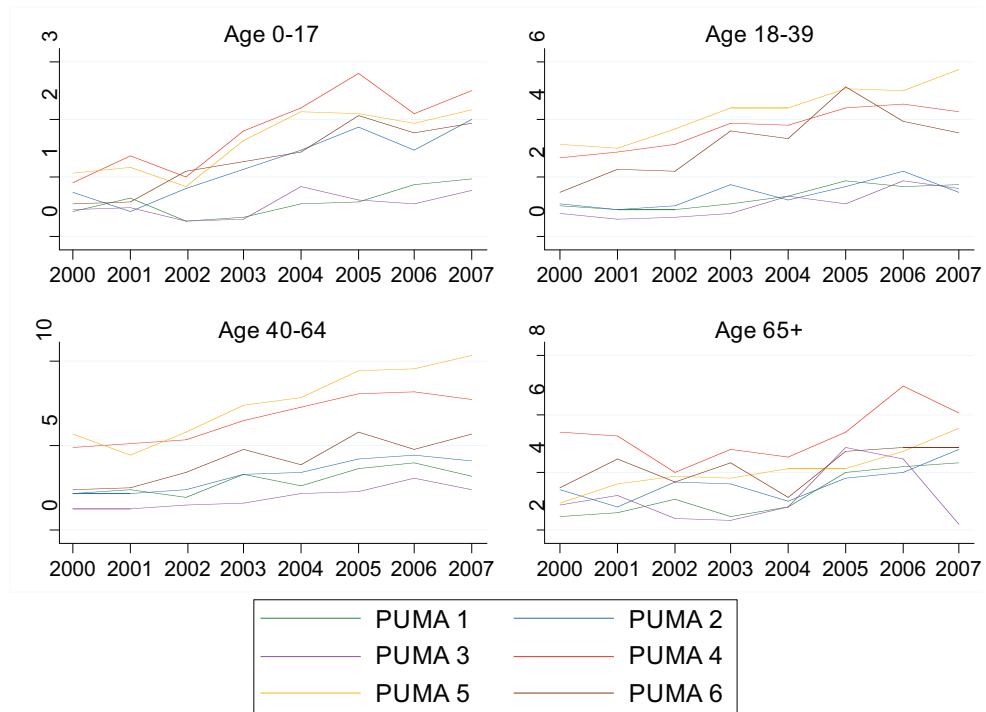
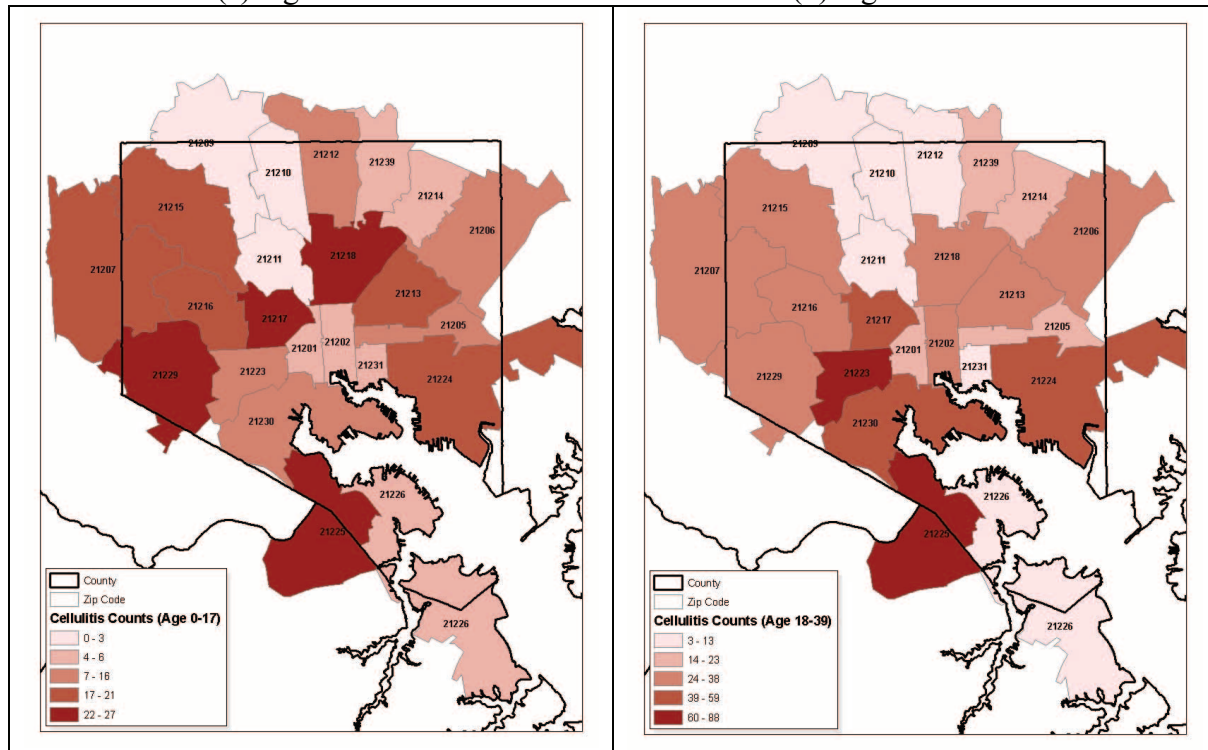


Figure 7 profiles the number of hospitalizations associated with cellulitis in 2007 for each zip code in Baltimore.

Figure 7: Number of Cellulitis-Associated Hospitalizations in 2007 by Zip Code

(a) Ages 0–17

(b) Ages 18–39



(c) Ages 40–64

(d) Ages 65+

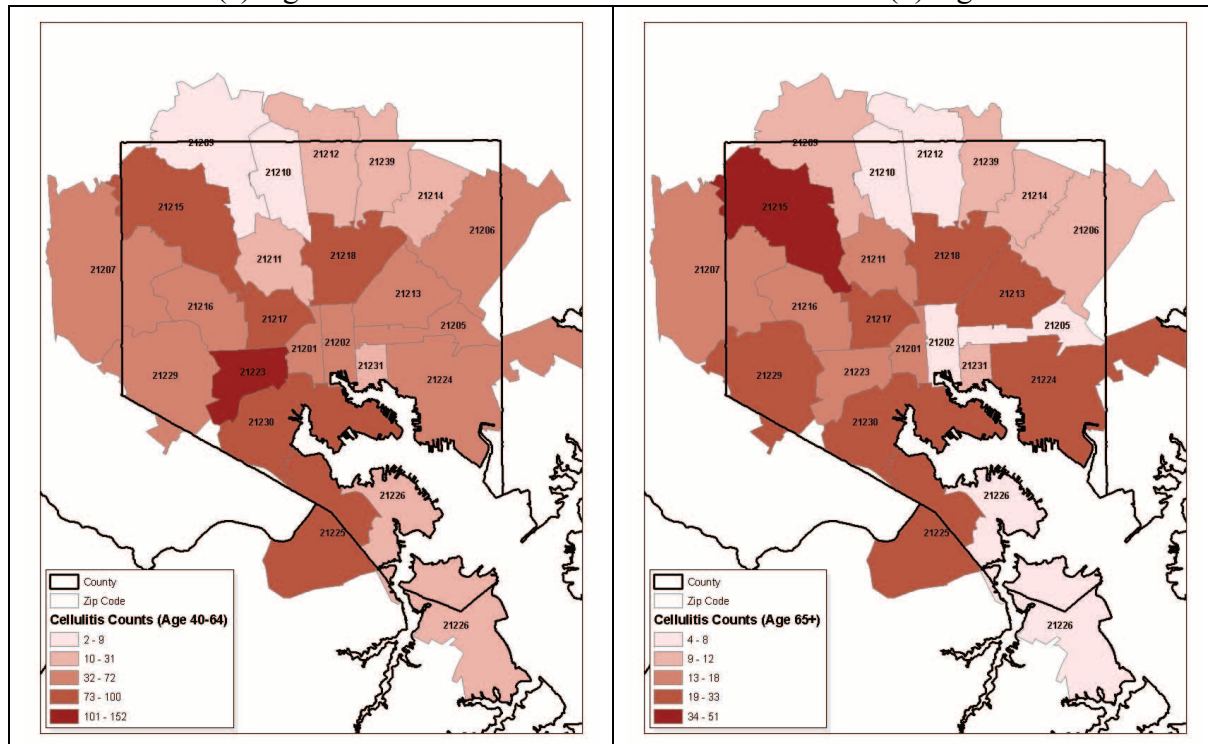


Table 2 provides a description of changes over time in cellulitis discharges between 2000 and 2007 for each zip code in Baltimore. (We are not able to construct rates by zip code because of the lack of available population data for each zip code).

Table 2: Change in Hospitalizations Associated with Cellulitis by Zip Code, 2000-2007

	Cases in 2000	Increase in Cases, 2000–2007 (All ages)
21201	58	37
21202	65	39
21205	64	30
21206	81	40
21207	54	57
21209	20	7
21210	9	2
21211	44	17
21212	41	13
21213	105	37
21214	26	33
21215	121	73
21216	77	54
21217	124	82
21218	88	88
21223	144	124
21224	147	34
21225	59	161
21226	10	31
21229	69	84
21230	78	97
21231	37	9
21239	33	21

Note: Some zip codes contain areas not part of Baltimore City.

Zip codes 21225 and 21223 had the greatest numbers of cellulitis cases in 2007 and the greatest increase in cellulitis cases in absolute terms between 2000 and 2007. Zip code 21225 also had one of the steepest increase in terms of percentage change and experienced substantial increases in case numbers in every age group (see Table 4).

Table 3 describes changes in the number of cellulitis hospitalizations between 2000 and 2007 for individuals grouped by age and insurance status. The number of cases doubled among uninsured adults 18–64: from 283 to 554. However, the size of the uninsured population grew during that time period (from 9.8 to 13.5 percent of adults ages 18–64), according to estimates derived from the Behavioral Risk Factor Surveillance System. Between 2000 and 2007, the rate of cellulitis-associated hospitalizations increased from 7.2 per thousand to 10.1 per thousand among the uninsured. Among insured adults ages 18–64, cases increased from 732 to 1,235 and the rate increased from 2.0 to 3.5 per thousand insured adults. We cannot construct rates of cellulitis-

associated hospitalizations for children ages 0–17 because we lack data regarding insurance status.

Table 3: Change in the Number of Hospitalizations Associated with Cellulitis by Insurance Status, 2000–2007

Age	Total			Insured			Uninsured		
	2000	2007	Change in the Number of Hospitalizations	2000	2007	Change in the Number of Hospitalizations	2000	2007	Change in the Number of Hospitalizations
0–17	118	272	154	117	266	149	1	6	5
18–39	405	667	262	257	378	121	146	278	132
40–64	612	1,144	532	475	857	382	137	276	139
65+	321	366	45	321	365	44	0	0	0
All Adults 18–64	1,456	2,449	993	1170	1,866	696	284	560	276
	1,017	1,811	794	732	1,235	503	283	554	271
	Percent Change in Rate			Percent Change in Rate			Percent Change in Rate		
Rate per 1,000 (18–64)	2.5	4.5	76%	2.0	3.5	74%	7.2	10.1	41%

Table 4 profiles changes in cellulitis cases by zip code, age, and insurance status. We are unable to construct rates because we lack appropriate population data at the zip code level and by insurance status.

Table 4: Change in Hospitalizations Associated with Cellulitis by Zip Code and Insurance Status, 2000–2007

	0–17			18–39			40–64			65+		
	Total Change	Ins.	Unins.	Total Change	Ins.	Unins.	Total Change	Ins.	Unins.	Total Change	Ins.	Unins.
21201	1	1	0	7	2	5	22	16	5	7	7	0
21202	1	1	0	10	-2	6	23	14	1	5	5	0
21205	6	6	0	-4	-5	0	30	28	2	-2	-2	0
21206	4	5	-1	18	13	5	24	17	7	-6	-6	0
21207	10	10	0	24	19	5	20	16	4	3	3	0
21209	2	2	0	2	1	1	4	4	0	-1	-1	0
21210	-1	-1	0	3	3	0	-2	-2	0	2	2	0
21211	-2	-2	0	7	5	2	13	11	2	-1	-1	0
21212	12	12	0	-3	-5	1	9	7	2	-5	-5	0
21213	14	12	2	0	-4	4	21	13	8	2	2	0
21214	4	4	0	14	8	6	18	10	8	-3	-4	0
21215	10	10	0	3	1	2	37	25	12	23	23	0
21216	12	12	0	19	10	9	19	13	6	4	4	0
21217	16	16	0	13	9	4	40	30	10	13	13	0
21218	13	13	0	14	8	6	47	38	9	14	14	0
21223	0	-1	1	39	17	22	82	52	30	3	3	0
21224	9	7	2	23	10	13	18	20	-3	-16	-16	0
21225	20	20	0	53	27	26	73	45	28	15	15	0
21226	5	5	0	8	6	2	15	9	6	3	3	0
21229	21	21	0	12	7	5	44	34	9	7	7	0
21230	8	8	0	35	12	22	51	35	16	3	3	0
21231	2	2	0	0	0	0	5	0	5	2	2	0
21239	2	2	0	9	7	2	10	10	0	0	0	0

Notes: Some zip codes contain areas not part of Baltimore City.

4. Conclusion

This report provides an analysis of cellulitis-associated hospitalizations in Baltimore City. Key findings include the following:

- Among children ages 0–17, hospitalization rates for cellulitis increased steadily between 2002 and 2005, dipped in 2006, and rose again in 2007.
- Among nonelderly adults, cellulitis hospitalizations and hospitalization rates increased steadily between 2000 and 2006. Among adults over 65, rates of cellulitis-associated hospitalizations increased from 2004 to 2006.
- Cellulitis-associated hospitalization rates declined among all adults between 2006 and 2007.
- Hospitalization rates associated with cellulitis were higher in Baltimore than in other locations, and they rose more rapidly. The steepest increases in rates in Baltimore occurred in PUMAs 4 and 5.

- Zip codes 21223 and 21225 had the largest number of cellulitis cases in 2007. Zip code 21225 had the greatest increase in number of cases between 2000 and 2007.
- Hospitalization rates associated with cellulitis increased among both insured and uninsured adults 18–64. Among insured adults, rates increased from 2.0 to 3.5 per thousand per year between 2000 and 2007. Among the uninsured, rates increased from 7.2 to 10.1 per thousand per year during the same period.