Letters

RESEARCH LETTER

Use of Radiography in Patients Diagnosed as Having Acute Bronchiolitis in US Emergency Departments, 2007-2015

Bronchiolitis, a viral infection of the lower respiratory tract, is an important health burden among young children worldwide[1] and the most common cause of hospitalization in the first year of life in the United States.[2] Clinical practice guidelines of the American Academy of Pediatrics (AAP), published in 2006 and revised in 2014, recommend against routine radiography in the evaluation of infants with bronchiolitis.[2] Unnecessary imaging for bronchiolitis contributes to health care costs, radiation exposure, and antibiotic overuse and consequently was identified in 2013 as a national "Choosing Wisely" priority. In this study, a longitudinal assessment of the proportion of infants diagnosed as having bronchiolitis who received radiography in emergency departments (EDs) between 2007 and 2015 was performed.

Methods | Using data from the National Hospital Ambulatory Medical Care Survey (NHAMCS), we conducted a repeated cross-sectional analysis of ED visits in the United States from 2007 to 2015 (most recent year of data release). The NHAMCS is conducted annually by the Centers for Disease Control and Prevention National Center for Health Statistics and uses multistage probability sampling to collect data about EDs, outpatient departments, and ambulatory surgery locations in the United States. Each visit is the basic sampling unit and is assigned a weight to allow generation of nationally representative estimates.[3] Our analysis was restricted to the NHAMCS ED data set (approximately 30 000 visits to 300 randomly

Table. Characteristics of ED Visits Among Children Younger Than 2 Years With Bronchiolitis and Association With Radiography Use, 2007-2015

	Unweighted Observations, No.	Weighted Visits, % (95% CI)	Unadjusted Radiography Use, % (95% CI)	Adjusted Odds Ratio (95% CI)[a]	*P* Value
Calendar year, 2007-2015	612	1.1 (0.9-1.3)[b]	46.1 (39.5-52.8)	0.99 (0.91-1.08)	.84
Age group, mo					
<3	84	16.0 (12.3-20.6)	44.5 (25.4-65.4)	1 [Reference]	
≥3-<12	344	56.7 (51.1-62.2)	44.0 (36.5-51.8)	0.88 (0.45-1.73)	.71
≥12-<24	184	27.3 (23.0-32.0)	51.2 (38.7-63.6)	1.08 (0.51-2.28)	.84
Sex					
Female	250	41.2 (36.5-46.2)	46.5 (37.4-55.9)	1 [Reference]	
Male	362	58.8 (53.8-63.5)	45.8 (38.6-53.1)	0.93 (0.63-1.39)	.74
Race[c]					
White	396	66.9 (61.2-72.1)	45.1 (36.6-53.8)	1 [Reference]	
Black	183	28.4 (23.1-34.4)	44.2 (34.5-54.5)	1.01 (0.59-1.71)	.98
Other	33	4.7 (3.1-7.1)	71.4 (50.8-85.8)	3.08 (1.13-8.43)	.03
Type of hospital					
Teaching[d]	129	13.1 (9.0-18.6)	31.8 (20.9-45.2)	1 [Reference]	
Nonteaching	483	86.9 (81.4-91.0)	48.2 (41.0-55.5)	1.55 (0.81-2.98)	.19
Pediatric[e]	133	23.4 (16.5-32.2)	25.0 (15.4-37.9)	1 [Reference]	
Nonpediatric	479	76.6 (67.8-83.5)	52.5 (45.6-59.4)	3.06 (1.75-5.34)	<.001
Triage acuity level					
Immediate/emergent	55	7.6 (5.3-10.7)	43.4 (27.3-61.1)	1 [Reference]	
Urgent	241	37.1 (32.0-42.6)	46.7 (38.8-54.6)	0.96 (0.42-2.19)	.93
Semiurgent	181	30.5 (25.5-35.9)	49.3 (37.8-60.8)	0.98 (0.45-2.17)	.97
Nonurgent	36	6.6 (4.0-10.6)	53.7 (32.3-73.8)	1.12 (0.36-3.42)	.85
Unknown/unavailable	99	18.2 (13.7-23.8)	37.9 (24.1-54.0)	0.75 (0.31-1.83)	.53
Insurance provider					
Self-pay	31	4.6 (2.8-7.4)	54.0 (30.0-76.3)	1 [Reference]	
Private	140	20.2 (15.9-25.3)	40.6 (30.2-51.9)	0.64 (0.21-1.93)	.43
Medicare/Medicaid	398	66.7 (60.5-72.5)	48.0 (40.0-56.2)	0.91 (0.31-2.66)	.87
Other/unknown	43	8.5 (5.4-13.1)	39.3 (21.0-61.3)	0.59 (0.15-2.39)	.46

Abbreviations: ED, emergency department; NHAMCS, National Hospital Ambulatory Medical Care Survey.

[a] Covariates included in multivariable model: calendar year (modeled as a continuous variable), patient age, patient sex, patient race, triage acuity, insurance provider, pediatric hospital status, and teaching hospital status.

[b] Percentage of all pediatric visits for patients younger than 18 years in the NHAMCS.

[c] Race was included in the analysis because it has been associated with differential imaging use in various pediatric presentations including bronchiolitis specifically. The race variable is captured by NHAMCS site representatives as 1 of the following: white, black/African American, Asian, Native Hawaiian/other Pacific Islander, American Indian/Alaska Native, or more than 1 race reported. The NHAMCS then recategorizes race as white, black, or other. The recategorized race variable was used for the analyses of this study.

[d] EDs were classified as teaching hospitals if at least 25% of all patients were evaluated by a resident physician.

[e] EDs were classified as pediatric hospitals if at least 85% of all visits were for patients younger than 21 years.

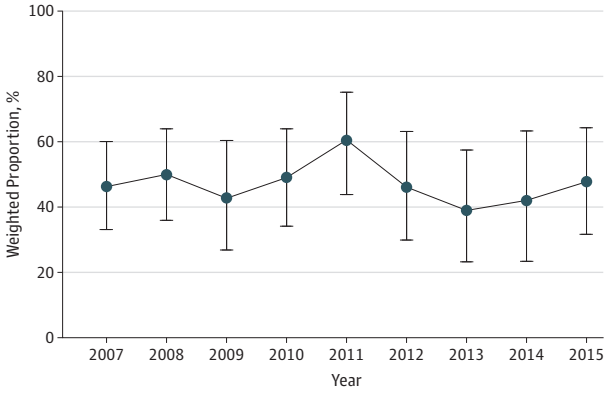
selected US EDs) and included children younger than 2 years with an ED discharge/admitting diagnosis of bronchiolitis (as identified by *International Classification of Diseases, Ninth Revision, Clinical Modification* codes 466, 466.11, and 466.19). We applied survey-weighting procedures to estimate annual frequency of radiography overall and in subgroups of admitted and discharged patients. Multivariable logistic regression was performed adjusting for patient- and ED-level covariates (STATA version 14.1; StataCorp). We analyzed trends using a Pearson χ^2 test of proportions. A 2-tailed $P<.05$ was considered statistically significant. This study was exempted from review by the McGill University Health Centre Research Ethics Board.

Results | Between 2007 and 2015, there were 269 721 unweighted ED visits in the NHAMCS, of which 59 921 were for children younger than 18 years. Among these, 612 (1.1% [95% CI, 0.9%-1.3%]; range, 53-75 observations annually) had an ED diagnosis of bronchiolitis. Median age was 8 months (interquartile range, 5-12 months), 58.8% were male, 66.9% were white, and the majority presented to nonteaching and nonpediatric hospitals (**Table**). The mean proportion of patients who were diagnosed as having bronchiolitis and received radiography was 46.1% (95% CI, 39.5%-52.8%). There was no change in the proportion of infants undergoing radiography by year (*P* for trend =.87; **Figure**), as confirmed in multivariable analysis (adjusted odds ratio for effect of year, 0.99 [95% CI, 0.91-1.08]). Among ED visits, 89.7% of patients were discharged and 10.3% were admitted. Restricting analysis to ED-discharged patients similarly revealed overall radiography use of 46.2% (95% CI, 39.4%-53.2%), which did not differ from the proportion among admitted children (44.8% [95% CI, 29.2%-61.6%]; $P = .83$). Using multivariable analysis, higher rates of imaging were associated with nonpediatric hospitals and race identity other than black or white (Table).

Discussion | Using a large representative sample of US ED visits, no decrease in radiography was observed between 2007 and 2015, despite AAP bronchiolitis guidelines in 2006 and 2014 and Choosing Wisely recommendations in 2013. Modest downward trends in radiography use were found in studies conducted immediately following AAP guidelines[4] and among admitted patients at pediatric centers.[5] Assuming study visits can be projected to reflect the US population, there would have been an estimated 2.92 million pediatric ED visits for bronchiolitis over the 9-year study period. In this broad ED context, radiography was performed in nearly half of bronchiolitis cases, and more frequently at nonpediatric hospitals. These results suggest that nationwide quality initiatives are still needed to translate bronchiolitis guidelines into practice.[6]

Study limitations include a lack of clinical data to determine the appropriateness of radiographic imaging, which may differ depending on physician experience. However, AAP guidelines recommend imaging only in severe cases that warrant intensive care or suggest the possibility of airway complication,[2] which is unlikely for ED-discharged patients. The NHAMCS does not specify body location of radiographs; chest imaging was assumed, which may have led to overestimation. The analyses relied on NHAMCS diagnosis accuracy and its rigorous validation processes to minimize misclassification.

Figure. Weighted Proportion of Children Undergoing Radiography in US Emergency Departments for Acute Bronchiolitis by Year



Error bars indicate 95% CIs. Mean value for 2007-2015, 46% (95% CI, 40%-53%; *P* for trend =.87).

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Drafting of the manuscript: Burstein.
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Statistical analysis: Burstein.
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Availability of Corn Masa Flour and Tortillas Fortified With Folic Acid in Atlanta After National Regulations Allowing Voluntary Fortification

In 1996, the US Food and Drug Administration (FDA) required all enriched cereal grains to be fortified with folic acid at a concentration of 1.40 µg/g.[1] Since then, there has been a significant reduction in the prevalence of spina bifida and anencephaly.[2] The regulation did not include fortification of corn masa flour, a staple food for many Hispanic people.[3] Hispanic women of reproductive age are less likely to take prenatal folic acid supplements, have lower blood folate concentrations, and have a higher prevalence of spina bifida and anencephaly than non-Hispanic women.[4,5] To address this disparity, the FDA published regulations allowing voluntary fortification of corn masa flour and tortillas in April 2016.[1,6] Our objective was to determine the availability of folic acid–fortified corn masa flour and tortilla products in Atlanta, Georgia, 20 months after the FDA permitted voluntary fortification.

Methods | In December 2017, we visited 11 grocery stores (Buford Highway Farmer's Market, Supermercado Chicago, Walmart [n = 2], Aldi [n = 2], Kroger [n = 3], and Publix [n = 2]) in northeast Atlanta that cater to a large concentration of Hispanic residents. We identified all products on the store shelves labeled "corn masa" and soft corn "tortillas," and from their nutritional labels, recorded whether the product was fortified with folic acid. Products labeled "cornmeal," "corn flour," or "wrap" without "masa" or "tortilla" on the label were excluded.

We sought to validate the labeling by measuring folate concentrations in selected products. We purchased 2 bags, with different production dates, of each product labeled as fortified with folic acid, and purchased 1 bag of each product not fortified with folic acid. We tested all bags labeled as fortified as well as an equal number of unfortified bags of corn masa flour, ensuring that each color of masa (blue, yellow, and white) and several producers were represented. We arbitrarily chose 5 corn tortilla products for testing, each from a different producer. As positive controls, we tested 2 "enriched" all-purpose flour and 2 "enriched" yellow cornmeal products. We sent coded, duplicate samples to a commercial research laboratory (Covance Laboratories) to test folate content in the products. Samples were analyzed using the standard microbiological method for folate concentration in foods. Summary statistics, including means and SDs, were analyzed using SAS software, version 9.4 (SAS Institute Inc).

Results | Forty-one corn masa flour and tortilla products were identified during our survey of grocery store shelves. Only 2 of 20 corn masa flour products (10%) and none of the 21 soft corn tortilla products (0%) identified were labeled as containing "folic acid." The mean folate concentration in the 4 bags of fortified corn masa flour tested was 1.28 (SD, 0.47) µg/g; the folate content was accurately labeled in 3 of these bags, while the fourth bag had an insufficient concentration (approximately 0.7 µg/g). The mean folate concentration in 4 bags of unfortified corn masa was 0.47 (SD, 0.30) µg/g and was 0.12 (SD, 0.01) µg/g in unfortified corn tortillas. The positive controls had a mean folate concentration of 1.43 (SD, 0.62) µg/g for "enriched" flour and 0.98 (SD, 0.39) µg/g for "enriched" cornmeal (**Table**).

Discussion | Twenty months after the FDA issued national regulations permitting voluntary fortification, all soft corn tortillas and most corn masa flour products were not fortified with folic acid in a convenience sample of grocery stores in northeast Atlanta. The laboratory analysis confirmed that folic acid content in fortified products was generally accurately labeled. The concentration of folic acid in unlabeled products, especially corn tortillas, was very low.

This study was conducted in 1 city but examined national brands; therefore, voluntary fortification could be low nationally. The FDA aimed to achieve widespread fortification of corn masa products to prevent health disparities among Hispanic people. If the study findings are generally representative, achieving this goal will require complete fortification of corn masa products. Until then, Hispanic women of reproductive age should eat only corn masa products and tortillas fortified with folic acid and take daily vitamin supplements containing 400 µg of folic acid.

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