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Impact of a Bronchiolitis Clinical Pathway on Management Decisions by Preferred Language

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Abstract

Background: Clinical pathways standardize healthcare utilization, but their impact on healthcare equity is poorly understood. This study aims to measure the effect of a bronchiolitis pathway on management decisions by preferred language for care. **Methods:** We included all emergency department encounters for patients aged 1–12 months with bronchiolitis from 1/1/2010 to 10/31/2020. The prepathway period ended 10/31/2011, and the postpathway period was 1/1/2012–10/31/2020. We performed retrospective interrupted time series analyses to assess the impact of the clinical pathway by English versus non-English preferred language on the following outcomes: chest radiography (CXR), albuterol use, 7-day return visit, 72-hour return to admission, antibiotic use, and corticosteroid use. Analyses were adjusted for presence of a complex chronic condition. **Results:** There were 1485 encounters in the preperiod (77% English, 14% non-English, 8% missing) and 7840 encounters in the postperiod (79% English, 15% non-English, 6% missing). CXR, antibiotic, and albuterol utilization exhibited sustained decreases over the study period. Pathway impact did not differ by preferred language for any outcome except albuterol utilization. The prepost slope effect of albuterol utilization was 10% greater in the non-English versus the English group (p for the difference by language = 0.022). **Conclusions:** A clinical pathway was associated with improvements in care regardless of preferred language. More extensive studies involving multiple pathways and care settings are needed to assess the impact of clinical pathways on health equity. *(Pediatr Qual Saf 2024;9:e714; doi: 10.1097/pq9.0000000000000714; Published online February 5, 2024.)*

INTRODUCTION

Clinical pathways designed to standardize care have proliferated in recent years with widespread adoption by health systems across the United States and Europe.[1–3] The impact of clinical pathways on health equity is poorly understood and may include: (a) the alleviation of disparities by reducing arbitrary variations in practice; (b) the exacerbation of disparities if the pathways are unequally applied across demographic groups, developed using data not representative of the larger population, or designed without an equity lens in mind; or (c) the maintenance of preexisting disparities, as may occur if pathway use affects quality for different groups in equal proportion.[4,5]

Bronchiolitis is the most common lower respiratory tract infection among infants and young children. It accounts for 18% of all pediatric hospitalizations in the United States, resulting in more than $500 million in direct costs annually.[6,7] National guidelines, quality improvement (QI) initiatives, and research efforts in bronchiolitis have focused on reducing low-value diagnostic and treatment modalities, including chest x-ray (CXR), inhaled bronchodilators, antibiotics, and corticosteroids.[8–15]

Disparities in bronchiolitis management have been quantified by preferred language, race, and ethnicity.[16,17] One study showed that children in families with Spanish as their preferred language for care had higher odds of receiving a CXR.[16] In contrast, another study demonstrated that non-Hispanic Black children had higher odds of asthma-directed therapies and lower odds of CXR.[17] The effect of clinical pathways on disparities in bronchiolitis care has not been thoroughly investigated.

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This study aims to deepen our understanding of the impact of care standardization on health equity and to generate hypotheses for future prospective investigations. To accomplish this, we performed a retrospective analysis to compare the impact of a clinical pathway on the management of children of families with English versus non-English preferred language presenting to the emergency department (ED) of a freestanding children's hospital.

METHODS

Research Study Design

We performed a retrospective time series study to assess the differential impact of a clinical pathway for bronchiolitis by preferred language on pertinent process and outcome measures.[18] All data were extracted from the Boston Children's Hospital (BCH) data warehouse.

Clinical Pathway for Management of Bronchiolitis in the Pediatric ED

The BCH ED is situated within a large academic quaternary care center with an annual ED volume of approximately 60,000 encounters. It is staffed by over 60 pediatric emergency physicians as well as 18 fellows, eight nurse practitioners and physician assistants, and over 200 rotating residents and medical students. BCH maintains a library of over 130 clinical pathways that are easily accessible via intranet and a smartphone application and are used broadly across the institution, with over 50,000 access episodes in 2021.

As has previously been published, the BCH clinical pathway for the management of bronchiolitis in the ED was developed by a multidisciplinary team chaired by a pediatric emergency physician and nurse between October 2010 and June 2011.[9] Twelve pediatric emergency medicine attending physicians reviewed multiple iterations of the pathway before implementation in November 2011.[9] The major recommendations of this pathway, which derived from the relevant American Academy of Pediatrics (AAP) guideline, were to refrain from routine utilization of viral testing, CXR, albuterol, or antibiotic administration (See **appendix 1, Supplemental Digital Content 1, http://links.lww.com/PQ9/A538**).[9] The pathway was revised in October 2015 to reflect the updated AAP clinical practice guideline on the diagnosis and management of bronchiolitis.[15] The original 2011 pathway stated that "routine use of bronchodilators is not recommended," however the revised 2015 pathway stated that the "American Academy of Pediatrics recommends that albuterol should not be used."

Two physicians, two nurses, a QI expert, a data analyst, and an administratorled guideline implementation, which was facilitated by the following principal strategies: (1) implementation of a bronchiolitis order set in the electronic medical record at the time of initial pathway release in November 2011, and removal of albuterol from the bronchiolitis order set in November 2017 (2) educational sessions related to albuterol de-implementation for clinicians in January 2014 and December 2017, (3) monitoring of division-level adherence to the pathway using statistical process control charts and periodic sharing of this data at staff meetings, and (4) individual ED physician performance reviews starting in November 2012.[9]

Inclusion and Exclusion Criteria

We included all encounters of patients aged 1–12 months with an ED discharge diagnosis of acute bronchiolitis by ICD-9-CM or ICD-10-CM code from 1/1/2010 to 10/31/2020. We defined the beginning of the study period as 1/1/2010 as earlier data were not available in the BCH data warehouse. We chose the 1–12 month age range to align with inclusion criteria in both the 2011 and 2015 versions of the bronchiolitis clinical pathway of age <12 months, while limiting the analysis to patients >1 months old, recognizing that neonates may appropriately receive interventions not typically recommended for bronchiolitis, especially laboratory testing and antibiotics when bronchiolitis occurs with fever. We excluded no encounters, and repeat encounters associated with the same medical record number were retained in the analysis.

Variable Definitions

The exposure variable was the preferred language for care as listed in the electronic medical record. Preferred language is ascertained by hospital registration staff during the patient's first clinical encounter at BCH (regardless of specific care location). It is modified after that only at family request. In the BCH ED setting, interpreter services are available 24 hours a day remotely for more than 40 languages via electronic tablet and in-person from 9 AM to midnight for Spanish and Arabic. Race and ethnicity were also reported as documented in the BCH electronic medical record, as ascertained by hospital registration staff.

For power calculations, we defined the primary outcome as CXR utilization and secondary outcome measures as albuterol administration, antibiotic administration, corticosteroid administration, 7-day ED return visit, and 72-hour ED return visit resulting in hospitalization. We identified return visits using a unique patient identifier linked to each index visit. Furthermore, we assessed the long-term durability of any changes in these outcomes associated with the pathway over time.

Definition of Time Periods

The bronchiolitis pathway was introduced on 11/4/2011; so we defined prepathway period as 1/1/2010–10/31/2011 and the postpathway period as 1/1/2012–10/31/2020 (after a 2-month washout period). Because there are seasonal fluctuations in the volume of bronchiolitis encounters throughout the year, we created a "time" variable by categorizing each calendar year into six distinct time increments, such that the number of

bronchiolitis encounters in each increment was roughly equal: (1) January, (2) February, (3) March–April, (4) May–August, (5) September–October, (6) November, and (7) December.

Statistical Analyses

Patient demographics in the pre- and postpathway implementation phases were characterized using frequencies with proportions and medians with interquartile ranges (IQR) for categorical and continuous variables, respectively (Table 1). Demographics stratified by preferred language (English versus non-English) were also tabulated among encounters in the pre- and postpathway phases (Table 2).

The preferred language variable was missing for 6% of the sample across the pre- and postpathway periods (n = 539). We addressed these missing data using logistic regression imputation.[19,20] All variables used in the analyses (including the outcome variables, as well as sex, age, race and ethnicity, and insurance status) were included in the prediction equations. Twenty imputed datasets were created.

We performed an interrupted time series (ITS) analysis to assess our primary and secondary outcomes.[21] We estimated a series of logistic regression models with the proportion of encounters in which patients received the diagnostic or treatment intervention as the dependent variable. Each model included terms for time (as defined above), implementation phase (pre- versus postpathway), preferred language (English versus non-English), and a three-way interaction term (time-by-phase-by-preferred language). This interaction term tested whether the implementation effect differed by preferred language. If the interaction term was significant, we estimated the implementation effect separately by preferred language subgroups. Based on a priori determination, a covariate for complex chronic conditions at the index visit was included in all models.[22] We fit all models using the imputed datasets and adjusted all effect estimates and confidence intervals for variability between imputations.[23]

We performed all analyses using the software package STATA SE, version 16.0 (StataCorp, College Station, Tex.). The BCH institutional review board (IRB-P00037309) considered the study exempted.

RESULTS

There were 1485 encounters before (77% English, 14% non-English, 8% missing) and 7840 encounters after (79% English, 15% non-English, 6% missing) pathway implementation (Table 1). The most common non-English preferred languages were Spanish (74% in both the pre- and postperiods) and Portuguese (9% in the preperiod versus 7% in the postperiod). Over the study period as a whole, non-English preferred language also included Cape Verdean Creole (3%), Haitian Creole (3%), Vietnamese (2%), Chinese Mandarin (2%), Somalian (1%), and Arabic (1%).

Emergency severity index (ESI) scores (a commonly used triage algorithm stratifying ED patients into five tiers based on acuity and resource needs) were less severe in the preperiod compared to the postperiod (9% of encounters were triaged as ESI 1 or 2 before pathway implementation versus 22% after pathway implementation). Demographic characteristics were qualitatively similar in the preperiod and postperiod (Table 1). The median age was 5 months (interquartile range 3–8 months) in both the preperiod and postperiod. Approximately 30% of encounters were by White patients, and 40% were by non-Hispanic Black or Hispanic patients in both periods. There were more encounters with missing race

Table 1. Demographic Characteristics before and after Pathway Implementation

	Preperiod (n = 1,485)		Postperiod (n = 7,480)	
Female Sex	572	(38.5)	2,993	(40.0)
Age (mo), median [IQR]	5	[3–8]	5	[3–8]
Race and Ethnicity				
Hispanic	376	(25.3)	1,656	(22.1)
Non-Hispanic Asian	27	(1.8)	182	(2.4)
Non-Hispanic Black	285	(19.2)	1,075	(14.4)
Non-Hispanic Multiracial	41	(2.8)	195	(2.6)
Non-Hispanic Other	173	(11.6)	776	(10.4)
Non-Hispanic White	468	(31.5)	2,198	(29.4)
Missing	115	(7.7)	1,398	(18.7)
Primary Language				
English	1,149	(77.4)	5,921	(79.2)
Not English	214	(14.4)	1,142	(15.3)
Missing	122	(8.2)	417	(5.6)
Emergency Severity Index				
1	0	(0)	41	(0.6)
2	127	(8.6)	1648	(22.1)
3	1005	(67.8)	4107	(55.1)
4	339	(22.9)	1581	(21.2)
5	11	(0.7)	72	(1.0)
Public Insurance	820	(55.2)	4232	(56.6)
CCC diagnosis at index visit	133	(9.0)	488	(6.5)

Values in table represent frequency (%) or median [IQR].
CCC, complex chronic condition.

and ethnicity in the postperiod (19% versus 8% in the preperiod).

In comparing demographic characteristics between patients with English versus non-English preferred language, race and ethnicity were more frequently non-Hispanic Black, non-Hispanic White, or missing among those with English preferred language, and more frequently Hispanic and non-Hispanic Other among those with non-English preferred language (Table 2). Those with a non-English preferred language were more frequently publicly insured.

Albuterol utilization rates were significantly lower at the beginning of the preperiod among non-English compared with English preferred language. However, the confidence interval for this result was wide (intercept comparison 0.52, 95% CI 0.29–0.93). (**See appendix 2, Supplemental Digital Content 2, http://links.lww.com/PQ9/A538**). Albuterol utilization increased among patients with non-English preferred language throughout the preperiod (preperiod slope OR 1.11, 95% CI 1.03–1.21) but remained stable among patients with English preferred language (Fig. 1) such that there were no significant differences in albuterol utilization by preferred language when examined over the preperiod as a whole (level comparison 0.91, 95% CI 0.68–1.22) (**Supplemental Digital Content 2, http://links.lww.com/PQ9/A538**). There were no significant slope or utilization rate differences between language groups for the other key outcomes during the preperiod (**Supplemental Digital Content 2,** http://links.lww.com/PQ9/A538).

After pathway implementation, albuterol utilization in both groups exhibited a downward trend (postperiod slope 0.96, 95% CI 0.96–0.96 among English versus 0.96, 95% CI 0.95–0.97 among non-English). The change in slope was greater among patients with non-English preferred language; the prepost change in slope was 10% greater among families with non-English compared with English preferred language groups (slope comparison difference of 0.90, 95% CI 0.82–0.99 between English versus non-English preferred language, three-way interaction $P = 0.022$). In an analysis of the most recent time period studied (January 2020–October 2020), there were no differences in albuterol utilization between groups (odds ratio 0.65, 95% CI 0.22–1.89).

The three-way interaction was insignificant for all outcomes other than albuterol administration, meaning that the implementation effect did not differ by preferred language. Both chest x-ray and antibiotic treatment exhibited significant immediate decreases in absolute utilization rates after pathway implementation – the odds of CXR acquisition decreased by 71% and antibiotic treatment by 37% from the beginning of the preperiod to the beginning of the postperiod (Table 3). No significant prepost effects were identified for corticosteroids, nor for balancing measures of 7-day return or 72-hour return to admission.

In the analysis of the durability of changes in outcomes, decreases in CXR, albuterol, and antibiotic utilization persisted throughout the postimplementation period, as indicated by the negative postimplementation slope for each of these measures (Table 3).

DISCUSSION

A bronchiolitis clinical pathway was associated with significant improvements in adherence to national guidelines, including sustained decreases in albuterol, CXR, and antibiotic utilization over a nearly 10-year period. In stratified analyses, the effect of decreased albuterol utilization was greater in the non-English compared with the English preferred language group. The other outcomes did not differ by language. Taken together, these stratified analyses show that the pathway was associated with approximately equal impact on all outcomes regardless of

Table 2. Demographic Characteristics by Language before Pathway Implementation

	Preperiod (1/1/2010–10/31/2011)						Postperiod (1/1/2012–10/31/2020)					
	English (n = 1,149)		Not English (n = 214)		Missing (n = 122)		English (n = 5,921)		Not English (n = 1,142)		Missing (n = 417)	
Female Sex	426	(37.1)	96	(44.9)	50	(41.0)	2,378	(40.2)	441	(38.6)	174	(41.7)
Age (Mo), median [IQR]	5	[3–8]	5	[3–8]	4.5	[2–7]	5	[3–8]	5	[3–8]	6	[3–9]
Race and Ethnicity												
Hispanic	214	(18.6)	148	(69.2)	14	(11.5)	1,006	(17.0)	608	(53.2)	42	(10.1)
Non-Hispanic Asian	19	(1.7)	6	(2.8)	2	(1.6)	119	(2.0)	50	(4.4)	13	(3.1)
Non-Hispanic Black	253	(22.0)	11	(5.1)	21	(17.2)	945	(16.0)	62	(5.4)	68	(16.3)
Non-Hispanic Multiracial	31	(2.7)	4	(1.9)	6	(4.9)	163	(2.8)	17	(1.5)	15	(3.6)
Non-Hispanic Other	126	(11.0)	35	(16.4)	12	(9.8)	583	(9.8)	161	(14.1)	32	(7.7)
Non-Hispanic White	415	(36.1)	2	(0.9)	51	(41.8)	1,999	(33.8)	33	(2.9)	166	(39.8)
Missing	91	(7.9)	8	(3.7)	16	(13.1)	1,106	(18.7)	211	(18.5)	81	(19.4)
Emergency Severity Index–												
1	NA		NA		NA		32	(0.5)	7	(0.6)	2	(0.5)
2	100	(8.7)	22	(10.3)	5	(4.1)	1,328	(22.4)	210	(18.4)	110	(26.4)
3	779	(67.9)	133	(62.2)	93	(76.9)	3,276	(55.3)	589	(51.6)	242	(58.0)
4	260	(22.7)	56	(26.2)	23	(19.0)	1,201	(20.3)	323	(28.3)	57	(13.7)
5	8	(0.7)	3	(1.4)	0	(0)	60	(1.0)	8	(0.7)	4	(1.0)
Public Insurance Status	575	(50.0)	186	(86.9)	59	(48.4)	3,031	(51.2)	1,007	(88.2)	194	(46.5)
CCC diagnosis at index visit	104	(9.1)	18	(8.4)	11	(9.0)	351	(5.9)	95	(8.3)	42	(10.1)

Values in table represent frequency (%) or median [IQE].
CCC, complex chronic condition.

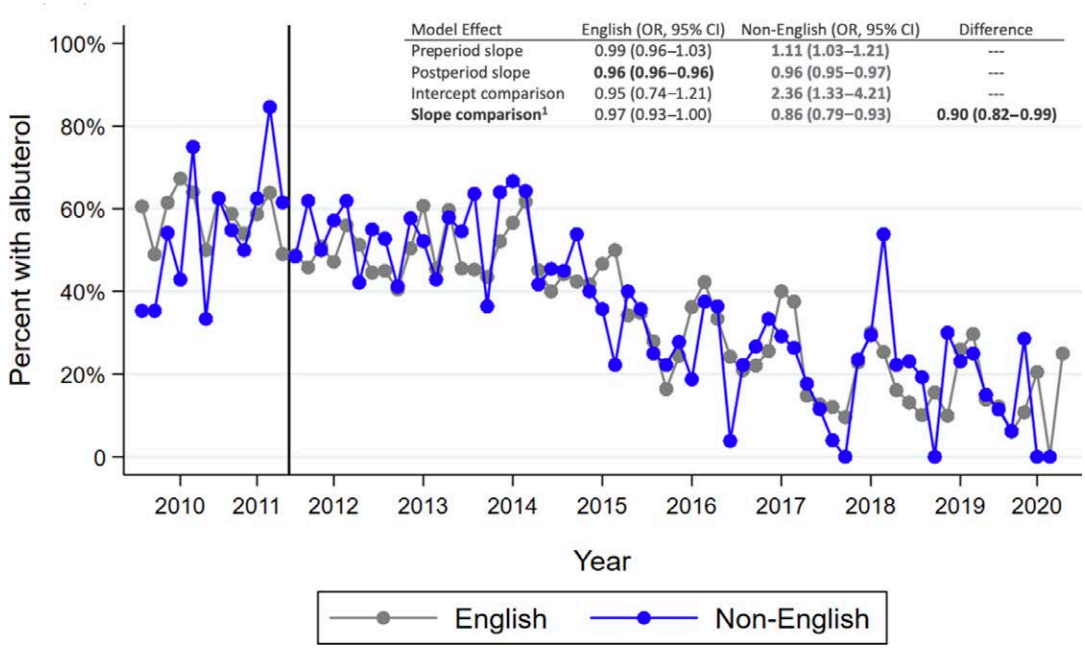

Fig. 1. Albuterol Administration before and after Pathway Implementation by Preferred Language.

Table 3. ITS Models for all Outcomes Except Albuterol Administration without Stratification by Preferred Language

Model Effect	CXR	Antibiotics	Corticosteroids	7-d Return	72-h Return
Preperiod slope	0.95 (0.92–0.98)	0.99 (0.95–1.04)	1.05 (0.99–1.11)	0.99 (0.95–1.04)	0.99 (0.93–1.04)
Postperiod slope	0.99 (0.99–0.99)	0.99 (0.99–0.99)	0.99 (0.99–1.00)	1.00 (0.99–1.00)	0.99 (0.99–1.01)
Intercept comparison	0.29 (0.23–0.37)	0.63 (0.44–0.89)	1.08 (0.69–1.69)	0.74 (0.53–1.03)	0.71 (0.48–1.05)
Slope comparison	1.05 (1.01–1.08)	0.99 (0.95–1.04)	0.95 (0.89–1.01)	1.01 (0.97–1.06)	1.01 (0.96–1.07)

Values in table represent odds ratio (95% confidence interval), adjusted for complex chronic condition status at index visit and primary language.

preferred language. The balancing measures of 7-day and 72-hour returns were unchanged over the study period suggesting that decreased utilization of these diagnostics and treatments did not result in a substantial burden of missed or undertreated cases.

Our study adds to a small body of the existing literature on the impact of clinical pathways on health equity. Some have theorized that protocolization of care may reduce disparities,[24,25] while others have suggested that guidelines may worsen disparities if the effects of proposed interventions: (1) differ between disadvantaged and privileged populations, (2) are valued differently by different populations, or (3) do not reach all populations equally due to implementation barriers that disproportionately impact one group over another.[26] For example, a single center prepost analysis found decreases in racial and ethnic disparities in skeletal survey acquisition for unwitnessed head trauma after the implementation of a clinical pathway.[27] Several other studies report racial and ethnic disparities in the management of pediatric conditions at the hospital level, despite the local availability of standardized pathways for those conditions.[4,28–32] Our study adds to this body of literature by using an ITS study design that examines preexisting trends.

The impact of clinical pathways on health equity will take on heightened importance as healthcare organizations, payors, and oversight regulators develop health equity dashboards that stratify key performance metrics by demographic variables (eg, race/ethnicity, sex, gender, preferred language).[33] To the extent that clinical pathways narrow disparities in healthcare utilization, they may represent a practical tool for healthcare organizations seeking to address identified disparities. On the other hand, if clinical pathways benefit groups unequally, organizations may seek to accelerate a transition toward incorporating equity as an explicit consideration in the guideline development and implementation process.[26,34]

Apart from the equity implications, this study also suggests that changes in management after clinical pathway implementation are sustained over time. A prior study of this bronchiolitis pathway also reported reductions in CXR and albuterol utilization, but the relatively short postperiod of 2011–2013 precluded conclusions about the persistence of the effect.[9] Our study extends this analysis for nearly 9 years after the date of pathway implementation and found long-term durability in practice improvements.

This study has several limitations. The analysis was performed with a single pathway at a single center, limiting generalizability. Data quality and completeness were limited by a retrospective design, which is particularly important in

the ascertainment of preferred language and race and ethnicity, given the potential inaccuracy of these variables as recorded in the electronic medical record and the proportion of patients for whom such data are missing in our sample. Although registration staff are instructed to obtain the patient's self-reported preferred language for care, this process has not been audited. Preferred language has important advantages as a measure of language status, but carries limitations: (1) the recorded preferred language may be of the caregiver rather than the patient, and (2) the preferred language is distinct from English proficiency, and some patients who prefer a language other than English may nonetheless have considerable English proficiency.[35] Furthermore, we did not have access to data on interpreter use and, therefore, cannot comment on potential modifying effects of this intervention on outcomes. Given the high proportion of missing race and ethnicity data, especially in the postperiod (18.7% of all encounters), we did not perform an analysis with race and ethnicity as the primary exposure, which, along with other intersecting demographic variables, might have enabled a broader assessment of pathway impact on equity.

The increase in ESI 1 and 2 scores in the postpathway period most likely reflects a concerted effort in the BCH ED in 2017 to improve the recognition of severe respiratory distress at triage, rather than a worsening in bronchiolitis severity over time. Specifically, the triage nurse orientation education was revised at this time to reinforce that the ESI algorithm definition of "severe distress" (prompting assignment of ESI 1 or 2) should include SpO2 < 90%. Finally, the analysis is limited by time-varying confounders in the form of other bronchiolitis-targeted QI interventions that occurred post-period, including the release of the revised 2014 AAP guideline. Although there seems to be a slope change in albuterol utilization starting around 2014 on a qualitative review of Figure 1, the sample size was inadequate to perform separate ITS analyses for this and other interventions.

CONCLUSIONS

A bronchiolitis pathway was associated with improvements in care regardless of patient language that were sustained over nearly a decade. The impact on albuterol administration was slightly greater among families with non-English versus English preferred language, but no difference by preferred language was observed for other outcomes. Given the growing use of clinical pathways nationally and internationally, it is important to understand their impact on health equity. Future studies examining multiple pathways across multiple centers may provide additional insights.

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