A Multicenter Collaborative to Reduce Unnecessary Care in Inpatient Bronchiolitis

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Dr Ralston conceptualized the project and codirected its implementation, coordinated and critically reviewed all analyses, and drafted the initial manuscript; Dr Garber conceptualized the project and codirected its implementation and critically reviewed and revised the manuscript; Ms Rice-Conboy coordinated all aspects of project design, implementation, and data collection and critically reviewed and revised the manuscript; Drs Mussman, Shadman, and Walley provided project leadership and content, performed a portion of the analysis, and critically reviewed and revised the manuscript; Ms Nichols performed the analyses, prepared all tables and figures, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

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Acute viral bronchiolitis represents one of the most frustrating care conundrums in pediatrics. No therapy has proven particularly useful, and evidence for overuse of unnecessary therapy is widely available.1-9 In response, the American Academy of Pediatrics (AAP) published a clinical practice guideline with the intention to improve the care of bronchiolitis.10,11 Furthermore, many institutions have published their own experience in reducing unnecessary care by using local guidelines and other quality improvement (QI) methods.12-25

Most published QI work has been accomplished in academic children’s hospitals, whereas the large majority...
of children’s care is delivered in community settings. Of the estimated 1.8 million, non–birth-associated childhood hospitalizations in the United States in 2012, only 28% occurred in freestanding children’s hospitals according to the 2012 Kid’s Inpatient Database.26 Nevertheless, little progress has been reported in translating lessons learned in academic settings to the settings where the most care is delivered. In response to this dichotomy, the Value in Inpatient Pediatrics network was established to facilitate implementation of effective interventions across the spectrum of hospitals that care for children.27 The Value in Inpatient Pediatrics network, under the auspices of the AAP, uses low-cost, practical strategies to disseminate best practices in voluntary collaboratives of hospital-based providers. Bronchiolitis was an early focus for this group because of its high volume, high rates of overuse, and the availability of an evidence-based guideline.

This project, titled “A Quality Collaborative for Improving Hospital Compliance With the AAP Bronchiolitis Guideline” (BQIP), aimed to improve the care of children hospitalized with bronchiolitis through increased compliance with the 2006 AAP clinical practice guideline over the period of 2 bronchiolitis seasons, with the following specific aims: (1) decrease the overall usage of bronchodilators by 50%; (2) decrease the overall usage of systemic corticosteroids by 50%; (3) decrease the overall usage of chest radiography by 50%; (4) achieve 90% compliance with the usage of an “objective method of assessment” of response to bronchodilators (ie, use of a respiratory score); (5) achieve 90% compliance with the implementation of an institutional policy on conversion from continuous pulse oximetry to intermittent pulse oximetry when children no longer require supplemental oxygen; and (6) achieve 90% compliance with screening and intervention for secondhand smoke exposure.

METHODS
This project was sponsored by the Quality Improvement Innovation Networks of the AAP and was approved by the AAP Institutional Review Board. Written informed consent was obtained from the team leader at each site. Local sites handled individual institutional review board applications as deemed necessary by the participating institution. No protected health information or patient identifiers were collected for the project, and sites were deidentified in public presentations of data.

Project Participants
The target size for the collaborative was 20 hospitals. Hospital selection criteria included use of a scoring system that gave higher priority to community sites that were not participating in other collaboratives. Eligibility criteria included having a minimum of 50 bronchiolitis admissions per year per hospital and the ability to assemble a core multidisciplinary improvement team consisting of, at minimum, a physician, a nurse, and a respiratory therapist.

Planning the Intervention
The project was conceived as an ~1-year virtual collaborative including webinars, teleconferences, a project list-serve, and individual site coaching by e-mail and telephone. No specific theoretical basis was explicitly chosen to plan the project; however, the approach was most closely allied with Nelson and Batalden’s work on clinical microsystems.28 The project required sites to assemble multidisciplinary teams recruited from the level of providers engaged in direct patient care, and maintained a focus on the interpersonal relationships that influenced care at the bedside.

Project planning began with an expert group meeting of members from a range of professional backgrounds. The 2 goals of this meeting were (1) to define measures developed from a comprehensive review of published QI studies29 and refined by group consensus and (2) to create a change package related to the measures which would serve as the primary intervention for the project. The change package developed consisted of (1) examples of evidence-based pathways and order sets; (2) an example of a respiratory scoring tool; (3) examples of effective communication tools, such as parent handouts and letters referring physicians; (4) slide sets for use in educational initiatives; and (5) a comprehensive guide to tobacco screening, brief intervention, and referral for smoking parents/caregivers. The change package is available for review on the project Web site at http://www.aap.org/quiin/vipbqip.

Monthly educational webinars were planned with topics including QI methods, clinical evidence around bronchiolitis, and published strategies to achieve practice change. Group aggregate performance feedback was periodically reviewed during the webinars. Teams planned their interventions after review of the baseline data to allow local patterns of care to inform choice of intervention. The AAP maintained an online project workspace with access to project materials, webinar recordings, individual site performance data, and group aggregate data. Additional guidance to sites came from a strategy of expert group members serving as coaches with a ratio of 3 to 4 sites per coach. Each coach was provided with the specific priorities of assigned sites as well as access to site performance data. Coaches were
assigned to sites based on their area of expertise matched to sites’ stated priorities. Coaches were encouraged to contact sites regularly to assess progress and provide individualized support, although no specific interaction was mandated and we did not track coaching interactions prospectively.

Planning the Study of the Intervention

The study of the intervention began with ongoing review of monthly data cycles as simple run charts by sites. All data were collected by chart review for 2 bronchiolitis seasons, defined as January, February, and March of 2013 and 2014. Sampling strategy was to include the first 20 admissions per month that met study criteria or all admissions if fewer than 20 patients were found. Teams initially reviewed run charts from the 2013 bronchiolitis season to establish a baseline and plan their intervention, then reviewed postintervention data monthly as they rolled out specific interventions. Patient-specific inclusion criteria were: hospitalized patients aged 24 months or younger; inpatient or observation status with the primary diagnosis of bronchiolitis as defined by International Classification of Diseases, Ninth Revision codes 466.11, 466.19, or 079.6. Exclusion criteria were significant prematurity (<35 weeks’ completed gestational age), chronic illness (congenital heart disease, bronchopulmonary dysplasia, asthma, chromosomal, genetic, congenital or neuromuscular abnormalities), or admission to the ICU.

Web-based data collection was accomplished by using the AAP’s Quality Improvement Data Aggregator, which created run charts that allowed participants to see their real-time performance compared with aggregate performance. All data collected in reference to project metrics were based on compliance with the metrics at the chart level, that is, a hospital may have had a policy on use of a respiratory score or tobacco screening but compliance with the use of that policy was measured and reported at the chart level.

Data entry was done by the practice sites, and there were no specific data integrity controls. Data cycles remained open for ~45 days after the end of the month to give sites time to review charts and pose queries to AAP Quality Improvement Innovation Networks staff.

Methods of Evaluation

A pre- and postproject survey assessed baseline site characteristics; self-reported knowledge, attitudes, and behaviors surrounding bronchiolitis care; and site-specific priorities. Local progress was tracked qualitatively with monthly narrative progress reports, providing information on timing and types of interventions attempted, challenges encountered, and perceived successes.

Although the seasonality of bronchiolitis limited our ability to analyze for secular trends throughout the study period, we analyzed preadmission management in the ambulatory setting (outpatient clinics and emergency departments) as a means of assessing changes in community practice during our QI initiative. We assessed length of stay and readmission as balancing measures.

Data Analysis

Data were analyzed at the collaborative and individual hospital levels. During the project, simple run charts were continuously available to sites on the Quality Improvement Data Aggregator, along with comparisons to the group mean. Afterward, continuous variables were summarized with medians and interquartile ranges. Wilcoxon rank-sum tests were used to compare hospital utilization before and after the intervention. Generalized estimating equations with robust SEs were used to assess the association of BQIP participation on hospital utilization while accounting for hospital clustering. The results were robust to generalized estimating equation models and yielded comparable results to the bivariate analyses presented in the results section. Statistical analyses were performed using Stata version 13.0 (StataCorp, College Station, TX).

Analysis of means (ANOM) was also used to analyze project results on a measure-specific basis. ANOM is an established QI statistical method for performing multiple comparisons. ANOM was used to compare cycle mean to the overall group mean with the goal of determining if the variation between cycles was due to common-cause variation.30 The low-resource nature of the project necessitated choosing the least labor-intensive process for data collection, hence with monthly cycles and only 6 data points we used ANOM charts rather than statistical process control methods in the final analysis. Traditional rules for evaluating change based on statistical process control are not applicable to charts with 6 data points; however, ANOMs provide for hypothesis testing by using similar 3σ control limits adjusted for the smaller number of comparisons made. Rules for interpreting ANOMs state that bars crossing the upper or lower control limits are deemed to have differed from the overall project mean for that measure at the 3σ level.

RESULTS

Thirty hospitals applied and 22 were selected based on prespecified criteria. One hospital dropped out before the intervention period, leaving a final cohort of 21 hospitals. The majority (55%) of hospitals self-identified as community hospitals,
with most remaining hospitals self-identified as children’s programs within a larger hospital. Of note, 83 physicians claimed maintenance of certification credit for QI activity for their participation.

A total of 1869 charts were reviewed for the project, 995 for preintervention cycles 1 through 3 (January, February, March 2013) and 874 during postintervention cycles 4 through 6 (January, February, March 2014). Most hospitals (57%) reported having a bronchiolitis pathway/order set in place before the project, and 33% reported using a respiratory score: increasing to 86% and 95%, respectively, postproject.

Group aggregate performance on all measures improved during the project as seen in Table 1, which presents the median performance and interquartile range during the before and after periods, although individual site performance varied as seen in Fig 1, which presents the site specific percentage change from baseline on utilization measures.

**Utilization Measures**

The overall proportion of patients receiving any bronchodilator decreased 29% \((P = .03)\). Figure 2 presents the mean rate of use of any bronchodilator per cycle in aggregate, by site and 3 \(\sigma\) control limits. Volume of use, defined by doses per patient among patients receiving any bronchodilator, declined significantly from median 6.9 (mean, 7.8) to 3.8 (mean, 5.5) doses \((P \leq .01)\). The overall proportion of any use of steroids declined 68% \((P < .01)\). Figure 3 presents the mean rate of steroid use per cycle in aggregate and by site, and 3 \(\sigma\) control limits. Volume of use, defined by doses per patient among patients receiving any steroid, declined after implementation from median 2.3 (mean, 3.1) to 1.5 (mean, 2.0) doses \((P = .04)\). Any use of chest radiography decreased by 36% from baseline \((P = .05)\). Figure 4 presents the rates of use of chest radiography per cycle and 3 \(\sigma\) control limits.

No community-based secular trend was noted in the rate of bronchodilator, steroid, or chest radiograph use in the outpatient or emergency setting during the project (Supplemental Figure 8).

**Process Measures**

Respiratory score use increased from hospital median 0% (mean, 17.2%) to 61% (mean, 55%) after BQIP implementation \((P \leq .01)\). Figure 5 shows rates of respiratory score use per site per cycle with 3 \(\sigma\) control limits. Pulse oximetry discontinuation increased fourfold to a median of 55% \((P < .01;\) Fig 6). Tobacco screening compliance increased 11% \((P = .03)\) with a project median of 89% (Fig 7). Additionally, 52% of project sites achieved the project goal of 90% compliance with tobacco screening.

**Balancing Measures**

Median length of stay decreased by 5 hours, from 49.6 to 44.6 hours \((P < .01)\). The median readmission rate during the before period was 2% (mean, 1.9%). After project implementation the median readmission rate was 0% (mean, 1.8%; \(P = .69)\).
DISCUSSION

This collaborative achieved reductions in overuse of unnecessary care in bronchiolitis in the majority of participating sites. We adapted existing resources to create a toolkit of easily implemented best practices and disseminated these interventions using a low-resource strategy. Another novel characteristic of this QI collaborative in comparison with the published literature is the type of hospital setting in which the work was performed. The only previous collaborative with a similar aim consisted of large freestanding children’s hospitals. We focused on enrolling community hospitals with the aim of establishing that successful dissemination of known best practices could be accomplished in a real-world setting with primarily volunteer participants.

It is worth noting that several sites in this project did not decrease the targeted unnecessary care. Two sites significantly increased any use of albuterol, and 3 sites significantly increased any use of steroids. Furthermore, >25% of sites increased chest radiography usage despite the aggregate rate declining. At the close of the project, we engaged teams in an in-depth qualitative interview to further analyze correlates of high- and low-performing sites and which we plan to report on in the future.

Our results compare favorably to other published QI work on bronchiolitis. Mittal et al recently published their experience with a similar project implementing a guideline intended to reduce resource utilization in bronchiolitis, providing a useful comparison by which to benchmark our project. We achieved a 29% reduction in bronchodilator use (to 32.7%), whereas Mittal reported a 48% reduction by the second year of the project (to 14%). It must be noted that their measure for bronchodilator use was >2 doses, and ours was ≥1 dose, so overall utilization may actually be lower among our cohort given the more stringent measure. Steroid use decreased by 68% (to 2%) in our cohort, whereas Mittal reported a 41% decrease (to 11.25%). We used length of stay as a balancing measure, and our data closely resemble Mittal’s with both projects suggesting standardization of care decreases length of stay. Readmissions were infrequent and did not measurably increase in either study. Parikh et al compared resource utilization before and after publication of the AAP bronchiolitis guidelines.
guideline using a large cohort of administrative data from 41 freestanding children’s hospitals. This study compared a preguideline season (2004–2005) to an early (2007–2008) and late (2011–2012) postguideline season. Bronchodilator use decreased by 10%, and chest radiography utilization decreased by 15%. This study likely indicates the presence of national secular trends toward decreased utilization in inpatient bronchiolitis care in freestanding children’s hospitals.

One major limitation of our study is an absence of data integrity controls. Cohort participants performed their own chart review and entered their own data, which would allow for social desirability bias to affect our results; for example, the desire to appear improved may have unconsciously motivated individuals to alter results. Evidence to the contrary exists because several sites reported no improvement. Furthermore, the voluntary nature of the project and the significant time commitment are likely to attract individuals seeking real change in their systems. Another significant limitation is the short duration of the project and hence the lack of any ability to comment on the sustainability of the change demonstrated. Nevertheless, the majority of centers adopted enduring tools such as guidelines or respiratory scores embedded in their medical record, which should mitigate return to previous patterns of care. Finally, the small number of data points and absence of a control group limited our ability to examine the temporal relationship between interventions and outcomes and distinguish these from existing secular trends. The postintervention season was considerably lighter in terms of volume with 121 fewer charts reviewed. Less volume may have allowed for more attention to the QI efforts and augmented the impact of the intervention. However, there is at least 1 study suggesting that unnecessary care in bronchiolitis actually declines as volume increases.

The most striking characteristic of our project was the primary focus on discontinuation of unnecessary therapies (with the exception of tobacco cessation counseling). There is a paucity of QI work on exactly how to reduce unnecessary care, and “deimplementation” is a newly coined term. On the basis of our experience in this collaborative and a previous iteration, we hypothesize that sharing experience...
in a collaborative has a specific value in reducing unnecessary care in its effect on establishing normative behavior among a peer group. The collaborative is also likely to provide a mechanism to overcome the inertia of clinical practice and increase participant’s sense of self-efficacy, both known barriers to guideline uptake. As the study of deimplementation progresses, we suggest that studies of the psychological drivers of unnecessary care will be important to further define what makes this work different from implementation science. Other future work could expand this methodology to include the full care continuum, in particular, the emergency department and outpatient settings.

CONCLUSIONS

Unnecessary care for bronchiolitis was reduced in a voluntary multisite collaborative with a focus on community hospitals. The results of this project are potentially generalizable to the settings in which the majority of children are hospitalized in the United States.

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Sacred Heart Hospital, Pensacola, FL
Northeast Georgia Medical Center, Gainesville, GA
Silver Cross Hospital, New Lenox, IL
Rush University Medical Center, Chicago, IL
Northwestern Lake Forest Hospital, Lake Forest, IL
Loyola University Medical Center, Maywood, IL
Children’s Hospital University of Illinois, Chicago, IL
Wesley Medical Center, Wichita, KS
Stormont-Vail Healthcare, Topeka, KS
Mott Children’s Hospital, Ann Arbor, MI

FIGURE 6
Compliance with limiting pulse oximetry.

FIGURE 7
Tobacco exposure screening documented after hospital admission.
REFERENCES


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