RESEARCH ARTICLE

Actively Doing Less: Deimplementation of Unnecessary Interventions in Bronchiolitis Care Across Urgent Care, Emergency Department, and Inpatient Settings

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ABSTRACT

BACKGROUND AND OBJECTIVES: Quality improvement (QI) initiatives have increased provider adherence to individual components of a bronchiolitis clinical practice guideline (CPG). Few have evaluated complete adherence to a guideline in multiple types of care settings. Our aim with this study was to increase complete adherence to our institutional bronchiolitis CPG in urgent care center, emergency department, and inpatient settings.

METHODS: We conducted a QI study at a single pediatric institution with multiple care settings. Encounters for patients with bronchiolitis ages >60 days to <24 months occurring between October 1 and March 31 in 2015–2018 were included. Those in intensive or subspecialty care were excluded. Management of each encounter was considered adherent to the CPG if none of the following were ordered: respiratory pathogen panel, respiratory syncytial virus antigen, complete blood cell count, blood culture, chest radiography, bronchodilator, antibiotic, or systemic corticosteroid. Medical team education, family engagement, order set modifications, and data dissemination were employed to drive deimplementation. We used interrupted time series to assess changes in processes and outcomes both across and within seasons.

RESULTS: Analysis included 13 063 patient encounters. Hospital-wide complete adherence to the CPG increased ($P < .001$) from 40.9% (95% confidence interval 39.3%–42.5%) to 54.6% (95% confidence interval 53.2%–56.0%). Although CPG adherence improved in all 3 clinical settings, the use of individual CPG components varied by setting. Direct cost decreased in the urgent care center ($P < .001$) and emergency department ($P = .001$).

CONCLUSIONS: We created a strict definition of CPG adherence and used QI methodology to deimplement multiple overused tests and medications across the continuum of patient care.

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Drs Nedved and Berg contributed equally as co–first authors, conceptualizing and designing the quality improvement study, analyzing and interpreting the data, and drafting the initial manuscript; Dr Richardson assisted in study design and analyzed and interpreted the data; Drs Montalbano, Michael, and Johnson mentored Drs Nedved and Berg throughout the study, including in quality improvement planning and data interpretation, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

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In 2014, the American Academy of Pediatrics (AAP) updated its clinical practice guideline (CPG) on the evaluation and management of patients with bronchiolitis. The AAP guideline recommends diagnosing bronchiolitis on the basis of history and physical examination, without the need for radiographic or laboratory tests.[1] The guideline also discourages the use of bronchodilators, systemic corticosteroids, and antibiotics for treatment of bronchiolitis. Despite these recommendations, significant variability in care and persistence of overtreatment exist nationally.[2–4]

Since the updated AAP guideline, multisite quality improvement (QI) studies have been focused on improving individual components of the AAP bronchiolitis guideline in the inpatient[5–8] or emergency department (ED) settings[3,9] independently. There have also been successful collaboratives involving both inpatient and outpatient settings achieving decreased use of unnecessary tests and medications.[3,10–12]

Although many studies have focused on improving ≥1 component of the AAP bronchiolitis guideline, fewer have used a composite score to evaluate complete adherence to the guideline. In a retrospective cohort study, Bryan et al[11] used a scoring system to classify level of adherence into low, middle, or high tertials, demonstrating that clinical pathway adherence in the ED and inpatient settings was associated with shorter length of stay (LOS) and lower cost.[11] Henao-Villada et al[12] used a composite score to measure adherence to multiple components of a bronchiolitis CPG but defined adherence as the use of 3 or fewer tests or medications.[12]

To address overuse and provide high-value care for patients with bronchiolitis at our institution, we identified a need to bridge the gaps among multiple settings along the continuum of patient care and create a strict definition of CPG adherence. The aim of this QI study was threefold: to (1) increase complete adherence with our institutional bronchiolitis CPG in patients 60 days to 24 months of age treated in the urgent care center (UCC), ED, and general inpatient units from a baseline of 41% to 60% within 2 bronchiolitis seasons; (2) evaluate the degree of deimplementation of each test or medication by care setting; and (3) assess the impact of high-value care on direct cost.

METHODS

Setting

The setting was a tertiary-care pediatric medical center with 2 freestanding pediatric hospitals each with an ED and 3 affiliated freestanding pediatric UCCs located throughout the metropolitan area. The UCC and ED directly admitted patients to the inpatient units, which were staffed by pediatric hospitalists.

Study Design

Our workgroup of nurses, respiratory therapists, a hospitalist, an ED physician, and an urgent care physician used QI methodology to identify drivers of poor adherence to the AAP guideline (Supplemental Fig 4). Among these were outdated order sets that included low-value tests and medications, as well as the availability of standing orders for nurses to obtain viral testing in the UCC and ED before provider evaluation. Additionally, we hypothesized that providers' discomfort with watchful waiting and supportive care alone, heightened by families' expectations or requests, was a driver of resource overuse. Finally, we recognized the absence of a standard, unified message to families from providers, nurses, and respiratory therapists across multiple care settings.

In this QI study, we included encounters for patients with a primary diagnosis of bronchiolitis ages >60 days to <24 months in the pediatric UCC, ED, or general inpatient units from October 1 to March 31 in 2015–2016 (baseline), 2016–2017 (season 1), and 2017–2018 (season 2). Patients admitted to the PICU or subspecialty services were excluded because they were outside the scope of our CPG. Those transferred from the general inpatient unit to the PICU were included in the balancing measure of transfer to higher level of care (LOC) but were excluded from other measures. The quality of the query was audited with a manual chart review of 10% of encounters. The study received exempt status from the institutional review board.

Interventions

In preparation for season 1 (October 1, 2016–March 31, 2017), improvement interventions included (1) updating the institutional CPG to reflect the 2014 AAP bronchiolitis guideline, (2) updating the UCC or ED and inpatient order sets consistent with the new CPG, (3) removing standing orders for viral testing, (4) providing multidisciplinary education, and (5) implementing standardized family engagement. We created a new family engagement handout to address our hypothesis that family requests and inconsistent communication were drivers of overuse (Supplemental Fig 5). These handouts, available in English and Spanish, were reviewed with families once the diagnosis of bronchiolitis was made. The standardized family engagement also included demonstration of nasal suctioning and provision of a bulb syringe.

Just before season 2 (October 1, 2017–March 31, 2018), improvement interventions included (1) extending multidisciplinary education to our institution's nurse advice phone service and primary care clinics and (2) distributing a metrics dashboard to increase transparency. This dashboard was widely disseminated to nursing, respiratory therapy, providers, and hospital leadership on a monthly basis. It displayed hospital-wide process and outcomes measures as well as information about use of individual CPG components in each care setting (Supplemental Fig 6).

Measures

The primary outcome measure was the percentage of encounters in which the provider was completely adherent to the bronchiolitis CPG. Adherence was defined as ordering none of 8 medical interventions: respiratory pathogen panel (RPP), rapid respiratory syncytial virus (RSV) antigen, complete blood cell count (CBC), blood culture, chest radiograph (CXR), bronchodilators, antibiotics, or systemic corticosteroids. A medication was considered used if ≥1 doses were ordered. An antibiotic was included if administered or prescribed during the patient encounter regardless of codiagnoses. Each patient

TABLE 1 Characteristics of Patient Encounters Included in Study Cohort During Baseline, Season 1, and Season 2

	Overall	Baseline	Season 1	Season 2	*P*
Admissions, *N*	13 063	3722	4375	4966	—
Age, mo, *n* (%)					.071
2–6	6007 (46.0)	1697 (45.6)	1966 (44.9)	2344 (47.2)	—
7 –12	3921 (30.0)	1156 (31.1)	1308 (29.9)	1457 (29.3)	—
13 – 24	3135 (24.0)	869 (23.3)	1101 (25.2)	1165 (23.5)	—
Sex, *n* (%)					.673
Female	5437 (41.6)	1564 (42.0)	2036 (41.0)	1837 (42.0)	—
Male	7624 (58.4)	2157 (58.0)	2929 (59.0)	2538 (58.0)	—
Missing	2 (0.0)	1 (0.0)	1 (0.0)	0 (0.0)	—
Race, *n* (%)					.228
Non-Hispanic white	7012 (53.7)	2029 (54.5)	2334 (53.3)	2649 (53.3)	—
Non-Hispanic African American	2663 (20.4)	780 (21.0)	867 (19.8)	1016 (20.5)	—
Hispanic	2032 (15.6)	558 (15.0)	703 (16.1)	771 (15.5)	—
Asian American	160 (1.2)	35 (0.9)	52 (1.2)	73 (1.5)	—
Other	1196 (9.2)	320 (8.6)	419 (9.6)	457 (9.2)	—
Payer, *n* (%)					.002
Commercial	7639 (58.5)	2178 (58.5)	2607 (59.6)	2854 (57.5)	—
Government	5413 (41.4)	1544 (41.5)	1767 (40.4)	2102 (42.3)	—
Other or self-pay	11 (0.1)	0 (0.0)	1 (0.0)	10 (0.2)	—
H-RISK, mean (SE)	0.58 (0.00)	0.57 (0.01)	0.57 (0.01)	0.61 (0.01)	<.001
Setting, *n* (%)					<.001
UCC	3628 (27.8)	900 (24.2)	1289 (29.5)	1439 (29.0)	—
ED	6621 (50.7)	1874 (50.3)	2203 (50.4)	2544 (51.2)	—
Inpatient	2814 (21.5)	948 (25.5)	883 (20.2)	983 (19.8)	—

—, not applicable.

encounter was unique, and each test or medication was linked to the setting in which it was ordered. For example, if a CXR was ordered in the ED and the patient was subsequently admitted, that CXR was associated only with the ED encounter. Secondary outcome measures were (1) the frequencies at which each of the individual tests and medications were ordered in each setting and (2) the mean direct cost of all products and services in the UCC and ED settings.

Process measures were (1) the percentage of encounters for which the bronchiolitis order set was used and (2) the percentage of encounters during which the standardized family engagement was ordered. The balancing measures for UCC and ED encounters were LOS and frequency of hospital admission. The balancing measures for inpatient encounters were LOS, percentage of readmissions within 72 hours, and percentage of patients who required a transfer to higher LOC. Frequency of returns to the UCC or ED was not used as a balancing measure because reevaluation is often encouraged if access to the primary care provider is limited. Inpatient cost was not used as an outcome measure because of the challenges of separating per diem "room and board" from costs of medical interventions.

Statistical Analysis

Demographics and severity of illness were obtained from the Pediatric Health Information System. Severity of illness was measured by using the Hospitalization Resource Intensity Scores for Kids (H-RISK).[13] Patient encounter characteristics in baseline, season 1, and season 2 were compared by using χ^2 tests for association for categorical variables and 1-way analysis of variance for continuous variables.

We used an interrupted time series (ITS) approach rather than statistical process control charts to assess hospital-wide changes in percent of complete CPG adherence, order set use, and percent of family engagement both across and within bronchiolitis seasons because we could not safely assume that patterns observed at the end of 1 bronchiolitis season would persist to the beginning of the next.[14] ITS models included a random patient effect to account for the clustering of multiple bronchiolitis encounters for the same patient. Categorical balancing measures were compared across seasons by using a χ^2 test for association. Monthly direct costs were obtained from the StrataJazz Decision Support system by using a ratio of cost-to-charge allocation methodology.[15] Direct costs in all 3 care settings were normally distributed and were modeled across seasons adjusting for severity of illness by using linear regression models. We used log-linear models to assess changes in geometric mean LOS across seasons.

We then performed a secondary analysis of use of individual CPG components by care setting to further elucidate areas of high adherence and opportunities for continued improvement. We used multivariable logistic regression models to adjust for encounter characteristics (age, sex, race, payer, setting, severity of illness [H-RISK]) that could potentially change from season to season. All statistical analyses were performed by using SAS 9.4 (SAS Institute, Inc, Cary, NC). When applicable, *P* values <.05 were considered statistically significant.

RESULTS

Patient encounter characteristics of the 13 063 distinct patient encounters included in this analysis can be found in Table 1. There was no significant difference in age, sex, or race across seasons. Season 2 included encounters with higher mean severity of illness based on H-RISK, a higher proportion from a government payer, and a higher proportion occurring in the ED.

At baseline, mean complete adherence to the bronchiolitis CPG in all 3 clinical settings combined was 40.9% (95% confidence interval [CI] 39.3%–42.5%). By the end of

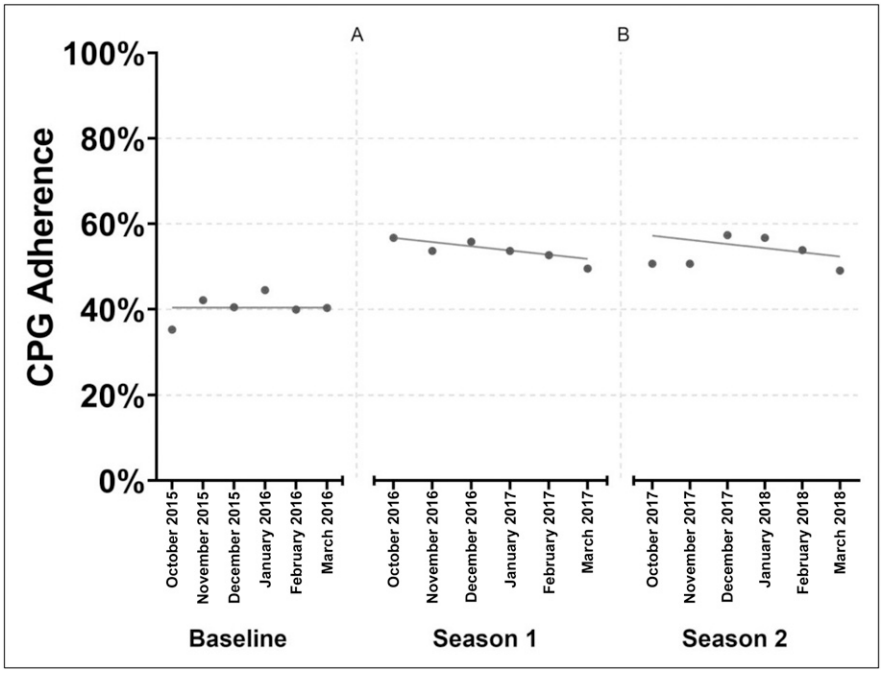

FIGURE 1 ITS of aggregate (UCC, ED, inpatient) CPG adherence. A, Interventions A: updated CPG, updated order sets, removed standing orders for viral testing in the UCC or ED, multidisciplinary education, standardized family engagement. B, Interventions B: multidisciplinary education of primary care clinics and nurse advice phone service, distributed monthly metrics dashboard.

season 1, mean adherence increased ($P <$ .001) to 53.8% (95% CI 53.8%–55.3%). There was no additional change between season 1 and season 2 ($P = .776$), and the improvement between baseline and season 1 was maintained at 54.6% (95% CI 53.2%–56.0%) through the end of season 2. ITS results (Fig 1, Supplemental Table 3) revealed no change in CPG adherence within the baseline season ($P = .744$). Although there was an increase in CPG adherence between the end of 1 season and the beginning of the next ($P <$ .001, baseline to season 1; $P = .026$, season 1 to season 2), adherence decreased within season 1 from 56.7% to 51.8% and within season 2 from 57.2% to 53.3%. Adjustment for patient encounter characteristics, including age, sex, race, payer type, severity of illness (H-RISK), and setting, yielded similar results (Supplemental Table 3). Order set use (Fig 2A) increased ($P <$ .001) from 70.9% to 84.7% within season 1 and increased again ($P = .003$) from 85.4% to 88.3% during season 2. Standardized family engagement (Fig 2B) did not change significantly ($P = .538$) within season 1 but increased ($P = .007$) from 36.3% to 43.4% during season 2.

Analysis of CPG components revealed that hospital-wide use of CXR, bronchodilators, rapid RSV antigen, and RPP decreased, with the largest reductions seen in the use of bronchodilators and rapid RSV antigen (Table 2). The use of CBC and use of blood culture were already low at <4% at baseline and did not change over time. Antibiotic use increased during season 1 but decreased back to baseline by the end of season 2. Direct cost per encounter decreased ($P <$ .001) from \$277 (95% CI \$267–\$286) to \$227 (95% CI \$217–\$237) in the UCC and decreased ($P = .001$) from \$429 (95% CI \$409–\$450) to \$348 (95% CI \$320–\$375) in the ED.

Deimplementation of medical interventions varied by clinical setting. Adjusted odds of using each test or medication are found in Fig 3. In the UCC, odds of using CXR, bronchodilators, and rapid RSV antigen all decreased from baseline. The ED revealed substantial improvement in rapid RSV antigen and RPP use. The inpatient setting successfully decreased use of antibiotic and bronchodilators.

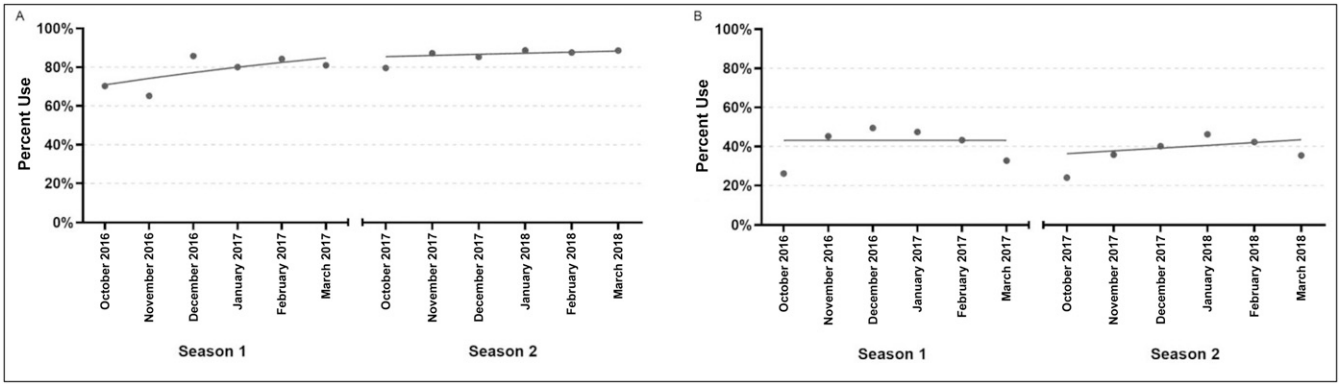

FIGURE 2 ITS of aggregate (UCC, ED, inpatient) process measures. A, Percent of encounters during which the bronchiolitis order set was used. B, Percent of encounters during which the family engagement order was placed during intervention seasons.

TABLE 2 Hospital-Wide Frequency of Use of Individual CPG Components (UCC, ED, Inpatient) Over Baseline, Season 1 and Season 2

	Baseline	Season 1	Season 2	*P*
Patient encounters, *n*	3722	4375	4966	—
CXR, % (95% CI)	18.1 (16.9–19.4)	15.8 (14.8–16.9)	14.6 (13.6–15.6)	<.001
Antibiotics, % (95% CI)	14.6 (13.5–15.8)	18.1 (17.0–19.3)	13.5 (12.5–14.4)	<.001
Bronchodilators, % (95% CI)	24.9 (23.6–26.3)	14.1 (13.1–15.1)	16.1 (15.1–17.2)	<.001
Rapid RSV, % (95% CI)	22.0 (20.7–23.4)	11.1 (10.2–12.1)	12.2 (11.4–13.2)	<.001
RPP, % (95% CI)	4.3 (3.7–5.0)	2.9 (2.5–3.5)	2.5 (2.1–2.9)	<.001
CBC, % (95% CI)	3.9 (3.4–4.6)	4.3 (3.7–4.9)	4.1 (3.6–4.7)	.754
Corticosteroids, % (95% CI)	6.3 (5.5–7.1)	4.1 (3.5–4.7)	6.0 (5.3–6.7)	<.001
Blood culture, % (95% CI)	2.8 (2.3–3.4)	2.9 (2.4–3.4)	2.5 (2.1–3.0)	.529

—, not applicable.

Balancing measures were followed in all 3 care settings. At baseline, the rate of admission in the UCC for patients with bronchiolitis was 6.6% and remained stable in season 1 (6.1%) and season 2 (6.2%). In the ED, the rate of admissions for bronchiolitis significantly decreased ($P <$ .001) from 20.0% to 15.8% in season 1 but returned to 19.9% in season 2. In the UCC, geometric mean LOS did not change significantly ($P = .604$) from baseline (1.50 hours) to season 1 (1.51 hours) and season 2 (1.53 hours). ED geometric mean LOS initially decreased from baseline (2.36 hours) to season 1 (2.20 hours) but then increased ($P <$ .001) in season 2 (2.57 hours). Inpatient geometric mean LOS decreased ($P = .060$) from a baseline of 45.7 to 40.7 hours by the end of season 2. Frequency of transfer to higher LOC in the inpatient setting increased ($P <$ .001) from baseline (3.1%) to season 1 (7.5%) and remained stable in season 2 (7.4%). There were no statistically significant changes ($P = .103$) in 72-hour readmissions from 1.8% at baseline to 1.0% by the end of season 2.

DISCUSSION

We created a strict definition of CPG adherence, classifying an encounter as adherent if none of 8 overused tests or medications were ordered. We approached our goal of 60%, reaching hospital-wide CPG adherence of 54.6% by the end of season 2. CPG adherence improved in the UCC, ED, and inpatient settings. Improvements in individual components varied by setting, but each setting achieved significant deimplementation in at least 2 of the overused tests or medications. Although cost per encounter in the UCC and ED decreased, UCC and ED LOS and admission rate fluctuated throughout the study period without significant change from baseline to the end of season 2.

In season 1, our use of standardized messaging to families across patient care settings created a framework to support deimplementation of unnecessary interventions. To highlight successes in season 1 and expose areas of opportunity, we created a dashboard to disseminate data throughout season 2. Our dashboard allowed viewers to quickly recognize achievements and opportunities for improvement in their care settings and across the institution. Implementation of the dashboard was associated with maintenance of CPG adherence during season 2 despite an increase in severity of illness.

Our results are consistent with those of previous studies that revealed that implementation of a bronchiolitis CPG successfully reduced the use of bronchodilators[3,5–8,10] and CXR.[6–10] Decreased viral testing was achieved in the UCC and ED settings, consistent with the multisetting study by Tyler et al.[10] Our results are also consistent with those of Bryan et al[11] who demonstrated adherence to a bronchiolitis clinical pathway was associated with shorter inpatient LOS and decreased ED costs.[11] These results support the use of a CPG as an effective tool to promote high-value care. Henao-Villada et al[12] demonstrated improvement in their more flexible definition of adherence, although neither use of inhaled bronchodilators nor use of CXR decreased. Their definition of adherence allowed for some variability in practice.[12] Although we used a strict definition of adherence, we emphasized that medical team members should be mindful of exceptional cases in which the CPG should not be applied.

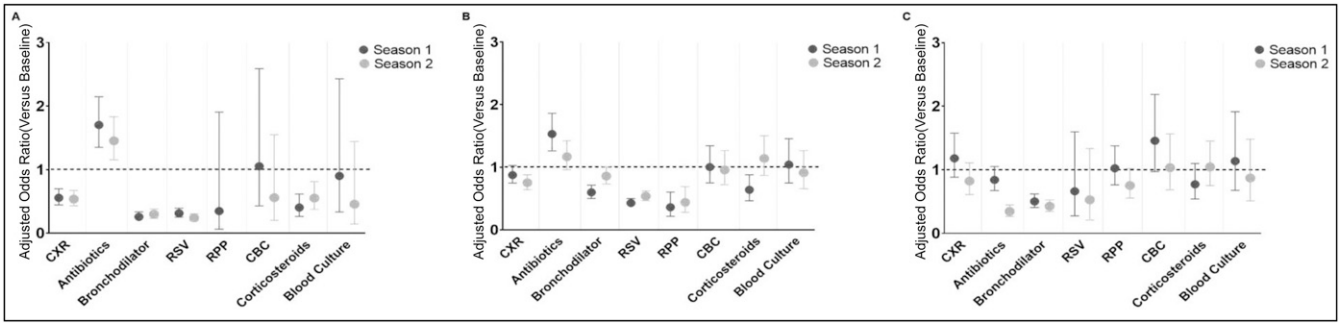

FIGURE 3 Adjusted odds ratio (95% CI) of individual CPG components by setting during intervention seasons versus baseline. A, UCC. B, ED. C, Inpatient. Odds adjusted for patient encounter characteristics (age, sex, race, payer type, severity of illness [H-RISK], and setting). RPP was not ordered in UCC during season 2.

Because of its complexity, this multidisciplinary QI study launched across a variety of care settings had limitations to the generalizability and interpretation of results. Encounters with patients with complex medical needs and diagnoses of bacterial coinfection were not excluded from our results because of the challenges of accurately identifying such encounter characteristics. These encounters likely contributed to higher resource use.

Transfer to higher LOC in the inpatient setting increased after the baseline season. However, our institution implemented the use of high-flow nasal cannula (HFNC) outside of the ICU just before the start of season 1. In the baseline period, those requiring HFNC were admitted to the PICU and were therefore excluded from our data entirely. During seasons 1 and 2, these patients were admitted to the general pediatric inpatient unit and then transferred to the PICU if HFNC settings exceeded certain limits. This change in process between the baseline and intervention seasons that allowed higher-acuity patients to be admitted to the general pediatric inpatient floor could account for the increased transfers to higher LOC.

Because of the seasonal nature of bronchiolitis, improvement interventions were made just before the beginning of each study season. Multiple changes were implemented at once, making it difficult to determine the degree to which each specific intervention drove improvement. During season 1 and season 2, the use of bronchiolitis education was highest during midseason when the incidence of bronchiolitis was also highest and then decreased toward the end of each season. The degree of improvement in CPG adherence from baseline also dropped off near the end of each season, suggesting that midseason interventions may be valuable in maintaining improvement throughout the duration of each season.

Although it is not appropriate to directly compare clinical settings with widely differing patient acuity, measuring use of individual CPG components in each clinical setting shed light on specific gaps in provision of high-value care unique to each care setting. Antibiotic use remained high in the UCC and ED, and RPP use remained high in the inpatient setting. Evaluating the use of tests and medication at the encounter level also allowed for monitoring for unintended consequences. In season 1, decreased use of CXR in the UCC and ED was accompanied by increased inpatient CXR use. However, inpatient CXR use decreased below baseline in season 2 even with continued outpatient improvement. Although deimplementation took place in the UCC and ED, there were no other reciprocal increases in inpatient use.

CONCLUSIONS

We successfully deimplemented medical interventions discouraged by the AAP bronchiolitis guideline to provide high-value care for patients across multiple care settings. We achieved this deimplementation by using a strict definition of CPG adherence and promoting consistent communication with families by medical team members in the UCC, ED, and inpatient settings. However, there remains room for improvement. We identified specific gaps in high-value care that may not be obvious when evaluating single care settings or CPG components. We also learned that improvements wane midseason. Although global interventions across clinical settings were associated with improvement from baseline, further improvement may depend on customized interventions specific to patient encounter characteristics, care setting, and CPG component with attention to the midseason to attain even greater improvement.

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