Group-facilitated audit and feedback to improve bronchiolitis care in the emergency department

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CLINICIAN'S CAPSULE

What is known about the topic?
Supportive care is the mainstay of treatment for most infants with bronchiolitis, yet many still receive low-value care.

What did this study ask?
What is the impact of providing individual practice data on improving bronchiolitis care management?

What did this study find?
Individual practice and peer-comparator data, in addition to group-facilitated audit and feedback, reduced the use of low-value bronchiolitis care.

Why does this study matter to clinicians?
Audit and feedback and group-facilitated feedback sessions can be an effective method to reduce low-value interventions.

ABSTRACT

Objective: Despite strong evidence recommending supportive care as the mainstay of management for most infants with bronchiolitis, prior studies show that patients still receive low-value care (e.g., respiratory viral testing, salbutamol, chest radiography). Our objective was to decrease low-value care by delivering individual physician reports, in addition to group-facilitated feedback sessions to pediatric emergency physicians.

Methods: Our cohort included 3,883 patients ≤ 12 months old who presented to pediatric emergency departments in Calgary, Alberta, with a diagnosis of bronchiolitis from April 1, 2013, to April 30, 2018. Using administrative data, we captured baseline characteristics and therapeutic interventions. Consenting pediatric emergency physicians received two audit and feedback reports, which included their individual data and peer comparators. A multidisciplinary group-facilitated feedback session presented data and identified barriers and enablers of reducing low-value care. The primary outcome was the proportion of patients who received any low-value intervention and was analysed using statistical process control charts.

Results: Seventy-eight percent of emergency physicians consented to receive their audit and feedback reports. Patient characteristics were similar in the baseline and intervention period. Following the baseline physician reports and the group feedback session, low-value care decreased from 42.6% to 27.1% (absolute difference: −15.5%; 95% CI: −19.8% to −11.2%) and 78.9% to 64.4% (absolute difference: −14.5%; 95% CI: −21.9% to −7.2%) in patients who were not admitted and admitted, respectively. Balancing measures, such as intensive care unit admission and emergency department revisit, were unchanged.

Conclusion: The combination of audit and feedback and a group-facilitated feedback session reduced low-value care for patients with bronchiolitis.

RÉSUMÉ

Objectif: Malgré les recommandations fondées sur des données probantes solides selon lesquelles la prise en charge de la bronchiolite chez la plupart des nourrissons devrait reposer principalement sur les soins d'entretien, des études démontrent que les patients sont encore soumis à des soins de faible valeur (recherche de virus respiratoires, salbutamol, radiographie pulmonaire, etc.). L'étude visait donc à diminuer le recours aux soins de faible valeur par la remise de rapports individuels aux médecins d'urgence pédiatrique (MUP) ainsi que par la tenue de séances collectives de rétroaction avec animateur.

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Méthode: La cohorte comptait 3883 patients âgés de ≤ 12 mois et traités pour une bronchiolite au service des urgences (SU) pédiatriques à Calgary (Canada), du 1er avril 2013 au 30 avril 2018. La collecte de données administratives a permis de dégager les caractéristiques de base et les interventions thérapeutiques. Les MUP consentants ont reçu deux rapports d'audit et de rétroaction, contenant leurs données personnelles ainsi que celles des pairs comparateurs. De plus, on a présenté, au cours d'une séance collective et pluridisciplinaire de rétroaction avec animateur, les données recueillies, de même que les obstacles à la diminution du recours aux soins de faible valeur et les facteurs facilitants. Le principal critère d'évaluation consistait en la proportion de patients soumis à des interventions de faible valeur, quelles qu'elles soient, et des analyses ont été effectuées à l'aide de cartes de contrôle de processus statistique.

Résultats: Au total, 78% des médecins d'urgence ont accepté de recevoir les rapports d'audit et de rétroaction. Les caractéristiques des patients étaient comparables au cours de la période de référence et de la période d'intervention. On a noté, après la remise des premiers rapports aux médecins et la tenue de la séance collective de rétroaction, une diminution de la proportion des soins de faible valeur, qui est passée de 42,6% à 27,1% (différence absolue : −15,5%; IC à 95% : −19,8% à −11,2%) et de 78,9% à 64,4% (différence absolue : −14,5%; IC à 95% : −21,9% à −7,2%) chez les patients non hospitalisés et hospitalisés, respectivement. Les mesures de stabilisation, telles que l'admission au service de soins intensifs ou les reconsultations au SU, sont restées stables.

Conclusion: L'association des rapports d'audit et de rétroaction et de la séance collective de rétroaction avec animateur a permis de réduire le recours aux soins de faible valeur chez les patients souffrant d'une bronchiolite.

Keywords: Audit and feedback, bronchiolitis, low-value care

INTRODUCTION

Bronchiolitis is a viral respiratory tract infection and the most common cause for hospitalization in infants under 12 months of age in Canada[1] and the United States.[2] Despite the commonality of bronchiolitis and the availability of clinical practice guidelines,[1,2] prior studies have shown that the management and treatment of bronchiolitis are variable and often inconsistent with best evidence.[3] This gap between best evidence and current practice provides an opportunity for quality improvement and reducing low-value care.

Due to the self-limited nature of bronchiolitis, supportive care is the mainstay of treatment for most patients. The Canadian Pediatric Society recommends supplemental oxygen and hydration for the treatment of bronchiolitis.[1] Some studies suggest that epinephrine nebulization may be effective in the first 24 hours of care.[4] However, the American Academy of Pediatrics guidelines recommend against routine epinephrine use.[2] Pharmacotherapy, such as corticosteroids,[5] bronchodilators,[6] antibiotics,[7] and antivirals, is not recommended because reductions in hospital admission rates or length of stay have not been observed. While chest radiographs and nasopharyngeal swabs do not improve diagnostic decisions or lead to changes in the management of most cases, they may be warranted in certain clinical scenarios.[1]

Due to existing evidence, rather than recommending specific interventions, bronchiolitis guidelines focus on reducing the overuse of low-value therapies.[8] Several projects have used quality improvement methodologies to reduce low-value therapies for bronchiolitis. Providing practice data, in addition to pledges of commitment from healthcare workers, has proven effective in reducing the use of bronchodilators, chest radiographs, and respiratory viral testing.[9] Tailored comparisons along with personal explicit targets can increase the effectiveness of audit and feedback interventions,[10] and contribute to actionable responses by staff.[11] Factors that influence the effectiveness of audit and feedback draw upon implementation science, motivational and behaviour change theory, and educational feedback.[12] When healthcare professionals are provided with peer data and opportunities to self-reflect on their disease management decisions, stronger adherence to bronchiolitis guidelines can occur.[13] These studies suggest that practice variation and the gap between evidence and care in bronchiolitis can be identified and addressed using quality improvement methods. The primary aim of this project was to reduce low-value care by providing physicians with their practice and peer comparator data by hosting group-facilitated audit and feedback sessions.

METHODS

Population

We identified patients ≤ 12 months old, diagnosed with bronchiolitis, and seen at any of the 7 emergency

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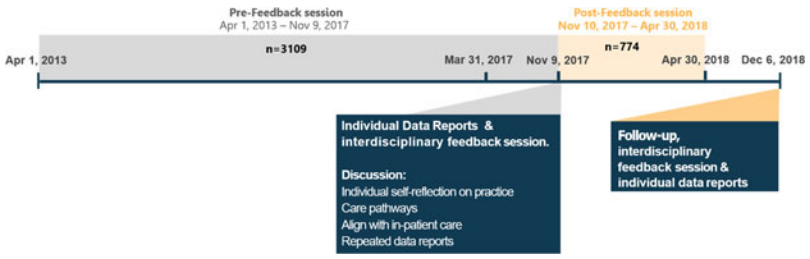

Figure 1. Timeline showing study periods and group-facilitated feedback sessions.

departments (ED) in Calgary, Alberta, by a pediatric emergency physician (hereinafter *physician*) between April 1, 2013, and April 30, 2018. More than 99% of patients were from two EDs, the Alberta Children's Hospital (ACH) (89.9%), and South Health Campus (SHC) (9.8%), which has pediatric ED coverage. For the 2017-2018 fiscal year, there were 77,274 pediatric ED visits to ACH and 14,378 to SHC. ED visit information was extracted from data in the electronic medical record system used at all sites and the National Ambulatory Care Reporting System database. The patient population included cases with a first-time ED discharge diagnosis of viral pneumonia (ICD-10-CA J12*), acute bronchitis (ICD-10-CA J20*), acute bronchiolitis (ICD-10-CA J21*), unspecified acute lower respiratory infection (ICD-10-CA J22*), respiratory syncytial virus (ICD-10-CA B97.4*), wheezing (ICD-10-CA R06.2), or asthma (ICD-10-CA J45*). Ethics for this study was obtained from the Conjoint Health Research Ethics Board at the University of Calgary (REB17-0247). The reporting of this study followed the revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0) guidelines.[14]

We excluded cases occurring in the out-of-season period (May 1–October 31) in this report for several reasons. Firstly, we only had in-season data for the intervention period. Secondly, the number of cases occurring out of season is low (16.6%). Thirdly, statistical process control charts data points representing a small number of cases will have considerably wider control limits.

Intervention

A study timeline including collection periods and interventions is summarized in Figure 1. Forty-one consenting physicians (of the 60 eligible) received an individual data report characterizing their bronchiolitis management between April 1, 2013, and March 31, 2017. Data reports outlined patient characteristics and initial presentation, investigations performed in the ED, medications administered, length of stay measures, admissions, ED revisit within 72 hours of index visit, and admitted to the hospital or pediatric intensive care unit (ICU) at return visit. Data reports compared individual practice to peer comparators at the 10th and 50th percentiles. Included in the data report was a summary of the Canadian Pediatric Society clinical guidelines for bronchiolitis.[1]

Physicians, respiratory therapists, nurses, hospitalists, and learners attended a multidisciplinary, group-facilitated feedback session on November 9, 2017. Two peer physicians facilitated the discussion using the Calgary Audit and Feedback Framework.[15] This framework fosters a socially constructed learning environment to aid recipients in moving from receiving and reacting to their data to action planning, which is based on theories from behaviour and performance change.[16] Mediating factors used to make group-facilitated feedback sessions more effective include relationship building between the facilitator and physician group, addressing questions that are actionable by physicians, providing easily interpretable data visualization, and reflective questioning. At the end of the discussion, participating physicians were encouraged to complete a Commitment to Change Form (Supplementary Figure 1), where they identified three concrete, measurable changes to improve their bronchiolitis management.

To assess the effect of the intervention, we collected data for 6 months following the group-facilitated feedback session. Forty-seven consenting physicians received a second individual data report and attended a second group-facilitated feedback session on December 6, 2018. This session summarized their bronchiolitis management practice before the intervention ("baseline period," April 1, 2013, to November 9, 2017) and 6 months following the intervention ("intervention period," November 10, 2017, to April 30, 2018). This study reports on the

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bronchiolitis management practices of all physicians (consenting and non-consenting) in these two periods (up to April 30, 2018).

Outcome measures

The primary outcome was the proportion of patients who received at least one of the following low-value bronchiolitis management practices in the ED: salbutamol, respiratory viral test, or chest radiograph. The secondary outcomes included usage of the previously mentioned practices individually, and the administration of steroids or epinephrine. Balancing measures included admission to hospital, admission to pediatric ICU, ED, length of stay, and ED revisit within 72 hours. There were no missing values for the outcome or balancing measures.

Statistical analysis

We compared patient characteristics, outcomes, and balancing measures before and after the individual physician report distribution and the first group-facilitated feedback session on November 9, 2017, stratified by hospital admission status. For outcomes and balancing measures, we calculated differences and confidence intervals (CI) using two-sample independent proportion tests or two-sample independent *t*-tests (assuming common variance).

We described biweekly percentages of patients receiving the primary and secondary outcomes using statistical process control charts. The baseline period before the intervention was used to calculate the centre line (mean) and the control limits, ±3 SDs of the mean, were calculated using the formula for *p*-charts.[17] To identify possible underdispersion or overdispersion in our data, we examined the difference between the *p*-chart and Laney P' chart control limits.[18] The control limits were similar so *p*-chart control limits were used for the rest of the analysis. Points outside of the control limits indicated special cause variation based on the Institute for Healthcare Improvement rules.[19]

We estimated the effect of the feedback session on the primary outcome using an interrupted time series design with segmented regression models.[20] Due to the relatively short intervention period, we did not have enough data to reliably estimate a slope. Therefore, we estimated a common slope in the baseline and intervention periods and a level change at the time of the intervention. Crude estimates were adjusted for hospital admission status.

All analyses were conducted using R version 3.5.0 (The R Foundation), and a two-sided p value < 0.05 was considered statistically significant. *P* values and CIs comparing secondary outcomes and balancing measures were not adjusted for multiple comparisons.

RESULTS

A total of 3,883 patients with bronchiolitis were treated in the ED during the five seasons (four in the baseline period and one in the intervention period). Table 1 shows patient characteristics in the baseline and intervention periods stratified by admission status. Admitted patients tended to have lower Canadian Triage and Acuity Scale (CTAS) scores and oxygen saturation levels compared to non-admitted patients. Patients had similar characteristics in the baseline and intervention periods.

For the primary outcome, a composite of three low-value bronchiolitis treatments and tests, the proportion of patients who received any of these three treatments or tests, decreased from 42.6% to 27.1% (absolute difference: −15.5%; 95% CI: −19.8% to −11.2%) and 78.9% to 64.4% (absolute difference: −14.5%; 95% CI: −21.9% to −7.2%) in patients who were not admitted and admitted to hospital, respectively (Table 2). In terms of the secondary outcomes, respiratory viral tests were ordered significantly less often in the intervention period in both groups, whereas salbutamol rates were significantly lower only for patients not admitted. There was no statistically significant change in the use of chest radiographs. ED length of stay decreased significantly for admitted patients, with no other interventions occurring that might have impacted patient flow during the time period. Regarding balancing measures, no statistically significant changes in admission to ICU (admitted patients only) or ED revisits within 72 hours of discharge were observed (see Table 2).

Process control charts for the percentage of patients receiving a low-value treatment or test are shown in Figure 2. Special cause variation indicated improvement for the composite outcome as well as the administration of salbutamol and respiratory viral test ordering (see Figure 2A-C). In the post-intervention bronchiolitis season, a run of 8 consecutive points below the centre line was observed for each of these measures. No special cause variation was observed for chest radiographs (see Figure 2D). Interrupted time series analysis supports the findings from control charts, where respiratory

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Table 1. Patient characteristics by hospital admission status in the baseline and intervention periods

Characteristic	Not admitted to hospital		Admitted to hospital	
	Baseline period (n = 2,408)	Intervention period (n = 558)	Baseline period (n = 701)	Intervention period (n = 216)
Demographics				
Age, median (IQR), mo.	5 (3–8)	5 (3–7)	3 (1–6)	3 (1–6)
Female, n (%)	974 (40.4)	222 (39.8)	313 (44.7)	99 (45.8)
Clinical characteristics at ED presentation				
Canadian Triage and Acuity Scale (CTAS) score, n (%)				
1 – Resuscitation	4 (0.2)	1 (0.2)	79 (11.3)	26 (12.0)
2 – Emergent	727 (30.2)	213 (38.2)	478 (68.2)	157 (72.7)
3 – Urgent	1,403 (58.3)	294 (52.7)	128 (18.3)	31 (14.4)
4 – Less urgent	206 (8.6)	46 (8.2)	11 (1.6)	2 (0.9)
5 – Non urgent	23 (1.0)	4 (0.7)	0 (0.0)	0 (0.0)
Not recorded	45 (1.9)	0 (0.0)	5 (0.7)	0 (0.0)
Weight, median (IQR), kg	7.5 (6.2–8.7)	7.3 (5.9–8.5)	5.6 (4.3-7–.4)	5.6 (4.4–7.9)
Missing, n (%)	717 (29.8)	145 (26.0)	31 (4.4)	7 (3.2)
Temperature, median (IQR), °C	37.1 (36.8–37.6)	37.1 (36.8–37.7)	37.2 (36.8–37.9)	37.3 (36.8–37.8)
Missing, n (%)	625 (26.0)	146 (26.2)	371 (52.9)	101 (46.8)
Oxygen saturation, median (IQR),%	96 (94–98)	96 (94–97)	92 (89–95)	92 (88–96)
Missing, n (%)	114 (4.7)	14 (2.5)	57 (8.1)	10 (4.6)
Heart rate, median (IQR), beats per min	148 (136–162)	150 (137–163)	160 (146–174)	160 (143–175)
Missing, n (%)	73 (3.0)	5 (0.9)	55 (7.8)	7 (3.2)
Respiratory rate, median (IQR), breaths per min	42 (36–52)	44 (36–52)	52 (42–60)	50 (44–60)
Missing, n (%)	120 (5.0)	10 (1.8)	65 (9.3)	16 (7.4)

IQR = interquartile range.

viral testing had an absolute decrease and no change was observed in chest radiographs (Table 3).

Observations (from session recordings) from the two group-facilitated feedback sessions provided important perspectives on what physicians identified as current gaps in care (first session) and how the group-facilitated feedback sessions may lead to sustainable practice change (second session). In the first session, physicians identified strategies to reduce low-value interventions, including self-reflection on practice, following a care pathway, aligning ED management with in-patient care, and receiving repeated data reports. Themes emerging from the second group-facilitated feedback session included the group's reduction of low-value tests and medications, continuing to align practice with nurses and in-hospital physicians, and following the newly released practice order set.

DISCUSSION

Providing physicians with individual practice data, along with a group-facilitated feedback session, helped reduce low-value care for bronchiolitis patients in the ED. A composite of three tests (salbutamol, any respiratory viral test, and chest radiography) decreased by 14.5 and 15.5 percentage points for patients admitted and not admitted to hospital, respectively. Balancing measures, such as ED revisit within 72 hours, did not change.

Previous studies have shown similar findings that address bronchiolitis care management. In a quality improvement project for adherence to UK guidelines, there was a 38% relative reduction in salbutamol use,[21] while we observed a 35% relative reduction. In contrast, chest radiography use decreased 80% in the UK study, while we observed a modest 18% relative reduction for admitted cases. Some studies have shown that test use decreases depending on the patient group. In a tertiary children's hospital, the relative decrease in viral testing was 57% in ED patients and 11% for inpatients.[22] Use of bronchodilators in EDs had a relative decrease of 33%,[22] while we observed a 39% relative decrease in any bronchodilator use in ED patients (from 23.4% to 14.3%). In a multi-site collaborative project at 35 hospitals, site teams demonstrated absolute improvements of

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Table 2. Outcomes and balancing measures by hospital admission status and intervention periods

	Not admitted to hospital			Admitted to hospital		
Variable	Baseline period (n = 2,408)	Intervention period (n = 558)	Absolute difference, % (95% CI)	Baseline period (n = 701)	Intervention period (n = 216)	Absolute difference, % (95% CI)
Primary outcome						
Composite of salbutamol, respiratory viral test, or chest radiograph, n (%)	1,025 (42.6)	151 (27.1)	−15.5 (−19.8, −11.2)	553 (78.9)	139 (64.4)	−14.5 (−21.9, −7.2)
Secondary outcomes						
Salbutamol, n (%)	431 (17.9)	60 (10.8)	−7.1 (−10.2, −4.0)	148 (21.1)	34 (15.7)	−5.4 (−11.4, 0.7)
Respiratory viral test, n (%)	561 (23.3)	62 (11.1)	−12.2 (−15.4, −9.0)	445 (63.5)	101 (46.8)	−16.7 (−24.6, −8.9)
Chest radiograph, n (%)	332 (13.8)	61 (10.9)	−2.9 (−5.9, 0.2)	296 (42.2)	75 (34.7)	−7.5 (−15.1, 0.1)
Other outcomes						
Steroids, n (%)	216 (9.0)	28 (5.0)	−4.0 (−6.2, −1.7)	97 (13.8)	14 (6.5)	−7.4 (−11.8 to −2.9)
Epinephrine, n (%)	54 (2.2)	6 (1.1)	−1.2 (−2.3, −0.01)	139 (19.8)	16 (7.4)	−12.4 (−17.3, −7.5)
Balancing measures						
Admitted to PICU, n (%)	–	–	–	79 (11.3)	23 (10.6)	−0.6 (−5.7, 4.4)
ED length of stay						
Length of stay in ED, mean (SD), hours	2.7 (1.5)	2.6 (1.3)	−0.1 (−0.2, 0.03)*	7.9 (5.0)	5.4 (2.2)	−2.5 (−3.0, −2.0)*
Time from ED MD sign up to disposition, mean (SD), hours	1.4 (1.3)	1.2 (1.0)	−0.2 (−0.3, −0.1)*	7.3 (4.8)	4.7 (2.1)	−2.6 (−3.0, −2.1)*
MD sign up time missing, n (%)	62 (2.6)	2 (0.4)	–	3 (0.4)	0 (0.0)	–
ED revisit						
ED revisit within 72 hours, n (%)	295 (12.3)	68 (12.2)	−0.1 (−3.1, 3.0)	6 (0.9)	4 (1.9)	1.0 (−1.2, 3.2)
Admitted to the hospital at first revisit within 72 hours, n (%)	108 (4.5)	30 (5.4)	0.9 (−1.3, 3.0)	4 (0.6)	3 (1.4)	0.8 (−1.1, 2.8)

*Difference in mean.
IQR = interquartile range.

12.6% and 17.2% for ED bronchodilator and viral testing use, respectively.[23] Quality improvement projects can be useful to advance patient outcomes and avoid unnecessary harm that can arise due to practice variation in the management of bronchiolitis.

Hospital readmission is a healthcare quality indicator and highlights areas where potentially preventable readmissions can be minimized in efforts to curtail rising healthcare costs. Bronchiolitis is one of the top five potentially preventable readmissions to a hospital within 30 days with an estimated cost of USD 14 million.[24] A retrospective analysis of 267 patients suggested that higher adherence to clinical pathway recommendations were associated with shorter length of stay for both ED and inpatients.[25] Additionally, costs were lower for patients in the highest tertile of adherence.[25] We observed that ED length of stay decreased post-intervention for admitted patients, which suggests our bronchiolitis intervention may have contributed to improved healthcare efficiency.

Limitations

A higher proportion of cases admitted in the intervention (28%) compared with baseline (23%) periods could have influenced our intervention to reduce low-value bronchiolitis testing. It is possible that the bronchiolitis season in the intervention period was more "severe" relative to the seasons in the baseline period and patients in this cohort presented with more substantial symptoms in the ED. Choosing Wisely Canada recommendations could have influenced physicians prescribing antibiotics,[26] yet that was not a primary focus of the intervention. We were also limited to one

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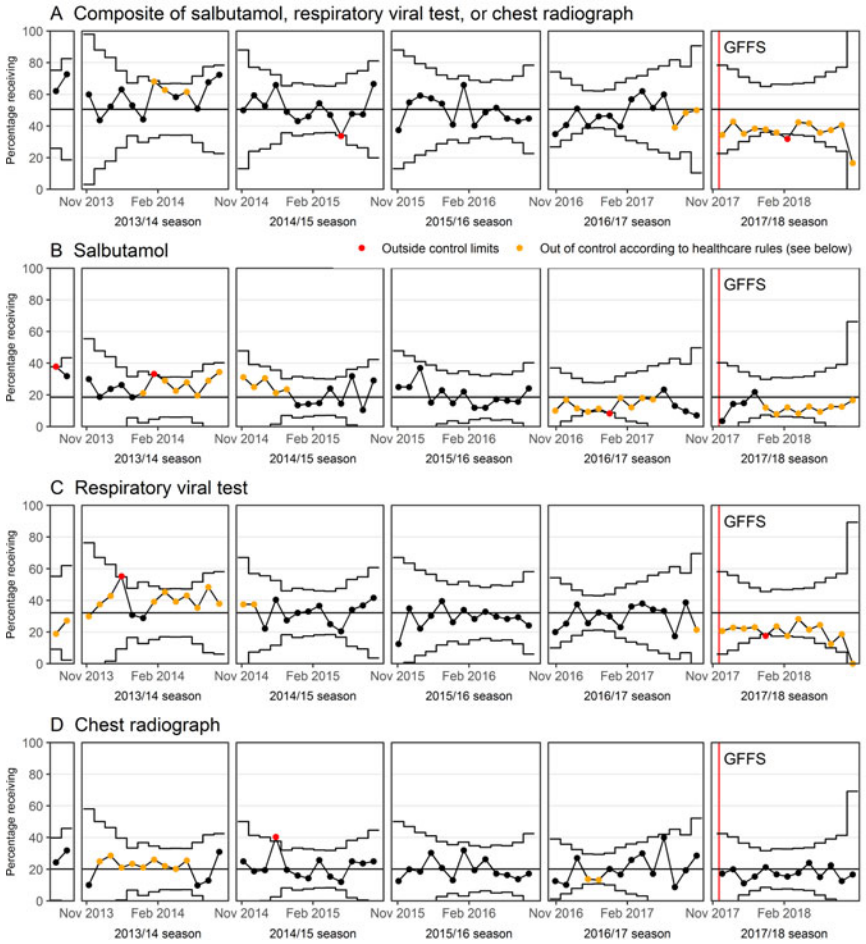

Figure 2. Statistical process control charts showing biweekly percentages of patients receiving several tests and treatments not recommended for the diagnosis and treatment of bronchiolitis before and after the GFFS (group-facilitated feedback session). Legend: The centre line is the percentage in the baseline period and the upper and lower lines are the control limits, calculated using the formula for *p*-charts (± SDs). Gaps indicate the out-of-season period (May to October). Out of control points (orange) are highlighted according to the Institute for Healthcare Improvement (IHI) rules.

Table 3. Interrupted time series analysis results

	Crude		Adjusted for hospital admission status	
Outcome	Absolute level change after feedback session, % (95% CI)	*p* value	Absolute level change after feedback session, % (95% CI)	*p* value
Salbutamol	4.2 (0.4 to 7.9)	0.029	4.1 (0.4 to 7.9)	0.03
Respiratory viral test	−6.5 (−11.2 to −1.7)	0.007	−6.7 (−11.1 to −2.3)	0.003
Chest radiograph	0.0 (−4.2 to 4.2)	1.00	−0.1 (−4.2 to 3.9)	0.95

bronchiolitis season post-intervention. However, previous studies have only measured an intervention effect for one season.[26, 27] The majority of physicians (78%) consented for individual data, yet the possibility of bias due to consent and the impact of the intervention on low-value care is currently unknown. Further research is needed to understand the influence of receiving individual data reports compared to not participating in feedback sessions. Although U.S.-based studies have clearly shown a cost-benefit for reducing low-value bronchiolitis interventions, the price differences between the two healthcare systems warrant a separate

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analysis to determine the cost reductions in a Canadian healthcare system.

The strengths of our project include the participation rate of physicians, engagement of a multidisciplinary team, the use of administrative data which is replicable rather than data-based on chart review, and our analysis plan which used statistical process control charts. A final strength is our use of audit and feedback to address low-value care in the ED. The audit and feedback process has strong evidence to support its use in multiple clinical areas.[28] Our approach to audit and feedback provides clinical performance data that are actionable to change, in both written and verbal formats and presented by a respected, credible colleague to help optimize interventions.[29] Further, The Calgary Audit and Feedback Framework fosters socially constructed learning and helps plan for change by focusing on relationships, question choice, data visualization, and facilitation.[15] Given the relative low cost of the intervention, and how common bronchiolitis is, this project has the potential for broad scale and spread.

CONCLUSIONS

Providing individualized practice data reports to physicians and hosting a group-facilitated feedback session led to a reduction in low-value care for infants with bronchiolitis. Exploring opportunities to spread and scale similar initiatives will provide additional support that low-value care can be identified and reduced, while longer follow-up with multiple bronchiolitis seasons will provide data on sustainability of practice changes. Use of audit and feedback and group-facilitated feedback session should be considered as a quality improvement strategy to reduce low-value care.

Competing interests: None declared.

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