Individual QI Projects from Single Institutions

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A Quality Initiative to Prioritize Enteral Feeding in Bronchiolitis

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Abstract

Introduction: Recent studies have identified enteral feeding as a safe alternative to intravenous fluid hydration for inpatients with bronchiolitis receiving respiratory support. Specifically, it can improve vital signs, shorten time on high-flow nasal cannula, and is associated with reduced length of stay. We aimed to increase the percentage of patients receiving enteral feeding on admission with mild-to-moderate bronchiolitis, including those on high-flow nasal cannula, from 83% to 95% within 6 months. **Methods:** A multidisciplinary quality improvement team identified key drivers preventing enteral feeding as lack of standardization, perception of aspiration risk, and lack of familiarity with feeding orders. PDSA cycles focused on developing and implementing a bronchiolitis clinical practice pathway with an embedded guideline and order set as decision support to prioritize enteral feeding. Additionally, educational sessions were provided for trainees and attendings who were impacted by this pathway. **Results:** Following interventions, initiation of enteral feeding increased (83%–96%). Additionally, intravenous line placement decreased (37%–12%) with a mirrored increase in nasogastric tube placement (4%–21%). This was associated with a shorter overall length of stay and no increased transfer rate to intensive care. **Conclusions:** Using quality improvement methodology to standardize enteral feeding and hydration increased the initiation rate of enteral feeding in patients admitted with bronchiolitis. These changes were seen immediately after the implementation of the clinical pathway and sustained throughout the bronchiolitis season. *(Pediatr Qual Saf 2024;9:e735; doi: 10.1097/pq9.0000000000000735; Published online June 11, 2024.)*

INTRODUCTION

Acute viral bronchiolitis is the most common cause of hospital admission among infants in developed countries.[1] Recent studies demonstrate that providing early enteral nutrition for infants admitted to the hospital with respiratory distress due to bronchiolitis does not increase the risk of aspiration or other complications, including those supported with a high-flow nasal cannula (HFNC).[2–9] The literature demonstrates that enteral nutrition can decrease respiratory rate and provide apparent patient comfort by addressing irritability from hunger that compounds the existing respiratory distress.[10] Evidence supports that providing adequate nutrition early in acute illness leads to a faster recovery and significantly decreases total length of stay (LOS) for children admitted with bronchiolitis.[11–15] There has been some previous quality work looking at the time to initiation of enteral feeding and hydration in patients receiving HFNC, though this looked broadly at all respiratory diagnoses and not exclusively bronchiolitis[16]

At our institution, feeding management for infants with bronchiolitis is highly variable between the emergency medicine, hospitalist, and intensive care teams and individual physicians within these groups. This variability is similar to studies of pediatric emergency department (ED) management.[17] We used QI methodology to standardize bronchiolitis management at our institution, specifically focusing on promoting enteral nutrition early in hospitalization. Because the safety of early enteral nutrition has been established with some evidence indicating positive efficacy, our project focused on increasing the initiation of enteral feeding at admission, utilizing either oral (PO) or nasogastric (NG) routes. The pathway guided using enteral fluid resuscitation as a safe alternative to

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intravenous (IV) fluid resuscitation in predefined clinical scenarios. We targeted the ED as the primary intervention location because the hydration route chosen and initiated in the ED often continued upon hospital admission.

Our primary aim was to increase the percentage of eligible children receiving enteral feeding at admission with bronchiolitis from a baseline of 82% to greater than 95% within 6 months.

METHODS

Context:

This quality improvement (QI) project was performed at a 244-bed tertiary care children's hospital within a larger hospital system with university affiliation and postgraduate training programs. There is a dedicated pediatric ED with approximately 55,000 visits annually. The data collection period was October 2019 through February 2022. Our institutional review board deemed this QI project was nonhuman subjects research.

All patients with bronchiolitis who qualify for admission from the ED are either admitted to the pediatric hospital medicine (PHM) service or the pediatric ICU, depending on the severity of presentation and respiratory support required. Hospital policy permits HFNC on the general care floors with an upper limit of 2 L/kg/min.

Improvement team:

We assembled a QI team in August 2021. Our team consisted of two pediatric hospitalists, a PHM fellow, two pediatric residents, a pediatric emergency medicine (PEM) physician, a clinical nurse specialist, an improvement specialist, and a statistician. These members included section leadership for the pediatric hospitalists and institutional-level QI leadership.

Targets for improvement:

We identified several key areas for improvement in managing these patients (Fig. 1). Management variation between physician groups and individual physicians was viewed as a significant contributor to the frequency of patients being admitted while receiving IV fluids. Given this, the primary interventions were standardizing care via a clinical pathway and electronic health record order set. We also educated providers about the evidence supporting this change in practice. Lastly, we educated the ED nursing staff about the procedure and goal of placing NG tubes to facilitate enteral nutrition.

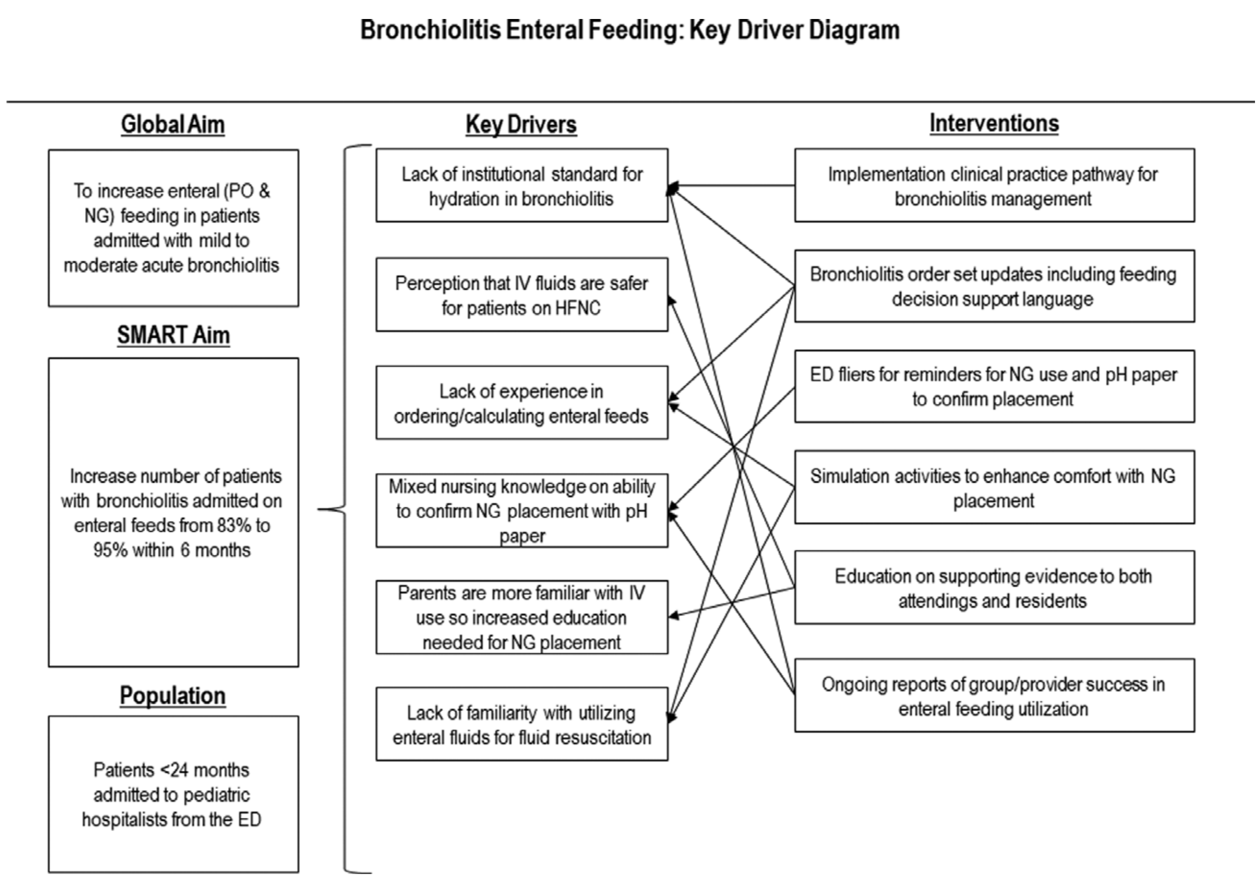

Fig. 1. Key driver diagram illustrating the aims, key drivers, and interventions generated to increase frequency of enteral feeding upon admission.

INTERVENTIONS

Clinical practice pathway:

In conjunction with our healthcare system's Clinical Standardization Program, a comprehensive clinical practice pathway for evaluating and managing bronchiolitis was developed and approved in September 2021 and implemented in October 2021 (**See figure, Supplemental Digital Content 1,** which shows enteral feeding pathway included within the overall bronchiolitis pathway. For RDS scoring criteria, see "Methods" section. **http://links.lww.com/PQ9/A559.**). One part of the pathway determined suitability for enteral nutrition, hydration, and the optimal route. This feeding pathway excluded patients with cardiac disease requiring baseline medications, anatomic airway defects, neuromuscular disease, dysphagia, or chronic lung disease diagnoses. All other patients were stratified using a respiratory distress score (RDS).This score was developed internally utilizing validated scoring tools as references. A score of 0-2 was given for each of the five domains, including respiratory rate, accessory muscle use, wheezing, oxygen requirement, and inspiratory to expiratory ratio. This allows for a minimum score of 0 and maximum score of 10. Respiratory therapists were primarily responsible for assigning RDS scores within the pathway. They were taught the RDS scoring system with pathway initiation with additional education as requested by individual therapists. Patients with mild bronchiolitis (RDS 0–4) were universally allowed to feed by mouth. Patients with severe bronchiolitis (RDS score ≥8) were considered high risk and likely in need of ICU; therefore IV hydration and nothing by mouth were advised. Patients with moderate bronchiolitis (RDS score 5–7) were candidates for enteral nutrition/hydration and allowed to feed by mouth. If oral feeding was not tolerated, or if significant dehydration was present, then an NG tube was inserted to provide enteral hydration/nutrition. (**See figure, Supplemental Digital Content 2,** which displays a chart showing the scoring criteria for our local respiratory distress score. Minimum score is 0 with a maximum score of 10. RR, respiratory rate; SpO_2, pulse oximetry; LPM, liters per minute; I:E ratio, inspiratory to expiratory ratio. **http://links.lww.com/PQ9/A560.**) Decision support was provided in the pathway to guide the selection of appropriate NG tube fluid resuscitation rates and infant feeding volumes. The pathway did not provide a preference for bolus or continuous feeding plans as there has not been evidence to support one over the other.[18]

Order set:

In October 2021 we implemented a new electronic health record order set for bronchiolitis admissions. We adapted infant and pediatric feeding panels from our general pediatric admission order set, including formula and hydration options appropriate for patients aged less than 2 years.

Nursing education:

We provided education starting in September 2021 to the Pediatric ED nursing staff regarding the placement of enteral feeding NG tubes and the preferred practice of utilizing pH paper to confirm correct placement. Local policy uses pH paper in place of x-ray for confirmation unless fluid cannot be aspirated from the placed NG or if the aspirated fluid is not acidic. Before these interventions, placement of an enteral feeding NG was an uncommon procedure for ED nurses. Demonstration competency was required for feeding tube placement involving a simulated demonstration with a trained educator. ED nurses were familiar with placement of suction NG tubes, so comfort was rapidly attained with feeding tube placement.

Physician education:

We provided education regarding the new clinical pathway to both PHM and PEM physician teams, including attendings, fellows, and residents in both groups in September and October 2021. This focused on introducing the pathway, addressing questions, and highlighting the evidence supporting the safety and benefits of early enteral feeding in bronchiolitis.

Resident simulation activity:

We developed a simulation activity for pediatric residents involving a patient with bronchiolitis in October 2021. As part of the simulation, they applied the clinical pathway to determine if the patient was appropriate for enteral feeding via NG tube. They also were able to practice placing NG tubes on a simulated patient to ensure resident comfort with the procedure.

Data sharing:

As data collection was ongoing, the impacts to patient care were shared with the PHM and PEM groups at the project mid-point in January 2022. Statistical process control charts (SPC) of our primary and secondary measures and aggregate data were disseminated during monthly business meetings. Opportunities were provided to discuss barriers to pathway implementation, though the participating providers identified no meaningful barriers.

STUDY OF INTERVENTIONS

We obtained monthly patient data. Data were acquired through a combination of EMR abstraction and manual chart review and stored securely in Research Electronic Data Capture (REDCap). We identified patients by targeting age less than 2 and discharge diagnoses consistent with bronchiolitis, including respiratory failure. The team performed manual chart review to confirm the diagnosis of bronchiolitis, identify the presence of exclusion criteria, and confirm admission from our local pediatric ED to our general care floors. A manual review was also used to determine the feeding status of eligible patients on admission and the presence of an NG tube or IV line. Baseline data were collected from October 2019 to March 2020 and July 2021 to September 2021, given the absence of a typical bronchiolitis season in 2020 due to the COVID-19 pandemic and the early start of the 2021 bronchiolitis season. We released the clinical pathway in October 2021, and the team collected data through February 2022, when bronchiolitis patient volumes significantly decreased.

MEASURES

Primary measure:

As management of feeding and hydration at the time of admission generally dictates the plan in the initial days of hospitalization, we selected the percentage of patients receiving enteral feeding at the time of hospital admission, by PO and NG routes, as our primary outcome measure. This was determined by a feeding order specifying either PO or NG feeds in the admission orders.

Secondary measures:

We also tracked the presence of an IV line or NG tube at admission. This was to monitor adherence to the pathway guidance which prioritized NG tubes in place of IV lines for patients unable to tolerate PO feeding. Additionally, we tracked total hospital LOS.

Balancing measures:

We selected ED LOS, percentage of ICU transfer, and percentage of x-ray orders to confirm tube placement as balancing measures. ED LOS was monitored to identify any delays in throughput in our ED that were associated with our interventions. The ICU transfer rate was collected as a proxy measure for escalation of care due to poor tolerance of enteral feeding. The percentage of x-ray orders for tube placement confirmation was monitored to evaluate for an increase in radiation exposure associated with our interventions. Confirming placement with pH strips is a safe alternative to x-rays, and teaching this technique was a focus of our interventions.

ANALYSIS

We conducted our analysis using Rstudio. Continuous outcome variables, ED LOS, and total hospital LOS were not normally distributed; therefore, each was assessed using the Mann-Whitney U test. Categorical outcome variables were evaluated using either the chi square or Fisher exact test. The significance level for all inferential tests was $\alpha = 0.05$.

Additionally, p-charts were created using the SPC IV plug-in for Microsoft Excel to assess incidence variables (total enteral feeding, IV line placement at admission, and NG tube placement at admission) over time. Patients were assigned into groups of 20 based on the rolling date of presentation, with primary, secondary, and balancing measures calculated for each group of 20 presentations. The dates listed below are for the first presentation in that grouping. A centerline shift was determined based on eight consecutive points on a single side of the centerline.

RESULTS

During our study period, 490 bronchiolitis admissions qualified for enteral feeding per the practice pathway, with 350 patients in the baseline period and 140 patients after initiating the clinical pathway. Our baseline data (November 2019–September 2021) showed 81.3% of eligible patients received enteral feeding at admission. This improved to 95.6% of patients receiving enteral feeding at admission following PDSA testing and pathway implementation. This centerline shift was sustained throughout our data collection period (Fig. 2). Regarding IV line placement, our baseline data demonstrated a mean percentage of 38.8% of eligible patients with an IV line placed at the time of admission. We noted a centerline shift down to 11.9% of patients following the practice pathway initiation (Fig. 3). Lastly, baseline data on NG tube placement demonstrated a mean percentage of 4.1% of eligible patients with an NG tube placed at admission. Special cause variation occurred immediately following the order set launch with a sustained centerline shift upward to 20.7% of patients (29/140) following pathway initiation (Fig. 4).

Our balancing measures included the percentage of X-rays used to confirm NG tube placement and the rate of PICU transfer following admission as a proxy for increasing complications associated with enteral feeding (Table 1). The rate of x-ray usage following NG tube placement was 28.6% in the baseline data and showed a decrease to 10.3% during our intervention period. In our baseline data, the ICU transfer percentage following admission was 19.4%. A downward centerline shift occurred following our interventions, with a mean transfer percentage of 10% after pathway initiation.

Total hospital LOS and ED LOS were also monitored (Table 1). In the baseline group, the mean ED LOS was 3.4 hours. Postintervention, this increased to 4.1 hours, a statistically significant increase ($P < 0.001$). Following intervention implementation, the baseline data demonstrated a mean total hospital LOS of 56 hours, which decreased to 44.7 hours ($P < 0.001$).

DISCUSSION

In this QI project, we demonstrated that using a clinical practice pathway, a supporting order set, and focused physician and nursing education effectively met our target of initiating enteral feeds in greater than 95% of patients with mild to moderate bronchiolitis upon admission from the ED.

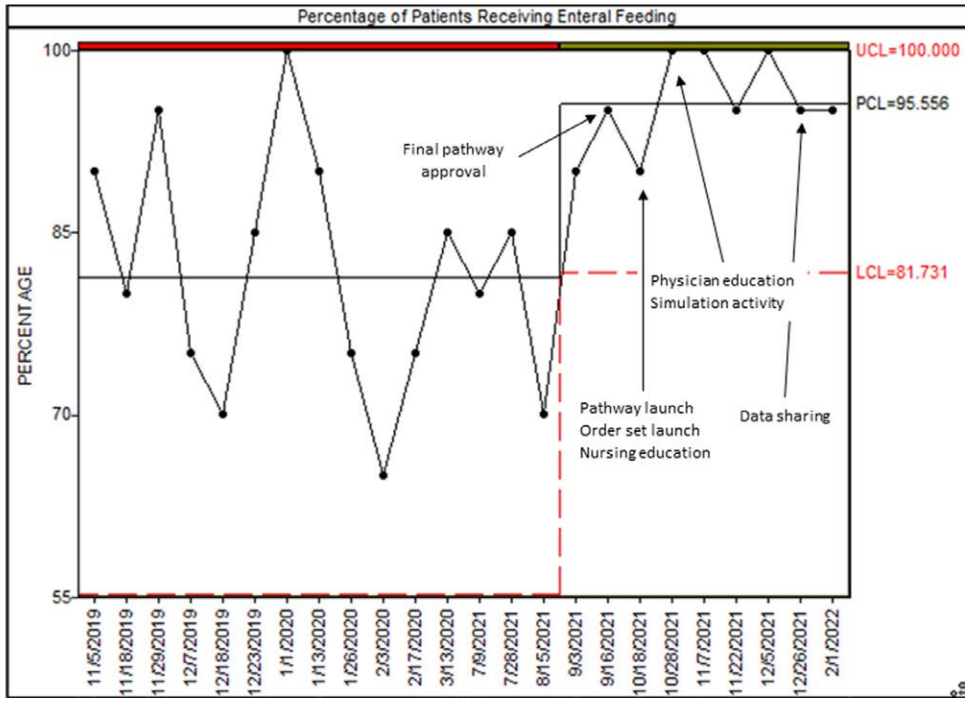

Fig. 2. P-chart demonstrating percentage of enteral feeding upon admission. Interventions with arrow indicating month in which they were provided. *Y*-axis ranges from 55% to 100%. UCL, upper control limit; LCL, lower control limit; PCL, center line.

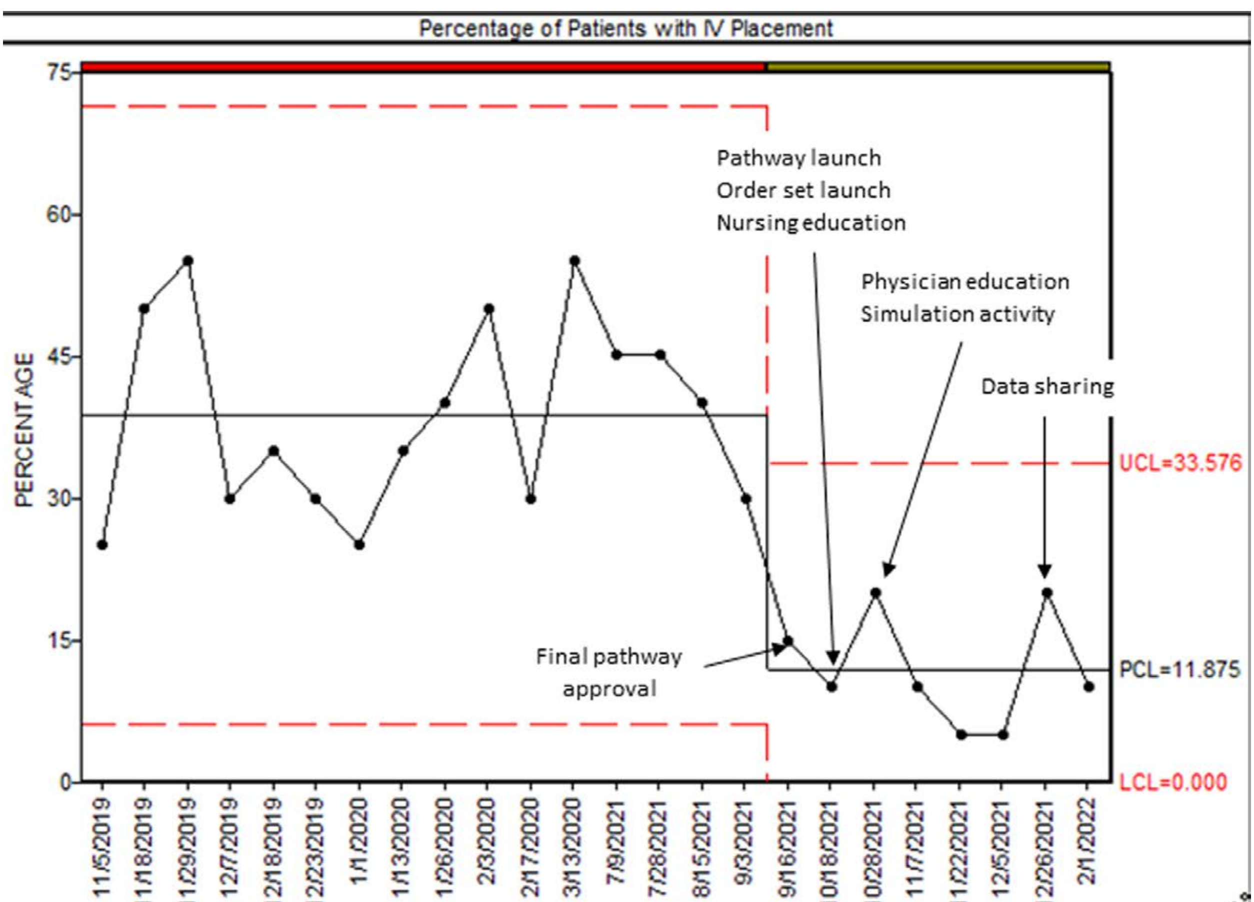

Fig. 3. P-chart demonstrating percentage of intravenous line placement upon admission. Interventions with arrow indicating month in which they were provided. *Y*-axis range 0% to 75%. UCL, upper control limit; LCL, lower control limit; PCL, center line.

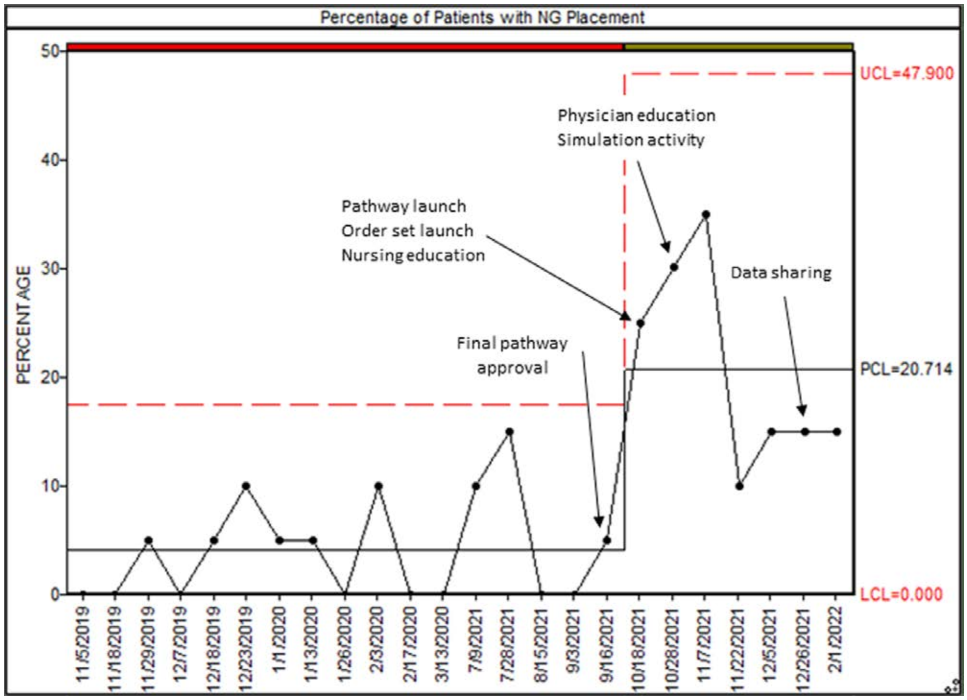

Fig. 4. P-chart demonstrating percentage of nasogastric tube placement upon admission. Interventions with arrow indicating month in which they were provided. *Y*-axis range 0% to 50%. UCL, upper control limit; LCL, lower control limit; PCL, center line.

Table 1. Data Set Comparing Baseline to postintervention Group following Pathway Initiation

	Baseline	With Pathway	*P*
All Qualifying Admitted Patients			
No. patients	350	140	
No. NGs placed (%)	14 (4.0)	29 (20.7)	<0.001
No. x-rays ordered for tube placement (% of NGs placed)	4 (28.6)	3 (10.3)	0.190
No. ICU transfers (%)	68 (19.4)	14 (10.0)	0.211
ED LOS in hours (IQR)	3.4 (2.8–4.5)	4.1 (3.2–5.0)	<0.001
Hospital LOS in hours (IQR)	56 (38.7–85.7)	44.7 (28.6–69.0)	<0.001
Patients Admitted on HFNC Therapy			
No. patients	223	91	
No. with PO or NG feeds ordered at admission (%)	166 (74.4)	86 (94.5)	<0.001
No. IVs placed (%)	99 (44.4)	10 (11.0)	<0.001
No. NGs placed (%)	12 (5.4)	21 (23.1)	<0.001
No. x-rays ordered for tube placement (% of NGs placed)	4 (33.3)	2 (9.5)	0.159
No. ICU transfers (%)	54 (24.2)	11 (12.1)	0.024
ED LOS in hours (IQR)	3.4 (2.8–4.5)	4.1 (3.3–5.1)	<0.001
Hospital LOS in hours (IQR)	65.6 (46.5–92.2)	46.2 (32.6–61.0)	<0.001

Counts shown with percentage (%) or interquartile range (IQR) listed in parentheses.

We also demonstrated that promoting safe enteral hydration and nutrition yielded an increase in NG tube placement with a reciprocal decrease in IV line placement. These changes were sustained throughout our study period.

Notably, the shift in enteral feeding began in the month preceding our pathway rollout. The pathway was developed with significant physician input from the ED and PHM physicians. Given this, both groups were aware of the expected changes, and some practice changes likely began to occur before the full pathway release. We still view our QI intervention as impactful on our primary outcome as we had continued improvement following the pathway release with stabilization around 95% of patients admitted receiving enteral nutrition/hydration. Our secondary measure of NG placement did not demonstrate a similar preceding practice change in the summer before pathway release. The clinical practice pathway substantially changed this practice within our institution. The data demonstrated special cause variation in the IV placement metric that began preceding the release of the practice pathway. The development of this pathway was prompted by institutional awareness of the changing literature on the use of enteral nutrition for these patients, and combined with the engagement of our local physician teams; we believe this led to some gradual change in the months leading up to our clinical standardization. However, as is shown in Figure 2, despite some minor changes preceding the release of the new clinical pathway, there was a meaningful increase in the rate of change following pathway launch.

Recent studies demonstrated the safety of enteral feeding, especially NG feeding, in patients with bronchiolitis and showed that having a feeding protocol increases the rate of NG tube placement.[5,18] However, to our knowledge, no studies demonstrate successful widespread implementation of enteral feeding (both PO and NG) on admission using QI methodology. Our QI project is unique because it targeted increasing the use of multiple forms of enteral hydration and nutrition, including PO and NG routes.

Similar to the results of other recent studies, our data showed a decrease in LOS for patients admitted with bronchiolitis who received enteral feedings.[5,11,14] The bronchiolitis pathway, including the standardization of HFNC weaning practices, impacted this. Further, during the intervention period, our hospital participated in the national Value in Inpatient Pediatrics QI project, sponsored by the American Academy of Pediatrics, targeting rapid weaning of HFNC. Both interventions shortened the duration of HFNC use.

A major concern expressed in the planning period before implementation of this pathway was the potential for increased burden of care in the ED. Specifically, there was concern that ED LOS would be prolonged due to the need for PO trial, NG tube placement if failed PO trial, and confirmation of tube placement. Our data demonstrated a slight increase in total ED LOS. However, in a follow-up focus group conducted with the ED team, the feedback was positive and NG tube placement was actually preferred to IV line placement. Additionally, no barriers to NG tube placement were identified on a Pareto log that was provided for ED nursing staff for the duration of the implementation period. Initially, there was concern that family preference for IV lines over NG tubes would be a barrier. However, there were limited examples of family preference influencing the decision-making process, and many families verbally appreciated being able to provide nutrition to their children.

In our project, increased enteral feeding was achieved without a noticeable increase in adverse clinical events for patients. Specifically, there was no increase in ICU transfers or rate of X-rays done to confirm NG tube placement. We focused on limiting radiation exposure by using pH testing for NG tube placement confirmation. This practice has been standard in our organization, and no patient safety patterns have been noted internally. However, this practice may not be as easily implemented at other institutions. If an institution required x-ray confirmation of NG tube placement, early NG placement would be less beneficial. Additionally we focused on X-rays obtained at the time of placement and did not collect data on X-rays later in the course. This limitation of our study could have missed a more subtle consequence of increased enteral feeding. Despite these limitations, we feel the results are congruent with the growing body of evidence supporting the safety of early enteral feeding in bronchiolitis.

There are several additional limitations to our study. Due to the effect the COVID-19 pandemic had on the seasonality and volume of bronchiolitis in 2020–2021, we had to include the year before the pandemic in our baseline data. We did not collect broader patient-specific factors that could confirm similarities in these groups. However, we eliminated the patients with more co-morbidities due to the particular exclusion criteria in the pathway. Further, the onset of the bronchiolitis season was also in the summer, before the previously planned timeline for initiating the new practice pathway. Consequently, the number of patients seen before and after the release of the pathway is unequal.

The use of QI methodology to standardize enteral feeding and hydration increased the rate of initiation of enteral feeding in patients admitted with bronchiolitis. These changes occurred immediately after the implementation of the clinical pathway and were sustained throughout the bronchiolitis season. Future work in this area could study other barriers to providing enteral feeding throughout a hospital stay by evaluating the frequency and rationale for holding feeds during a hospitalization. As early enteral feeding becomes a more common practice, identifying frequency and risk factors for NG feeding failure could continue to help inform safe enteral feeding in bronchiolitis.

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