

# A Pilot Quality Improvement Project to Reduce Preoperative Fasting Duration in Pediatric Inpatients

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## Abstract

**Introduction:** Despite guidelines allowing clear liquids up to 2 hours before anesthesia, preoperative fasting for pediatric inpatients is often unnecessarily prolonged. This delay can lead to prolonged recovery time and increased postoperative pain. Efforts to reduce fasting duration in pediatric surgical patients is an evolving standard in pediatric anesthesiology. The primary aim of this quality improvement project was to reduce the average inpatient fasting duration undergoing anesthesia by 25% within a year of our pilot intervention. Secondary aims included measuring the adoption rate of the intervention and comparing aspiration rates as a balancing measure. **Methods:** At an academic pediatric hospital, we created the preanesthesia diet order, a standardized, clear liquid diet for eligible inpatients undergoing anesthesia to decrease preoperative fasting duration. After implementation in January 2018, a statistical process control chart was used to measure the fasting duration of all eligible inpatients by month, and the Wilcoxon rank-sum test assessed differences. A Poisson test was used to determine differences in aspiration rates. **Results:** Over the first year of our pilot intervention, 127 inpatients received the preanesthesia diet. The average fasting duration before its implementation was 12.5 and 5.7 hours postimplementation. The average adoption rate for eligible inpatients was 17.6%, and there was no difference in aspiration rates. **Conclusion:** This quality improvement project demonstrated that a standardized, clear liquid diet on the morning of surgery could reduce preoperative fasting times among pediatric inpatients. The adoption of this pilot intervention was limited, highlighting the challenges of implementing a practice change. (*Pediatr Qual Saf* 2019;4:e246; doi: 10.1097/pq9.000000000000246; Published online December 16, 2019.)

## INTRODUCTION

Nil per os (NPO) commonly refers to the medical order to fast before induction of anesthesia. Ordering surgical

patients to be NPO has been a well-established practice for over 80 years since the first study demonstrated increased mortality after solid food aspiration in obstetric patients undergoing general anesthesia.<sup>1</sup> The American

Society of Anesthesiologists (ASA) provides fasting recommendations to reduce the risk of aspiration based on the time of their exposure to anesthesia. Despite these recommendations, many patients are empirically ordered to be NPO at midnight on the day of their procedure, including inpatients at our pediatric hospital. This practice contributes to prolonged fasting.

The ASA preoperative fasting guidelines allow clear liquids to be consumed up to 2 hours before anesthesia. These recommendations are based on multiple studies that suggest pulmonary aspiration is a rare complication of anesthesia, and that there is little relationship between fasting duration of clear liquids and gastric pH or volume.<sup>2</sup> Conversely, prolonged NPO duration may cause harm, including delayed recovery time, increased postoperative pain, and unfavorable physiologic and metabolic effects.<sup>3–5</sup> Due to this emerging knowledge, encouraging preoperative clear fluid intake is a core component of early recovery after surgery in adult perioperative care.<sup>6</sup> Despite this, fasting for pediatric patients before anesthesia is often unnecessarily prolonged.<sup>7,8</sup>

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Given that prolonged fasting periods may cause adverse postoperative effects, our multidisciplinary perioperative quality improvement team initiated a project to minimize clear fluid fasting times among inpatients. After securing executive support, we utilized a quality improvement methodology to develop, implement, and study the effects of the intervention.

The primary aim was to reduce the average clear fasting duration of inpatients undergoing anesthesia by 25% within a year of its implementation, excluding neonates, inpatients requiring thickened liquids, and inpatients NPO for other reasons. The secondary aims were to (1) reach an adoption rate of the intervention of at least 10% among eligible inpatients and (2) compare aspiration rates before and after the intervention as a balancing measure.

## METHODS

### Context

We conducted this project at a 365-bed, academic children's hospital in Northern California. Different specialties direct inpatient care, including pediatric and surgical services consisting of academic faculty, fellows, residents, physician assistants, and nurse practitioners. The hospital serves as a quaternary care trauma center with a diverse surgical population. The patients included in this project were surgical inpatients scheduled for elective surgeries.

### Intervention

The perioperative quality improvement team, consisting of anesthesiologists, surgeons, pediatricians, nurses, clinical nutritionists, quality managers, and family advocates, initiated efforts to create a standardized, clear liquid diet for eligible inpatients undergoing anesthesia to decrease preoperative NPO duration. Current state analyses revealed that the patients' primary teams initiated the NPO orders and that surgical inpatients were routinely ordered to fast from all solids and clear liquids beginning at midnight on the day of their procedure, regardless of its scheduled time. The standard clear liquid diet provided by nutrition services included fatty broths, which would not qualify as a clear liquid under ASA guidelines. Using lean methodology, the improvement team developed an A3 project plan (see **Supplemental Digital Content** at <http://links.lww.com/PQ9/A151>),<sup>9</sup> which included a review of the background, current state, problem analysis, aim statements with measurable goals, and a key driver diagram with associated countermeasures.

Key drivers used to guide interventions included: provider education and adherence, nursing staff education and adherence, optimization of the clinician-electronic medical record (EMR) interface, and diet accessibility and adherence to ASA guidelines (Fig. 1). The drivers were the result of team discussions. Because the team felt that they were all equally important for the optimization of the study, they were not necessarily prioritized or ranked. The first countermeasure was to create a "pre-anesthesia diet" consistent

with ASA-approved clear liquids that could be integrated into our institution's existing foodservice system. This diet consisted of water, apple juice, clear gelatin, and oral rehydration beverages. It was distinct from the existing "clear liquid diet" tray to avoid the inclusion of the opaque or fat-containing liquids. The diet was designed to replace the "NPO at Midnight" order for any inpatient scheduled to undergo anesthesia after 10 AM the following day and could be consumed until 8 AM on the day of their procedure, after which time they would become NPO. The diet tray, which was prepared by our hospital nutrition department, was automatically delivered at 6 AM on the day of the procedure. Patients who could not consume clear liquids such as neonates or patients requiring thickened liquids or who were NPO for other medical reasons were not eligible. After receiving the preanesthesia diet for breakfast, a standardized 8 AM NPO time went into effect, rather than attempting to tailor the NPO time to individual procedure times to maintain scheduling flexibility in case procedure times were changed on the day of surgery. However, even after developing this new diet tray, it could not be tested until it was integrated into the institution's EMR.

The second countermeasure was to integrate this diet into the institution's EMR as an order set. The order was titled "NPO at 8 AM for operating room (OR) case after 10 AM" so that it appeared when NPO orders were searched. It automatically selected the preanesthesia diet order to start at midnight and included an order to convert the patient to NPO at 8 AM. This order set also automatically caused any additional diet tray orders to discontinue at midnight to avoid NPO violations.

Once this order set was successfully integrated into the EMR, we introduced multiple educational efforts. Initially, these efforts were directed at the ordering providers such as faculty, residents, nurse practitioners, and physician assistants. These educational efforts included formal lectures at resident conferences, visual aid reminders, and tip sheets posted in team workrooms, prospective reminder pages, and email updates. After provider education, we aimed complementary educational efforts at nurses given their role of providing the diet trays to inpatients. Visual aids were distributed to the nursing leadership staff of acute care floors and included in monthly huddles and weekly emails.

The launch of the order set occurred after the educational efforts on January 1, 2018. Postimplementation, we frequently communicated with frontline staff to identify barriers and conducted intermittent audits of patient charts to observe for practice change.

### Outcomes

The primary outcome was to reduce the average clear fasting time of inpatients undergoing anesthesia by 25% within a year of its implementation. Secondary outcomes included measurement of adoption of the diet order and comparison of aspiration rates before and after the intervention.

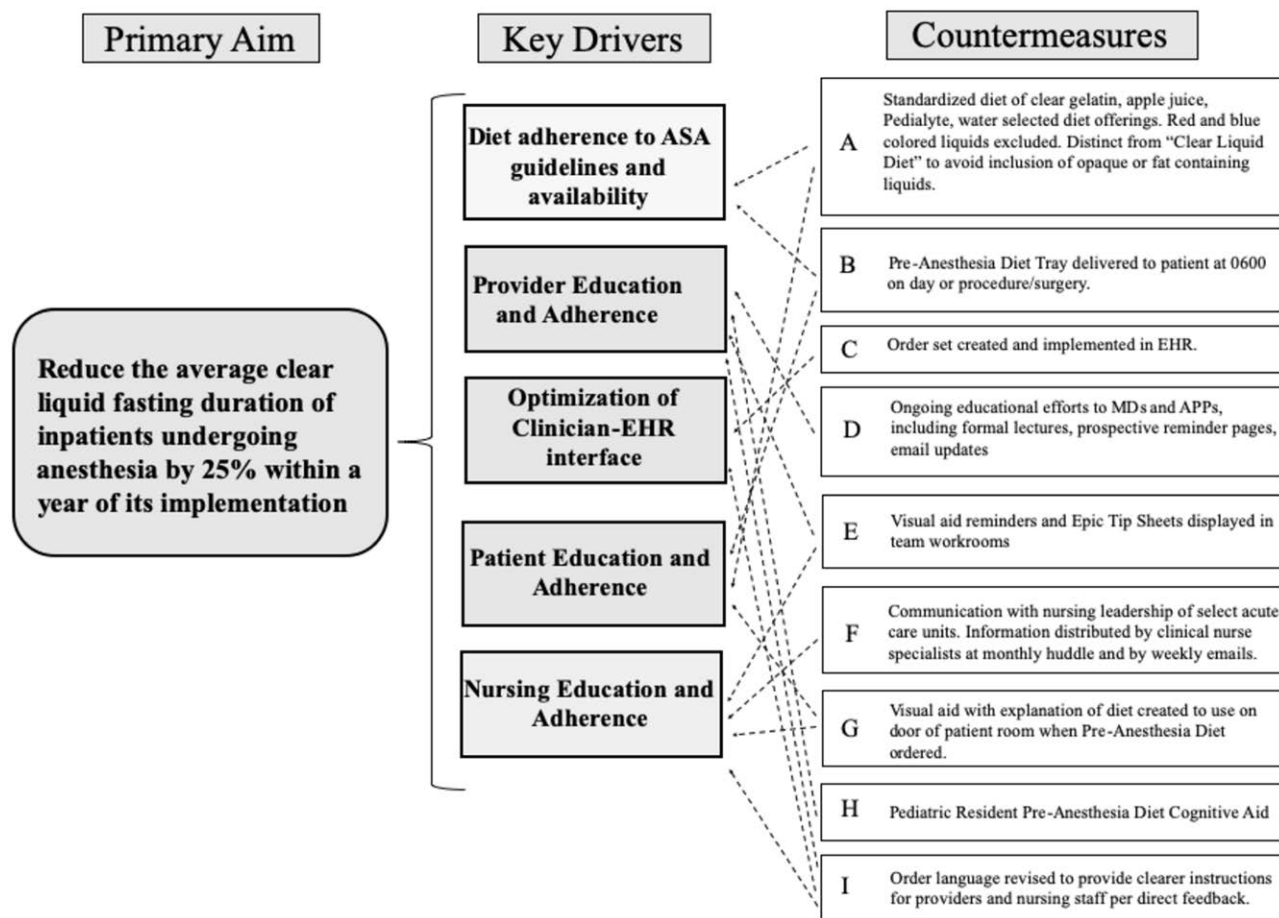


Fig. 1. Key driver diagram. Lettered countermeasures are used to denote in Figure 2 the timing of their deployments. ASA indicates American Society of Anesthesiologists; EHR, electronic health record; MD, medical doctor.

**Measures**

We conducted a review of eligible hospitalized patients who underwent surgical procedures requiring anesthesia between January 1, 2017, and December 31, 2017, to measure average fasting times before implementation. We included patients if they were ≥1 year old, and if their surgery start times were after 10 AM because these patients would be eligible for the preanesthesia diet. Each patient’s age, sex, and diet order were recorded. Preoperative fasting duration was the difference in hours from the start of

the patients’ NPO time to the patients’ anesthesia start time. We recorded ongoing patient fasting times from January 1, 2018, to January 31, 2019. Patients were stratified by type of diet order in this period, NPO at midnight or preanesthesia diet, and distribution of NPO duration stratified by 2-hour intervals.

We measured order adoption as a percentage of patients who received the preanesthesia diet compared with those who received the traditional NPO after midnight order. Aspiration rates before and after implementation of the

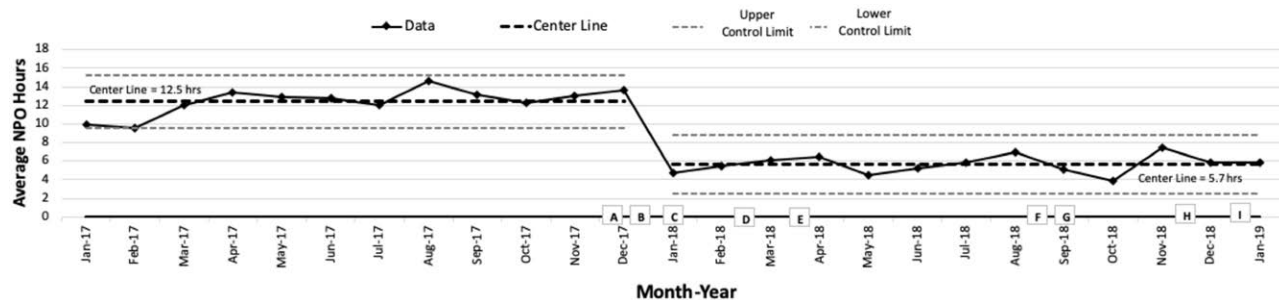


Fig. 2. Average NPO duration of patients prescribed NPO at midnight compared with preanesthesia diet. Letters along x axis correlate to the time of countermeasure initiation, as listed in Figure 1.

preanesthesia diet were compared as a balancing measure. These data were collected from a mandatory adverse event intake form that is submitted after every anesthetic procedure by the attending anesthesiologist.

### Analysis

A statistical process control chart was used to display the fasting duration of eligible inpatients by month. Centerlines (CLs), representing average fasting time, were displayed to demonstrate the response to the implementation of the new diet order. Three SD upper and lower control limits were included, and a CL break was due to special cause variation attributed to nonrandom conditions, per Western Electric Rules.<sup>10</sup> We collected and analyzed the data using Microsoft Excel (Microsoft, Redmond, Wash.) and R version 3.5.1 (r-project.org, Vienna, Austria). Wilcoxon rank-sum test was used to determine the statistical significance of group differences in fasting duration before and after implementation of the diet order, with  $P < 0.05$  considered significant. Proportions were used to describe the adoption of the preanesthesia diet order. A Poisson test was used to assess differences in aspiration rates before and after adoption.

## RESULTS

Patient demographics were similar among those ordered to be NPO at midnight versus those ordered the preanesthesia diet (Table 1). Before the intervention, 928 inpatients were prescribed NPO at midnight (average of 77 patients per month) (Table 1). Following implementation, 127 patients received the preanesthesia diet (average of 10 patients per month) (Table 1). The average fasting duration of those made NPO at midnight was 12.5 hours as denoted by the CL, and the average fasting duration of those prescribed the preanesthesia diet was 5.7 hours ( $P < 0.001$ ) (Fig. 2). Greater than half of patients who had the preanesthesia diet had a fasting duration of less than 6 hours, whereas all made NPO at midnight had fasting durations of at least 8 hours. Greater than half of the patients made NPO at midnight had fasting durations of >12 hours (Table 2).

During the postimplementation period, an average of 17.6% of eligible patients received the preanesthesia diet (Fig. 3). Before implementation, there were 11 aspiration events over 13,341 cases and no difference after implementation, with 14 aspirations over 14,810 cases ( $P = 0.842$ ).

**Table 1. Demographics**

	NPO at Midnight	Preanesthesia Diet
Total patients	928	122
Average patients per month	77	10
Average age, yr ( $\pm$ SD)	11.4 $\pm$ 0.92	10.3 $\pm$ 4.0
Sex (females), %	41.7	44.2

Patient demographics (age, sex) and average monthly rate of inpatients prescribed NPO at midnight versus the preanesthesia diet during intervention period (February 2018–January 2019).

**Table 2. Fasting Duration**

Fasting Duration (h)	Proportion (%)	
	NPO at Midnight	Preanesthesia Diet
2–4	0	24
4.1–6	0	29
6.1–8	0	30
8.1–10	3	13
10.1–12	46	2
12.1+	51	0.7

Proportion of patients who were NPO for specified time ranges among those ordered NPO at midnight versus the preanesthesia diet during the intervention period (February 2018–January 2019).

## DISCUSSION

This quality improvement project aimed to reduce preoperative fasting times of inpatient pediatric patients undergoing anesthesia. Guided by a key driver diagram, a multidisciplinary team designed and implemented a preanesthesia diet. Fasting times were reduced by over 50% in those patients prescribed the intervention preoperative diet. We have used the order in approximately 17% of eligible patients without any increase in aspiration rates.

To the authors' knowledge, this project describes the first quality improvement project to reduce clear liquid fasting time among inpatient pediatric patients, primarily through the creation of an EMR-integrated preanesthesia clear liquid diet order. This work adds to previous studies that have demonstrated safe reductions in clear liquid fasting times in outpatient pediatric patients presenting for elective surgery.<sup>11,12</sup> The intervention described for outpatients included improved preoperative fasting instructions, parental guidance, offering drinks in the preoperative ward to eligible patients, and allowing clear fluids 1 hour before anesthesia.<sup>11,12</sup> Compared with those presenting for surgery as outpatients, pediatric inpatients are particularly vulnerable to prolonged NPO durations given the dynamic nature of scheduling add-on patients, and the wider variability of practices and providers involved in the care of inpatients. Previous studies have demonstrated the difficulty in reducing inpatient NPO times without clear solutions.<sup>8,13</sup> However, at our institution, inpatients are rarely the first OR case, which provides the opportunity to serve the preanesthesia clear fluids for breakfast. This project demonstrates that this diet on the morning of surgery can significantly reduce preoperative fasting times in pediatric inpatients while still maintaining scheduling flexibility.

There were several limitations to this project. First, patients who received the preanesthesia diet were nonrandomly chosen based on provider preference, so patients who did receive the preanesthesia diet may have been subject to bias. However, patient demographics seemed similar between those with the preanesthesia diet and NPO at midnight orders. Second, although this diet did provide a substantial decrease in the average fasting duration of those who received it, approximately 16% of

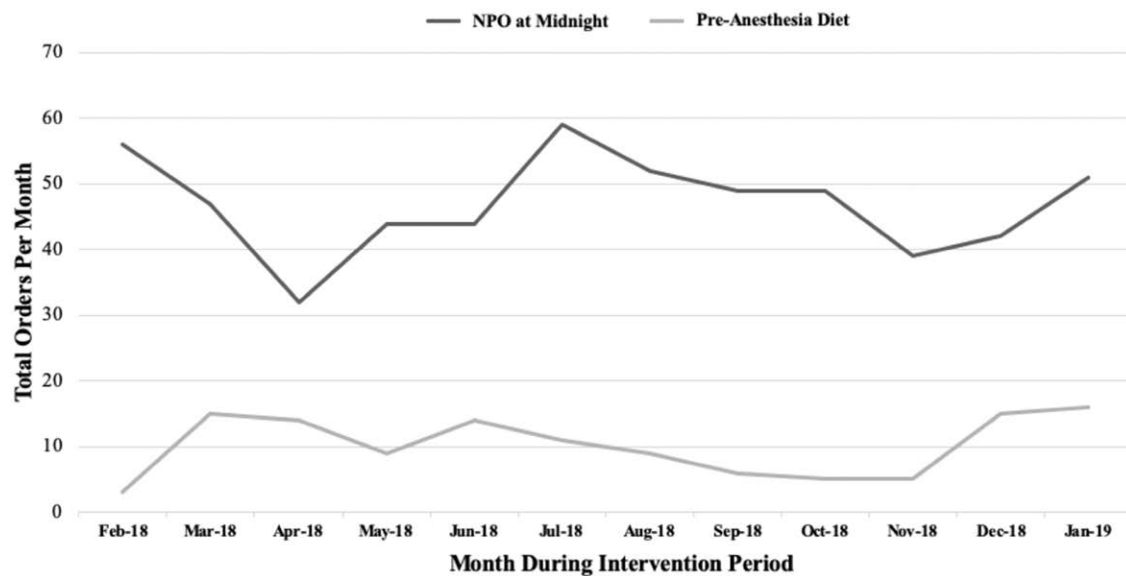


Fig. 3. Number of preanesthesia diet orders vs NPO at midnight orders by month (February 2018–January 2019).

this population still endured NPO times of >8 hours. This finding is due to the standardized end-time to the diet of 8 AM, which was chosen as a compromise to still lend flexibility to scheduling changes on the day of surgery. Third, because the aspiration data are deidentified, aspiration events were not stratified to just those who received the preoperative diet but rather reflected rates for all cases. Despite this, there were no anecdotal or data-driven conclusions that patients with the preanesthesia diet had a greater risk of aspiration. Fourth, given the low aspiration incidence, it would be unlikely to capture an increased risk given the small sample of patients utilizing the preanesthesia diet. Finally, although we achieved our secondary aim of at least 10% adoption, acceptance of this diet order was challenging despite multiple verbal, electronic, and written cues. Given the uncertainty related to the new diet order, we accepted a low adoption rate until we could report the safety data and further assess barriers.

We identified several variables that likely contributed to the low institutional adoption. First, many ordering providers are medical trainees that rotate through inpatient services for a short time. These providers spend the majority of their training at the affiliated adult hospital, which has a different EMR and different processes for preoperative NPO orders. Despite consistent educational efforts, it proved difficult to maintain a level of familiarity with the diet among the frequently rotating providers. Second, the intervention was initiated during a transition into a large hospital expansion, during which many new nurses were hired, who are the primary custodians of how these orders are executed, making their education a key driving factor. Our team responded to this by collaborating with the nursing leadership during the latter part of the intervention period to initiate various educational efforts to bedside nurses. This knowledge was difficult to

maintain due to several traveling nurses that rotated to new sites after educational efforts. Finally, unlike surgical outpatients who generally receive their NPO instructions from a single, consistent source such as a preoperative clinic, surgical inpatients are cared for by a variety of different services, which compounded the difficulties of our educational efforts. Overall, we found that despite local and international data demonstrating the benefit and safety of shorter NPO duration, there remains a strong cultural affinity toward using an NPO at midnight preoperative diet order.

Efforts to minimize unnecessary preoperative fasting in pediatric patients is an evolving practice in pediatric anesthesia. This project reported initial efforts to introduce a standardized, preoperative diet for inpatients. It demonstrated the ability to safely decrease NPO duration among pediatric inpatients without increasing overall aspiration events. Future directions of this project will involve educational efforts to providers and staff to increase adoption and continued safety event monitoring.

## DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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