

# Should Children Drink before Discharge from Day Surgery?

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The ability to drink clear liquids without vomiting after anesthesia and surgery is a commonly used criteria for discharge of pediatric day surgery patients. We hypothesized that the ability to drink as a prerequisite for discharge would not affect the frequency of vomiting, delay discharge, or increase the frequency of readmission of children for dehydration after day surgical procedures. We randomized 989 patients between the ages of 1 month and 18.0 yr to one of two groups. The 464 "mandatory drinkers" were required to demonstrate the ability to drink clear liquids without vomiting prior to discharge from the hospital, whereas 525 "elective drinkers" were allowed but not required to drink. Other than the discharge criteria, the patients were managed in an identical fashion; the minimum volume of intravenous fluids received by all patients was adequate to supply a calculated 8-h fluid deficit prior to discharge from the hospital. There were no differences between the two groups in the incidence of vomiting in the operating room, the postanesthesia care unit, or after discharge from the hospital. However, in the day surgery unit, only 14% of the elective drinkers vomited compared to 23% of the mandatory drinker group ( $P < 0.001$ ). The mandatory drinkers had a more prolonged stay in the day surgical unit, averaging  $101 \pm 58$  min (mean  $\pm$  SD) compared to  $84 \pm 40$  min for elective drinkers ( $P < 0.001$ ). No patient in either group required admission to the hospital for persistent vomiting on the day of surgery, and no patient required readmission for vomiting or dehydration after discharge from the day surgery unit. We conclude that it is unnecessary to make drinking a prerequisite for discharging pediatric patients after day surgery. (Key words: Anesthesia; outpatient; pediatric. Complications: vomiting. Fluids, oral: postoperative balance.)

NAUSEA AND VOMITING commonly occur in the immediate postoperative period, with children experiencing the highest incidence.<sup>1,2</sup> Vomiting is the most common medical reason requiring unscheduled hospital admission for children after day surgery procedures and is the most common posthospitalization complication.<sup>3,4</sup> Ensuring that children can tolerate oral liquids prior to discharge from the day surgery unit (DSU) is an attempt to provide

conditions that minimize the potential for readmission secondary to dehydration.<sup>5,6</sup> Conversely, requiring children to drink oral liquids prior to discharge from the hospital may precipitate vomiting in the postoperative period and actually make matters worse. This suggests that the ability to drink oral liquids may not be necessary for discharge after day surgery.<sup>7-9</sup> There are few data to support either treatment. We therefore compared the effect of mandatory drinking to voluntary drinking prior to discharge from the hospital on the incidence of vomiting and the time interval between the completion of surgery and discharge to home.

## Materials and Methods

Following institutional approval, 1,002 ASA physical status 1 and 2 day surgery patients whose intraoperative management included insertion of an intravenous catheter were randomized on alternating weeks to one of two sets of discharge criteria. All children were required to stay at least 1 h in the DSU and could be discharged when they demonstrated easy arousability, the ability to follow simple commands, hemodynamic stability, achievement of adequate pain control, and minimal vomiting (fewer than three episodes). There was no mandatory interval after administration of an analgesic or an episode of emesis and the time to discharge. Children who vomited more than twice were detained at the discretion of the nursing staff. One group ("mandatory drinkers") was required to drink clear liquids (minimum of 60 ml) prior to discharge, whereas the other group ("elective drinkers") was allowed but not required to drink. Parents of elective drinkers received postoperative feeding instructions that stated the following: "Don't offer food or drink unless your child has asked for something or has indicated that he/she is hungry. Giving fluids too soon may result in vomiting. If a dry mouth sensation is the major complaint, try rinsing the mouth or brushing the teeth to relieve this sensation." The recommendation to offer small quantities of clear liquids was also included. Mandatory drinkers received no specific postoperative feeding instructions.

Other than the discharge criteria, children in both groups were treated in an identical manner. The anesthetic technique was not dictated in any way by the study. However, the anesthesiologist caring for the patient was not blinded to the patient's group assignment. To ensure adequate hydration at the time of discharge and sufficient reserve to tolerate a period without oral intake, all chil-

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dren received their preoperative fluid deficit, intraoperative maintenance fluid, and their third-space fluid loss and blood loss replacement. Each milliliter of blood loss was replaced with 3–4 ml of lactated Ringer's solution. Because day surgery patients at our institution are allowed to drink clear liquids until 2 h prior to induction of anesthesia, the preoperative fluid deficit was arbitrarily defined as 8 h of maintenance fluid, calculated by the method of Holliday and Segar.<sup>10</sup>

Data collected on all patients included demographics (age, gender, and weight), type of oral preanesthetic medication, surgical procedure, anesthetic agents, and techniques used. The maintenance anesthetic was characterized into one of five groups: 1) inhalation agent only, 2) inhalation with opioid supplementation, 3) inhalation with opioid and regional anesthetic block, 4) inhalation and regional anesthetic block, and 5) other (primarily propofol used with or without opioid or regional nerve block). We noted the administration of antiemetics or analgesics in the operating room, postanesthesia care unit (PACU), and DSU; the duration of surgery, PACU stay, and DSU stay; all episodes of vomiting in the OR, PACU, and DSU; and all intake of oral liquids in the DSU. Every family was contacted by telephone on the day after surgery to ascertain if, how often, and when each child vomited after discharge from the DSU.

All data are presented as the mean  $\pm$  SD. Differences between the two groups were analyzed using an unpaired *t* test for interval data, and contingency table analysis was used for nominal data. Bonferroni's correction was used for multiple comparisons. Vomiting severity was scored as follows: none, mild (one or two episodes), moderate (three or four episodes), or severe (more than four episodes). Comparison of the severity of vomiting between groups was made using the Mann-Whitney U test. Differences were considered significant for  $P < 0.05$ .

A stepwise multiple linear regression analysis was performed to determine those variables that related to the incidence of vomiting in the DSU and after discharge from the DSU. The variables that were included in the analysis included: group (mandatory or elective drinker), age (in years), age group ( $\leq 2.0$  yr or  $> 2$  yr), age group ( $\leq 2.0$  yr,  $> 2$  to  $\leq 4.0$  yr, or  $> 4$  yr), gender, maintenance anesthetic technique (one of the five anesthetic types described above), opioid administration in the operating room, gastric fluid emptied in the operating room (yes or no), surgical procedure, type of preanesthetic medication, antiemetic administration in the operating room, surgical service (otorhinolaryngology, general surgery, urology, gastroenterology [endoscopies], ophthalmology, orthopedics, plastic surgery, radiology, dental, and other), type of procedure (hernia, strabismus, tonsillectomy and adenoidectomy [T & A], or other), risk of vomiting (high risk: T & A or strabismus repair; low risk: all other pro-

cedures), duration of operating room stay, fluid administration (whether the patient received or did not receive the calculated amount of intravenous replacement fluid), antiemetic administration in the PACU, analgesic administration in the PACU, incidence of vomiting in the PACU, and analgesic administration in the DSU. One additional factor, the incidence of vomiting in the DSU, was included in the regression analysis for postdischarge vomiting. An F test was performed with each variable as part of the stepwise regression. If F was  $> 4$ , the variable was considered to be significantly correlated with vomiting.

### Results

One patient in each group was deleted from the study because of insufficient demographic data, and 11 additional patients were deleted from the study because they were older than 18.0 yr. Of the remaining 989 patients, 464 patients were randomized to the mandatory drinker group and 525 to the elective drinker group. The elective drinkers were slightly younger and weighed slightly less (table 1). However, the distribution of patients by age group was not significantly different (table 1). There were no differences between the two groups in the distribution of gender, type of surgery, or type of preanesthetic medication (table 1).

Of the 989 anesthetics, sufficient detail was recorded on the data sheets of 928 patients to categorize the anesthetic maintenance regimen into one of the five categories (table 1). There were no differences between groups in the distribution of type of anesthetic. Intraoperatively, 53% of the patients in both groups received an opioid as a component of their general anesthetic. Of the elective drinkers, 80% received an opioid in the preanesthetic medication or in the operating room compared to 83% of the mandatory drinkers. There were no differences between the groups in frequency of administration of opioid and nonopioid analgesics in the PACU and the DSU (table 1).

### DURATION OF STAY

The duration of surgery averaged 5 min longer for the mandatory drinkers than for elective drinkers (table 2). Although this difference was statistically different ( $P < 0.05$ ), it was considered clinically unimportant. Although there were no differences between groups in the duration of PACU stay, the elective drinkers stayed in the DSU an average of  $84 \pm 40$  min compared to  $101 \pm 58$  min for the mandatory drinkers ( $P < 0.001$ ). Of the elective drinkers, 411 of the 525 (78%) voluntarily chose to drink and stayed an average of  $83 \pm 39$  min in the DSU. This duration of stay was not significantly different than the remaining 114 elective drinkers, who chose not

to drink and stayed an average of  $90 \pm 44$  min ( $P = 0.08$ ). Although the protocol required all mandatory drinkers to drink clear liquids in order to be discharged home, 22 patients (4%) were unwilling to drink even after a prolonged wait. These children were discharged at the discretion of the attending anesthesiologist without drinking after an average of  $160 \pm 78$  min. The remaining 442 mandatory drinkers stayed in the DSU for an average of  $98 \pm 55$  min.

### SEVERITY OF VOMITING

No patient had severe vomiting in the PACU or DSU, and only 14 (1.4%) had vomiting of moderate severity. Six of these 14 patients were from the elective drinker group, and 8 were from the mandatory drinker group.

TABLE 1. Patient Demographics and Type of Operation, Anesthetic Technique, and Opioid Usage for 989 Children Discharged the Day of Surgery

	Mandatory Drinkers	Elective Drinkers	P
Number	464	525	
Gender (M/F)	301/163	353/172	0.47
Age (yr)	$5.3 \pm 4.8$	$4.7 \pm 4.2$	0.04
Weight (kg)	$23.1 \pm 18$	$20.9 \pm 16$	0.05
Age group (%)			
≤ 2 yr	39	41	0.81
> 2, ≤ 4 yr	17	17	
> 4 yr	44	42	
Preadhesive medication (%)			0.25
Atropine	20	23	
Atropine/meperidine/diazepam	75	69	
None	5	7	
Other	0.2	0.2	
Type of surgery (%)			0.40
Otorhinolaryngologic	10	11	
General	50	51	
Genitourinary	10	10	
Gastroenterology (endoscopies)	3	1	
Eye	15	14	
Orthopedic	6	5	
Plastic	4	4	
Special studies	0.4	0.6	
Dental	1.5	4	
Anesthetic technique (%)			0.77
Inhalation only	28	30	
Inhalation + opioid	33	31	
Inhalation + opioid + RNB	18	20	
Inhalation + RNB	18	16	
Other	3	3	
Analgesics in PACU (%)			0.34
None	47	45	
Acetaminophen	42	47	
Acetaminophen + opioid	4	3	
Opioid	7	5	
Analgesics in DSU (%)			0.76
None	81	83	
Acetaminophen	16	15	
Acetaminophen + opioid	3	2	

Totals may not equal 100% due to rounding.

RNB = regional nerve block; PACU = postanesthesia care unit; DSU = day surgery unit.

TABLE 2. Duration of Stay and Incidence of Vomiting in the OR, PACU, and DSU for Mandatory Drinkers and Elective Drinkers

	Mandatory Drinkers	Elective Drinkers	P
Drank in DSU, n (%)	442 (95)	411 (78)	—
Duration ± SD (minutes)			
OR	$72 \pm 35$	$77 \pm 41$	0.04
PACU	$70 \pm 24$	$68 \pm 20$	0.11
DSU	$101 \pm 58$	$84 \pm 40$	<0.001
Vomiting (%)			
OR	0	0	—
PACU	6	6	0.99
DSU	23	14	<0.001
Home	27	26	0.72
Total	39	32	0.04

DSU = day surgery unit. OR = operating room; PACU = postanesthesia care unit.

After discharge from the hospital, 40 patients (4.1%) had vomiting of moderate severity, and 20 (2%) had severe vomiting. The average time to the first episode of vomiting after discharge was  $2 \pm 2.5$  h for the mandatory drinkers, and  $2 \pm 3$  h for the elective drinkers ( $P = 0.90$ ). Information on the location of the first emesis was available for 246 patients of the 258 patients who vomited after discharge from the hospital. The first episode of vomiting occurred within the hospital (hallway or garage) 15 times (6%), during the car ride home 67 times (27%), and at home 164 times (67%). Of the 15 children who vomited in the hospital, only 2 vomited during the car ride home.

### FACTORS AFFECTING VOMITING IN THE DAY SURGERY UNIT AND POSTDISCHARGE

Stepwise multiple regression analysis revealed six variables that correlated with vomiting in the DSU and four variables that correlated to postdischarge vomiting. The group assignment (mandatory drinker vs. elective drinker) correlated with vomiting only in the DSU, whereas the intraoperative administration of opioids, surgical procedures known to be associated with a high incidence of vomiting (T & A and strabismus repair), and age group were related to vomiting in the DSU and after discharge from the hospital. There was no correlation between the choice of maintenance anesthetic and vomiting.

### ELECTIVE DRINKING VERSUS MANDATORY DRINKING

The incidence of vomiting in the operating room, in the PACU, and after discharge from the hospital was similar for both groups (table 2). In the DSU, fewer children in the elective drinker group vomited. Only 14% of elec-

tive drinkers vomited compared to 23% of mandatory drinkers ( $P < 0.001$ ). The elective drinkers experienced a lower overall incidence of vomiting (32%) compared to the mandatory drinkers (39%) ( $P = 0.04$ ), which was attributable to their lower incidence of vomiting in the DSU. The severity of vomiting was similar in the PACU ( $P = 0.86$ ), postdischarge ( $P = 0.99$ ), and overall ( $P = 0.11$ ). Elective drinkers experienced less severe vomiting in the DSU than did mandatory drinkers ( $P < 0.001$ ), but when

TABLE 3. The Incidence of Vomiting by Location for All Patients in Each Age Group Combined

Location	Age $\leq 2$ yr	2 < Age $\leq 4$ yr	Age > 4 yr	P
PACU	1*	4	11	<0.001
DSU	8*	22	26	<0.001
Postdischarge	12*	28	39	<0.001
Total	19*	38	49	<0.001

PACU = postanesthesia care unit; DSU = day surgery unit.

\*  $P < 0.01$  compared to 2 < age  $\leq 4$  and age > 4.

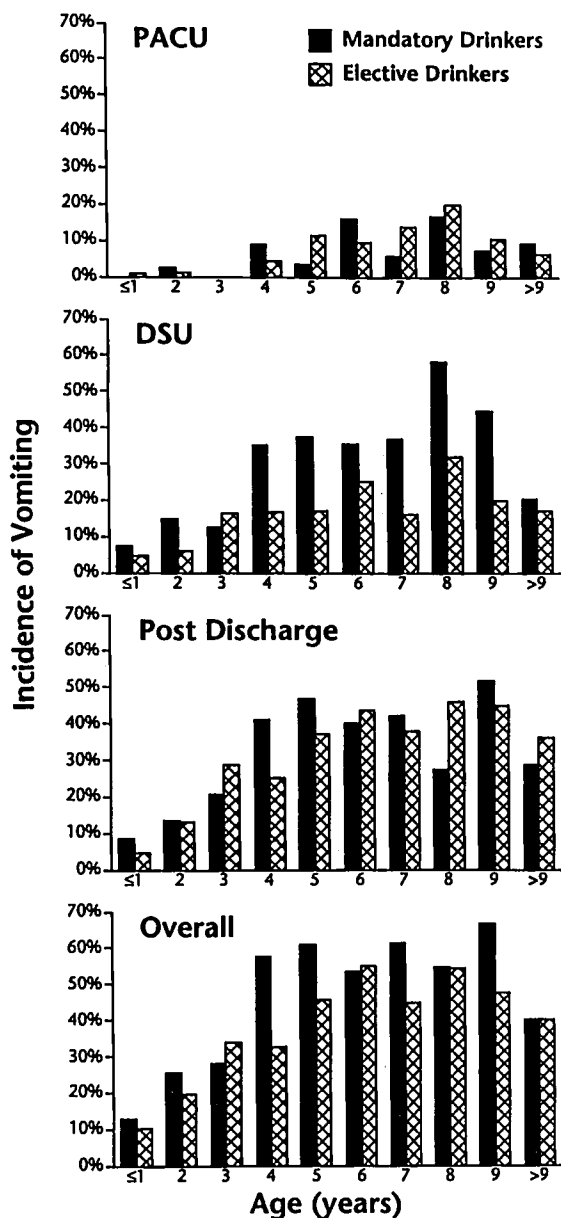


FIG. 1. The incidence of vomiting by age group in the postanesthesia care unit (PACU), day surgery unit (DSU), and postdischarge, as well as the overall incidence of vomiting for both elective drinkers and mandatory drinkers. Elective drinkers vomited less than mandatory drinkers in the DSU ( $P < 0.001$ ), and younger children ( $\leq 2$  years) vomited less than older children.

the analysis was limited to patients who vomited, no difference was evident ( $P > 0.86$ ). The 102 mandatory drinkers who vomited while in the DSU did so an average of  $1.7 \pm 1.1$  times, whereas the 69 elective drinkers who vomited in the DSU averaged  $1.6 \pm 1.2$  episodes ( $P = 0.72$ ). Therefore, the difference in the severity of vomiting between the two groups in the DSU can be attributed to a decreased incidence of vomiting by elective drinkers and not to a decreased number of episodes for those patients who vomited.

The 114 elective drinkers who chose not to drink had a 19% incidence of vomiting in the DSU and a 40% incidence after discharge. The remaining 411 elective drinkers who chose to drink in the DSU had a 12% incidence in the DSU (not significantly different,  $P = 0.08$ ) but only 22% after discharge ( $P < 0.001$ ). The 114 elective drinkers discharged without drinking took their first drink at home an average of  $6 \pm 7$  h after discharge.

Seventy-one patients, 25 mandatory drinkers and 46 elective drinkers, received droperidol in the operating room as prophylaxis against vomiting ( $P < 0.05$ ). Strabismus repair was the indication for droperidol in 56 of the 71 patients (79%), and the remainder received droperidol because of a history of severe postoperative emesis after a previous surgical procedure (11 patients) or because they were undergoing T & A (3 patients). Even though there was an uneven distribution of patients receiving droperidol, eliminating the data from these 71 patients did not change the outcome of the analyses. Seven patients received an antiemetic in the PACU (3 mandatory drinkers and 4 elective drinkers), and 2 received an antiemetic in the DSU (one from each group).

#### AGE EFFECTS

Because of the slight but significant difference in the mean age of the two groups, we investigated the effect of age on postoperative vomiting. The incidence of vomiting after surgery varied with the age of the child (fig. 1). The histogram displays the overall incidence of vomiting by age and the incidence in each of the three locations (PACU, DSU, and postdischarge). In all locations children  $\leq 2$  yr of age vomited the least (table 3). Even though the mandatory drinkers were slightly older on average, the

elective and mandatory drinkers had nearly identical distribution of patients by age group (table 1).

#### HIGH-RISK PATIENTS

Of the 989 patients, 80 underwent strabismus surgery and 62 underwent T & A; both procedures are associated with a higher than average incidence of postoperative vomiting. The groups were comparable with the exception of the age of the T & A patients. The patients undergoing T & A from the elective drinker group were on average nearly 2 yr younger than their counterparts from the mandatory drinker group. However, because no child less than 4 yr of age underwent T & A as a day surgery procedure, the distribution of patients by age group was identical. There was no difference in the distribution of preanesthetic medication type nor in anesthetic management. The incidence of vomiting in the DSU (10% *vs.* 45%,  $P < 0.001$ ) and the duration of stay in the DSU ( $85 \pm 26$  min *vs.*  $128 \pm 58$  min,  $P < 0.001$ ) was reduced for the strabismus patients from the elective drinker group compared to the mandatory drinker group. The incidence of vomiting in the DSU (32% *vs.* 65%,  $P < 0.05$ ) and the total incidence of vomiting (48% *vs.* 80%,  $P < 0.05$ ) was reduced for T & A patients from the elective drinker group. There were no differences between the two groups in the duration of DSU stay.

#### ANESTHETIC MAINTENANCE AND OPIOID ADMINISTRATION

Even though the majority of patients received meperidine in the oral preanesthetic medication, opioid administration in the operating room (almost exclusively morphine 0.05–0.1 mg/kg) was highly correlated with subsequent vomiting ( $F = 20.4$ ). Assessing the effect of opioids on postanesthetic vomiting is complicated by the fact that younger patients received opioids less frequently than older patients and by the fact that a wide variety of surgical procedures were included in the analysis. Only 41% of the 393 children  $\leq 2$  yr of age received an opioid during their anesthetic compared to 61% of the children who were older than 2 yr of age.

To control for bias introduced by patient age and type of surgical procedure, the effect of opioids was examined in greater detail in the 300 children who underwent hernia repair. The type of anesthetic used for maintenance was unrelated to postoperative vomiting. Therefore, the four maintenance anesthetic types were combined into only two groups: intraoperative opioid supplementation or no opioid supplementation. Patients who received intraoperative opioids experienced a significant increase in vomiting in the DSU and in total compared to those patients who did not receive opioids. However, because a lower proportion of children  $\leq 2.0$  yr of age received intraoperative opioid supplementation compared to chil-

dren  $> 2$  yr of age, the incidence of vomiting in children  $\leq 2.0$  yr of age was analyzed separately from the incidence of vomiting in children  $> 2$  yr of age. After stratification by age group, no significant difference in the incidence of vomiting was apparent in any location for those who received intraoperative opioids compared to those who did not.

#### COMPLICATIONS

Neither admission to the hospital for intractable vomiting nor readmission for dehydration or vomiting after discharge from the hospital was required for any patient.

#### Discussion

Our null hypothesis stated that requiring a group of children to drink clear liquids in the DSU prior to discharge from the hospital would not increase the incidence of vomiting or delay discharge compared to a group of children who were allowed but not required to drink. However, our results demonstrate that making drinking a prerequisite for discharge increases the incidence of vomiting in the DSU by more than 50% and slightly prolongs hospital stay.

Left to choose, 78% of our elective drinkers requested oral liquids in the DSU, and these patients had the lowest incidence of vomiting. Most of the overall difference between elective drinkers and mandatory drinkers is therefore likely to be due to the remaining elective drinkers, who chose not to drink. It is likely that this subgroup of elective drinkers would have had a much higher incidence of vomiting if drinking had been a prerequisite for discharge. If all of the differences between the two groups were attributable to this subgroup of patients and if they had been required to drink prior to discharge, the predicted incidence of vomiting for these 114 patients would have been 63% rather than the 19% observed.

Requiring children to drink prior to hospital discharge appears to increase the incidence of vomiting and prolong the duration of hospital stay. Our data demonstrate that pediatric day surgical patients vomit more frequently after discharge from the hospital than during the hospital stay. Therefore, the decrease in the incidence of vomiting in the DSU had only a small but significant impact on the overall incidence of vomiting, decreasing it from 39% to 32%. Although only 136 of our patients went home without drinking, the fact that a child drinks clear liquids without vomiting prior to discharge does not guarantee that vomiting or dehydration will be avoided after discharge.

The anesthesiologists caring for the patients were not blinded to the patients' group assignment. It is possible that some alteration in anesthetic technique could have affected the results. However, we find no evidence of a change in anesthetic practice that could account for the

differences observed. One potential confounding variable was the uneven distribution of droperidol administration between the two groups. Eliminating the data from these patients did not affect the results of the statistical analyses in any way. Therefore, we do not believe that this unexpected finding was of material importance.

The multiple factors that have been associated with an increased incidence of vomiting include individual predisposition (history of motion sickness), gender (women), age (children), type of preanesthetic medication, type of anesthetic, use of opioids, and site of operation.<sup>11</sup> Children have twice the incidence of vomiting of adults.<sup>12</sup> However, children should not be thought of as a homogeneous group. Although we report a lower incidence of vomiting than Rowley and Brown, our data support their contention that younger children vomit less often than older children.<sup>13</sup>

Although the intraoperative administration of opioids correlated with vomiting, this finding must be viewed with some caution. Younger patients received opioids less frequently, biasing the result. When we limited our analysis to patients who underwent hernia repair and stratified by age group, there was no evidence that opioids increased vomiting in this relatively homogenous subgroup. The magnitude of the effect of opioids cannot be determined from this study. Further investigation is needed to answer this important clinical question.

Recent changes have liberalized preoperative feeding practices, making it more likely that a variable preoperative fluid deficit will exist from child to child.<sup>14-16</sup> Discharging patients from the hospital who might not feel ready to drink for several more hours further complicates perioperative fluid management. Patients in this study received a minimum of 8 h of maintenance fluid replacement in the operating room and PACU, plus calculated hourly maintenance fluid during the operation, and replacement of operative losses. The goal was to infuse sufficient intravenous fluid to prevent dehydration after discharge from the hospital. Further study will be required to determine whether this represents optimal fluid management, but given the lack of complications during this study, it appears to be a reasonable approach.

Based on the results of this study we conclude that children can be safely discharged after day surgery without making drinking a prerequisite.

### Addendum

Since the completion of this study, more than 6,000 day surgery patients have been cared for in our DSU without being required to drink prior to discharge. Approximately 20% of our patients continue to choose not to drink prior to discharge. We now allow children who undergo brief procedures without supplemental intravenous fluids, such as placement of myringotomy tubes, to be discharged from the DSU without requiring them

to drink. Three patients have required admission for vomiting, and one patient required readmission from home for intractable vomiting and dehydration. The three admitted patients included two who had undergone T & A and one who was an insulin-dependent diabetic patient. The patient who required readmission drank clear liquids prior to discharge and had previously required readmission for vomiting after minor surgery.

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