

Predictors of Unanticipated Admission in Paediatric Patients after Ambulatory Surgery

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Abstract

Background: Unplanned hospital readmission following ambulatory surgery is a source of stress and inconvenience to the patients and their care givers. The present study aims to establish the incidence and causes of unplanned readmissions following ambulatory surgery in children.

Methods: We conducted our study in paediatric patients [06 months to 16 years] undergoing minor procedures from June 2013 to December 2015 at Sainte-Justine University Hospital, Montréal, Canada. The study involved a retrospective evaluation of later complications during the 07-day postoperative period by using the hospital computer system to determine any visits to the emergency room or hospital readmissions. Unanticipated admission patients were compared to a random sample of patients not requiring admission in this case-control study. Demographic data, surgical information, medications, intraoperative events, and patient comorbidities were collected from both groups. The reason for admission was classified and factors associated with unanticipated admissions were analysed with a multiple conditional logistic.

Results: After 4272 operations performed as a day case surgery, 81 patients returned to the emergency room within 7 days after ambulatory surgery discharge. Eleven of these patients were readmitted. Reasons to readmission after ambulatory surgery discharge were: bleeding, bronchospasm, fever and upper respiratory tract infection. General surgery and otolaryngology were responsible for 91% of readmitted patients, plastic surgery accounted for 9% of readmitted patients.

Conclusions: 0.25% of our patients were readmitted after ambulatory surgery. This study will be helpful in order to identify patients at risk of rehospitalization and improve our patient selection for same day surgery.

Keywords: Ambulatory Procedures; Paediatric Procedures; Unplanned Admission

Introduction

The terms fast-track surgery, ambulatory surgery, day surgery and outpatient surgery are used to describe non-emergency surgery performed on selected patients who are discharged home after recovery from anaesthesia on the same day [1-3]. The term fast-track surgery was established in the 1990s and represents a comprehensive program for optimization of perioperative care in elective surgery, by reducing stress and discomfort and speeding up convalescence [4]. The popularity of day case surgery may be attributed to the reduction of the waiting, the lowered hospitalization costs as well as the reduced risk of hospital acquired infection, better convalescence and outcome in the home environment because of lack of separation trauma and sudden change of environment [3,5-7].

Although day surgery has been beneficial to both patients and hospitals it has been associated with postoperative problems relating to anaesthesia, patient mobilization, analgesia and rehabilitation upon return to the home environment [2,8,9]. Aside from cost implications, unplanned hospital readmission following fast-track surgery can cause stress and inconvenience to the patients and their care givers [10-14]. The incidence of unplanned hospital readmission reported ranged from 0.1% to 5.3% [8,9,12-16]. The most common causes for readmission after ambulatory surgery are surgical bleeding, inadequate pain relief and vomiting [1,12,14]. However, some studies demonstrated that proper patient selection reduced unplanned readmission [8,18,19].

At Sainte-Justine University Hospital, we developed a fast-track concepts for ambulatory surgery for various minor paediatric procedures, including minimally invasive techniques. One day case surgery in fast-tracking hospitalisation is a term used to describe a process wherein preselected patient who meet specific criteria while still in the post-anaesthesia care unit are allowed to bypass the hospital's pediatric day care unit and be discharged home after undergoing minimally invasive interventions. With the increased emphasis on quality improvement, day case surgery requires periodic evaluation of surgical activities, including monitoring of unplanned admission rates to minimize unfavourable outcomes. So, the present study aimed to retrospectively review our one day case surgery in fast-tracking hospitalisation in order to analyse the rates of and causes of unplanned admissions following discharge from a Canadian paediatric tertiary hospital.

Material and Methods

After approval from the local Research Ethics Committee we conducted a case-control study on paediatric patients [06 months to 16 years] undergoing minor procedures at Sainte-Justine University Hospital from June 2013 to December 2015. The CHU Sainte-Justine is a Quebec health care establishment dedicated to children, adolescents and mothers. Data were collected retrospectively from computerized patient medical records (ChartMaxx[®], Quest Diagnostics[®], New Jersey, USA).

The primary outcome of this study was a retrospective evaluation for later complications during the 7-day postoperative period (from the day of surgery until 7 days after ambulatory surgery) to determine any emergency room visits or hospital admissions. The control group was randomly sampled among the other patients to match the number of cases, after stratification by the year of surgery, kinds of surgery and age.

Data included demographics, preoperative clinical findings, surgical procedure (classified according to the International Classification of Disease Procedures Code [ICD.10.CM]), type of anaesthesia, duration of procedure, time of completion of surgery, intraoperative events (difficult intubation, bronchospasm, laryngospasm, aspiration, blood loss requiring transfusion, and hemodynamic instability, etc.). We searched for information about pain, bleeding, nausea, vomiting, fever, sleepiness, sore throat, and symptoms of croup, because these were the most common problems encountered by previous studies [12-14,17-20].

One day fast-track process

During the study period, all children enrolled in a one day surgery fast-track process were eligible. The surgical specialties involved in our one day fast-track process are dental, ophthalmic, orthopaedic, otolaryngology (ORL), paediatric general surgery, plastic surgery, physiatrist and urology. All children are scheduled for superficial procedures like dental treatment, myringotomy tube placement, otoplasty, ophthalmology examination under anaesthesia, repairing ptosis, trichiasis treatment with electrolysis, pulsed dye laser for infantile haemangioma, nasolacrimal duct probing and irrigation, cystoscopy, preputial adhesions and circumcision, dermoid cyst treatment, epigastric hernia, portacath removal and imaging techniques like magnetic resonance imaging.

A dedicated day surgery nurse leads preoperative assessment, and the child's medical history was evaluated to confirm if the child is admissible for the day case surgery. Parents received medical advice and information about the fasting rules and what to do in case of respiratory infection.

Exclusion criteria for one day surgery fast-track process in our institution include social factors, surgical and anaesthetic and patient related factors.

Social factors

- Inadequate postoperative transport arrangement,
- Parent unable or unwilling to care for the child at home postoperatively,
- No telephone,
- Poor housing conditions,
- Excessive commute time from home to the hospital (>1 hour).

Anaesthetic and surgical factors

- Postoperative pain unlikely to be relieved by oral analgesics,
- Prolonged procedure (> 60 minutes),
- Opening of a body cavity,
- High risk of perioperative haemorrhage/fluid loss,
- Malignant hyperpyrexia susceptibility,
- Sibling of a victim of sudden infant death syndrome.

Patient related factors

- ASA 3 or more,
- Difficult airway (including obstructive sleep apnoea),
- Term baby less than one month in age,
- Preterm or expreterm baby < 60 weeks post conception age,
- Poorly controlled systemic disease,
- Inborn errors of metabolism,
- Complex cardiac disease or cardiac disease requiring investigation,
- Sick cell disease (not trait),
- Active infection (especially of respiratory tract).

In our study, the operating room time was defined as the time from the beginning of anaesthesia procedure to the time when the patient was ready to be transferred to the post-anaesthesia care unit. The post-anaesthesia care unit recovery time was the interim between arriving in the post-anaesthesia care unit and meeting home discharge criteria (Aldrete score \geq 9).

Before being discharged home, child's care givers were given verbal and written instructions regarding postoperative care at home. Those included details of analgesia, diet, wound care, mobilisation and resumption of normal activity.

Statistical analysis

All results are presented as median \pm mean absolute deviation. The mean absolute deviation is a variation of the median, which is less affected by extreme values, because these values have less influence on the calculation of the median than the average. Ordinal or continuous variables were analysed with the Mann-Whitney test and qualitative variables were analysed with the Fisher test. All tests were two-sided. The variables with P-value < 0.2 were selected as candidates to be put into the multiple regression model. To match the stratified sampling method used to select the patients for control group, multiple variable logistic regression model was used to

identify the potential predictors for unanticipated admission [21]. Forward stepwise method with the criterion of $P < 0.1$ was applied in the multiple regression to select the finally independent variables staying in the final model. The result from the regression model was reported as odds ratio (OR) and corresponding 95% confidence interval (CI). P-values lower than a 0.05 chosen level were regarded as statistically significant. Presently, there is no standard statistical criterion used to report the goodness of test for the conditional logistic model. Thus, the model fitting for the final model was assessed by comparing to the standard logistic model, without adjusting for the matching variable [22].

All statistical analyses were performed using the StatView® software for Windows (version 4.57, Abacus Concepts Inc.®, Berkeley, CA, USA).

Results

The databases of patients in one day surgery fast-track process of the Sainte-Justine University Hospital, Montreal, Canada were analyzed from June 2013 to December 2015. During these 31 months 4,272 operations were performed in the one day surgery fast-track process of which, 81 patients (1.8%) returned to the emergency room after ambulatory surgery discharge (Figure 1). Characters of paediatrics participants are presented in table 1 and 2.

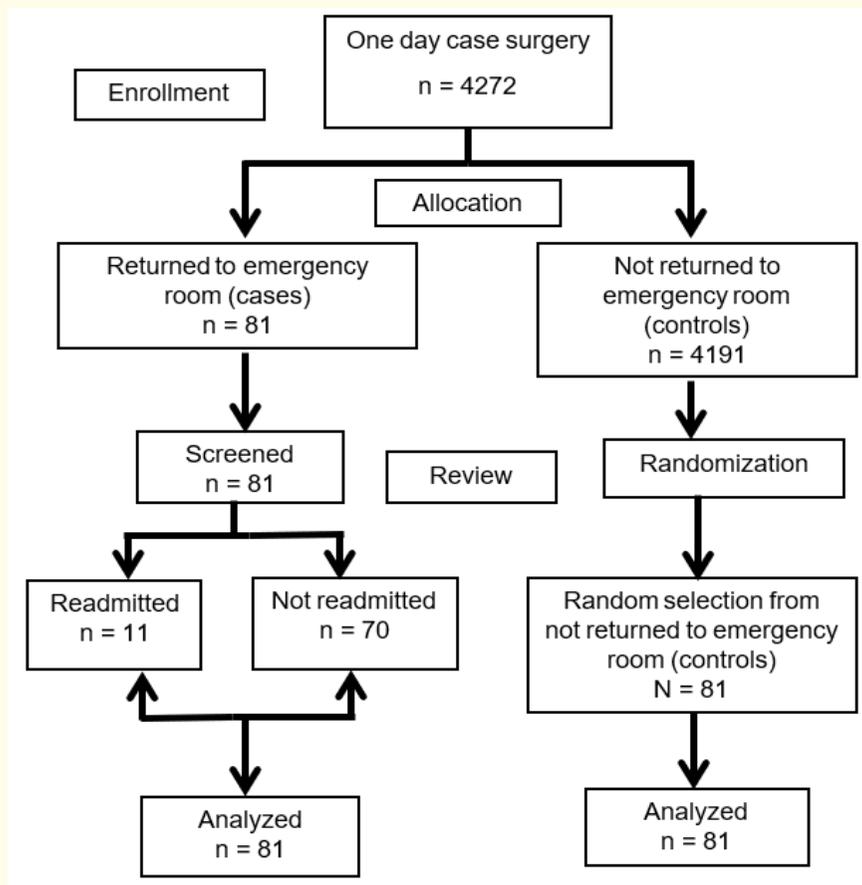


Figure 1: Protocol flow diagram.

	RP (n = 81)	NRP (n = 81)
Age (years) ^a	4 ± 2	5 ± 3
Height (cm) ^a	104 ± 11	100 ± 6
Weight (kg) ^a	19 ± 5	18 ± 4
Male (%) ^b	67	70
ASA I (%) ^b	78	73
ASA II (%) ^b	22	27
PACUS (minutes)	41 ± 14	39 ± 12
Surgery time (minutes)	30 ± 15	33 ± 13
Facial mask (%) ^b	48	46
Larygeal mask (%) ^b	35	39
Tracheal intubation (%) ^b	17	15

Table 1: Characteristic of pediatric participants in returned patients to the emergency room and control group. RP: Returned patients to the emergency room without hospital readmission; NRP: Non-returned patients to the emergency room with hospital readmission; n: number of patients; PACUS: Post-anesthesia Care Unit Stay. Data are expressed as median ± median absolute deviation. a: Mann-Whitney U test; b: Fisher test. There is no difference between groups.

	Group 1 (n = 70)	Group 2 (n = 11)
Age (years) ^a	4 ± 2	4 ± 2
Height (cm) ^a	105 ± 4	94 ± 8
Weight (kg) ^a	18 ± 5	19 ± 6
Male (%) ^b	70	45*
ASA I (%) ^b	74	73
ASA II (%) ^b	26	27
PACUS (minutes)	41 ± 14	38 ± 9
Surgery time (minutes)	30 ± 15	37 ± 10
Facial mask (%) ^b	47	45
Larygeal mask (%) ^b	33	45*
Tracheal intubation (%) ^b	20	10*

Table 2: Characteristic of pediatric participants returned to the emergency room. Group 1: Returned patients to the emergency room without hospital readmission; Group 2: Returned patients to the emergency room with hospital readmission; n: number of patients; PACUS: Postanesthesia Care Unit Stay. Data are expressed as median ± median absolute deviation. a: Mann-Whitney U test; b: Fisher test; *: P < 0.05 group 2 versus group 1.

The gender distribution in the returned patients was: males 66.7%, females 33.2% (p < 0.05). However, the number of females in readmitted patients were higher than males (6 versus 5 respectively).

Patients returned to the emergency room 3 ± 1 days after ambulatory surgery discharge. Reasons to return to the emergency room after ambulatory surgery discharge were: bleeding (19 patients), upper respiratory tract infection (18 patients), pain (14 patients), wound exudates (9 patients), fever (6 patients), otitis (6 patients), atopic dermatitis (eczema) (2 patients), bronchospasm (2 patients), dizziness (2 patients), constipation (1 patient), vomiting (1 patient) and ingested foreign body (coin) (1 patient).

13.6% (11 patients) of these 81 patients were readmitted, so our percentage of readmitted patient during these periods was 0.25%. General surgery and otolaryngology were responsible for 91% of readmission (5 patients each other), plastic surgery came in third place with 9% of readmitted patients.

Reasons for readmission after ambulatory surgery discharge were: bleeding (7 patients), upper respiratory tract infection (2 patients), bronchospasm (1 patient) and fever (1 patient).

When analysing surgical specialties, it was noted that otolaryngology and general surgery were responsible for 47% and 34.5% respectively of returned visits to the emergency room after ambulatory surgery discharge. However, these areas are also responsible for the greatest number of fast-track surgeries, otolaryngology performed around 51.6% (2203 patients) of the total volume of operations during the 31 months and general surgery around 11.5% (491 patients). The others specialties were responsible for approximately 36.9% of the total number of operations performed in the period from June 2013 to December 2015, dental performed 642 cases (15% of fast-track surgeries programmed in these 31 months), plastic surgery performed 281 cases (6.6%), urology performed 245 cases (5.7%), ophthalmology performed 196 cases (4.6%), physiatrist performed 136 cases (3.2%) and orthopaedic surgery performed 78 cases (1.8%).

In order to calculate the true rate of post-operative visit to the emergency room after discharge, the number of those visits was divided by the number of the total surgical procedures programmed.

In this respect, general surgery has the highest number and the otolaryngology the lowest with a rate of 5.75 and 0.01% respectively (Table 3).

Specialty	Rate of return to the emergency room
Dental	0.6% (4/642)
Ophthalmic	0% (0/196)
Orthopedic	3.8% (3/78)
Otolaryngology	0.01% (38/2203)
Paediatric general surgery	5.7% (28/491)
Plastic surgery	1.42% (4/281)
Physiatry	1.4% (2/136)
Urology	0.81% (2/245)

Table 3: The rate of return to the emergency room visits after ambulatory surgery discharge by specialties (ratio between the number of return to the emergency room visits by specialty by the total volume of surgeries performed in that area).

Source: Database of the Sainte-Justine University Hospital, Montreal, Canada (from June 2013 to December 2015).
 During these 31 months 4,272 operations were scheduled in one day fast-track process.

Reasons to return to the emergency room visits after ambulatory surgery discharge by specialties are presented in tables 4 and 5.

	Dental	Orthopedic	ORL	GS	Plastic	Physiatry	Urology
Otitis (n)		1	4			1	
URTI (n)	2	1	5	8	1		
Pain (n)	2	1	6	3	2		
WE (n)				9			
Bleeding (n)			8	1			2
Fever (n)			2	1		1	
Vomiting (n)				1			
Eczema (n)			2				
Bronchospasm (n)			2				
Dizziness (n)			2				
Constipation (n)			1				
IFB (n)			1				

Table 4: Reasons to return to the emergency room visits without hospital admission after ambulatory surgery discharge by specialties.

GS: General Surgery; IFB: Ingested Foreign Body (Coin); n: Number of patients returned to the emergency room visits after ambulatory surgery discharge without hospital readmission; ORL: Otolaryngology; Plastic: Plastic Surgery; URTI: Upper Respiratory Tract Infection; WE: Wound Exudates.

Source: Database of the Sainte-Justine University Hospital, Montreal, Canada (from June 2013 to December 2015).
 During these 31 months 4,272 operations were scheduled in one day fast-track process.

Discussion

One day surgery fast-track process is a term used to describe a process wherein preselected patient who meet specific criteria while still in the post-anaesthesia care unit can bypass the hospital's paediatric day care unit and be discharged home after undergoing minimally invasive interventions. The first known ambulatory paediatric surgery service was established in 1899 by a Scottish paediatric surgeon, Dr James H. Nicoll [23]. He recognized the advantages of recovery at home, especially for sicker children and the possible disadvantages of routine postoperative hospitalization [23].

The ambulatory surgeries have gain in popularity given their tendency to toward shorter wait times hospitalization, their lower cost and risk of infection, minimal separation from parent and more rapid return to home [3,5-7].

The ambulatory surgeries are particularly appropriate for children, provided the operation is not complex or prolonged and the child is healthy with no significant co-existing medical illness [3,5-7].

However, a proportion of children may require unanticipated admission and free standing day units should ensure that they have capability to transfer children to inpatient facilities if need arises. Also, unanticipated admission following ambulatory surgery may serve as an interesting marker of quality for ambulatory surgery and anaesthesia practice, as well as a way to identify patient types that are unsuitable for ambulatory surgery [9,14,15,17-19].

Since 2013, we have developed at Sainte-Justine University Hospital the concepts of One day - Fast-tracking. Our one day surgery fast-track process is the outcome of applying a range of multimodal strategies that are designed to prepare and optimize patients before, during and after surgery, ensuring prompt recovery and discharge. So, it is important to identify criteria that can be used to determine when patients are discharged into the home environment appropriately. In this retrospectively study we would like to identify groups of patients with the greatest likelihood of being readmitted to the hospital.

According to some studies, the rates of unplanned hospital readmission after ambulatory surgery range from 0.1% to 5.3% and the most common causes for readmission are surgical bleeding, inadequate pain relief and vomiting [8,9,12,13,15,16].

However, patient's selection criteria, the nature of the procedure and the organisation of the healthcare facilities may affect considerably the rate of unanticipated admission [8,17-19]. Some studies have showed that proper patient selection reduced unplanned readmission and well-organized outpatient facilities have an unanticipated hospital admission rate less than 1% [8,17-19]. As stated by others screening can be achieved in a variety of ways [17-19]. In our institution an experienced day unit nurse reviews parent and child, clarifying and doubts with the parent. According our institution criteria for one day surgery fast-track process the nurse sorts children into those who are suitable for one day surgery fast-track process, those who are not suitable and those who will need further assessment by an anaesthetist before a final decision can be made. All children are reviewed by the anaesthetist and surgeon on the day of surgery.

We have a helpline for the first 24h after discharge and nurse telephones to the parents the next day. We think that telephone follow-up is highly rated by patients, provides support for any immediate complications, and is useful for auditing postoperative symptoms and parents/patient satisfaction.

Recently, Whippey, *et al.* [17] in a retrospective study found the incidence of unanticipated admission following pediatric ambulatory surgery of about 0.97%. They stated as patient predictive factors of admission: age (< 2 years), ASA 3 class, type of surgery (orthopaedics, dental and otolaryngology), duration of surgery (> 1h in children), time of completion of surgery (later than 3 pm) and the presence of obstructive sleep apnoea [17].

During the 31 months of our study 4,272 operations were performed in the one day surgery fast-track process of which, 81 patients (1.8%) returned to the emergency room after ambulatory surgery discharge and 13.6% (11 patients) of these 81 patients were readmitted. Reasons for readmission in our study were bleeding, bronchospasm, fever and upper respiratory tract study. Our inclusion criteria were different than those of Whippey' study [17] which may explain our lower incidence of readmission.

Concerning type of surgery, general surgery and otolaryngology were responsible for 91% of readmission (45.5% each other), plastic surgery came in third place with 9% of readmitted patients. However, if we calculate the “true” rate of returned patients, we found that general surgery is the area with the highest rate with 5.7%, plastic surgery came in second place with 1.4%, and otolaryngology had the lowest rate with 0.01%.

Even with modern agents, prolonged surgery is associated with prolonged recovery and complication such as vomiting, pain and bleeding, which could result in increased unanticipated admission [8,15-19]. For these reasons, at our institution we stated as exclusion criteria for one day surgery fast-track process procedures that take more than 60 minutes to complete.

Concerning the respiratory adverse events as a reason for readmission, we have 1 patient with bronchospasm and 2 patients with upper respiratory tract infection that were hospitalized. Kozanhan and Iyisoy [24] have demonstrated an association between red cell distribution width and respiratory adverse events. This association remained significant after adjustments for other risk factors and demographic variables [24]. Unfortunately, we did not ask for systematic red cell distribution width. More studies will be necessary to evaluate if doing this exam will be helpful to identify children at risk for postoperative respiratory adverse events in our population included for one day fast-track process.

Whippey, *et al.* [17] reported that anaesthetic causes were more frequent than surgical causes as reasons of unanticipated admission. Postoperative hypoxia was the most common cause of readmission and both obstructive sleep apnoea and intraoperative events (like laryngospasm) are predictive of readmission [17]. Our low rates of respiratory adverse events may be explained because most of our procedures were done with a fascial mask or a laryngeal mask avoiding the use of neuromuscular blocking drugs and problems such as extubation stridor and bronchospasm.

In addition, as shown in table 2, the percentage of tracheal intubation is rather lower in returned patients to the emergency room with hospital readmission than in returned patients to the emergency room without hospital readmission.

Effective pain control is very important for successful one day surgery fast-track process [8,17-19]. Multimodal analgesia therapy can increase analgesic effects while simultaneously reducing the side effects associated with certain medications [17,20]. Multimodal analgesia therapy allows early mobilisation, drinking and eating and plays a vital role in enhanced recovery [8,17-19]. In our Institutional protocol acetaminophen 15 mg/kg/dose orally or rectally, naproxen 10 mg/kg/dose orally or rectally, local infiltration or nerve blocks are systematically used. Morphine (0.1 mg/kg/dose) can be used to achieve rapid pain control in postoperative period if acetaminophen, naproxen and regional anaesthesia are inadequate.

14 patients returned to the emergency room visits because pain (Table 4). However, pain was not a reason for hospital rehospitalisation. In 8 patients naproxen was not done and in 6 patients parents did not give prescribed analgesics. We are working our verbal and written instructions concerning pain management at home in order to be clearer.

Postoperative nausea and vomiting (PONV) are ranked as an important causes of unanticipated hospital admissions for children who undergo ambulatory surgery [15,17]. The average incidence of PONV in childhood of between 33 and 82% when no prophylactic antiemetic is given [25,26]. Factors affecting PONV after paediatric anaesthesia are patient characteristics, surgical procedure, anaesthetic technique, and postoperative care [25,26]. Patient-related factors that may be associated with increased PONV in children, but not under the control of the anaesthetist, include age, sex, and a previous history of PONV or motion sickness [25,26].

So, the successful management of PONV is an important component in the care of children after surgery. PONV may cause discomfort and distress, delay recovery and prolong hospitalisation. A multimodal management approach is useful. The current recommendations at our institution are avoid emetogenic anaesthesia techniques, perioperative intravenous hydration, adequate pain control and multiple different antiemetic medications (double or triple combination antiemetic therapy acting at different neuroreceptor sites). In our Institutional protocol for postoperative nausea and vomiting we use dexamethasone 0.1 mg/kg, Dimenhydrinate 0.5 mg/kg and Ondansetron 0.1 mg/kg. Our prophylaxis for paediatric PONV was highly effective as demonstrated by the fact that only one patient returned to the emergency room because of vomiting. It is possible that a combination of antiemetics with different sites of activity would

be more effective than one drug alone [25,26]. The ability to tolerate oral fluids is a criteria used in our institution for discharge from one day surgery fast-track process but it seems that this approach does not increase vomiting rates in our population.

Conclusions

From June 2013 to December 2015 in one day fast-track process, 1.8% of our patients returned to the emergency room and 0.25% of patients were readmitted. Bleeding was the most important reason for readmission. Our study population included a wide variety of patients and will be helpful to identify patients at risk of rehospitalisation and improve our patient selection for one day surgery. Proper selection and adherence to criteria of suitability for one day surgery fast-track process would make unanticipated admission a rarity.

Study Limitation

One limitation of this study is that it only reports patient readmission to Sainte-Justine University Hospital. Therefore, there may be an underreporting of the actual return rate. Another potential limitation of this study is the external validity of our results. Although our intention is to provide a generalizable analysis of readmission causes for paediatric one day fast-track process the patient population (and care received) at Sainte-Justine University Hospital may not be representative of other hospitals throughout the world. The retrospective nature of the study presents serious limitations as to missing data in patient's files and difficulties obtaining accurate answers to questionnaires sometime after the actual events.

Author Contribution

E.P. Souza Neto: conceptualised and designed the study, designed the data collection instruments, carried out the initial analyses and verified statistics, drafted the initial manuscript, corrected the manuscript and approved the final manuscript as submitted.

J.L. Martinez: conceptualised and designed the study, verified statistics, proofread the manuscript and approved the final manuscript as submitted.

K. Dekoven: proofread the manuscript and approved the final manuscript as submitted.

P. Ruest: proofread the manuscript and approved the final manuscript as submitted.

M.A. Girard: proofread the manuscript and approved the final manuscript as submitted.

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Disclosure of Interest

The authors report no conflict of interest.

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