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Analysis of Inter-Hospital Pediatric Surgical Transfers: Patient Demographics, Clinical Characteristics, and System Implications

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Abstract

Objective: This study aims to comprehensively analyze the demographic, clinical, and logistical profiles of pediatric surgical patients undergoing inter-hospital transfers. By examining the level of referring hospitals, geographic origins, age distribution, diagnostic categories, respiratory support needs, and final admitting departments, we seek to identify patterns in transfer demand, evaluate the efficiency of current transfer systems, and propose evidence-based strategies for optimizing resource allocation and clinical pathways. **Methods:** We conducted a retrospective cohort study of 408 pediatric surgical transfer cases recorded between January 1 and September 30, 2025. Data were extracted from the institutional transfer database and electronic medical records. Descriptive statistics were employed to summarize categorical and continuous variables, with results presented as frequencies and percentages. **Results:** The analysis revealed that a majority of transfers originated from tertiary hospitals (70.8%), with a significant proportion coming from other cities within the province (58.3%). Neonates (0 - 28 days) constituted the largest age group (54.2%), and over 80% of all transferred patients were under one year of age. Congenital heart disease (16.9%) and intracranial hemorrhage (11.0%) were the most frequent diagnoses. Regarding respiratory support, 24.0% of patients required invasive ventilation during transfer. The primary receiving departments were neonatal and pediatric intensive care units (NICU: 31.6%, SNICU: 22.3%). **Conclusion:** Pediatric surgical transfers are characterized by a high volume of critically ill neonates with complex congenital conditions, necessitating advanced respiratory and surgical care. These findings underscore the pivotal role of tertiary pediatric centers within regionalized care networks. To enhance system efficiency and patient outcomes, we recommend the standardization of transfer protocols, strengthening of telemedicine support for referring hospitals, and the development of specialized transport teams equipped for neonatal and surgical critical care.

Keywords

Pediatric Surgical Transfer, Neonatal Transport, Congenital Anomalies, Inter-Hospital Coordination, Resource Allocation, Critical Care Transport

1. Introduction

The inter-hospital transfer of pediatric surgical patients represents a critical juncture in the continuum of care for children with complex or life-threatening conditions. Unlike routine medical transfers, surgical transfers often involve neonates and infants with congenital anomalies, traumatic injuries, or emergent surgical pathologies that require timely access to specialized operative and postoperative resources not available in all healthcare settings [1]. The efficiency and safety of these transfers are not merely logistical challenges but are directly linked to clinical outcomes, including reduced morbidity, mortality, and long-term disability [2].

In recent years, the trend toward regionalization of pediatric surgical care has intensified, with high-acuity cases increasingly centralized at designated children's hospitals or specialized pediatric surgical centers [3]. This model, while improving outcomes for complex cases, inherently increases the volume and distance of patient transfers. Consequently, the transfer system itself becomes a vital component of the regional healthcare infrastructure, requiring coordination among emergency medical services, referring hospitals, and receiving specialty units.

Despite its importance, there is a relative paucity of detailed analyses focusing specifically on the surgical pediatric transfer population. Most existing literature either amalgamates medical and surgical transfers or focuses exclusively on neonatal transfers without stratifying by surgical need [4]. Understanding the unique demographics, clinical profiles, and resource utilization patterns of surgical transfers is essential for several reasons: it informs the training and composition of transport teams, guides the allocation of specialized equipment (e.g., transport ventilators, surgical resuscitation kits), and helps design predictive models for bed management in receiving hospitals.

This study aims to fill this gap by providing a detailed retrospective analysis of all pediatric surgical transfers to a major tertiary children's medical center over a nine-month period. We will systematically examine the origins of these transfers, the clinical characteristics of the patients, the intensity of care required during transit, and their final destinations within the hospital. By doing so, we seek to achieve three primary objectives: first, to delineate the epidemiological and clinical landscape of pediatric surgical transfers; second, to assess the alignment between patient needs and existing transfer system capabilities; and third, to generate actionable insights for optimizing transfer protocols, enhancing inter-hospital communication, and ultimately improving the quality and safety of care for this vulnerable patient population during a critical phase of their treatment journey.

2. Materials and Methods

2.1. Study Design and Setting

We employed a retrospective, observational study design. The study was conducted at the Guangzhou Women and Children's Medical Center, a nationally recognized tertiary pediatric care institution serving as a major referral hub for complex pediatric cases in Southern China. The center operates a dedicated, physician-led pediatric and neonatal transport team available 24/7.

2.2. Study Population and Data Source

The study population included all pediatric patients (aged 0 - 18 years) who were transferred to our institution for a primary surgical diagnosis or surgical consultation between January 1 and September 30, 2025. Patients transferred for purely medical management (e.g., pneumonia, sepsis without surgical complication) or those whose transfer records were incomplete were excluded. Data were extracted from two primary sources: 1) the centralized electronic database of the Emergency Transfer Center, which logs all inter-hospital transfer requests and dispatch records, and 2) the hospital's Electronic Medical Record (EMR) system, which was accessed to confirm diagnoses, procedures, and admission details.

2.3. Variables and Measures

The following variables were collected for each eligible transfer case:

1) Demographic and Referral Characteristics:

Referring Hospital Level: Categorized as primary (community hospitals, health centers), secondary (general hospitals with pediatric services), or tertiary (specialized children's hospitals or large general hospitals with advanced pediatric subspecialties).

Geographic Origin: Classified as intra-city (within Guangzhou), inter-city within the province (from other cities in Guangdong Province), or inter-provincial (from other provinces in China).

2) Patient Clinical Characteristics:

Age Group: Stratified into clinically relevant pediatric groups: 0 - 28 days (neonate), 29 days - 1 year (infant), 1 - 3 years (toddler), 3 - 6 years (preschool), 6 - 12 years (school-age), and 12 - 15 years (adolescent).

Primary Diagnosis: The principal surgical diagnosis prompting transfer, as documented by the receiving surgical team. Diagnoses were grouped into broader categories for analysis (e.g., congenital anomalies, trauma, surgical oncology).

Respiratory Support During Transfer: The highest level of respiratory support provided by the transport team, categorized as: None, Supplemental Oxygen (via nasal cannula or mask), Non-Invasive Ventilation (e.g., CPAP, BiPAP), or Invasive Mechanical Ventilation (endotracheal tube).

3) System and Outcome Measures:

Receiving Department: The clinical department to which the patient was directly admitted upon arrival, such as the Neonatal Intensive Care Unit (NICU), Surgical Neonatal ICU (SNICU), Pediatric ICU (PICU), Cardiac ICU (CICU), Surgical ICU (SICU), General Surgical Ward, or others.

2.4. Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics software (Version 26.0, Armonk, NY, USA). Given that this initial analysis is primarily descriptive in nature, the data are presented mainly through descriptive statistical methods, summarized as frequencies (n) and percentages (%).

3. Results

During the nine-month study period, a total of 1552 inter-hospital transfers were recorded by our center. After applying the inclusion and exclusion criteria, 408 pediatric surgical transfer cases were identified and constituted the final analytic cohort for this study.

3.1. Referring Hospital Level and Geographic Distribution

The distribution of transfers by referring hospital level is detailed in **Table 1**. Tertiary hospitals were the most frequent source of transfers, accounting for 289 cases (70.8%). Secondary hospitals initiated 113 transfers (27.8%), while primary hospitals referred only 6 patients (1.4%).

Table 1. Level of the referring hospital for pediatric surgical transfers.

Hospital Level	Number of Transferred Patients (n)	Percentage
Tertiary Hospital	289	70.8%
Secondary Hospital	113	27.8%
Primary Hospital	6	1.4%
Total	408	100%

Geographic analysis revealed a broad catchment area (**Table 2**). The majority of patients (n = 238, 58.3%) were transferred from other cities within Guangdong Province. Intra-city transfers from within Guangzhou accounted for 112 cases (27.5%). A notable proportion, 58 patients (14.2%), were transferred from other provinces, indicating the institution's role as a supra-regional referral center.

3.2. Age Distribution of Transferred Patients

The age distribution was markedly skewed toward the youngest patients (**Table 3**). Neonates (0 - 28 days old) formed the largest single group, comprising 221 patients

(54.2%). Infants aged 29 days to 1 year accounted for an additional 107 transfers (26.2%). Combined, patients under one year of age represented 80.4% of all surgical transfers. The numbers declined significantly in older age groups.

Table 2. Geographic origin of transferred pediatric surgical patients.

Geographic Origin	Number of Transferred Patients (n)	Percentage
Intra-city (Guangzhou)	112	27.5%
Other cities within province	238	58.3%
Other provinces	58	14.2%
Total	408	100%

Table 3. Age distribution of transferred pediatric surgical patients.

Age Group	Number of Transferred Patients (n)	Percentage
0 - 28 days (Neonate)	221	54.2%
29 days - 1 year (Infant)	107	26.2%
1 - 3 years (Toddler)	25	6.1%
3 - 6 years (Preschool)	18	4.4%
6 - 12 years (School-age)	30	7.4%
12 - 15 years (Adolescent)	7	1.7%
Total	408	100%

3.3. Diagnostic Categories

A wide spectrum of surgical diagnoses was observed (**Table 4**). Congenital anomalies dominated the list. Congenital heart disease was the most common single diagnosis (n = 69, 16.9%), followed by intracranial hemorrhage (n = 45, 11.0%) and various tumors/masses (n = 31, 7.6%). A significant number of transfers were for gastrointestinal emergencies, including intestinal obstruction/volvulus/malrotation (n = 29, 7.1%) and necrotizing enterocolitis/appendicitis (n = 25, 6.1%). Congenital anomalies such as anorectal malformation (imperforate anus, n = 27) and esophageal atresia (n = 22) were also prominent.

Table 4. Primary diagnostic categories of transferred pediatric surgical patients.

Diagnostic Category	Number of Transferred Patients (n)	Percentage
Congenital Heart Disease	69	16.9%
Intracranial Hemorrhage	45	11.0%
Tumor/Mass	31	7.6%
Intestinal Obstruction/Volvulus/Malrotation	29	7.1%

Continued

Imperforate Anus	27	6.6%
Necrotizing Enterocolitis/Appendicitis	25	6.1%
Esophageal Atresia/Tracheoesophageal Fistula	22	5.4%
Gastrointestinal Malformation	22	5.4%
Trauma (Vehicle Accident/Fracture)	20	5.0%
Pierre-Robin Sequence/Cleft Lip/Palate	19	4.7%
Hydrocephalus	12	2.9%
Retinopathy of Prematurity	12	2.9%
Laryngomalacia/Airway Stenosis	11	2.7%
Vascular Malformation	7	1.7%
Gastrointestinal Perforation	5	1.2%
Choledochal Cyst/Dilation/Perforation	5	1.2%
Eventration of diaphragm/diaphragmatic hernia	3	0.7%
Lymphatic malformation/chylothorax	3	0.7%
Omphalocele	2	0.5%
Other (e.g., spina bifida, choanal atresia, etc.)	39	9.7%
Total	408	100%

3.4. Respiratory Support Status During Transfer

The level of respiratory support required during transit is a key indicator of patient acuity (**Table 5**). A substantial portion of patients (n = 98, 24.0%) required invasive mechanical ventilation, signifying critical instability. Another 67 patients (16.4%) were managed with non-invasive ventilation. Supplemental oxygen was provided to 81 patients (19.9%). Notably, 162 patients (39.7%) required no respiratory support during the transfer, suggesting that the indication for transfer in these cases was primarily the need for specialized surgical expertise rather than immediate cardiorespiratory instability.

Table 5. Respiratory support status during transfer.

Respiratory Support Status	Number of Transferred Patients (n)	Percentage
Invasive Mechanical Ventilation	98	24.0%
Non-Invasive Ventilation	67	16.4%
Supplemental Oxygen Therapy	81	19.9%
No Respiratory Support	162	39.7%
Total	408	100%

3.5. Distribution of Receiving Departments

The final destination of transferred patients within the hospital underscores the critical care needs of this population (Table 6). The Neonatal Intensive Care Unit (NICU) was the most frequent admitting department, receiving 129 patients (31.6%). The Surgical Neonatal ICU (SNICU) admitted 91 patients (22.3%). General surgical wards received 67 patients (16.4%), and the Pediatric ICU (PICU) admitted 53 patients (13.0%). Other intensive care settings, including the Cardiac ICU (CICU) and Surgical ICU (SICU), accounted for smaller proportions. This distribution highlights that the majority of surgical transfers (approximately 80.2%) required admission to an intensive or critical care unit immediately upon arrival.

Table 6. Distribution of receiving departments after transfer.

Receiving Department	Number of Transferred Patients (n)	Percentage
Neonatal ICU (NICU)	129	31.6%
Surgical Neonatal ICU (SNICU)	91	22.3%
General Surgical Ward	67	16.4%
Pediatric ICU (PICU)	53	13.0%
Cardiac ICU (CICU)	35	8.6%
Surgical ICU (SICU)	19	4.7%
Emergency Observation Unit	14	3.4%
Total	408	100%

4. Discussion

This study provides a detailed epidemiological and clinical snapshot of pediatric surgical transfers to a major tertiary referral center. Our findings illuminate several key characteristics of this patient flow and have important implications for the organization of regional pediatric surgical care, transport system design, and hospital resource planning.

The Central Role of Tertiary Hospitals and Regional Networks

The observation that over 70% of transfers originated from other tertiary hospitals is particularly noteworthy [5]. This finding challenges a simplistic model where transfers flow primarily from lower-level hospitals to higher-level centers. Instead, it suggests a complex referral network among tertiary institutions, likely driven by sub-specialization. For instance, a tertiary general hospital may transfer a neonate with complex congenital heart disease to a pediatric cardiac surgery center. This underscores the concept of "centers of excellence" within pediatric surgery and highlights the need for seamless coordination and established referral pathways between tertiary institutions themselves, not just from primary/secondary to tertiary levels. The significant inter-provincial transfer volume (14.2%) further solidifies our center's role as a national-level referral hub, necessitating robust systems for long-distance transport coordination and family support.

The Dominance of the Neonatal and Infant Population

The overwhelming predominance of neonates and infants (80.4% under 1 year) in surgical transfers aligns with the epidemiology of major surgical conditions in childhood, which are often congenital or present early in life [6]. This concentration has profound implications for transport teams, which must be exceptionally proficient in neonatal physiology, thermoregulation, vascular access, and the management of conditions like pulmonary hypertension and patent ductus arteriosus. The transport vehicle and equipment must be specifically configured for this age group. Furthermore, this demographic trend reinforces the argument for integrating neonatal and pediatric critical care transport teams or ensuring deep cross-training.

Spectrum of Disease and Implications for Preparedness

The diagnostic profile reveals a heavy burden of congenital anomalies (cardiac, gastrointestinal) and surgically correctable conditions of prematurity (e.g., NEC, ROP). The high prevalence of congenital heart disease and intracranial hemorrhage, both conditions prone to acute decompensation, partly explains the substantial need for advanced respiratory support during transfer. The finding that nearly one-quarter of patients required invasive ventilation is a critical metric for system planning. It mandates that transport teams are not merely "scoop and run" services but are mobile intensive care units, staffed by personnel skilled in advanced airway management, ventilator management in motion, and the use of inotropes and sedatives [7]. The concurrent need to be prepared for a wide variety of surgical pathologies—from trauma to oncology—requires transport teams to have broad knowledge and adaptable protocols.

Resource Allocation and Receiving Unit Coordination

The distribution of patients directly into intensive care units (NICU, SNICU, PICU, CICU, SICU) for the majority (80.2%) of arrivals places significant pressure on these high-acuity resources. It necessitates very close communication between the transport team, the transfer center, and the receiving ICU bed managers to ensure a bed is available upon arrival. Delays at this interface can negate the benefits of a timely transfer. The data argue for predictive modeling that incorporates surgical transfer patterns into daily ICU capacity planning. Furthermore, the fact that 16.4% went directly to a surgical ward suggests a subset of transfers are for elective or semi-elective complex operations. Optimizing scheduling and pre-transfer workup for these patients could improve efficiency and reduce last-minute strains on the system [8].

Limitations and Future Directions

This study has several limitations. Its single-center, retrospective design limits generalizability. We did not collect data on transfer times, distances, en-route complications, or ultimate clinical outcomes (e.g., mortality, postoperative complications), which are crucial for a full assessment of system effectiveness. The

"Other" diagnostic category remains heterogeneous and merits further sub-analysis.

Future research should focus on multi-center collaborations to validate these patterns across different healthcare systems. Prospective studies linking transfer characteristics (e.g., team composition, pre-transfer stabilization) to patient outcomes are essential [9]. Additionally, qualitative studies exploring the decision-making process of referring surgeons and the challenges faced by transport teams could provide rich insights for process improvement. Investigating the cost-effectiveness of different transport modalities (ground vs. air) for specific surgical diagnoses would also be valuable for resource stewardship.

5. Conclusion

This analysis delineates the pediatric surgical transfer population as predominantly neonatal, critically ill, and originating from within a complex network of tertiary hospitals across a wide geographic region. The high acuity is evidenced by the frequent need for invasive respiratory support and direct ICU admission. These findings underscore that pediatric surgical transfer is a specialized discipline distinct from general pediatric or adult transfer. To meet the needs of this vulnerable population effectively, healthcare systems must invest in: 1) **Specialized Transport Teams** with expertise in neonatal/pediatric critical care and surgery; 2) **Enhanced Telemedicine Infrastructure** to facilitate pre-transfer consultation and stabilization, particularly for long-distance referrals; 3) **Standardized Regional Protocols** for triage, communication, and handover between referring and receiving centers, especially given the high volume of transfers originating from other tertiary hospitals; and 4) **Integrated Bed Management Systems** that anticipate the high ICU utilization from surgical transfers. By addressing these areas, we can strengthen the vital link that inter-hospital transfer represents in the chain of survival and recovery for children requiring surgical care.

Authors' Contribution

Qiang Wang contributed to the conception of the study, literature review, and drafting of the manuscript. **Yongling Song** and **Yan Hong** provided clinical expertise, participated in data interpretation. **Yanhuan Mao** and **Yongxian Liang** participated in data collection, validation, and database management. **Zihao Tan** and **Rong Chen** was responsible for the data curation, and performed the statistical analysis. **Guangming Liu** contributed to revising the manuscript.

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Data Availability Statement

All data generated or analyzed during this study are included in this published article.

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Conflicts of Interest

The authors declare that they have no competing interests.

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