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SPECIAL ARTICLE

Current status of specialized pediatric and neonatal transport in Catalonia

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MODEL OF PEDIATRIC AND NEONATAL TRANSPORT IN CATALONIA

Interhospital transport of critically ill patients, particularly in the pediatric and neonatal setting, is a significant challenge within medical emergency systems (MES). These transfers are crucial to ensure that patients receive advanced therapies not available in less technologically complex hospitals. The specialization of these teams results in improved transport outcomes for these patients[1,2]. While most of these transfers can be performed with advanced life support units, the increasing use of complex devices such as ventricular assist systems and extracorporeal membrane oxygenation (ECMO) has increased the demand for specialized expertise to ensure the safe and effective transport of these patients.

For more than 29 years, the MES of Catalonia has developed a service specialized in the interhospital transport of neonatal and pediatric critically ill patients[3], in a patient- and family-centered model. The initial model has evolved to the current one, which has two pediatric advanced life support (PALS) land units specialized in pediatric and neonatal transport, located at the Sant Joan de Déu University Hospital and the Vall d'Hebron University Hospital, operating 24 h/365 days. It also has a specialized pediatric air unit, operated by personnel from the Parc Taulí University Hospital in Sabadell and the Santa Creu i Sant Pau University Hospital in Barcelona, and a pediatric intermediate life support unit during the winter months.

This service, with its comprehensive and highly specialized approach, is activated from the initial contact between the requesting center and the interhospital coordination desk, ensuring that the appropriate level of care is provided from the outset. The pediatric MES is composed of multidisciplinary teams of over 60 professionals, including physicians, nurses, and technicians, all of whom have specialized training in the care of critically ill neonatal and pediatric patients. The competency profiles of these professionals are in accordance with the recommendations of the corresponding scientific societies[4,5]. Given the relatively low number of pediatric and neonatal transfers compared to adults, maintaining the skills of these professionals presents a challenge. However, their continued education and dual roles within the MES and in highly complex intensive care units support the ongoing development and maintenance of their expertise in pediatric and neonatal transport.

PEDIATRIC MES CARE ACTIVITY IN CATALONIA

Since the establishment of the pediatric MES in 1995, over 30,000 patients have been transferred. The vast majority (95%) involve interhospital transports, where critically ill children are stabilized and transported to facilities with the appropriate level of care. In recent years, these teams have also expanded their scope to respond to emergencies in homes, public areas, or primary care centers, in coordination with local support units.

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The MES receives approximately 75,000 calls per year for interhospital transport, of which the pediatrician handles an average of 8,500 consultations per year for telephone support to the healthcare network or MES units.

Of the 8,500 interventions, an average of 1,400 transfers are generated by pediatric units each year. Figure 1 shows the total number of interventions with mobilization of pediatric resources from 2021 to 2023. Thirty-eight percent of the patients transferred were under 1 month old, 38% were between 1 month and 3 years old, and the remaining patients were between 4 and 18 years old. The most common reason for transfer was respiratory disease, followed by neurological, infectious, cardiovascular, and traumatic conditions and prematurity. Between 2017 and 2021, 64,276 pediatric consultancy calls were attended, with 25,775 (4%) classified as priority 0. These critical cases were managed by the coordinating pediatrician, together with other consulting professionals, including physicians and nurses.

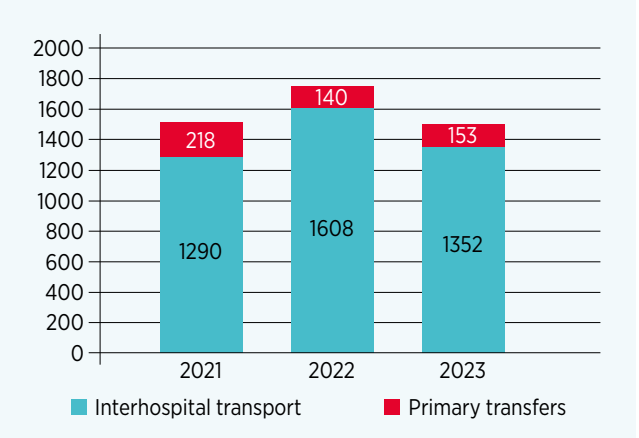


FIGURE 1. Interhospital and primary pediatric and neonatal transport conducted by pediatric MES bases between 2021 and 2023.

INCORPORATION OF THE PEDIATRICIAN INTO THE MES COORDINATION CENTER

The integration of a pediatrician into the MES Central Coordination Center (CECOS) in 2017 has been fundamental in optimizing resource coordination, enabling the provision of remote care support via telephone or video call. This role is essential in managing and coordinating the resources required for complex pediatric emergencies across the healthcare network, ensuring that transfers and treatments are performed with maximum efficiency and safety. The pediatrician's responsibilities include:

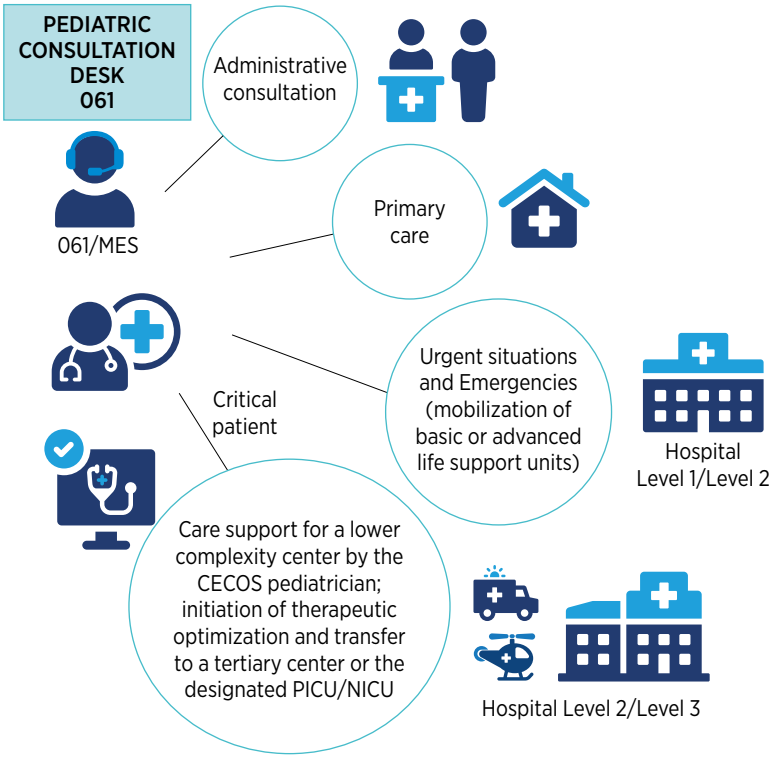
- Management of interhospital transport requests: coordination and consultation.
  Transfers of patients aged 16 years or younger are managed directly. When a healthcare center requests the transport of a pediatric or neonatal patient, the call is first directed to a manager who collects essential affiliation details. The call is then immediately forwarded to a coordinating pediatrician, who evaluates the patient's condition, considers potential additional therapeutic measures, and determines the most appropriate destination center and transport resource. It should be noted that pediatric units do not always carry out the transport, as this depends on factors such as resource availability, travel time, and the patient's time-sensitive condition. The care model is outlined in Figure 2.
- Telephone support during emergencies.
  Another key role of the coordinating pediatrician is to provide specialized assistance during consultations requiring expert guidance due to their complexity and severity. These calls are often initiated by citizens and have already been screened by the initial call handlers. Typically, they involve cases classified as "priority 0," where the primary concerns include unconsciousness, severe respiratory distress, or other life-threatening conditions. The coordinating pediatrician also supports MES teams managing pediatric patients and healthcare professionals from other medical centers (Figure 3).

PROGRAM OF PEDIATRIC TRANSPORT ON ECMO

Extracorporeal Membrane Oxygenation (ECMO) is a technique that temporarily replaces the function of the heart and lungs. Although available in our country for over 20 years, its complexity limits its use to specialized centers, such as H. Universitari Vall d'Hebron and H. Sant Joan de Déu in Catalonia. In cases where a critically ill neonatal or pediatric patient in a facility without ECMO capabilities requires this support but cannot be safely transferred without it, consideration may be given to transferring the patient with ECMO support. This involves moving the ECMO team to the referring center, initiating therapy on-site, and transferring the stabilized patient to the specialized center. For these transfers, the MES utilizes all PALS units and the high-complexity transport unit (Figure 4).

Since 2019, the MES has significantly expanded its capacity to perform ECMO-supported transfers of pediatric patients in collaboration with the ECMO teams from Vall d'Hebron University Hospital and Sant Joan de Déu University Hospital. These advancements have been driven by the continuous evolution of neonatal and pediatric care and transport models. The ECMO pediatric transport service comprises one of the hospital-based ECMO teams, either from Vall d'Hebron or Sant Joan de Déu, consisting of two pediatric intensivists, a cardiac surgeon, and two nurses, all with over three years of ECMO experience. Additionally, the team includes professionals from one of the two PALS land units, which consists of two emergency medicine technicians, a nurse, and a pediatrician, all specialized in critically ill pediatric patient transport. In select cases, based on patient severity and transport distance, air transport is considered for the ECMO unit. For long-distance ECMO transports, when one PALS unit is activated, a third PALS team remains available to cover the territory while the transfer is underway.

The regulation of these processes is outlined in Order SLT/139/2013 by the Department of Health of Catalonia, which designates CECOS as the body responsible for managing and coordinating urgent or emergency care, including interhospital transport. Instruction 01/2024, effective since February 20246, further strengthens coordination across dif-



MES: Medical Emergency System; CECOS: Central Coordination Cente; PICU: Pediatric Intensive Care Unit; NICU: Neonatal intensive care unit.

FIGURE 2. General care model of the MES for pediatric patients.

FIGURE 3. MES pediatrician in the coordination center.

FIGURE 4. MES high complexity unit.

ferent levels of care and specialized services for pediatric patients requiring highly complex procedures. This ensures equitable access to care throughout Catalonia and, when necessary, beyond the autonomous community.

This operational framework guarantees the quality of care and safety required for managing critically ill patients, ensuring that the appropriate material and human resources are in place to facilitate safe and effective interhospital transport, even in the most complex situations.

Since 2019, our units have performed 16 primary ECMO transports, of which only two were within Catalonia, while the remaining cases involved patient transfers from other autonomous communities (Islas Baleares n= 7, Navarra n= 2, Castilla-La Mancha n= 2, Castilla-León n= 1, Aragón n= 1, La Rioja n= 1). These patients were transported with extracorporeal support to the ECMO center in Barcelona. Additionally, two secondary ECMO transfers were conducted within the city of Barcelona, involving patients in need of solid organ transplants who were transferred to Vall d'Hebron Hospital. Furthermore, transfers from Barcelona airport to Vall d'Hebron were carried out for ECMO patients from outside Catalonia (Andalucía n= 3 y Portugal n= 1), who required transplants and were flown to Barcelona by the medical teams from their originating centers.

CONCLUSION

The neonatal and pediatric transport system in Catalonia ensures high-quality care for critically ill children requiring

remote or in-person management during transfers to more specialized centers. The organization of transfers involving high-complexity and ECMO units offers a new dimension of territorial equity, enabling patients across Catalonia to receive enhanced care from specialized staff. Given the relatively low number of such transfers, maintaining the expertise of care teams is essential. This is achieved through continuous training and the integration of professionals into high-complexity units.

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