

Challenges in Organ Transportation: A Practical Multidisciplinary Approach for Safe and Timely Delivery of Donor Organs

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Abstract

Organ transplantation is a time-sensitive, multidisciplinary process in which safe and timely transportation of a donated organ is an essential link between organ retrieval and transplantation. Transportation may involve transplant coordinators, retrieval surgeons, operating-room teams, recipient teams, blood banks, ambulance personnel, hospital administration and security teams, police and traffic authorities, airlines or railway authorities, and the donor and recipient hospitals. This practical narrative review describes the operational challenges that may arise from the initial organ alert and confirmation through retrieval preparation, recipient and operating-room readiness, road or air transportation, green-corridor coordination, organ packing, cold-chain maintenance and final handover. A structured approach is proposed that emphasizes early communication, checklist-based preparation, reliable primary and backup transportation, route and contingency planning, appropriate coordination with authorities, secure organ packaging, continuous communication and safe driving practices. The central principle is that speed must never compromise safety: the objective is safe delivery within the required time while maintaining organ integrity, traceability and preservation conditions.

Keywords: organ transplantation; organ transportation; transplant coordinator; cold ischemia time; green corridor; ambulance; logistics; cold chain; retrieval; multidisciplinary coordination

1. Introduction

Organ transplantation can be life-saving for patients with end-stage organ failure, but transplantation is dependent on a sequence of time-sensitive activities extending from donor identification and organ allocation to retrieval, preservation, transportation and implantation. Transportation is therefore not a simple movement of a package from one hospital to another; it is a clinical and logistical process in which delays, communication failures, route disruptions, vehicle problems or inadequate preparation may affect the overall transplant timeline.

The importance of transportation is reflected in the relationship between logistics and cold ischemia time (CIT). Transport time is one component of the overall period during which a graft remains without blood supply, and studies have shown that logistical factors can materially influence CIT. [3,4] For this reason,

organ transportation should be planned as a coordinated clinical pathway rather than as an isolated transport activity.

In India, the National Organ & Tissue Transplant Organization (NOTTO) has issued Standard Operating Procedures for transportation of live human organs by different modes, including road and air transport. These SOPs emphasize security-controlled transport, coordination with relevant authorities, green-corridor mechanisms and specific requirements for air transportation. [1] The NOTTO Transplant Manual also provides guidance on organ packaging, labeling and transport-box preparation. [2]

2. Aim

To describe the major operational challenges in organ transportation and propose a practical multidisciplinary framework for safe, timely and coordinated transport of donor organs.

3. Scope of the Practical Framework

This article is intended as a practical framework for transplant coordinators, transplant surgeons, retrieval teams, operating-room teams, recipient-care teams, transport personnel, security personnel and hospital administrators. It should be adapted to the organ-specific clinical requirements, current national regulations, institutional SOPs and instructions of the relevant organ-allocation and regulatory authorities.

4. The Organ Transportation Pathway

The transportation pathway begins before the organ is physically moved. Preparation starts with the alert and confirmation of organ availability and continues until the organ is safely handed over at the recipient centre.

Stage	Key Action	Main Stakeholders	Major Risk
1. Alert & confirmation	Confirm organ offer, donor/recipient details and timeline.	Transplant coordinator, allocation authority, surgeon	Incomplete or delayed information
2. Clinical & OT preparation	Inform transplant surgeon, OT team, recipient team and blood bank; prepare recipient.	Surgeon, OT, recipient team, blood bank	Recipient/OT not ready
3. Retrieval preparation	Prepare retrieval instruments, checklist, packing materials and documentation.	Retrieval team, coordinator	Missing equipment or documentation
4. Transport planning	Confirm ambulance, driver, backup vehicle and route.	Transport team, coordinator	Vehicle/route failure
5. Authority coordination	Coordinate green corridor/police and other agencies when applicable.	Police, traffic authorities, coordinator	Traffic or communication delay

6. Departure & transit	Verify packing, seal, documentation, cold chain and communication.	Medical escort, driver, coordinator	Packing/cold-chain/traffic incident
7. Air/rail transport	Complete required documents and coordinate airport/railway authorities.	Airline/airport/railway, medical escort	Security or connection delay
8. Recipient-centre handover	Update base hospital and complete safe handover.	Recipient team, coordinator	Poor handover or late readiness

5. Major Challenges in Organ Transportation

5.1 Alert and Confirmation

The first challenge is obtaining clear, timely and complete information after an organ offer or allocation alert. The transplant coordinator should confirm the organ, donor and recipient information, the expected retrieval timeline, the location of the donor hospital and the proposed mode of transport. Any uncertainty at this stage can propagate into later delays.

5.2 Multidisciplinary Communication

Early communication with the transplant surgeon, retrieval team, operating-room team, recipient-care team and blood bank is essential. The recipient should be prepared according to the clinical plan, while the receiving hospital should have sufficient time to prepare the operating room and other required services. A defined communication chain reduces the risk of conflicting information.

5.3 Retrieval Instruments, Checklist and Packing Preparation

Retrieval preparation should begin early. Instruments, consumables, organ-specific packing materials, labels, documentation and the retrieval checklist should be verified before departure. Preparation should follow current institutional and national guidance. NOTTO guidance states that organ packaging is a medical activity performed under the advice and guidance of an appropriately trained doctor, and describes structured packaging and labeling requirements. [2]

5.4 Ambulance and Backup Vehicle Preparedness

Transportation depends on reliable vehicles and trained personnel. A major operational risk is assuming that the primary vehicle will remain available throughout the journey. Mechanical failure, puncture, accident or other unexpected events may occur. A practical contingency measure is to identify a backup vehicle and driver before departure whenever feasible. The backup plan should be realistic, immediately deployable and communicated to the relevant team.

5.5 Donor-Hospital Coordination

The donor hospital and recipient centre should agree on the expected retrieval and departure timeline. The receiving team should remain informed of changes because recipient preparation and operating-room

readiness depend on the expected arrival of the organ. The coordinator should maintain a clear record of major time points.

5.6 Route Planning and Early Departure

A transportation plan should include the expected route, estimated travel time, known traffic conditions and alternative routes. Departure should be planned with sufficient contingency time for traffic congestion, road closures, diversions, weather or minor vehicle problems. The principle is to create a time buffer rather than rely on an ideal travel time.

5.7 Green Corridor and Police Coordination

Where road transport requires priority movement, early coordination with the appropriate police and traffic authorities is essential. NOTTO's 2024 transport SOP describes a mechanism for requesting a green corridor through the relevant organ-allocation authority and recommends nodal coordination within police systems. [1] The transport team should provide a realistic tentative departure and arrival plan and maintain communication when timings change.

5.8 Staff Coordination and Alternative Transport Modes

Long-distance or intercity transport may require coordination beyond the hospital. Depending on the route and applicable arrangements, railway or aviation authorities may be involved. The decision should be made early enough to allow documentation, reservations, security coordination and receiving arrangements. NOTTO's air-transport SOP includes specific responsibilities for accompanying medical personnel, airlines and airport authorities. [1]

5.9 Organ Packing, Security and Cold-Chain Maintenance

Once retrieval is complete, the organ must be handled and packed according to current organ-specific guidance. The transport box must be secure, correctly labeled and appropriately sealed, and the required documentation and samples must be checked before departure. NOTTO guidance describes triple-bag packaging, preservation solution, ice-based cooling and transport-box labeling requirements. [2] The cold chain must be protected throughout the journey.

5.10 Continuous Communication During Transit

Communication should continue after the vehicle leaves the donor hospital. The transport team should update the coordinator or receiving centre regarding departure, progress, unexpected delay and estimated arrival. If a green corridor or police escort is involved, communication with the designated liaison should remain active.

5.11 Air Transportation and Airport Coordination

When air transport is required, planning must begin early. Required travel and organ-transport documents should be checked, and airline and airport authorities should be informed as required. NOTTO's 2024 SOP specifies documentation and facilitation measures for air transport, including coordination with airport security and airline personnel. [1]

5.12 Safety Must Take Priority Over Speed

A critical challenge is balancing urgency with road safety. Excessive speed or unsafe driving can create a catastrophic risk to the transport team and the organ. The objective is not to reach the recipient centre by

driving beyond safe limits; it is to reach safely within the required clinical time window. Early departure, route planning, traffic coordination and backup arrangements are safer strategies for gaining time than unsafe driving.

6. Practical Pre-Departure Checklist

- Organ alert and allocation information confirmed.
- Transplant surgeon informed and retrieval plan confirmed.
- Operating-room team informed and recipient preparation initiated.
- Blood bank and other required support services informed.
- Retrieval instruments and organ-specific checklist verified.
- Packing materials, labels, documentation and transport box ready.
- Primary ambulance/vehicle and driver confirmed.
- Backup vehicle/driver identified where feasible.
- Route and alternative route reviewed.
- Police/traffic coordination and green-corridor request initiated when applicable.
- Air/rail arrangements and required documentation confirmed when applicable.
- Receiving/base hospital informed of planned departure and expected arrival.
- Organ packing, seal, labeling and required documentation checked before departure.
- Communication contact list confirmed.
- Cold-chain requirements confirmed.
- Safe-speed and emergency driving principles communicated to the transport team.

7. Proposed Contingency Planning Model

Organ transportation should be planned using a primary plan and at least one realistic alternative. The alternative should cover the most probable failure points: vehicle failure, route closure, traffic disruption, weather, airport/railway delay or loss of communication.

Potential Event	Immediate Preparedness	Alternative Action
Vehicle mechanical failure	Vehicle check and backup vehicle	Shift to backup vehicle and inform receiving centre
Puncture/roadside problem	Spare tyre/roadside support	Use backup vehicle if delay is significant
Traffic congestion	Traffic monitoring and early departure	Use pre-planned alternate route
Road closure/diversion	Route review before departure	Activate alternate route and update authorities
Communication failure	Multiple contact numbers	Use secondary communication channel
Air travel disruption	Early airline/airport coordination	Reassess alternative approved transport option
Unexpected delay	Time buffer and live monitoring	Escalate and revise ETA; protect cold chain

8. Figure 1. Proposed Organ Transportation Coordination Pathway



Figure 1. Schematic pathway showing multidisciplinary coordination, transport preparedness, route planning, green-corridor coordination, secure organ packing and cold-chain maintenance.

9. Discussion

The practical challenges described in this review demonstrate that organ transportation is a system-level activity rather than a single transport event. The transplant coordinator frequently acts as the operational link connecting clinical, logistical, administrative, security and external stakeholders. A delay in one component can affect the entire pathway, particularly when recipient preparation, operating-room readiness and preservation time are closely linked.

Published evidence supports the importance of logistics in transplantation. A multicentre prospective study of deceased-donor kidney transplantation found that transport time and other logistical factors significantly influenced cold ischemia time, and identified potentially modifiable contributors to delay. [3] More recent literature continues to emphasize that transportation is a critical determinant of transplant logistics and that prolonged transfer can increase cold ischemia exposure. [5]

The Indian context has additional operational considerations because organ transport may involve coordinated road, air, railway or other modes. NOTTO's 2024 SOPs provide a national framework for facilitating transport and describe specific arrangements for green corridors, airport coordination and accompanying medical personnel. [1] The practical framework proposed here complements such national guidance by emphasizing preparedness before the organ leaves the donor hospital.

The most important safety principle is that urgency should not be interpreted as permission for unsafe driving. A transportation system that starts early, maintains a backup plan, monitors the route and communicates continuously is more resilient than one that depends on excessive speed. The goal is safe, traceable and timely delivery while preserving the organ under the required conditions.

10. Recommendations

1. Develop a hospital-specific organ transportation SOP aligned with current NOTTO, SOTTO/ROTO and applicable regulatory requirements.
2. Use a standardized pre-departure checklist for every organ transport.
3. Establish a single communication chain led by the transplant coordinator or designated coordinator.
4. Maintain reliable primary transportation and a feasible backup vehicle arrangement.
5. Start planning immediately after confirmed organ allocation/acceptance and avoid unnecessary waiting time.
6. Use realistic travel-time estimates and build contingency time into the plan.
7. Maintain a primary and alternate route for road transportation.
8. Coordinate with police and traffic authorities early when a green corridor is required.
9. For air or rail transportation, complete documentation and notify relevant authorities as early as possible.
10. Verify packing, labeling, sealing, documentation and cold-chain requirements before departure.
11. Maintain communication with the receiving hospital throughout transit.
12. Record actual departure, key transit events and arrival times for quality improvement.
13. Review every significant delay or transport incident and implement corrective actions.
14. Train drivers, medical escorts, security personnel and coordinators in organ-transport responsibilities and emergency contingencies.

15. Never compromise road safety for speed.

11. Conclusion

Organ transportation is a time-critical, high-responsibility process that requires coordinated action before, during and after the organ leaves the donor hospital. The major challenges include alert confirmation, multidisciplinary communication, retrieval preparation, recipient and operating-room readiness, ambulance and backup-vehicle availability, route and contingency planning, green-corridor coordination, air or railway arrangements, secure packing, cold-chain maintenance, documentation and safe transit.

A reliable organ transportation system should not depend on last-minute action or excessive driving speed. Early preparation, standardized checklists, clear communication, alternative transport plans, coordination with relevant authorities and strict adherence to organ-handling and safety requirements can improve the reliability of the entire pathway. The ultimate priority is safe and timely delivery of a viable organ to the recipient centre.

12. Declarations

Ethics approval: Not applicable for this narrative/practice review. If hospital-specific patient or transport data are added, appropriate institutional ethics and administrative approvals should be obtained.

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Suggested Submission Note

This manuscript is intentionally written as a narrative/practice review rather than as an original observational study because no patient-level or transport-event dataset has been supplied. If the author has retrospective organ-transport records, the manuscript can be strengthened by adding a Methods section, anonymized transport data, delay categories, statistical analysis, tables and a Results section.