Prehospital Emergency Medical Services

Medical Surge Capacity

Management of Inter-Hospital Transfer Of Patients with COVID-19

PAHO
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Contents

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Abbreviations and Acronyms

AMCS	alternative medical care site
ALS	advance life support
BLS	basic life support
ED	emergency department
EMS	emergency medical service
EMT	emergency medical team
ICU	intensive care unit
ITCD	inter-hospital transfer coordination desk
MCI	mass casualty incident
PAHO	Pan American Health Organization
PPE	personal protective equipment
WHO	World Health Organization

Introduction

The transfer of patients between different health facilities is a fundamental component of a health-care system during non-surge times. The main aim of all such transfers is maintaining the continuity of medical care, allowing patients to have expanded access to specialty care, and to improve upon the existing management of the patient (*1*).

COVID-19, caused by the SARS-CoV-2 infection, has caused a high incidence of patients with acute respiratory failure and multi-organ failure (*2*), requiring oxygen support, organ support and/or intensive care resulting in high numbers of hospital and intensive care unit (ICU) admissions. During several surges, patients were frequently transferred from hospitals that had excess patient load to alternative hospitals that had resources (*3*), including the transfer and care of critically ill patients to hospitals with higher levels of care (*3*), while optimizing patient distribution. Inter-hospital transfers can be complex and may pose a risk both to patients and providers if not conducted appropriately. They are contingent on successful coordination between facilities and ambulance services. This coordination can occur at a local, regional or even national level.

This document provides technical recommendations on the methodology of developing a system to transfer COVID-19 patients from one hospital to another, in preparation for the ongoing and anticipated surge of patients in outbreaks, epidemics or disasters. It outlines procedures and recommendations at each stage of the inter-hospital transfer from dispatch to patient arrival. This document is intended for all decision-makers and professionals involved in the assessment, care, and management of patients requiring secondary transfers between hospitals, emergency medical teams (EMTs) and alternative medical care sites (AMCS) that are providing inpatient services and critical care (*4*). This does not address patient transfers from clinics, or urgent care centers to hospitals.

Overview of Inter-Hospital Transfer

Figure 1. Inter-hospital transfer algorithm

Centralized Transfer Coordination

Regions and hospitals should establish a dedicated centralized COVID-19 Inter-hospital Transfer Coordination Desk (ITCD) to coordinate the inter-hospital transfer of COVID-19 patients. Depending on the existing structures in each country, the government or a federal organization may coordinate the ITCD or it may be coordinated at a local level.

An existing mass casualty incident (MCI) operations plan may provide the infrastructure for the COVID-19 ITCD. Organizations can draw upon pre-existing centralized coordination plans designed for MCI that can be prolonged and modified to meet the needs of the COVID-19 pandemic environment. Agencies and governments should take advantage of systems that are already in place for secondary patient transfer. This is usually part of an existing health system, and local or national government bodies may administer such systems depending on the country. The basic principles of organization apply regardless of system size.

This system will act as a single point of contact between stakeholders including Emergency Medical Services (EMS), hospitals and AMCS.

The ITCD must have information on available hospital and EMS resources as well as procedures and protocols with the hospital network to coordinate transfers based on criteria of complexity, availability and location.

Table 1. Operating principles for inter-hospital transfer coordination of COVID-19 patients

- All entities must agree to submit data to support situational awareness
- All entities must respond in a timely manner to requests for data
- All entities must have staff who are effective communicators
- Acute care facilities agree to accept patients based on the triage decisions of the sending facility
- Facilities agree to minimize the number of occupied beds and maximize additional surge capacity
- Facilities initiating transfer will establish communication with the ITCD as early as possible and all patient transfers related to the incident (COVID-19) will be coordinated through the ITCD during this crisis
- EMS agencies agree to support patient movement as directed by the ITCD
- All representatives agree to participate in regular briefings and hold each other accountable

Source. Adapted from: American College of Surgeons. How to Set Up a Regional Medical Operations Center to Manage the COVID-19 Pandemic. Chicago, IL: ACS; 2020. Available from: https://www.facs.org/for-medical-professionals/covid-19/clinical-guidance/rmoc-setup/

Stakeholder communication and resource management

Successful coordination must include resource availability across the region of interest.

Each stakeholder within the region must contribute information on resource availability to the centralized ITCD (*3*). Communication is the responsibility of all parties involved and is integral to a successful transfer. Communication gaps between facilities and EMS can be critical to patient care.

It is essential that the ITCD collects data and metrics to be reintegrated into the system (*5, 6*). Metrics include inventory of existing resources, ambulance availability, gap identification, weather, and patient information.

It is recommended that ITCDs have a series of technical aids to facilitate coordination and transfer operations between installations:

- High speed internet access
- Real time data management and collection systems
- Access to digital file (if applicable)
- Redundant communication: radio communications with available units and equipment
- Exclusive telephone line

Mapping existing resources

Existing resources must be continuously updated in real time. This requires stakeholders to actively feed information back to the ITCD so they may make appropriate allocation decisions. An agreed-upon procedure should clearly outline expectations including data submission, communication guidelines and cooperation commitments. Resource metrics may include personnel availability, tracking of beds and ventilators (including the complexity of the beds), and available ambulances.

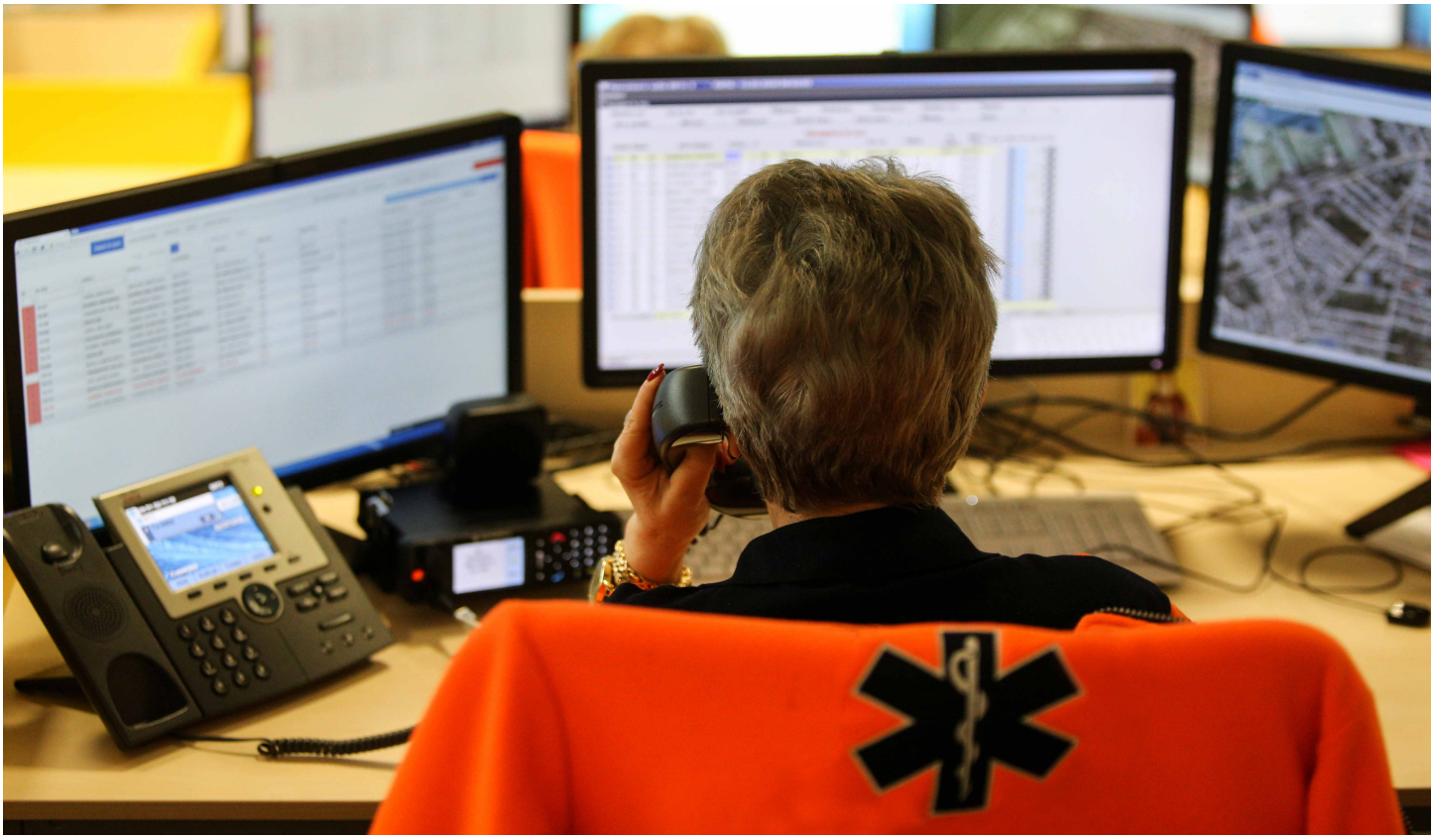
As normal inter-hospital transfers will continue in addition to transfers specifically for COVID-19 patients, instituting an independent COVID-19 transfer system with its own COVID-19 specific staff and ambulances may present a desirable option (*7*). The ITCD must also coordinate with the routine inter-hospital transfer mechanisms to ensure bed and staff availability at the accepting facility.

Systems may benefit from the use of a centralized electronic dashboard containing relevant resource tracking from all regional facilities and EMS agencies (see below an example of a “Resource Tracking Dashboard”).

Table 2. Resource tracking dashboard	
Health care facilities	**EMS agencies**
Emergency department boarding admissions	Staffed basic care ambulances
Inpatient medical-surgical bed availability	Staffed advanced/critical care ambulances
Intensive care unit critical care staff	Ambulance oxygen resources including delivery modalities: Nasal cannulas High flow nasal cannula Nonrebreather masks BiPAP/CPAP ventilators
	Ambulance oxygen carrying capacity
Intensive care unit bed availability, ventilator availability	Additional resource availability including: Ground transportation (fly cars etc.) Rotor wing (helicopter) Fixed wing (airplane) Maritime (boat)
Personal protective equipment (PPE) status	

Rather than collect multiple data points, an alternative method is to require stakeholder facilities to list beds and ambulances as "open" contingent on specific personnel and resource criteria. For example, an ITCD may choose to only collect information on bed availability that define unoccupied beds as:

1. Clean and available physical beds
2. Have the appropriate personnel with safe nursing ratios
3. Have the necessary medical resources and devices available to care for a patient including ventilator, oxygen, etc.



Gap identification is essential to the operation of an ITCD including resource gaps or gaps in communication between facilities. If the availability of beds and ambulances is not updated in real time there may be inaccuracies in bed availability and thus the distribution of transfers. The designation of bed managers at receiving hospitals tasked to report the status of hospitalization and bed availability to ITCD can be of great support for real-time data management.

Logistical information ITCDs must keep abreast of logistical information that will affect operations. This may include weather conditions that could affect transport (*8*), the maintenance of operational systems (electronic tracking, radio, telephone communication), and any inoperative periods necessary for cleaning, disinfecting and replacement of material in vehicles/ambulances.

Depending on workload and crew scheduling, there may be times when crews are unavailable due to mandatory rest periods.

Sending Facility

Initiating Transfer

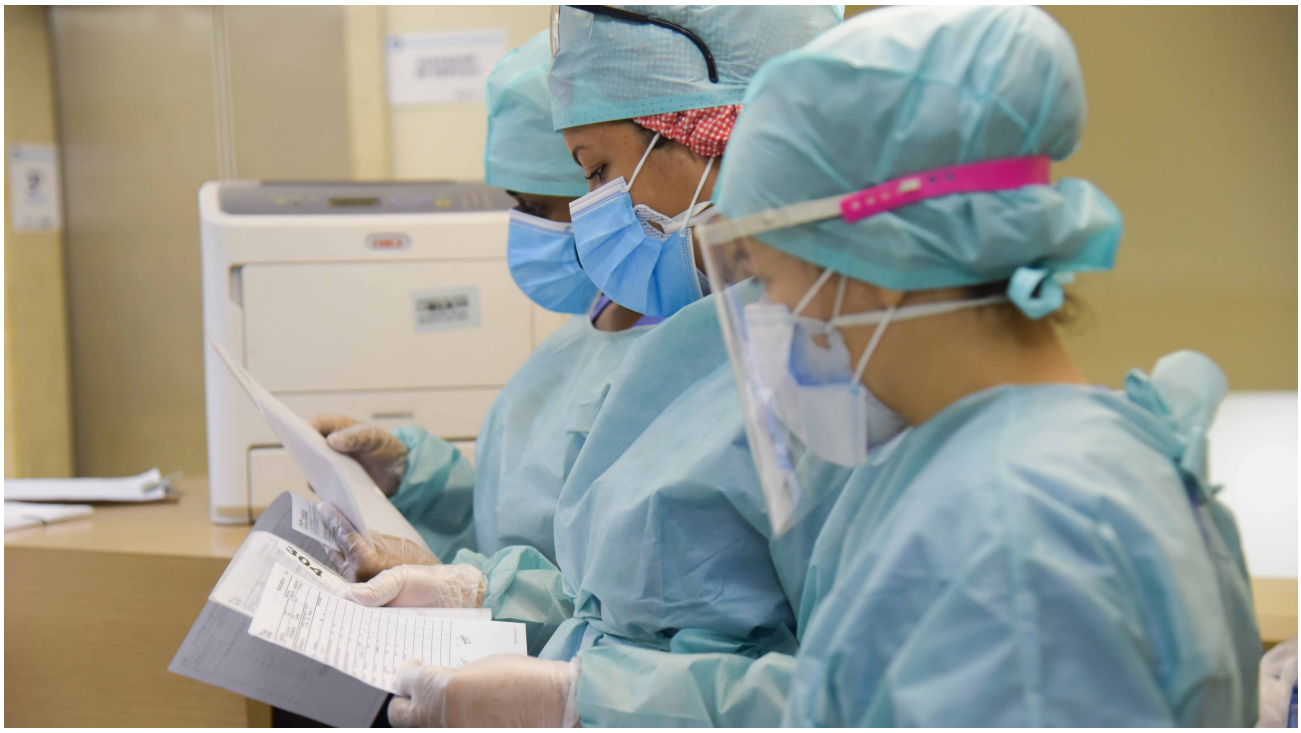
Identifying and preparing patients for transfer

Often patients will present to smaller community hospitals and require transfer to a higher level of care secondary to their critical clinical status. In scenarios of severe medical surge, bulk redistribution of patients may be considered.

Patients may be transferred to the closest facility with the appropriate level of care (*9*) or in the case of medical surge, to a facility with bed availability and with the appropriate resources for the care of the patient. Each sending facility should have predetermined thresholds for transfer (*10*), established specifically for the COVID-19 context. Transfer may be pursued to allow critical patients to access a higher level of care or to redistribute patients from high to low volume areas.

To the best of their ability, providers at these primary sites should isolate the patient and utilize all necessary PPE measures until they are able to be transported (*9*).

Holding severely or critically ill patients in the emergency department (ED) in anticipation of intra-hospital ICU transfer is also associated with adverse outcomes (*8*); whenever possible, these patients should be taken to the ICU rather than boarding in the ED or their transfer should be prioritized (*11*). Prioritizing boarding ED patients can also increase efficiency by minimizing repeated cleaning of inpatient rooms (*3*).



ICU Team at hospital são josé specialized in the treatment of covid-19. Duque de Caxias (Brazil).

Preparation of patients for transfer

All staff members should be aware of and follow local regulations regarding transfer practices or aware of the crisis standard of care (*8*). Crisis standards of care refers to modifications of traditional care standards during periods of overwhelming patient volumes with critically ill patients. These modified standards aid health-care professionals to distribute limited resources and maximize patient treatment. During a crisis when providers utilize modified standards, staff members should use these guidelines to determine the appropriateness of patient transfer. Hospital providers should endeavor to stabilize any patient requiring transfer prior to their exit from the facility.

Always, in the case of a critically ill patient, initiating providers must assess the risks and benefits of transfer. There are some patients such as those with profound multisystem organ failure who would unlikely survive transfer and require further resuscitation efforts before a transfer may be reasonably executed (*10, 12*). In such cases, it is very important to inform the patient and/or their family of the risks before initiating transfer.

If the patient cannot be transferred, either due to clinical complications or operational complications of the medical transport itself, the transferring center has to update the clinical situation of the patient while the transfer is being reassessed.

Pre-transfer communication

With the patient and the family of the patient

If the patient is conscious, providers should communicate their reasons for transfer to another hospital whether due to lack of beds, capacity or other reasons. With the patient's consent, family/next-of-kin should also be informed. If the patient is admitted to the ICU on mechanical ventilation, the family should be informed of the transfer

Communication with the ITCD

Once the hospital has decided to transfer a patient, they should communicate with the ITCD to report the status of the patient. This facilitates the selection of the transfer vehicle that is assigned according to severity and location of the patient.

The ITCD may determine which hospitals are available to accept that patient and inform the sending hospital. The ITCD may give an approximate time of arrival of EMS to the hospital.

Dispatch communications

Dispatch communications may differ between operating regions. The ITCD must coordinate with local dispatch and ambulance agencies to establish a clear line of communication and standardized dispatch practices for patient transfers.

Prehospital resource mapping at the local level is essential to know the response capacity, including the number and type of ambulances and the availability of specialized or trained personnel.

Sending hospitals should communicate with the ITCD, who then coordinate the local dispatch to facilitate the transport.

Patient acuity, COVID-19 status and location may determine the types of prehospital resources that are necessary.

Systems may consider utilizing a separate radio channel or communication system specifically for COVID-19 patient transfers or they may use the existing 9-1-1 dispatch system.

Using an existing dispatch system that continues to function for non-COVID related dispatch can prove challenging. If the same 9-1-1 system or medical dispatch system is used for this purpose as well as normal emergency response, it is important to consider the distribution of resources to both COVID-19-related as well as for non-pandemic related calls. It is important to maintain accurate and up-to-date calculations of ambulances left in service to respond to non-COVID-19 related calls. Each organization should calculate the minimum number of ambulances needed to cover their region for both COVID-19 and non-COVID-19 related transport.

All ITCDs that have the capacity to separate the call lines should do so. It would be convenient to have a dedicated line only for the coordination of calls and inter-hospital transfers of COVID-19 patients and a typical line for conventional emergency response calls.

Communication with the receiving hospital

The physician responsible for accepting patients should have completed their medical training and should be the supervisor of the particular floor or unit that will care for the incoming patient. Following acceptance by this physician at the receiving hospital, transfer of information should occur before the patient is transported; however, additional documentation may accompany or follow the patient.

Essential information that should be communicated to receiving providers prior to transport includes:

- Need for isolation and projected duration of stay.
- Onset of symptoms.
- Testing dates.
- Current symptoms and symptom severity.
- Devices in place (ventilator, central lines, etc.).
- Medical therapy initiated including medications received.
- Plan for any medical therapy.
- Images / radiography.
- Scheduled monitoring of lab values and prior notable values.
- Expected timing for transport / estimated time of arrival.

Receiving providers should be encouraged to ask further questions that will be beneficial for the optimal care of the patient.

Documentation to prepare prior to transfer

Proper documentation and protocols for documentation are essential for appropriate communication and patient care. All documentation transferred between hospitals should use common language and universal abbreviations (*9*).

- Clear documentation of COVID-19 testing and dates.
- Do-Not- Resuscitate or advanced directive orders.
    - Individual “do-not-resuscitate” orders should be made readily apparent in documentation and to transport crew members. Circumstances for universal “do-not-resuscitate” orders should be outlined and communicated verbally as well as in written form to all patient-care staff (*7*).

- Laboratory values and radiology studies.
- Artificial ventilation settings if required. Providers should also specify if the patient requires another type of oxygen support therapy and the settings.
- Other equipment settings required for transport such as continuous monitors, capnography or intravenous pumps.
- Adequate encryption of any electronic data.
- Medications received in the hospital and medications that providers anticipate the patient may need during transport.

Transfer procedures for transfer of the patient from the sending hospital to EMS

Handoff delivery may take several forms (*3*).

- Nursing staff may consider a traditional SBAR form that includes the situation, background, assessment and recommendations.
- All critically ill patients require a verbal physician-to-physician handoff, and the physician should be present for the prehospital provider handoff when patient arrives at the transfer facility.

Sending hospital clinical teams should have standardized patient transfer procedures with the ITCD, with the ambulance, and with the receiving hospital clinical teams.

Emergency Medical Services

Universal protocols

Universal protocols are predesigned procedures for responding to common circumstances. They can prevent mistakes and provide an algorithm in times of crisis.

An example of a universal protocol could include a clear procedure in case of a cardiac arrest en route. Other extenuating circumstances that may be protocolized include dislodgement of an endotracheal tube (ETT), arrhythmia en route, and dyssynchrony with the ventilator (*9*).

In the case of inter-hospital transfers of COVID-19 patients, protocols may indicate the level of PPE that health-care personnel should use depending on the care provided. For example, the decline of a severely ill patient during transfer may necessitate airway management, which would require staff wearing a lower level of protection to don the appropriate level of PPE before performing the procedure.

It is important that staff are familiar with universal procedures and that they are tailored to the event (e.g., epidemics, disasters) and in line with up-to-date regional crisis standard operating procedures.

Universal protocols should also take into consideration the possibility of limited or unavailable resources that may impact patient care such as a lack of medication, oxygen administration capability, sanitation materials, PPE, or availability of transport units.

Protocols should be established to address COVID-19 patients specifically including situationally appropriate Infection Prevention and Control (IPC) and decontamination measures related to an event. Vehicle decontamination methods should also be protocolized and should include the concentration requirements for appropriate cleaning fluids and how to prepare them.

Preparing the medical oxygen equipment.

Before Transfer

Equipment checks and initiation of care

All equipment should be checked prior to the initiation of care to ensure that all medical equipment including ventilators, infusion pumps, suction etc. are functioning appropriately. Previous evidence has shown an association between adverse outcomes of transferred patients secondary to their clinical status, technical equipment failures, and medial error by providers. One of leading causes of complications is respiratory equipment failure (*13*).

A predetermined route for EMS to retrieve patients from the sending hospital should be established (*10*). There should be a clear protocol in place for when and how a patient is to be located and taken by EMS personnel. The path should minimize exposure risk to other patients and staff. Ensure an adequate supply of PPE.

Patients should be accompanied by experienced personnel who are trained to move patients that are ventilator-dependent (*14*). A lack of both medical and nursing personnel trained in critical care or advance life support transport can lead to complications.

Meeting oxygen requirements and ambulance carrying capacity

Many COVID-19 patients will require oxygen supplementation during transport, although the amount necessary will vary depending on illness severity and the duration of the inter-hospital transport (short duration < 3hours or long-term duration >3 hours medical transport).

It is essential that ambulance services have documentation of the oxygen carrying capacity of each ambulance or other transport vehicle.

Alternative strategies should be considered when medical oxygen demands may exceed oxygen transport capacity.

Providers should obtain a generous calculation of patient oxygen needs prior to transport, adding contingency calculations to consider a potentially prolonged transport time or increased patient oxygen demand. It is important to be aware of estimated oxygen need of the patient, the anticipated transport time and the carrying capacity of the vehicle

It is recommended that ambulance agencies have tools for estimating oxygen consumption according to patient needs, equipment used and duration of medical transport between facilities. “Oxygen specifications for ambulance” and “Oxygen estimation for inter-hospital transport” are presented in Annex 1 and Annex 2.

In cases of prolonged transport, it may be necessary to coordinate a liaison with another vehicle to replenish oxygen supplies.

In the case of aeromedical transport, providers must take altitude into consideration as patient oxygen needs will increase with altitude.

During Transfer

Communication with the ITCD: activation of EMS

When the patient is ready for transfer and the above steps are complete. EMS should communicate with the ITCD that EMS is on scene and that the patient is actively being transferred.

Personal protective equipment

All PPE should be available in the transport vehicle or at the entrance of the sending hospital.

As discussed in the document "COVID-19 Recommendations: Prehospital Emergency Medical Services (EMS) Version 4.4", all COVID-19 patients who are not on a ventilator or on non-invasive ventilation equipment (BIPAP/CPAP), should have a surgical mask in place if they are able to tolerate it, this includes patients on other forms of supplemental oxygen.

Providers should always have proper PPE in place (Table 3). PPE waste should be placed in a labeled, leak-proof container.

Table 3. Personal Protective Equipment for Inter-hospital Transfer of Patients with COVID-19

Level of care	Hand hygiene	Medical mask	Respirator (N95 or FFP2)	Gown	Goggle or face shield	Gloves
Transport WITHOUT aerosol-generating procedure	X	X		X	X	X
Driving WITH patient compartment isolated	X	X				
Driving WITHOUT patient compartment isolated	X	X				
Transport WITH aerosol-generating procedure	X		X	X	X	X
Cleaning the Ambulance	X	X		X	X	X

Source: COVID-19 Recommendations: Prehospital Emergency Medical Services (EMS). Draft document, Version 4.4. Washington, DC: PAHO; 2020. P atient monitoring and care during transport

Patient monitoring and care during transport

Continuous end-tidal CO2 monitoring is recommended when available.

Transport monitoring including defibrillation function. All critically ill patients should have, at minimum, a secure IV in place prior to transport (*8*).

Programs may elect to utilize transport checklists as these have been shown to reduce the rate of total and serious unexpected events during transport (*15*).

- Checklist may include patient identifiers, verification of destination (name of receiving facility), transport equipment, clinical status measurements, items related to devices in place and safety checks such as positions of the side rails on the stretchers.

Consider a multidisciplinary team for the transport of critically ill patients with at least two advanced providers (8, 13, 16).

Completion of the transfer form

Predetermined transfer forms may improve efficiency and prevent the loss of important information.

These forms should include:

- Patient information and contact information at a minimum of an emergency contact.
- The name of the sending hospital and the name of the receiving hospital.
- The date and time of transfer.
- The name and contact information of the sending physician at the sending hospital.
- The name and contact information of the accepting physician at the receiving hospital.
- Contact information of the members of the EMS team who carry out the transfer.
- Patient condition prior to transfer.
- Medications received prior to transfer with doses and routes of administration. Indicate if an infusion pump medication is needed.
- Medications expected to be given during the transport.
- Oxygen administration settings if necessary (including nasal cannula, non-rebreather mask, high flow nasal cannula, CPAP / BIPAP and ventilator).
- Any incidents that occurred during transfer.
- Belongings that the patient is taking to the receiving hospital.

Receiving Hospital

Delivery And Reception Of The Patient

Upon arrival at the receiving facility, EMS providers should communicate with dispatch to notify the receiving facility.

Deliver the patient's information to the admission service of the receiving hospital.

EMS and members of the receiving hospital team should coordinate to do the following:

- Meet upon arrival with staffing members that may include, but not be limited to, respiratory technician, nursing staff, supervising physician, specialist physician, etc.
- Immediately move the patient to a designated COVID-19 room with aerosolized precaution procedures implemented using a predesignated route.
- Move patient from transport equipment to hospital equipment taking great care to minimize unnecessary movements (*14*).

Verbal handover should be given by EMS to the receiving team, including any updates in patient status that have occurred during transport.

It is essential that proper documentation is passed from EMS to the receiving team.

Taking care COVID-19 ICU patient

Return To Service, Operability Of The Transfer Vehicle

Post-transfer, transport units should be allotted adequate time to execute decontamination procedures as well any necessary decontamination required for personnel. Transport units should refer to universal protocols or regional crisis protocols for further guidance on returning to “available” status.

When appropriate decontamination procedures have been completed, EMS providers may notify dispatch and ITCD of their availability for service.

At that time the process will begin again as hospitals identify transfer needs and EMS services become available for transport.

Discarded PPE should be placed in a leak-proof, labeled container in accordance with the country’s biohazard waste management protocols.

Crew fatigue is a threat to safety during interhospital transport. The risk of medical errors, ambulance collisions and adverse patient events are higher when working long shifts, and experiencing overwhelming medical transport responses without sufficient rest periods and lack of sleep.

Ambulance crew members may face challenges to their overall mental health and well-being during prolonged interhospital transport responses. They may experience stress and anxiety among other issues.

EMS managers should allow some time and space for the crew to rest and recover, as well as provide them support for their mental wellbeing.

EMS agencies need to develop procedures, protocols, and policies to monitor and mitigate the effect of fatigue and to protect the mental health and wellbeing of the first responders.

Ambulance decontamination

As with any EMS transport of Person Under Investigation (PUI) or known COVID-19 patients, ambulance decontamination is essential. It is important to communicate with each facility and identify a site for ambulance decontamination prior to patient transport.

A designated decontamination site must be established with a secure perimeter. If providers are unable to remain with the vehicle, a security plan must be in place.

Hospitals and ambulance managers should consider waste management, public perception and media visibility when selecting the decontamination site.

Hospitals and ambulance managers should define a clear boundary designating clean and dirty areas that is marked around the ambulance and the required PPE.

Delays in the decontamination process can lead to bottlenecks in patient flow as it will prevent the ambulance from going back into service.

In addition to the time allotted for cleaning and decontamination of the ambulance, the crew must also perform a general and basic mechanical check of the vehicle, including the need for refueling before returning to service.

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Annex 1: Oxygen Specifications for Ambulance

This document presents a compilation of recommendations established in international norms or standards for the installation and use of oxygen in ground ambulances.

Ambulances are mobile units that can go at high speeds (in addition to being subject to acceleration) and that provide out-of-hospital assessment and medical care. For this purpose, they are generally equipped with electricity (generated or stored in batteries), oxygen and other gases, and have a storage of fuel. Therefore, ,it is imperative to know and follow the recommendations of international or national standards and regulations to ensure a safer work and patient care environment.

	NFPA 1917-2019 (6.28)	UNE-EN-1789:2021 (6.3.8)	GSA Federal Specification for the Star of Life Ambulance (3.11.3 and 3.12)	CAAS GVS V2.0 (C.13)
General / Source Supply	The ambulance shall have a medical gas system capable of supplying a minimum of 793 gallons (3000 liters) of medical gas.	The source of supply shall consist of one or more of the following: a) Medical gas in cylinders, e.g. oxygen, air. b) Non-cryogenic liquid in cylinders, e.g. N20, CO2. c) Cryogenic liquid in cylinders, e.g., oxygen. d) Cryogenic liquid in stationary vessels. e) Non-cryogenic liquid in stationary vessels. f) Air compressor system. g) Proportioning system. h) Vacuum system. i) Oxygen 93%. *Note: EN ISO 7396-1:2016+A1:2019 can be used as guidance for designing the source of supply.	The ambulance shall have a piped medical oxygen system capable of storing and supplying a minimum of 3000 liters of medical oxygen.	Unless otherwise specified by the purchaser, the ambulance shall have a piped medical oxygen system. The purchaser shall specify the minimum capacity, in liters, of medical oxygen required.
	If a compressed gas cylinder is used, a cylinder-changing wrench shall be secured within the medical gas storage compartment.			
	All medical gas system controls shall be accessible from inside the vehicle. (Medical gas and suction ports should be located so that emergency medical service provider (EMSPs) does not have to reach behind themselves, a structure, or a piece of equipment to access the ports.)		The main oxygen supply shall be from a single compressed gas cylinder that the consignee will provide and install at the time the vehicle is placed in service. A cylinder changing wrench shall be furnished. The wrench shall be chained and clipped within the oxygen cylinder compartment	The main oxygen supply shall be from a compressed gas cylinder(s) that the consignee will provide and install at the time. the vehicle is placed in service
	A medical gas–capacity indicator shall be visible from the designated primary patient care seating position.		The cylinder controls shall be accessible from the inside the vehicle. A device shall be visible from the EMSP's seat that indicates cylinder pressure. The use of remote high-pressure lines and gauges are not allowed. The oxygen cylinder shall be accessible for changing from the exterior of the body	Unless otherwise specified, a cylinder changing wrench shall be furnished. The wrench shall be chained and clipped within the oxygen cylinder compartment.
	The medical gas port shall be accessible from the designated primary patient care seating position.			The cylinder controls shall be accessible from the inside the vehicle. A device shall be visible from the EMSP's seat that indicates cylinder pressure. The use of remote high-pressure lines and gauges are not allowed.

Medical Gas System	The purchaser shall specify the quantity and location of medical gas ports.	Medical gas piping: All ducts for medical gas installations or medical gas piping shall be vented. If the road ambulance is intended to carry a transport incubator system, there shall be an adapter for medical gases cross- border transportation meeting the requirements of EN 13976-1:2018subclause 4.3.3.	The purchaser shall specify the type of quick disconnect, to be used. The FSAM shall install all other components and accessories required for the piped oxygen system which shall include as a minimum: • A pressure regulator. • Low pressure, electrically conductive, hose approved for medical oxygen. • Oxygen piping concealed and not exposed to the elements, securely supported to prevent damage, and be readily accessible for inspection and replacement. • Oxygen piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet. • Outlets shall be adequately marked and identified and not interfere with the suction outlet.	The purchaser shall specify the type of quick disconnect, as well as the location and the number of outlets to be furnished.
	Medical gas system shall include the following: (1) A pressure regulator. (2) Low pressure, electrically conductive hose and fittings approved for medical gas. (3) Medical gas piping that is concealed and not exposed to the elements, securely supported to prevent damage, and readily accessible for inspection and replacement. (4) Medical gas that is piped to a medical gas port with a minimum flow rate of 26.4gpm (100 L/min) at the outlet. (5) Outlet(s) that is marked and identified and does not interfere with the suction outlet.	Terminal units shall comply with EN ISO 9170-1:2017. Pneumatic power supply: If the road ambulance is equipped with terminal units, the range of operating pressure shall be: — for compressed medical gases 400kPa0 +100 kPa; for tolerances see EN ISO 7396-1:2016+A1:2019, Table 2. — for vacuum ≤ 60 kPa absolute pressure. The maximum allowable pressure change between the source of supply and the terminal units shall be: — for compressed medical gases 10 % at a flow of 40 l/min; — for vacuum 20 % at a flow of 25 l/min. For road ambulances complying with previous point, one additional outlet connector (i.e., a terminal unit or agas- specific connection point) complying with EN ISO 9170-1:2017 shall be fitted in addition to the outlet connectors necessary for the devices intended to be normally used. Pin- index outlet connections of cylinder values shall comply with EN ISO 407: 200		The final stage ambulance manufacturer (FSAM) shall install all other components and accessories required for the piped oxygen system which shall include as a minimum: • A pressure regulator. • Low pressure, electrically conductive, hose and fittings approved for medical oxygen. • Oxygen piping shall be concealed and not exposed to the elements, securely supported to prevent damage, and be readily accessible for inspection and replacement. • Oxygen shall be piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet. • Outlets shall be marked and identified and not interfere with the suction outlet

Medical Gas System	Medical gas and suction ports shall be within reach of EMSPs while remaining seated and restrained in the designated primary patient care position.	Flexible hoses for connecting medical devices to outlet connectors (i.e., terminal units or a gas-specific connection points) shall comply with EN ISO 5359:2014+A1:2017. If flexible hoses are used for medical gas supply between the pressure regulators and the terminal units, the requirements of EN ISO 11197: 2018 apply. The stationary oxygen supply shall comprise a source in accordance with stationary oxygen a Minimum 2000 liters, (under normal temperature and pressure), flowmeter/ flow gauge with maximum capacity of at least 15 l/ min and regulating valve, pressure regulators and terminal units or pressure regulators with flow metering devices. The portable oxygen supply shall comprise a source in accordance with portable oxygen minimum 400 l, (under normal temperature and pressure), flowmeter/ flow gauge with maximum capacity of at least15 l/min and regulating valve and a pressure regulator with flow metering device.		
Medical Gas Pressure Regulator	The medical gas pressure reducing and regulating valve system shall be provided with the following features: (1) An inlet filter at the cylinder. (2) A line relief valve set at 200 psi (1380 kPa) maximum. (3) A gauge or digital monitor with a minimum range of 0 psi to 2500 psi (0 kPa to 17 237 kPa) graduated in not more than 100 psi (690 kPa) increments. (4) A locking adjustment preset at 50 psi ± 2 psi (345 kPa ± 14 kPa) line pressure.	Pressure regulators and pressure regulators with flow metering devices shall conform to EN ISO 10524-1:2019 or EN ISO 10524-2:2019 or EN ISO 10524-3:2019. The pressure regulators shall be directly connected to the source of supply. Flow metering devices for connection to terminal units and for connection to flow- rate control units shall conform to EN ISO 15002: 2008.	The medical, oxygen pressure reducing, and regulating valve with inlet filter at the cylinder shall have line relief valve set at 200 psi maximum, and a gauge or digital monitor with a minimum range of 0 to 2500 psi with the gauge or display scale graduated in not more than 100 PSI increments.	The medical, oxygen pressure reducing, and regulating valve with inlet filter at the cylinder shall have line relief valve set at 200 psi maximum, and a gauge or digital monitor with a minimum range of 0 to 2500 psi with the gauge or display scale graduated in not more than 100 PSI increments. The regulator shall be easy to connect and preset, with a locking adjustment, at 50 +/- 5 psi line pressure.

Medical Gas Pressure Regulator	The regulator shall meet the performance required next at an inlet pressure range from 150 psi to 2500 psi (1034 kPa to 17 237 kPa).		The regulator shall be easy to connect and preset, with a locking adjustment, at 50 +/- 5 psi line pressure, permitting a minimum 100 LPM flow rate at a bottle pressure of 150 psi.	With the regulator set at 50 +/- 5 psi, a 100 LPM minimum flow rate shall be available at all oxygen outlets.
	With the regulator set at 50 psi ± 2 psi (345 kPa ± 14 kPa), a 26.4 gpm (100 L/min) minimum flow rate shall be available at all medical gas ports.			This regulator shall perform as required at an inlet pressure range from 150 psi to 2600 psi.
Medical Gas Tank Storage	Storage for an “M” or “H” size main medical gas cylinder shall be accessible for replacement from an outside position.		Storage for the main oxygen cylinder shall be accessible for replacement from an outside position.	
	Any exterior medical gas compartment, if so equipped, shall be provided with at least 9 in.2 (580 mm²) of open vent to dissipate or vent leaking medical gas to the outside of the ambulance.		The oxygen compartment shall be provided with at least a 9 sq. in. of open vent to dissipate/vent leaking oxygen to the outside of the ambulance.	
	Medical gas cylinder compartment shall not be utilized for storage of any other equipment and shall be labeled “Medical Gas Storage Only.”		Oxygen cylinder compartment shall not be utilized for storage of any other equipment.	
			Oxygen cylinder(s) shall be mounted with a restraining device(s).	
Medical Gas Tank Retention	A medical gas cylinder(s) shall be mounted with a restraining device(s) that meets the requirements of SAE J3043, Ambulance Equipment Mounts, in the lateral and longitudinal directions.			
	Compliance of the medical gas tank retention device, in the lateral and longitudinal directions, shall be validated by testing a sample retention device using a substantially similar ambulance or body structure in accordance with the testing requirements of SAE J3043, Ambulance Equipment Mounts.			
	A medical gas cylinder(s) shall be mounted with a restraining device(s) that meets the requirements of AMD 003, Oxygen Tank Retention System Static Test, in the vertical direction.			
	Compliance with the medical gas retention device in the vertical direction shall be validated by testing a sample retention device using a substantially similar ambulance or body structure in accordance with the testing requirements of AMD 003, Oxygen Tank Retention System Static Test			

Medical Gas System Integrity	The medical gas system of each ambulance shall be tested prior to delivery in accordance with AMD 015, Ambulance Main Medical Gas System Test.	Test pressure for mechanical integrity: The gas piping and flexible hoses used for medical gas supply shall withstand a pressure of 1,000 kPa+20 % for at least 5 min. *Note: The pressure of 1000 kPa is the maximum pressure supplied by pressure regulators complying with EN ISO 10524-1:2019, EN ISO 10524-2:2019 and EN ISO 10524-3:2019 in single fault condition.	The installed medical oxygen piping and outlet system shall be leak tested to 200 PSI. After the successful completion of tests, the system shall be capped then tagged with date and signature of person and firm performing the tests.	The installed medical oxygen piping shall be leak tested to 80 PSI. After the successful completion of piping test, the system shall be completely assembled, and the flow rate of the outlets tested with the system pressurized at normal working pressure. The system shall be capped then tagged with date and signature of person and firm performing the tests.
	The medical gas system shall lose no more than 5 psi (34 kPa) of pressure in a 2-hour period.	Test pressure for leakage After a test period of 2 h to 24 h at nominal distribution pressure, the pressure drop in the gas piping of the distribution system shall not exceed 0.4 %/h of the test pressure. After a test period of 2 h to 24 h at nominal distribution pressure, the pressure drop in flexible hoses for medical gas supply of the distribution system shall not exceed 0.6 %/h of the test pressure.		
	Each port shall be capable of delivering at least 26.4 gpm (100 L/ min) of medical gas.	Marking and instructions for use shall comply with EN ISO 15223-1:2016 and EN 1041: 2008+A1:2013. Operating and maintenance instructions, service records and any other appropriate requirements shall accompany the product. Standardized symbols should be used, or it should be written in the native language of the area where the equipment is to be used		
Medical Gas System Integrity	A label shall be provided near the medical gas tank stating the following: THE INTEGRITY OF THIS MEDICAL GAS SYSTEM WAS TESTED IN ACCORDANCE WITH NFPA 1917 AND MEETS THE REQUIREMENTS THEREOF.	The manufacturer shall supply instructions for carrying out preventive maintenance.		
	The label shall be signed and dated by an authorized representative of the ambulance manufacturer or test agency.			

Sources:

- Commission on Accreditation of Ambulance Services (CAAS), GVS, Ground Vehicle Standard for Ambulances V 2.0, July 2019.
- General Services Administration (GSA), Federal Specification for the Star-of-Life Ambulance, August 2007.
- NFPA 191: 2019, Standard for Automotive Ambulances.
- UNE-EN 1789:2021, Medical Vehicles and their Equipment, Road Ambulances, May 2021.

Annex 2: Oxygen Estimation For Inter-Hospital Transport

Continuity of oxygen therapy is essential during the inter-hospital transfer of patients with COVID-19. Therefore, the estimate of oxygen required for the journey should be calculated, taking into account the amount of oxygen stored in cylinders prior to a transfer and according to the oxygen flow required for patient oxygenation and the medical equipment used (e.g., High-flow cannula, mask, conventional cannula, etc.).

The below values are needed to determine how long an oxygen cylinder would last.

- Current Cylinder Pressure (psi)
- Flow of the medical device to be used and/or administered to the patient (LPM)
- Cylinder Factor (“Constant”):

This number is calculated by dividing the next formula:

$$\textbf{Factor} = \frac{\textbf{Max Cylinder Volume (L)}}{\textbf{Max Cylinder Pressure (psi)}}$$

For example:

The “factor” for a type E cylinder with the maximum volume of 680L and the maximum pressure of 2000 psi will be;

$$\textbf{Factor} = \frac{680}{2000} = 0{,}34$$

The "factor" for a type E cylinder with the maximum volume of 625L and the maximum pressure of 2200 psi will be;

$$\textbf{Factor} = \frac{625}{2200} = 0.28$$

Note: The maximum volume and pressure for a type E cylinder can differ in some countries, and therefore it is important to confirm with the supplier and the standards of the country. Also, the type of cylinder, the terminology, volumes and pressures are not universally standard. Check with manufactured cylinder capacity size, material, and pressure and with local or applicable standards.

Once the values are obtained, the time in minutes is calculated using the following formula:

$$\textbf{Time (minutes)} = \frac{\textbf{Remaining Supply}}{\textbf{Flow Rate}}$$

To obtain the remaining supply, the cylinder factor, gauge pressure and residual pressure is needed. The gauge pressure is the one that the operator or responsible person can see in the manometer of the cylinder, and the residual pressure is a safe residual pressure in the cylinder that typically is 200 psi.

With the previous values the complete formula would be:

$$\textbf{Time (minutes)} = \frac{\textbf{(Gauge Pressure-Residual Pressure)} \times \textbf{Cylinder Factor}}{\textbf{Flow Rate}}$$

As an example, the following duration times are presented, obtained by modifying some of the parameters necessary for the calculation.

Type of cylinder	E			M
Max Volume (L)	680 L			3000 L
Max Pressure (psi)	2000 psi			2000 psi
Factor	0.34			1.5
Gauge Pressure	2000 psi			2000 psi
Flow rate (LPM)	High Flow Canula 60 LPM	Conventional Canula 5 LPM	Ventilator 12 LPM	High Flow Canula 60 LPM
Time (minutes)	10 min	122 min (2 hr)	45 in	45 min

Annex 3: Computerized Aid During Inter-Hospital Transport

Computerized Ambulance Dispatch and Coordination systems (known as CAD) are used by most 911 systems and ambulance dispatch centers to handle calls for emergencies and inter-hospital transports.

When time is essential to ensure that the patient receives the necessary care and can be transferred to the appropriate facility, CAD improves response times and ensures efficient communication between all entities involved in patient care and transport.

These systems allow prioritization and logging of calls, identification and location of available ambulances, and effective dispatching of available EMS resources. CADs also allow responders to receive key information and use other technologies such as geographic information systems (GIS), automatic vehicle location (AVL) or caller identification (ID).

In addition, automated free-voice communication facilitates silent dispatching, which helps reduce radio traffic and information handling overhead, especially in scenarios where a high number of calls and responses are expected.

The handling of primary calls and requests for interhospital transfers has highlighted the importance of 911 dispatch centers, ambulance dispatch centers and EMS resources having these types of tools in place to adequately manage the increase in incoming calls.

In the Americas, PAHO developed the SISMED911 platform for the systematization and digitalization of the processes of emergency medical systems (EMS), with the objective of helping country EMS to optimize the response and/or actions upon request of an urgency or emergency. During the COVID-19 pandemic, the tool was updated with new improvements mainly focused on facilitating the management of strategies for medical surge capacity.

The SISMED911 platform has several modules to facilitate the management of EMS response:

INTER-HOSPITAL	Module that manages requests and coordination of interhospital transfers, as well as patient follow-up during the transfer process.
PRE-HOSPITAL	Module that captures information on pre-hospital processes and procedures from the point of the incident to its transfer to the hospital emergency room.
PARAMEDIC	A mobile app designed for the process of recording clinical information of the patient, as well as administrative data generated in the ambulance.
MED-SURGE	Module that monitors the clinical capacity of hospitals and their medical surge capacity in case of need during emergencies. It uses technologies such as web or chat Bot.
AMBULANCE	Module to assist in the administrative management of emergency response vehicles
E-CLINICAL	Patient monitoring module in hospital emergency rooms.
TRAKING	Tracking and tracing module for ambulances or emergency vehicles.
E-REPORT	Application integrated in all modules to facilitate the reporting of indicators and EMS system response to managers and decision-makers

The technical characteristics of this platform are as follows:

- It is developed in web environment with open-source technology such as PHP v. 8.x, JavaScript and Postgresql12 database engine.
- Its layered architecture is Model View Controller (MVC) with Laravel and React frameworks. It guarantees scalability and interpolation to meet growing information and IT security requirements.

Among the advantages of SISMED911 are:

- High degree of parameterization and adaptability to the context of local processes.
- Modularity. Its design allows operation in autonomous and independent modules.
- Interoperability that enables interaction with other subsystems of the Organization, providing cohesion and reducing development times.
- The platform also has standardized parameters (ICD10, NFPA450, etc.) and/or formalized by national authorities (list of the health services network with its portfolio of services, administrative division of the country, ambulance resources, etc.). This allows for better data quality for decision making and its after action review.

Indicators generated by SISMED911 for the INTER-HOSPITAL module:

Time stamps	• Call for referral request. • Phone off hook. • Interview ends. • Response resource and hospital receiving are identified. • Dispatch time. • Unit acknowledgement. • Unit en route. • Arrived at referral hospital. • Unit left referral hospital. • Arrived at final hospital. • Transfer of patient. • Available for service.

Data variables	Applicant's data • Hospital requests the service. • Name of the person responsible for the request. • Contact information. • Type of services requested. Patient data • Patient's basic data (names, age, gender, etc.). • Clinical evaluation (vital signs, diagnosis, etc.). Destination hospital data • Hospital of destination. • Portfolio of hospital services. • Availability of requested service • Authorization to receive the transfer. Information of ambulances for transfer • Type of ambulances for transfer. • Availability of ambulation. • Ambulance location Ambulance crew.
Types of reports	• Hospitals with the highest number of transfer requests. • Report number of cases in time series and gender (day, month and year). • Report of services by locality (province, municipality). • Report of patients seen by age group. • Report of services by diagnostic group. • Dynamics of the network of services in interhospital transfers

This document provides technical recommendations on the methodology of developing a system* to transfer COVID-19 patients from one hospital to another, in preparation for the ongoing and anticipated surge of patients in outbreaks, epidemics or disasters. It outlines procedures and recommendations at each stage of the interhospital transfer from dispatch to patient arrival. This document is intended for all decision makers and professionals involved in the assessment, care, and management of patients requiring secondary transfers between hospitals, emergency medical teams (EMTs) and alternative medical care sites (AMCS) that are providing inpatient services and critical care.

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