Critical Care Retrieval in the Middle East: Descriptive Analysis of a Multidisciplinary Adult Critical Care Transfer and Retrieval Service in Qatar

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Abstract

Introduction The regionalisation of critical care resources has led to an increase in the need to transfer patients between facilities. The advent and implementation of critical care transfer and retrieval services have been the bridge to this divide, lying at the confluence of prehospital emergency care, in-hospital emergency medicine, and intensive care. Within the State of Qatar, the concept of critical care transfer and retrieval is a relatively new. Consequently, we conducted a retrospective cross-sectional study of all transfer and retrieval activity of a dedicated multidisciplinary transfer and retrieval service to better understand the use of these services in the region.

Methods Extracted patient care record data were analysed and described using univariate and multivariate descriptive statistics. A log-binomial regression model with robust variance estimator was used to calculate crude and adjusted prevalence ratios for intubation status and arteriovenous access; and intubation status and medication combination, adjusting for age and gender for each model.

Results Amongst the completed cases, the majority were male (60.39%), and within the 40-59 (27.7%) age group. Amongst the cases transferred, those with a primary respiratory pathology were the most common (19.59%), followed by cardiovascular patients (18.5%). Half of all patients had a self-maintained airway (51.6%), followed by a third who had an endotracheal tube in situ (36.74%). Midazolam was the most common hypnotic administered (51.27%), as was Fentanyl (88.02%) amongst the analgesic medications, and Noradrenaline amongst the inotropes (72.77%). Intubated patients had the highest proportion of severe and critical patients; patients transported with a Doctor; patients with multiple routes of arterial and/or venous access; and patients receiving any hypnotic, analgesic or inotrope, or a combination thereof.

Conclusion The transfer and retrieval of critical care patients across Qatar is a relatively common occurrence. Variations in patient type and severity and the expectations of the transfer team, are significant. Variation in airway type and ventilation modalities, types and combinations of hypnotic, analgesic and inotropes used, and the multitude of arteriovenous access points observed in this study directly contributed towards the complexity of moving these patients from one facility to another.

Introduction

Critical care is a clinically complex and resource-intensive discipline the world over. Consequently, the delivery of these services is compounded by the need to sustain a specialised workforce while maintaining consistent and high standards^{1,2}. The regionalisation of critical care resources and the creation of referral networks has been one approach that has led to success in this area²⁻⁷. However, as steps have been made towards regionalisation, so too has the need to transfer patients between facilities to access these services. An increase in the number of patients requiring the continuation of critical care in-transit has led to a need to expand the borders of traditional intensive care beyond the confines of the hospital.

The advent and implementation of critical care transfer and retrieval services have been the bridge to this divide, lying at the confluence of prehospital emergency care, in-hospital emergency medicine, and intensive care. Undertaking the transfer of a patient requiring the initiation or continuation of critical care is no simple task. Variations in patient type and severity of their medical condition and the expectations of the transfer team, are significant. Reports regarding the transfer of patients ranging from critical neonates to the multi-comorbid geriatric; with complex underlying surgical and medical diagnoses; involving the concomitant administration of multiple vasoactive and sedative medications; with various oxygenation and ventilation requirements, are commonplace in the literature^{6,9-15}.

Despite the relatively small size of the State of Qatar, critical care transfer and retrieval has nonetheless become a necessity within the country's healthcare system. Starting in 2014, a dedicated program was initiated to facilitate the transfer and retrieval of critical care patients across the country¹⁶. The Specialized High Acuity Adult Retrieval Program (SHAARP) is a joint initiative between the Hamad Medical Corporation Ambulance Service (HMCAS) and the Hamad Medical Corporation (HMC) Critical Care Network (CCN). It consists of a single dedicated purpose-built ambulance, manned and run 24 hours a day, seven days a week by various staff from both HMCAS and the CCN and deployed primarily for the transfer and retrieval of critical care patients across Qatar¹⁷. The program was further developed in 2016 and formalised under the Transfer and Retrieval division of the HMCAS, with dedicated HMCAS and CCN staff receiving bespoke training and continued education¹⁸; the addition of specialised and dedicated communications staff for call taking, dispatch and monitoring; and focused governance and audit to maintain the highest quality of patient safety and quality of

care. Since then, the program has seen considerable uptake within the country's health system. This study aimed to describe the activity of a dedicated high acuity adult retrieval program in the State of Qatar.

Methods

A retrospective cross-sectional study of all transfer and retrieval activity was conducted using patient care records of the Hamad Medical Corporation Ambulance Service's Specialised High Acuity Adult Retrieval Program.

Setting

The study was conducted within the Hamad Medical Corporation (HMC), the primary governmental provider of secondary and tertiary healthcare in Qatar, and the Hamad Medical Corporation Ambulance Service (HMCAS), the national ambulance service of Qatar. HMCAS is a two-tiered emergency medical service provider with Ambulance Paramedic (AP) staffed ambulances and advanced Critical Care Paramedic (CCP) staffed fast-response vehicles. Licensure and scope of practice within Qatar are governed by the Qatar Council for Healthcare Professionals (QCHP). Figure 1 highlights the locations of the tertiary health facilities across Qatar.

Data Collection

The study utilised routinely collected clinical data extracted from the HMCAS electronic patient care record (ePCR) database and the SHAARP case registry. The target population was identified by screening for all cases for which the SHAARP unit was dispatched. Patients for whom the SHAARP unit was dispatched, and arrived at patient side, were included in the analysis. Primary cases (i.e., community-based patients); patient's being transferred home; patients transferred to and from the airport, and cases that were cancelled prior to the crew reaching the patient side were excluded. All cases meeting criteria for the period of January 2017 to February 2020 were included in the analysis.

Study Variables

The data collected was a combination of continuous and categorical variables. A data extraction template was developed to retrieve and sort call-time intervals; patient demographics; departure, transport, and handover vital signs; interventions performed, and medications administered by the transferring crew. For descriptive purposes, each patient was categorised by broad category type and primary pathology, i.e. the primary diagnosis. Continuous data for age, call time intervals, Glasgow Coma Score (GCS) and Richmond Agitation-Sedation Scale (RASS) score were recategorized for analysis. Initial GCS was collected for non-ventilated patients and initial RASS score collected for all invasively ventilated patients. Methods of arterio-venous access were categorised as arterial, central venous and peripheral venous. Medications administered were categorised into primary hypnotic, primary analgesic and primary inotrope. Lastly, as part of the data extraction, the Risk Score for Transported Patients (RSTP) scale - a critical care inter-facility transfer risk score developed by Markakis et al.¹⁸ was retrospectively applied for all cases (Figure 2). Patient clinical data were collected starting from arrival at patient side by the transporting crew, throughout transport, until patient handover. All monitoring data was captured automatically and auto-populated into the unit's electronic health record following handover. All interventions and medications captured represent those continued or initiated primarily for the patient transfer.

Analysis

Extracted data were analysed and described using univariate and multivariate descriptive statistics. Chi-square analysis was used as the primary measure of association for all categorical data. A log-binomial regression model with robust variance estimator was used to calculate crude and adjusted prevalence ratios for intubation status and arteriovenous access; and intubation status and medication combination, adjusting for age and gender for each model. 95% confidence intervals were calculated where necessary and a p-value of 0.05 used as a cut-off for statistical significance. Missing data was reported where found and largely determined to be missing at random. All data was collected and sorted using Microsoft Excel (Microsoft Excel 2010; Microsoft, Redmond, Washington, USA) and analysed using Stata v15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC).

Institutional Review Board

Ethical approval to conduct the study was granted by the Medical Research Centre of the Hamad Medical Corporation, Qatar (Ref no.: MRC-01-19-154).

Results

A total of 1224 cases that met criteria were included in the analysis. Of these, 40 (3.27%) were cancelled following the transfer team's arrival at the patient side and/or attempted preparation for transfer (Table 1). Amongst the completed cases, the majority were male [n=715 (60.39%)], and within the 40-59 [n=328 (27.7%)] and 20-39 [n=299 (25.25%)] age groups. Transfers were generally conducted on either a Monday [n=200 (17.26)] or Sunday [n=200 (16.92)] and between the hours of 07:00 – 15:00 [n=545 (46.03)]. Mean patient preparation time at the referring facility was approximately one hour [01:08 (IQR 00:38-01:18)] while the mean handover time at the referring facility was just under an hour [00:53 (IQR 00:29-00:57)]. The mean total mission time (dispatch to unit availability at receiving facility) was 02:46 (IQR 01:59-03:14), likely reflecting the relatively short distances of travel between facilities. In terms of crew composition, a Critical Care Paramedic was present on 99% (n=1166) of transfers and a doctor on 22.3% (n=264) of transfers.

Table 1
Transfer and demographic data

Characteristic	n	(%)
Total	1224	
Status		
Completed	1184	(96.73)
Cancelled	40	(3.27)
Completed cases only		
Mean time at referring facility (hh:mm)	01:08 (IQR 00:38-01:18)	
Mean handover time (hh:mm)	00:53 (IQR 00:29-00:57)	
Mean total mission time (hh:mm)	02:46 (IQR 01:59-03:14)	
Hour of dispatch		
07:00-15:00	545	(46.03)
16:00-23:00	466	(39.36)
00:00-06:00	173	(14.61)
Day of dispatch		
Sunday	200	(16.92)
Monday	204	(17.26)
Tuesday	182	(15.40)
Wednesday	156	(13.20)
Thursday	188	(15.91)
Friday	119	(10.07)
Saturday	133	(11.25)
Gender		
Male	715	(60.39)
Female	301	(25.42)
Not documented	168	(14.19)
Age Category		
0 - 19	98	(8.28)
20 - 39	299	(25.25)
40 - 59	328	(27.7)
60 - 79	277	(23.4)
≥ 80	65	(5.49)
Not documented	117	(9.88)
Case Category		
Environmental	4	(0.34)
Medical	1069	(90.29)
Surgical	3	(0.25)

Characteristic	n	(%)
Trauma	74	(6.25)
Not documented	34	(2.87)
Crew Type		
Ambulance Paramedic	1147	(96.88)
Critical Care Paramedic	1166	(98.48)
Doctor	264	(22.3)
Nurse/Respiratory Therapist	18	(1.52)

Despite the clinical complexity of many patients transferred, a primary pathology was documented for recording purposes and represented the general focus for the patient's management. Amongst the cases transferred by the service, those with a primary respiratory/pulmonary pathology were the most common [n=232 (19.59)], followed by patients with an underlying cardiovascular [n=219 (18.5)] and those with a septic [n=177 (14.95)] focus (Table 2). Risk scores and per-patient activity echoed the complexity of the cases transferred, with the majority of patients scored to be moderate to severe in nature (5-12) (Table 2). The highest proportion of critical patients were those with a cardiovascular primary pathology [n=19 (21.35)], followed by respiratory pathologies [n=17 (19.10)] and septic patients [n=14 (15.73)]. From an intervention and patient management perspective, just over half of the patients analysed had a self-maintained airway [n=611 (51.6%)], followed by approximately a third of patients who had an endotracheal tube in situ for the transfer (n=435 [36.74]) (Table 3). Of the ventilated patients, the majority who had an initial Richmond Agitation and Sedation Scale (RASS) recorded on arrival scored <0 [n=282 (49.21%)]. For the non-ventilated patients, the majority were scored a Glasgow Coma Scale (GCS) of >12 [n=435 (79.23%)].

Table 2
Association between primary pathology and risk score

Characteristic	Total		0 to 4		5 to 8		9 to 12		13 to 16		p
	n	(%)	n	(%)	n	(%)	n	(%)	N	(%)	
Total	1184		329	(27.79)	375	(31.67)	391	(33.02)	89	(7.51)	
Burns	47	(3.97)	9	(2.74)	9	(2.4)	20	(5.12)	9	(10.11)	<0.0001
Cardiovascular	219	(18.5)	97	(29.48)	47	(12.53)	56	(14.32)	19	(21.35)	
Chemical exp/Poisoning/Drug overdose	13	(1.1)	4	(1.22)	2	(2.25)	2	(0.53)	5	(1.28)	
Endocrine	28	(2.36)	16	(4.86)	8	(2.13)	3	(0.77)	1	(1.12)	
Gastrointestinal	72	(6.08)	27	(8.21)	25	(6.67)	12	(3.07)	8	(8.99)	
Genitourinary	19	(1.6)	3	(0.91)	6	(1.6)	10	(2.56)	0		
Infectious/Parasitic	14	(1.18)	4	(1.22)	2	(0.53)	7	(1.79)	1	(1.12)	
Neurological	152	(12.84)	26	(7.9)	38	(10.13)	79	(20.2)	9	(10.11)	
Not documented	34	(2.87)	27	(8.21)	1	(0.27)	6	(1.53)	0		
Oncological	74	(6.25)	20	(6.08)	26	(6.93)	22	(5.63)	6	(6.74)	
Other	57	(4.81)	15	(4.56)	24	(6.4)	16	(4.09)	2	(2.25)	
Renal	14	(1.18)	5	(1.52)	4	(1.07)	5	(1.28)	0		
Respiratory/Pulmonary	232	(19.59)	39	(11.85)	101	(26.93)	75	(19.18)	17	(19.10)	
Sepsis/Infection	177	(14.95)	22	(6.69)	73	(19.47)	68	(17.39)	14	(15.73)	
Trauma - Neurological	5	(0.42)	0		3	(0.8)	2	(0.51)	0		
Trauma - Other	22	(1.86)	11	(3.34)	6	(1.6)	4	(1.02)	1	(1.12)	

Table 3
Primary interventions and medications

Characteristic	n	(%)
Total	1184	
Airway type		
ETT	435	(36.74)
Self-maintained	611	(51.6)
Tracheostomy tube	138	(11.66)
Ventilation		
Invasive	573	(48.4)
Non-invasive	62	(5.24)
Nil	549	(46.37)
Initial GCS in non-ventilated		
<8	19	(3.46)
8 to 12	51	(9.29)
>12	435	(79.23)
Not recorded	44	(8.01)
Initial RASS for invasive ventilated		
1 to 4	20	(3.49)
0	112	(19.55)
-1 to -5	282	(49.21)
Not recorded	159	(27.75)
Venous/Arterial access		
Arterial line	309	(26.1)
Central Venous line	388	(32.77)
Peripheral Venous line	893	(75.42)
Number of Venous/Arterial access points		
0	194	(16.39)
1	589	(49.75)
2	202	(17.06)
3	199	(16.81)
Primary hypnotic agent used		
Dexmedetomidine	33	(12)
Etomidate	1	(0.36)
Ketamine	6	(2.18)
Midazolam	141	(51.27)
Propofol	100	(36.36)
Primary analgesic used		

Characteristic	n	(%)
Fentanyl	294	(88.02)
Morphine	4	(1.2)
IV Paracetamol	6	(1.8)
Remifentanyl	30	(8.98)
Primary inotrope used		
Adrenaline	5	(2.23)
Dobutamine	2	(0.89)
Dopamine	33	(14.73)
Noradrenaline	163	(72.77)
Phenylephrine	21	(9.38)
ETT – Endotracheal tube		
GCS – Glasgow Coma Scale		
RASS - Richmond Agitation and Sedation Scale		
IV - Intravenous		

There was considerable variation regarding arterial/venous access among patients transferred, with peripheral access the most common route found, present among 75% of patients transferred. Combinations of access routes were equally varied, with the arterial/central venous/peripheral venous combination the most common reported [n=181 (15.29%)], followed by the central venous/peripheral venous combination [n=93 (7.85%)] (Table 4). Similarly, there was considerable variation regarding the medications administered for transfer and routes of administration/vitals monitoring. Midazolam was the most common hypnotic administered [n=141 (51.27)], as was Fentanyl [n=294 (88.02)] amongst the analgesic medications administered, and Noradrenaline amongst the inotropes used [n=163 (72.77)] (Table 3). The most common combination amongst the three medication types was a hypnotic/analgesic combination [n=139 (11.74%)], followed by hypnotic/analgesic/inotrope combination [n=110 (9.29%)] (Table 4).

Table 4
Association between key case characteristics and airway status

Characteristic	Total		Self-maintained		Self-maintained - NIV		Trach tube		Endotracheal tube		P value
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
Total	1184		549		62		138		435		
Crew Type											
Ambulance Paramedic	1147	(96.88)	524	(95.45)	61	(98.39)	137	(99.28)	425	(97.7)	0.051
Critical Care Paramedic	1166	(98.48)	531	(96.72)	62	(100)	138	(100)	435	(100)	<0.0001
Doctor	264	(22.3)	65	(11.84)	5	(8.06)	32	(23.19)	162	(37.24)	<0.0001
Nurse/Respiratory Therapist	18	(1.52)	1	(0.18)	0		2	(1.52)	15	(3.45)	<0.0001
Risk Score											
0 to 4	329	(27.79)	308	(56.1)	14	(22.58)	0		7	(1.61)	<0.0001
5 to 8	375	(31.67)	225	(40.98)	41	(66.13)	63	(45.65)	46	(10.57)	
9 to 12	391	(33.02)	16	(2.91)	7	(11.29)	72	(52.17)	296	(68.05)	
13 to 16	89	(7.52)	0		0		3	(2.17)	86	(19.77)	
Access type											
No access	194	(16.39)	71	(12.93)	17	(27.42)	66	(47.83)	40	(9.20)	<0.0001
Single access point (any)	622	(52.53)	364	(66.30)	36	(58.06)	57	(41.30)	165	(37.93)	
Arterial + Central Venous	93	(7.85)	44	(8.01)	3	(4.84)	7	(5.07)	39	(8.97)	
Arterial + Peripheral Venous	57	(4.81)	25	(4.55)	2	(3.23)	2	(1.45)	28	(6.44)	
Central Venous + Peripheral Venous	37	(3.12)	9	(1.64)	1	(1.61)	2	(1.45)	25	(5.75)	
Arterial + Central Venous + Peripheral Venous	181	(15.29)	36	(6.56)	3	(4.84)	4	(2.90)	138	(31.72)	
Medication combinations											
No Hypnotic/Analgesic/Inotrope	740	(62.50)	468	(85.25)	52	(83.87)	125	(90.58)	95	(21.84)	<0.0001
Single Hypnotic/Analgesic/Inotrope (any)	162	(13.68)	79	(14.39)	5	(8.06)	8	(5.80)	70	(16.09)	
Analgesic + Inotrope	27	(2.28)	2	(0.39)	0		2	(1.45)	23	(5.29)	
Hypnotic + Analgesic	6	(0.51)	0		0		1	(0.72)	5	(1.15)	
Hypnotic + Inotrope	139	(11.74)	0		4	(6.45)	0		135	(31.03)	
Hypnotic + Analgesic + Inotrope	110	(9.29)	0		1	(1.61)	2	(1.45)	107	(24.60)	

Table 5
Crude and adjusted prevalence ratios for intubation status and arteriovenous access; and medication combination

	N (%)	ETT/Trach Crude PR; 95% CI (p-value)	ETT/Trach Adjusted PR; 95% CI (p-value)*
Access type			
No access	194 (16.39)	1	1
Single access point (any)	622 (52.53)	0.65; 0.55 – 0.77 (< 0.0001)	0.65; 0.54 – 0.79 (< 0.0001)
Arterial + Central Venous	93 (7.85)	0.91; 0.71 – 1.15 (0.421)	1.02; 0.79 – 1.31 (0.897)
Arterial + Peripheral Venous	57 (4.81)	0.96; 0.73 – 1.27 (0.792)	1.08; 0.80 – 1.47 (0.697)
Central Venous + Peripheral Venous	37 (3.12)	1.34; 1.01 – 1.69 (0.016)	1.44; 1.14 – 1.83 (0.003)
Arterial + Central Venous + Peripheral Venous	181 (15.29)	1.44; 1.24 – 1.67 (< 0.0001)	1.62; 1.36 – 1.93 (< 0.0001)
Medication combinations			
No Hypnotic/Analgesic/Inotrope	740 (62.50)	1	1
Single Hypnotic/Analgesic/Inotrope	162 (13.68)	1.62; 1.33 – 1.97 (< 0.0001)	1.71; 1.37 – 2.13 (< 0.0001)
Analgesic + Inotrope	27 (2.28)	3.11; 2.67 – 3.63 (< 0.0001)	3.54; 2.94 – 4.27 (< 0.0001)
Hypnotic + Analgesic	6 (0.51)	3.36; 3.01 – 3.76 (< 0.0001)	3.43; 2.43 – 4.83 (< 0.0001)
Hypnotic + Inotrope	139 (11.74)	3.27; 2.91 – 3.66 (< 0.0001)	3.83; 3.32 – 4.41 (< 0.0001)
Hypnotic + Analgesic + Inotrope	110 (9.29)	3.33; 2.98 – 3.73 (< 0.0001)	3.74; 3.26 – 4.29 (< 0.0001)
*Adjusted by age and gender			

Airway/Ventilation status was found to be a relatively good proxy indicator of both severity and activity. Endotracheally intubated patients had the highest proportion of severe and critical patients; patients transported with a Doctor; patients with multiple routes of arterial and/or venous access; and patients receiving any hypnotic, analgesic or inotrope, or a combination thereof (Table 4). After adjusting for age and gender, the most prevalent access types and medication combinations among intubated patients was the arterial/central venous/peripheral venous access combination [PR 1.62; 1.36–1.93 (<0.0001)] and the hypnotic/Inotrope combination [PR 3.83; 3.32–4.41 (<0.0001)], followed closely by hypnotic/analgesic/inotrope combination [PR 3.74; 3.26–4.29 (<0.0001)].

Discussion

This study represents the first published data examining the activity of a dedicated multidisciplinary transfer and retrieval service, both in Qatar and the broader Middle East. Despite the relatively small size of the country, the frequency in which the service was utilised, and the nature and severity of the patients transferred by the unit has highlighted the potential niche of such a program in healthcare in Qatar.

Many of the patient and case demographics observed in this study align with that reported in the literature. Patients were generally found to be male, middle-aged and with a cardio-respiratory focus as the primary reason for their admission^{6,8–10}. Similarly, there was a relatively high proportion of “out-of-hours” activity, as reported in the literature^{8,10}, demonstrating the importance of a 24-hour service in this setting. While patient preparation and handover times were similar to those reported in the literature, actual transport times were shorter, likely a consequence of Qatar’s size and the location of its healthcare facilities^{6,8–10}. The transfer team composition observed in this study was more heavily weighted towards EMS staffing, which differs somewhat from conventional transfer team composition reported in the literature, where critical care transfer teams are primarily staffed by nurses and physicians^{7,8,14,14}.

Few studies have reported comprehensively on the interventions performed before and/or during transfer. Variation in airway type and ventilation modalities, types and combinations of hypnotic, analgesic and inotropes used, and the multitude of arteriovenous access points observed in this study directly contributed towards the complexity of moving these patients from one facility to another. The

occurrence of these transfer characteristics similarly highlighted the importance of the patient preparation phase prior to transfer, the time interval that contributed the most towards total mission time in this study. The development and implementation of transfer guidelines to limit variation and standardise practice are central towards maintaining quality the patient preparation phase's quality and safety and these services in general.

Conclusion

The transfer and retrieval of critical care patients across Qatar is a relatively common occurrence. Variations in patient type and severity and the expectations of the transfer team, are significant. Understanding the clinical needs of a patient is an essential step towards ensuring the safe and effective transfer of patients with complex needs across a challenging environment.

Declarations

- Funding: No funding was sought or awarded for this study
- Conflicts of interest/Competing interests: Nil
- Availability of data and material: Data can be made available upon reasonable request to the corresponding author
- Code availability: N/A
- Ethics approval: Ethical approval to conduct the study was granted by the Medical Research Centre of the Hamad Medical Corporation, Qatar (MRC-01-19-154). All study procedures and processes were conducted in accordance with that described in the ethics application and the guidelines and regulations outlined by the local medical research council.
- Consent to participate: Requirement for consent to participate was waived by the approving ethics committee based on the nature and content of the study.
- Consent for publication: Consent for publication was sought and approved as part of the ethics approval
- Author contributions: IH, WHA, IFH and LA conceptualised the study aim and objectives; IH, RS, SG and WT collected and analysed the data; all authors contributed equally towards the final draft of the manuscript

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Figures

Figure 1

highlights the locations of the tertiary health facilities across Qatar

Measurement Characteristic	Score
1. Haemodynamics	
Stable	0
Moderately stable (requires volume <15 ml/min in adults)	1
Unstable (requires volume >15 ml/min or inotropics or blood)	2
2. Arrhythmias (existing or probable)	
No	0
Yes, not serious (and AMI after 48 hours)	1
Serious (and AMI in the first 48 hours)	2
3. ECG monitoring	
No	0
Yes (desirable)	1
Yes (essential)	2
4. Intravenous line	
No	0
Yes	1
Pulmonary artery catheter	2
5. Provisional pacemaker	
No	0
Yes (not invasive). Always AMI in the first 48 hours	1
Yes (endocavity)	2
6. Respiration	
Respiratory rate between 10 and 14 breaths/min in adults	0
Respiratory rate between 15-35 breaths/min in adults	1
Apnoea <10 or >36 or irregular breathing	2
7. Airway	
No	0
Yes (Guedel tube)	1
Yes (intubation or tracheostomy)	2
8. Respiratory support	
No	0
Yes (oxygen therapy)	1
Yes (mechanical ventilation)	2
9. Assessment	
GCS =15	0
GCS 8-14	1
GCS <8 and/or neurological disorder	2
10. Prematurity	
Newborn >2000 g	0
Newborn between 1200 and 2000 g	1
Newborn <1200 g 2	2
11. Technopharmacological support (actual or en route)	
None 0	0
Group I	1
Inotropics	
Vasodilators	
Antiarrhythmics	
Bicarbonate	
Analgesics	
Antiepileptics	
Steroids	
Manitol 20%	
Trombolytics	
Moloxone	
Thoracic tube	
Suction	
Group II	2
Inotropics + vasodilators	
MAST	
Infant incubator	
General anaesthetics	
Uterine relaxants	

Figure 2

Patient clinical data were collected starting from arrival at patient side by the transporting crew, throughout transport, until patient handover. All monitoring data was captured automatically and auto-populated into the unit's electronic health record following handover. All interventions and medications captured represent those continued or initiated primarily for the patient transfer.