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ORIGINAL RESEARCH

Emergency Medical Services

Assessing variations in care delivered to rural out of hospital cardiac arrest patients in the interfacility transfer setting

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Abstract

Objective: There is significant variation in out-of-hospital cardiac arrest (OHCA) outcomes between different regions. We sought to evaluate outcomes of OHCA patients in the interfacility transfer (IFT) setting, between critical care transport (LifeFlight) and community Emergency Medical Services (EMS), in the state of Maine.

Methods: This was a retrospective analysis of our institution's electronic medical record and the Maine EMS database. Data were collected from January 1, 2019, to December 31, 2021. Only adult OHCA encounters requiring an IFT for definitive post-cardiac-arrest care were included. Demographics, EMS agency, IFT vital signs, targeted temperature management (TTM) medications, cerebral performance category (CPC) scores, survival to discharge, and other descriptive variables were collected.

Results: Ninety-three patients met inclusion criteria, with LifeFlight transferring 30 of them (32.3%). LifeFlight was more likely to initiate TTM compared to other EMS agencies ($p = 0.012$), have run-sheets reported ($p = 0.001$), and serve rural areas ($p = 0.036$). LifeFlight was associated with more epinephrine (0.034) and norepinephrine (<0.001) use. Only 37% of IFTs had physician orders, with none (0.0%) of them defining vital sign targets. No difference in survival to discharge or CPC scores was observed between LifeFlight and other EMS agencies. No significant variation in comorbidities or vital signs was observed.

Conclusions: There was no difference in survival to discharge or CPC scores between LifeFlight and ad hoc EMS agency. LifeFlight was associated with more TTM and vasopressor utilization during IFT. Most IFT encounters did not have dedicated physician orders, and none of the orders included vital sign targets.

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1 | INTRODUCTION

1.1 | Background

Out-of-hospital cardiac arrest (OHCA) occurs in over 356,000 Americans annually and remains one of the top causes of death nationwide as survival rates remain low.[1,2] Current American Heart Association (AHA) guidelines emphasize a "chain-of-survival" approach that seeks to optimize each step of care from the pre-hospital setting to post return-of-spontaneous-circulations (ROSC) care.[3] A strong focus of the AHA has been on quality cardiopulmonary resuscitation (CPR) and bystander-initiated CPR through educational models or dispatcher instructions.[4–6] While the chain-of-survival addresses important aspects of OHCA care, in rural patient populations the pathway to definitive post-ROSC care can be challenging. Rural populations experience long transport times and delays to transport, which is often necessary for definitive post-ROSC care.[7,8] Maine is a very rural state; with many smaller hospitals having limited resources, ultimately requiring interfacility transfer (IFT) of patients to a tertiary care center for definitive post-ROSC care. During the IFT, care is generally guided by a physician order from the sending physician, as there are no specific IFT guidelines illustrated in the Maine EMS protocol for post-ROSC care.

In the immediate post-arrest setting, definitive care includes consensus-driven management of hemodynamic parameters, ventilation, oxygenation, and treatment of seizures to mitigate progression of neurologic injury post-arrest.[9,10] Targeted temperature management (TTM) can potentially reduce progression of neurologic injury in the post-arrest setting.[11] The 2023 AHA guidelines recommend a deliberate TTM strategy to a temperature range of 32°C–37.5°C for patients that are unable to follow commands post-ROSC.[12] Earlier TTM initiation following OHCA may improve neurologic outcomes,[13–15] and titration of other vital sign targets (blood pressure, pCO2, pO2, glucose, etc) may also be associated with improved neurologic outcomes.[16,17] For this reason, it is paramount that the management of these clinical parameters are closely monitored post-ROSC; for more rural populations, this means some portion of that management should occur during an IFT.

1.2 | Importance

There is substantial variation in outcomes for OHCA between different regions and between different emergency medical service (EMS) departments.[18,19] The variability in the practice of IFT after cardiac arrest is largely unreported, representing an opportunity for improvement in the care and outcome of these patients. There are several challenges in patient care that are unique to the rural environment. For OHCA patients, rural populations have lower rates of bystander CPR and defibrillator use in the community.[7,20–23] Rural populations also experience longer transport times,[7,8] longer response times,[24–26] and a greater proportion of EMS volunteers rather than paid, full-time employees among EMS staff.[27] Additionally, rural populations are at higher risk for cardiovascular disease,[28,29] emphasizing the importance of streamlined, evidence-based protocols for IFT care in the rural setting where resources are likely to be limited.

THE BOTTOM LINE

Out of hospital cardiac arrest (OHCA) is a top cause of death nationwide. When patients require interfacility transfer (IFT) for definitive care, post arrest management occurs during transfer. Little is known on how IFT of OHCA patient management differs amongst various emergency medical services (EMS). This retrospective analysis sought to evaluate differences in patient outcomes and management between ad hoc community EMS IFT and our region's critical care transport team, LifeFlight of Maine. We found that there was no difference in survival to discharge or neurologic outcomes; however, LifeFlight was associated with more targeted temperature management utilization and resuscitative medications.

1.3 | Goals of this investigation

The goal of this investigation was to describe IFT care and identify discrepancies that could be improved to increase adherence to recommendations for post-OHCA care, including early TTM initiation and management of vital sign targets. The primary outcomes were to compare the post-OHCA management, mortality, and neurologic outcomes between EMS agencies within the southern Maine region that transport patients to Maine Medical Center Portland campus or Maine Medical Center Biddeford campus. We hypothesized that there would be variation between EMS agencies regarding patient outcomes, TTM initiation rates, and other treatment patterns.

2 | METHODS

2.1 | Study design

This retrospective study collected data for patients transported from January 1, 2019 to December 31, 2021 from MaineHealth's electronic medical record (EMR) via a query of Epic (Epic Systems Corp.) and the state of Maine EMS and Fire Incident Reporting System (MEFIRS) database. These two datasets were combined by matching identical patient encounters. In cases of duplicate records, data were retrieved from only the first encounter, and no encounters were counted twice. Study data were managed using REDCap electronic data capture tools hosted at Maine Medical Center.[30,31] This study was approved by the MaineHealth Institutional Review Board (IRB# 1868013-2).

2.2 | Study population criteria

Inclusion criteria were defined as all OHCA encounters that achieved ROSC and required an IFT to either Maine Medical Center in Portland, ME or Maine Medical Center in Biddeford, ME, within 24 h of the initial OHCA encounter (primary diagnosis of ICD10 code I46.*) and age 18–89 years. Patients were excluded if they suffered a traumatic cardiac arrest, were pronounced dead in the field, or died prior to transfer. Traumatic arrest was defined as blunt or penetrating trauma in the field resulting in a cardiac arrest. Death in the field was defined as an OHCA patient that did not achieve ROSC in the prehospital setting and was not transferred to an initial ED. Age, sex, EMS agency, vital signs, comorbidities, cerebral performance category (CPC) scores, survival to discharge, initial rhythm, initial temperature at receiving facility, medication, TTM initiation prior to IFT, physician orders, vital sign targets, run sheets scanned in, and other descriptive variables were collected.

2.3 | Measures

Three measures of quality and supervision were evaluated: whether run sheets were scanned into the "media" tab of our institutions EMR, whether a physician order form was present in the EMR or in the Maine EMS database, and whether vital sign targets were present on the run sheet during the IFT. Vital signs were identified on the run sheet or the first recorded vital signs at the receiving facility. Medications were identified by EMS documentation on the run sheet and initial medications ordered on the EMR from the receiving facility. Initiation of TTM was defined by TTM onset being documented, and identified by reviewing the EMS run sheet of the IFT, the EMR of the receiving facility, and the notes scanned from sending facility. Patients eligible for TTM were defined as patients that achieved ROSC without immediately following commands post-ROSC and recommendations by the intensivist under our institutions protocol to initiate TTM via documentation review. Our institution targets an initial temperature goal of 33°C using ice packs, in the groin and axilla, Blanketrol cooling blanket (Gentherm Medical), or Artic Sun medical device (Medivance, Inc.). Patients receiving TTM at receiving intensive care units (ICU) were treated at a temperature of 32°C–36°C.[9] Good neurologic outcome was defined as a CPC score of 1 or 2. Encounter location for OHCA was determined by the initial 911 response EMS agency Zone Improvement Plan (ZIP) code. Ruralness of encounter was defined by rural–urban commuting areas (RUCAs) codes (codes 1–3 = metropolitan areas, 4–6 = micropolitan areas, 7–9 = small town, 10 = rural areas). These codes are classified by the United States census tracts using measures of population density, urbanization, and daily commuting.

2.4 | EMS agencies

More than 276 licensed EMS agencies serve the state of Maine, including 173 fire departments, 21 non-profit services, 35 independent municipal services, 11 private services, 11 hospital-based teams, three college-based services, and two tribal teams. These services range from basic to paramedic-level providers. LifeFlight of Maine (the only air ambulance service in the state) is the only agency providing critical care transport between hospitals without a nurse required to accompany. The system is designed for LifeFlight to be activated for all critically ill patients (including post-ROSC), longer distances, or situations with a high likelihood of decompensation during IFT. However, if LifeFlight is not available, other available agencies will provide the IFT of these patients with the referring hospital sending a nurse or clinician with the transfer.

2.5 | Outcomes

The primary outcomes of this study were to compare variation in post-OHCA medication utilization, survival to discharge, and CPC scores between LifeFlight of Maine and other EMS agencies performing an IFT. Secondary outcomes included vital signs, the presence of physician orders, targets for vital signs within these orders, and whether TTM was utilized during IFT.

2.6 | Data analysis

Statistical tests including Fisher's exact test, Welch two-sample *t*-test, and Spearman rank correlation as indicated were performed using R Statistical Software (v4.1.2; R Core Team 2021), an open-source statistical programming language.[32] Data are presented as median (interquartile range) and categorical or nominal data as number (%). Two-sided p-values < 0.05 were considered statistically significant.

3 | RESULTS

Out of 122 patient encounters linked from the Maine EMS database to the MaineHealth database, 93 (76.2%) met inclusion criteria (Figure 1). The majority of patients were transported by an ad hoc community EMS agency (67.7%), which was composed of 20 different EMS agencies. The encounters ranged from rural to urban (metropolitan), with only 14% of IFTs coming from a metropolitan location. These encounters included 64 male patients (69%), 35 patients with a shockable rhythm (38%), and 23 patients with unwitnessed arrests (25%) (Table 1). The majority of patients (81%) did not have an automated external defibrillator (AED) placed prior to EMS arrival, and most patients (63%) experienced OHCA within a primary residence. Only 34 encounters (37%) had physician order sets scanned into the EMR, and 55 (59%) had EMS run-sheets scanned into the medical record.

Comparing LifeFlight with ad hoc community EMS IFT (Table 1) revealed similar rates of initial shockable rhythm, comorbidities, witnessed arrests, AED prior to EMS arrival, location of the arrest, survival to discharge, and CPC scores at discharge and at 6 months. LifeFlight accounted for the highest fraction of rural patients ($p = 0.036$) and a

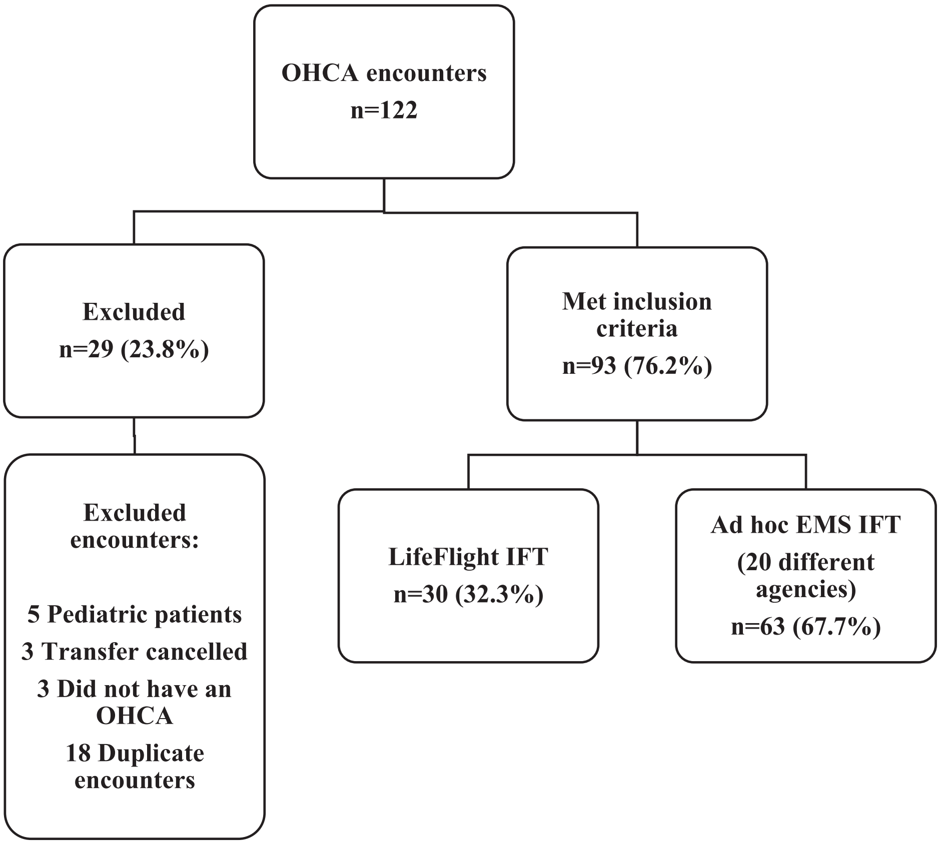

FIGURE 1 Flow diagram of out-of-hospital cardiac arrest (OHCA) patients requiring interfacility transfer (IFT).

significantly higher rate of medication administration during IFT, including norepinephrine, epinephrine, propofol, fentanyl, midazolam, and other medications. Similar trends were noted when comparing initial medications ordered at the receiving facility. LifeFlight was also more likely to have EMS run-sheets scanned into the medical record, but the rate of physician orders recorded was similarly low in both groups (37%), including no orders in either group defining vital sign targets to attain (0.0%).

Among 76 patients eligible for TTM, 16 patients received TTM in the IFT setting (21.1%) (Table 2). There was no significant difference between patients receiving TTM or not regarding the underlying etiology of arrest, witnessed arrest, patient sex, location of the arrest, or geographic rurality designation of the initial EMS agency. In the TTM-eligible cohort, 41% (9/22) of patients transferred by LifeFlight had TTM initiation compared to 13% (7/54) patients transported by other agencies ($p = 0.012$).

The vital signs recorded during IFT were similar for the full 93 patient cohort when comparing those transported by LifeFlight versus other EMS agencies, and for those 76 patients eligible for TTM who received TTM versus not (Table 3).

3.1 | Limitations

Several limitations to this study warrant mentioning. This study relied on retrospective data from the MaineHealth EMR, state EMS documentation, and EMS documentation by each respective agency performing IFT for OHCA. There was a level of missingness when it came to some variables, which we reported in our results and accounted for in our analysis. Fortunately, there was a very limited amount of missing data in general, and little to no missing data when it came to analysis that had statistical significance. Our conclusions are limited by the potential for bias and errors in documentation at each level of data entry. Additionally, since the setting was a single, predominantly rural health system, the results may or may not be generalizable to other rural regions or more urban locations. Finally, although the sample size of 93 patients appears small, we captured all transfers in the 3-year period and excluded pediatric patients, those with no cardiac arrest, or cancelled transfers. This cohort size is reflective of the small population of Maine rather than a failure to capture encounters during the period investigated. Nonetheless, this sample size limits the power of this study and the ability to identify differences between cohorts where they may exist. This is a challenging population to study, specifically as it pertains to rural populations, since rural populations will inherently have a smaller number of encounters than their more densely populated counterparts.

4 | DISCUSSION

In this observational study, we sought to describe care delivered to predominately rural post-ROSC patients during IFT after cardiac arrest

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TABLE 1 Comparison of LifeFlight and other interfacility transfer (IFT) agencies.

	All patients		LifeFlight		Ad hoc EMS		
	N	%	N	%	N	%	*p*-value
Total transports	93	100	30	100	63	100	
Age (median, IQ range)	59 (50–66)		59 (52–72)		59 (49–66)		0.4
Sex							0.6
Female	28	30	7	23	21	33	
Male	64	69	23	77	41	65	
Not recorded	1	1	0	0	1	2	
Shockable rhythm							0.9
Yes	35	38	11	37	24	38	
No	58	62	19	63	39	62	
Etiology							0.084
Cardiac	55	59	18	60	37	59	
Drug overdose	16	17	4	13	4	6	
Respiratory	8	9	7	23	9	14	
Others	14	15	1	3	13	21	
Witnessed							0.7
Health prof.	28	30	8	27	20	32	
Lay person	42	45	13	43	29	46	
Not witnessed	23	25	9	30	14	22	
Where occurred							0.9
Residence	59	63	18	60	41	65	
Recreation area	5	5	2	7	3	5	
Healthcare	4	4	1	3	3	5	
Other	25	27	9	30	16	25	
AED prior to arrival							0.8
Yes, with defibrillation	9	10	3	10	6	10	
Yes, without defibrillation	9	10	4	13	5	8	
No	75	81	23	77	52	83	
Hospital LOS							0.2
0–3 days	39	42	13	43	26	41	
4–14 days	40	43	10	33	30	48	
15+ days	13	14	7	23	6	10	
Unknown	1	1	0	0	1	2	
Ruralness of initial agency (designated via RUCAs codes)							0.036
Rural	16	17	9	30	7	11	
Small town	11	12	6	20	5	8	
Micropolitan	53	57	12	40	41	65	
Metropolitan	13	14	3	10	10	16	
Mortality							
Survival to discharge	41	44	13	43	28	44	0.9
CPC at discharge							>0.9
CPC score 1–2	11	12	4	13	7	11	
CPC score 3–5	40	43	16	53	24	40	
N/A	42	45	10	33	32	48	

(Continues)

TABLE 1 (Continued)

	All patients		LifeFlight		Ad hoc EMS		
	N	%	N	%	N	%	*p*-value
CPC at 6 months							>0.9
CPC score 1–2	10	11	4	13	6	10	
CPC score 3–5	41	44	16	53	25	41	
N/A	42	45	10	33	32	48	
Quality measures							
Run sheet scanned in	55	59	26	87	29	46	*0.001*
Physician order present	34	37	11	37	23	37	0.9
Vital sign targets present	0	0	0		0	0	
Comorbidities							
Total comorbidities	50		15	50	35	56	0.6
Obesity	11		3	10	8	13	>0.9
Diabetes	19		6	20	11	17	0.8
Cardiac disease	26		10	33	16	25	0.4
Kidney disease	21		6	20	15	24	0.7
IFT medications							
Norepinephrine	19		15	50	4	6.3	*<0.001*
Epinephrine	7		5	17	2	3.2	*0.034*
Propofol	20		14	47	6	9.5	*<0.001*
Fentanyl	32		20	67	12	19	*<0.001*
Midazolam	17		11	37	6	9.5	*0.002*
Albuterol	4		3	10	1	1.6	0.10
Amiodarone	8		4	13	4	6.3	0.3
Other medications	28		21	70	7	11	*<0.001*
Initial receiving facility meds							
Dobutamine	10		3	10	7	11	>0.9
Vasopressin	7		3	10	4	6.3	0.8
Phenylephrine	14		5	17	9	14	0.8
Dopamine	3		0	0	3	4.8	0.7
Norepinephrine	57		25	83	32	51	*0.007*
Epinephrine	60		26	87	34	54	*0.003*
Propofol	59		19	63	40	63	>0.9
Fentanyl	78		27	90	51	81	0.7
Midazolam	56		17	57	39	62	0.8
Insulin	43		16	53	27	43	0.7
Magnesium	50		18	60	32	51	0.7

Abbreviations: CPC, cerebral performance category; EMS, Emergency Medical Services; IQ, interquartile; RUCA, rural–urban commuting areas.

and to identify discrepancies of care between EMS agencies in the state of Maine. Although TTM during IFT was uncommon in our cohort (21% of eligible patients), patients transported by LifeFlight of Maine were more likely to receive TTM compared to ad hoc community EMS agencies. LifeFlight transport was also associated with higher rates of resuscitative medications, during the IFT, and when the patient arrived at the receiving institution. The majority of IFT encounters did not have dedicated physician orders (37%) entered into the EMR, and none had specific vital sign targets identified. Few studies have described the challenges and lack of standardization during IFT after cardiac arrest,[33–35] and we are not aware of any reporting data from a predominately rural patient population or describing care variation during transport.

It is difficult to explain why such a low rate of TTM implementation was observed. While it was not documented, the sending facilities may have not had the resources to initiate TTM prior to transfer, the

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TABLE 2 A comparison between targeted temperature management (TTM) received and not received.

	TTM received		TTM not received		*p*-value
Total	16		60		
Age (median, IQ range)	58 (53–66)		60 (50–57)		0.9
Sex					0.065
Female	2	12%	22	37%	
Male	14	88%	38	63%	
Not recorded					
Shockable rhythm					0.4
Yes	7	44%	20	33%	
No	9	56%	40	67%	
Etiology					0.11
Cardiac	10	63%	32	53%	
Drug overdose	2	12%	5	8%	
Respiratory	0	0%	14	23%	
Others	4	25%	9	15%	
Witnessed					0.4
Health prof.	2	13%	18	30%	
Lay person	9	56%	25	42%	
Not witnessed	5	31%	17	28%	
Where occurred					0.9
Residence	11	69%	40	67%	
Recreation area	0	0%	2	3%	
Healthcare	0	0%	3	5%	
Other	5	31%	15	25%	
AED prior to arrival					0.5
Yes, with defibrillation	3	19%	4	7%	
Yes, without defibrillation	2	13%	7	12%	
No	11	69%	49	82%	
IFT agency of transport					*0.012*
LifeFlight	9	56%	13	22%	
Others	7	44%	47	78%	
Hospital LOS					0.6
0–3 days	5	31%	27	45%	
4–14 days	8	50%	25	42%	
15+ days	3	19%	8	13%	
Unrecorded	0	0%	0	0%	
Ruralness of initial agency					0.6
Rural	4	25%	9	15%	
Small town	3	19%	5	8%	
Micropolitan	7	44%	36	60%	
Metropolitan	2	13%	10	17%	
Mortality					
Survival to discharge	7	44%	23	38%	0.7

(Continues)

TABLE 2 (Continued)

	TTM received		TTM not received		*p*-value
CPC at discharge					0.9
CPC score 1–2	2	12%	9	15%	
CPC score 3–5	11	69%	26	43%	
N/A	3	19%	25	42%	
CPC at 6 months					0.5
CPC score 1–2	4	25%	6	10%	
CPC score 3–5	9	56%	29	48%	
N/A	3	19%	25	42%	
Quality measures					
Run sheet scanned in	12	75%	34	57%	0.2
Physician order present	6	38%	24	40%	0.9
Vital sign targets present	0	0%	0	0%	

Abbreviations: N/A, not applicable; CPC, cerebral performance category; LOS, length of state; IFT, interfacility transfer; IQ, interquartile.

TABLE 3 A comparison of hemodynamics.

	TTM received	TTM not received	*p*-value	LifeFlight	Ad hoc EMS	*p*-value
Total	16	60		30	63	
Hemodynamics (min, max)						
Temperature (C°)	36.7 (35.8, 37.0)	36.5 (35.8, 36.8)	0.5	36.4 (35.4, 36.9)	36.5 (36.0, 36.8)	0.5
Unknown	5	16		9	17	
Pulse (beats/min)	81 (72, 89)	92 (75,101)	0.11	90 (77, 110)	88 (72, 99)	0.4
Unknown	0	0		0	1	
Respiratory rate (resp/min)	19 (16, 24)	20 (17, 23)	0.6	20 (18, 26)	20 (16, 23)	0.2
Unknown	0	0		0	1	
Systolic blood pressure (mmHg)	120 (97, 144)	120 (94, 145)	0.9	121 (96, 150)	122 (96, 142)	0.9
Unknown	0	1		0	1	
Diastolic blood pressure (mmHg)	82 (67, 95)	76 (59, 93)	0.4	78 (63, 97)	80 (61, 91)	0.7
Unknown	0	1		1	1	
Mean arterial pressure	94 (79, 111)	91 (72, 108)	0.7	94 (79, 111)	91 (72, 108)	0.8
MAP (% of group)			0.7			>0.9
Mean MAP	94 (79, 111)	91 (72, 108)		7 (24%)	16 (26%)	
<75	3 (19%)	18 (31%)		6 (21%)	12 (19%)	
75–89	4 (25%)	10 (10%)		5 (17%)	14 (23%)	
90–104	3 (19%)	13 (22%)		11 (38%)	20 (32%)	
105+	6 (38%)	18 (31%)		1 (<1%)	1 (<1%)	
Unknown	0 (0%)	1 (<1%)				

Abbreviations: Mean arterial pressure, MAP; EMS, Emergency Medical Services; TTM, targeted temperature management.

transporting service may have lacked the experience, and the sending physicians and nurses may have been too overburdened. Why the LifeFlight patients more commonly received TTM is similarly not clear, but perhaps greater experience with these patients, more willingness to raise the issue, or better staffing may explain our findings. LifeFlight's protocols do include a section about TTM, which could contribute to the crew being more comfortable bringing up temperature management to the sending facility. However, this protocol does not include specifics on temperature targets, nor does it include specifics on other aspects of post-ROSC, such as blood pressure targets. A more detailed prospective investigation is needed to assess the reproducibility and potential reasons for our findings.

The similarity of temperatures between those receiving TTM and not during IFT and at the time of arrival at the receiving center was surprising. We believe the lack of vital sign targets in the physician orders contributed to this observation. Inadequate or incomplete cooling techniques before and during transport may also have contributed; this information is not easily obtained in a retrospective study. These findings suggest an important opportunity to reassess how and when TTM is delivered in the IFT setting to achieve optimal temperature management.

Our study found no difference in survival to discharge, CPC scores at discharge, or CPC scores at 6 months, between patients transferred by LifeFlight, or ad hoc community EMS agencies. Although more critical care interventions were performed (i.e., vasopressors, TTM, etc.) with LifeFlight transport, outcomes and risk factors were similar between groups. While no statistically significant mortality was detected between those receiving TTM or not, a higher survival for those not treated with TTM was seen, suggesting heterogeneity in risk of death. This study was underpowered to find these differences, and perhaps a larger cohort would be able to detect a signal.

Many community EMS agencies rely on a volunteer workforce to respond to calls throughout the small towns and municipalities within their range of service,[27] and volunteer-driven EMS programs experience unique difficulties with respect to staff attrition, training, and recruitment.[36] Educational outreach initiatives directed at community EMS agencies have been shown to improve care. [37] An outreach initiative meant to highlight the key management strategies in post-OHCA may be of particular benefit to community EMS agencies, which often assume the care of patients immediately following OHCA. Furthermore, given the low rates of physician order forms for the IFT observed in this study, standardizing order forms for OHCA during IFT care may improve use of TTM and outcomes for OHCA patients. These efforts may be less relevant to more populous urban regions with more resources and a robust transfer system, but many regions and states face similar challenges as Maine.

A significant challenge encountered during this study was the paucity of documentation during IFT care of OHCA patients, the low rates of physician order forms, and run-sheets rarely being entered into the EMR. Increasing emphasis on these aspects of IFT may provide improved insight into current workflows and the identification of new clinical targets to improve guideline-driven care. We are currently developing protocols and processes specific to the care of OHCA patients in the IFT setting, including a standard physician order form, and scheduled education of local emergency departments and EMS agencies.

In summary, this study identified significant variability in post-OHCA care during interfacility transportation. Most IFT encounters did not have dedicated physician orders, and none of the orders included vital sign targets. Lower than expected rates of TTM initiation were seen, and significant differences in TTM initiation and IFT management transporting services was observed. While no difference in outcomes was seen, further work to understand and standardize the challenges and care for rural OHCA patients in the IFT setting is warranted.

AUTHOR CONTRIBUTIONS

All listed authors meet the International Committee of Medical Journal Editor's requirements for authorship. All who contributed to this manuscript are listed as authors. No professional writing assistance was used in the writing of this manuscript. Michael J. Burla conceived the study, and with the guidance of Teresa L. May, he was able to obtain funding. Holly A. Stevens coordinated data collection. Jeanne S. Wishengrad provided analysis. Drew R. York and Peter C. Michalakes assisted with writing, as well as all other authors.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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