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Original Research

Use of Helicopter Emergency Medical Services in the Transport of Patients With Known or Suspected Coronavirus Disease 2019



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A B S T R A C T

Objective: Limited information exists regarding the response of helicopter emergency medical services (HEMS) programs to patients with known or suspected coronavirus disease 2019 (COVID-19). The purpose of this study was to determine changes in flight operations during the early stages of the pandemic.

Methods: A survey of the American College of Emergency Physicians Air Medical Section was conducted between May 13, 2020, and August 1, 2020. COVID-19 prevalence was defined as high versus low based on cases $> 2,500$ or $\leq 2,500$.

Results: Of the 48 respondents, the majority (89.6%) reported that their patient guidelines had changed because of COVID-19; 89.6% of programs reported transporting COVID-19–positive patients, whereas 91.5% reported transporting persons under investigation. The majority of respondents reported additional training in COVID-19 airway management (79.2%) and personal protective equipment use (93.6%). Permitted aerosol-generating procedures included bilevel positive airway pressure (40.4%) and high-flow nasal oxygen (66.0%). No difference in guideline changes, positive COVID-19/persons under investigation transport restrictions, or permitted aerosol-generating procedures were noted between high- and low-prevalence settings.

Conclusion: COVID-19 has resulted in changes to HEMS guidelines regardless of local disease prevalence. The pandemic has persisted sufficiently long that data regarding the effectiveness of guideline changes should be analyzed. In the absence of definitive data, national best practices should be developed to guide COVID-19 HEMS transport.

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Coronavirus disease 2019 (COVID-19) is highly contagious and spreads rapidly through human-to-human transmission.^{1–4} As of 16 November 2020, 11,114,151 COVID-19 cases have been reported in the United States, with 246,758 deaths.⁵ Most infections are mild or asymptomatic.^{6–8} However, some patients, particularly the elderly or those with cardiovascular or respiratory comorbidities, may experience severe hypoxia and acute respiratory failure.^{9–11} As part of their care, these patients may require transport to tertiary care facilities with advanced capabilities, including extracorporeal membrane oxygenation.¹²

Before the onset of the COVID-19 pandemic, helicopter emergency medical services (HEMS) were frequently used to transfer critically ill patients to tertiary care centers.^{13–15} COVID-19 has created unprecedented risk on prehospital providers in terms of potential transmission risks to transporting crews. As a respiratory virus, COVID-19 poses a risk to care providers, particularly during high-risk aerosol-generating procedures (AGPs), including endotracheal intubation, nasotracheal suctioning, bilevel positive airway pressure, and high-flow nasal oxygenation.¹⁶ The nature of HEMS transport has raised additional concerns for the transport of known COVID-19 patients or persons under investigation (PUIs) in regard to crew safety and airframe contamination. Transmission during commercial air travel has been already documented.¹⁷ In contrast with commercial jets, HEMS cabin space is limited, as is air recirculation.

Limited information exists regarding the response of HEMS programs to patients with known or suspected COVID-19. Given the level of uncertainty regarding current HEMS practices for the

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treatment and transportation of COVID-19 patients/PUIs, the purpose of the current study was to determine changes in US-based HEMS flight operations during the early stages of the current pandemic.

Methods

Study Design and Setting

An anonymous online survey of the American College of Emergency Physicians Air Medical Section was conducted using the RED-Cap (Center for Clinical and Translational Science Awards, Mayo Clinic, Rochester, MN) survey platform. The survey was administered between May 13, 2020, and August 1, 2020. An initial survey e-mail was sent on May 13, 2020, with 2 reminder e-mails sent before survey conclusion on August 1, 2020. The study was reviewed by the institutional review board and deemed exempt.

Survey

The survey consisted of 23 multiple-choice questions (Table 1). PUI status was defined as suspected but unconfirmed COVID-19 status. Demographic measures were collected, including operating region, provider model, annual transport volume, and reported COVID-19 cases within the service area. The operating region was defined as following using the Association of Air Medical Services criteria:

- 1 Alaska, California, Guam, Hawaii, Nevada, Oregon, and Washington
- 2 Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming
- 3 Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin
- 4 Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas
- 5 Connecticut, Delaware, District of Columbia, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Vermont
- 6 Florida, Georgia, North Carolina, Puerto Rico, South Carolina, Virginia, and West Virginia
- 7 International: Canada; Mexico; the Caribbean; and other countries in North America, Central America, South America, and Europe
- 8 International: Australia, New Zealand, Japan, Asia, and Antarctica

Only responses from regions 1 through 6 were included in the final data analysis. COVID-19 prevalence was defined as high versus low based on cases $> 2,500$ or $\leq 2,500$, respectively.

Data Analysis

Survey responses were summarized as frequency counts and percentages. Comparisons of survey responses between groups were performed using the Fisher exact and Kruskal-Wallis tests. All tests were 2-sided, with P values less than .05 considered significant.

Results

A total of 48 respondents completed the survey (Tables 2 and 3). Forty-seven respondents reported that their organizations (97.9%) had a formal written policy/plan for COVID-19 response, and 43 (89.6%) reported that their organization had changed their patient care guidelines because of COVID-19.

Forty-three (89.6%) of the respondents reported that their HEMS programs transported COVID-19–positive patients (Table 4). For HEMS programs that did not permit the transport of COVID-19 patients, 18.2% reported that they used the aircraft to transport critical care teams to the patient and then returned via ground-based

Table 1

Helicopter Emergency Medical Services in Coronavirus Disease 2019 (COVID-19) Transport Survey Questions

1. Have your patient care guidelines changed due to COVID-19?
Yes
No
2. Does your program have a formal written policy/plan for COVID-19 response?
Yes
No
3. Does your program fly known COVID-19 positive patients?
Yes
No
4. If you fly known positive COVID-19 patients, do you use an isolation pod/containment device?
Yes
No
Not applicable
5. If you fly known positive COVID-19 patients, do you require that the patient be intubated prior to transfer?
Yes
No
Not applicable
6. Do you fly patients meeting COVID-19 screening criteria for Persons Under Investigation (i.e. suspected but unconfirmed COVID-19 status)?
Yes
No
7. Do you require a negative COVID-19 test prior to transport of patients with suspected COVID-19?
Yes
No
8. If you do not transport known or suspected COVID-19 patients via helicopter, do you use your aircraft to transport medical personnel to the patient and then return via ground EMS?
Yes
No
9. In your aircraft, are you able to completely separate the cockpit from the patient care compartment?
Yes
No
I do not know
10. How is the separation achieved?
No separation
Curtain
Modified separation (plastic sheet)
Hard separation (wall)
Isolation pod
Other
11. Do you require that your pilot wear PPE during known or suspected COVID-19 transfers?
Yes
No
Not applicable
12. If you do require your pilot to wear PPE, what PPE do you require? Select all that apply
Cloth mask
Surgical face mask
N95 mask
PAPR
Eye protection (goggles or face shield)
Gown
Gloves
13. Do you permit any of the following moderate-to-high-risk aerosol-generating procedures during known or suspected COVID-19 patient transport? Select all that apply.
Endotracheal intubation/mechanical ventilation with a closed HEPA filter circuit
Endotracheal intubation/mechanical ventilation without a closed HEPA filter circuit
Supraglottic device (eg. iGel, King LT-D) with a closed HEPA filter circuit
Supraglottic device (eg. iGel, King LT-D) without a closed HEPA filter circuit
Non-Invasive Positive Pressure Ventilation (NIPPV, eg BiPAP, CPAP) with a HEPA filter

Table 1 (Continued)

Non-Invasive Positive Pressure Ventilation (NIPPV, eg BiPAP, CPAP) without a HEPA filter	
Nebulizer treatment without breath actuation	
High flow oxygen delivered > 6 LPM	
14. Have you had specific training in airway management in the suspected COVID-19 patient?	
Yes	
No	
15. Do you perform specific interventions to prepare the patient care compartment for known or suspected COVID-19 patients, such as removing unnecessary equipment or placing plastic coverings? Please comment below.	
16. Do you perform additional aircraft cleaning/decontamination procedures after transporting known or suspected COVID-19 patients?	
Yes	
No	
17. Have you changed your guidelines for scene flight responses for trauma patients because of potential for COVID-19 exposure?	
Yes	
No	
18. Have you had specific training in PPE use?	
Yes	
No	
19. Have you had N95 fit-testing?	
Yes	
No	
20. In which region do you primarily operate?	
Region 1: Alaska, California, Guam, Hawaii, Nevada, Oregon, Washington	
Region 2: Arizona, Colorado, Idaho, Montana, New Mexico, Utah, Wyoming	
Region 3: Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin	
Region 4: Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, Texas	
Region 5: Connecticut, Delaware, District of Columbia, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont	
Region 6: Florida, Georgia, North Carolina, Puerto Rico, South Carolina, Virginia, West Virginia	
Region 7: International: Canada, Mexico, the Caribbean, and other countries in North America, Central America, South America, and Europe	
Region 8: International: Australia, New Zealand, Japan, Asia, Antarctica	
21. Approximately how many COVID-19 cases have been reported in your region or service area?	
0-500	
501-1000	
1001-2500	
2501-5000	
5001-10000	
10001 or more	
I don't know	
22. Which best describes your provider model?	
Hospital	
Independent	
Public	
Other	
23. Approximately how many COVID-19 cases have been reported in your region or service area?	
Less than 500	
501-1000	
1001-1500	
1501-2000	
2001-2500	
2501-5000	
5001-7500	
7501-10000	
Greater than 10000	
I don't know	

BiPAP, bilevel positive airway pressure; CPAP, continuous positive airway pressure; EMS, emergency medical services; HEPA, high-efficiency particulate air; LPM, liters per minute; PAPR, powered air-purifying respirator; PPE, personal protective equipment.

Table 2
Respondent Demographics

Respondent Distribution		
	%	N
Provider model		
Hospital	63.8	30
Independent	19.1	9
Public	6.4	3
Other	10.6	5
Number of COVID-19 cases in the region of respondents		
0-500	14.6	7
501-1,000	14.6	7
1,001-2,500	16.7	8
2,501-5,000	6.3	3
5,001-10,000	20.8	10
10,001 or more	20.8	10
Not known	6.3	3
Approximate annual transport volume of the respondent's institute		
Less than 500	12.5	6
501-1,000	10.4	5
1,001-1,500	18.8	9
1,501-2,000	22.9	11
2,001-2,500	6.3	3
2,501-5,000	12.5	6
5,001-7,500	4.2	2
7,501-10,000	2.1	1
Greater than 10,000	8.3	4
Not known	2.1	1

COVID-19, coronavirus disease 2019.

emergency medical services (EMS). Seventeen (35.4%) respondents reported that their airframe permitted complete separation of the cockpit from the patient care compartment. Two respondents (4.2%) reported the use of an isolation pod/containment device when flying known positive COVID-19 patients. Seven (14.6%) respondents required COVID-19–positive patients to be intubated before transfer. Forty-seven (97.9%) respondents permitted the use of moderate- to high-risk AGPs during the transport of known or suspected COVID-19 patients. Thirty-eight (79.2%) respondents reported specific training in airway management in the suspected COVID-19 patient, and 44 (93.6%) reported specific training in personal protective equipment (PPE) use.

When comparing respondents reporting more than 2,500 regional COVID-19 cases with those reporting less than or equal to 2,500 cases, no significant difference was noted in terms of changes to patient care guidelines ($P = 1.0$), transport policies regarding known COVID-19 patients ($P = .649$), required intubation before transport ($P = .118$), the use of moderate- to high-risk AGPs ($P = .940$), and additional airway management training ($P = .478$).

No differences in the transport of COVID-19 patients ($P = .643$), PPE requirements for pilots ($P = 1.0$), airway management ($P = .225$), or AGP ($P = .165$) restrictions were noted based on the ability to separate cockpit from patient care compartments.

Twenty-one respondents (43.8%) reported guideline changes for scene flight responses for trauma patients because of the potential for COVID-19 exposure. No difference was noted between programs with high or low COVID-19 prevalence ($P = .393$).

Discussion

The COVID-19 pandemic has resulted in 54,785,073 cases and 1,322,400 deaths globally.⁵ Individuals suffering from COVID-19 have the potential for severe respiratory decompensation, requiring critical care transport, including air medical transport. Previous studies have suggested that frontline medical care providers caring for these patients may be at significance risk of subsequent infection.^{18,19}

Table 3
Respondents by Association of Air Medical Services (AAMS) Region

AAMS Region	States/Countries Included	No. of Respondents
1	Alaska, California, Guam, Hawaii, Nevada, Oregon, Washington	2
2	Arizona, Colorado, Idaho, Montana, New Mexico, Utah, Wyoming	5
3	Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin	12
4	Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, Texas	5
5	Connecticut, Delaware, District of Columbia, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, 45 New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont	17
6	Florida, Georgia, North Carolina, Puerto Rico, South Carolina, Virginia, West Virginia	6
7	International region including Canada, Mexico, the Caribbean, and other countries in North America, 5 Central America, South America, Africa, and Europe	0
8	International region including Australia, New Zealand, Japan, Asia, and Antarctica	0
	Total	47

Table 4
Coronavirus Disease 2019 (COVID-19) Transportation Guidelines and Crew Protection Modalities

	Number of Affirmative Responses (%)
Transport COVID-19–positive patients	43 (89.6)
Transport critical care teams to the patient	4 (18.2)
Ability to complete separation of the cockpit from the patient care compartment	17 (35.4)
Use of an isolation pod or containment device when flying known positive COVID-19 patients	2 (4.2)
Require COVID-19–positive patients to be intubated before transfer	7 (14.6)
Permit the use of moderate- to high-risk aerosol-generating procedures during transport of known or suspected COVID-19 patients	47 (97.9)
Report specific training in airway management in the suspected COVID-19 patient	38 (79.2)
reported specific training in PPE use	44 (93.6)
Require pilots to use PPE	46 (93.3)
Surgical face mask	7 (15.6)
N95 mask	43 (95.6)
PAPR	0
Eye protection	22 (48.9)
Gown	5 (11.1)
Gloves	8 (17.8)

PAPR, powered air–purifying respirator; PPE, personal protective equipment.

Given the advanced level of care provided by HEMS and the small, poorly ventilated space of the patient care compartment, potential for COVID infection during HEMS transport remains a concern. COVID-19 transmission during commercial air travel has already been reported.¹⁷ Infections during flights can be transmitted not only by aerosols that remain airborne and can be inhaled but also by large droplets that settle on surfaces or by direct contact with secretions, body fluids, or contaminated surfaces.

Several recent articles have highlighted HEMS use in the transport of European COVID-19 patients.^{20,21} However, little is known about changes to US HEMS programs as a consequence of COVID-19. Several articles have commented on changes secondary to COVID, but no formal studies have been performed.^{22–25} Based on responses to the current study, the majority of HEMS providers have instituted COVID-19 patient care protocols. Almost 98% of respondents indicated the presence of a formal written policy/plan. Moreover, almost 90% reported that their program had altered patient care guidelines as a direct consequence of COVID-19.

Despite the potential for COVID-19 transmission, nearly 90% of respondents in the current study reported that their programs transported patients with known COVID-19. Given the concern for droplet spread during AGPs, critical care guidelines during the early period of the pandemic emphasized rapid airway control via endotracheal intubation and ventilation using a high-efficiency particulate air filter.^{26–28} Approximately 15% of respondents stated that endotracheal intubation was required before COVID-19 patient transport. Further research is needed to investigate whether a low threshold for intubation could decrease COVID-19 transmission in HEMS aircraft. A recent systematic review demonstrated that most supplemental modalities increased the risk of COVID-19 transmission.¹⁶ In our study, nearly

80% reported that moderate- to high-risk AGPs remain permitted during the transport of known or suspected COVID-19 patients.

In the current study, 93.6% of respondents reported COVID-19–specific PPE training. Although the nature of the training, and therefore the efficacy, cannot be determined in this study, it demonstrates an awareness of a knowledge gap and need. Almost all respondents (93.3%) reported that HEMS pilots were also using PPE, predominantly N95 masks (95.6%), goggles or a face shield (48.9%), and gloves (17.8%). Preliminary EMS data suggest that the use of PPE is at least partly effective in mitigating the COVID-19 infection risk. In a study of King County medics during the early period of the COVID-19 pandemic, less than 0.5% of EMS providers experienced COVID-19 illness within 14 days of occupational exposure.²⁹

The HEMS response to the COVID-19 pandemic appears to be universal and not simply based on the prevalence of cases. No difference in response was noted based on high- and low-prevalence service areas.

More than half of the respondents (56.3%) reported no specific changes to guidelines for field care and the transportation of trauma patients. Given the potential for the patients to have COVID-19 and either be unable to complete a screen or be asymptomatic, further evaluation of trauma response guidelines should occur, particularly as case numbers increase.

Limitations

This study has several important limitations. This survey was sent to a single US-based emergency medicine physician section. As such, it is not comprehensive of all HEMS programs and is biased to programs with emergency medicine physician involvement. The number of respondents is smaller than the number of current US Commission

on Accreditation of Medical Transport Systems HEMS programs (128, including pediatric- and neonatal-specific HEMS programs), with potential for sampling bias. The study is unable to evaluate for compliance with operational guidelines and is subject to respondent recall bias. The actual roles of the respondents within HEMS cannot be verified because the responses were anonymous. The study evaluated HEMS during the early phases of the pandemic only and arbitrarily defined prevalence in the early period of the pandemic as high or low based on the number of cases > 2,500 or ≤ 2,500, respectively. Given the prolonged duration of the pandemic, policies and protocols may have evolved significantly as experience with COVID-19 patients has grown. Most importantly, there are no definitive data to evaluate the effectiveness of guideline changes in protecting patients and crew. A recent retrospective critical care transport program analysis demonstrated that despite 1,041 PUI transports, guideline changes resulted in no documented staff exposures or illnesses.³⁰ However, only 11 of these involved air medical transport. Further research should be performed to define the most effective way to protect the crew while transporting COVID-19–positive patients or PUIs.

Conclusion

COVID-19 has resulted in changes to HEMS patient care guidelines regardless of local disease prevalence. The pandemic has persisted sufficiently long that data regarding the effectiveness of guideline changes in protecting patients and crew should be identified and analyzed. In the absence of definitive data, national best practices should be developed to guide HEMS transport in the era of COVID-19. Further study is needed to investigate the actual impact of protective measures in use.

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