**Secondary** **Outcomes**

Six studies20, 22, 23, 24, 26, 27 found no significant difference in secondary outcomes between groups treated by physician-led crews versus non physician-led crews. Four studies18, 21, 21, 25 found significant improvements in secondary outcomes for patients treated by physician-led crews, compared to non-physician-led crews.

***Hemodynamic status***

Mabry30 found that patients treated by the advanced care paramedic crew were less likely to be hypotensive on arrival at the trauma centre when compared to patients treated by a basic paramedic crew. However, this finding was not statistically significant (mean systolic blood pressure [standard deviation] was 122 [63.7] vs. 112.7 [32.6] for CCFP vs EMT-B treated groups, p = 0.21). In another study25, a lower percentage of hypotensive patients on arrival at the trauma centre (21% versus 59%) in the physician treated group compared to the paramedic treated group was demonstrated. Furthermore, Hamman19 did not identify significant differences in clinical deterioration (by Revised Trauma Score) during transport between the same types of crews. The same study reported a non-significant difference in missed critical injuries: 18/145 (12%) in the physician led group versus 7/114 (6%) in the non-physician-led group.

***Length of stay and disposition***

Length of stay was addressed in a few studies. Burney20 found that patients treated by the physician-led HEMS group had significantly longer ICU and hospital stays, reflective of physician involvement in the care of patients with complex injuries. Another study26 found no meaningful difference in length of hospital stay between groups treated by a dual flight nurse group (mean LOS 21.97) versus a paramedic + flight nurse group (mean LOS 19.33). Cameron27 found no significant difference between lengths of stay for admitted patients (7.12 days in the physician group vs 7.27 days in the paramedic group).

***Discharge and transfers***

Abbot24 found no significant difference between discharge rates between treatment groups. In the HEMS treated group there was a 10% increase in discharge to rehabilitation facilities (OR 1.85, p<0.01), and a statistically significant 6% decrease in discharges to extended care facilities (OR 0.44, p<0.05). In another study, Wirtz26 reported no significant difference between disposition to home (53.4%, nurse + nurse group vs. 47.1%, nurse + paramedic group) or in disposition to rehab (24.6%, nurse + nurse group vs. 23.8%, nurse + paramedic group). Finally, Cameron27 showed no difference in the proportion of patients transferred or discharged home from ED when a comparison between a physician treated group and a paramedic treated group was assessed.

***Mean response time, scene time, delivery time***

Most studies18, 19, 21, 22, 23, 25, 26, 29 did not find a significant difference in response times, scene times, and transport times when comparing different crews. Baxt18 found no differences. The mean response time, scene time, and delivery time of the flight nurse/flight paramedic crew were 15.5, 18.6, and 16.9 minutes, compared to 14.9, 19.1, and 16.1 minutes for the flight nurse/physician crew. Hamman19 found no statistical differences in on-scene time between physician and non-physician crews. In the study conducted by Schmidt21, the authors reported longer launch time and flight times, and shorter on-scene times in the American flight nurse + flight paramedic group compared to the German physician led HEMS group. Another study22 found no statistical difference in mean scene time between a dual flight nurse treated group (29 minutes and 42 seconds) and a resident physician + flight nurse treated group (30 minutes and 58 seconds). Furthermore, a study by Burney23 found that flight times were nearly uniform between a dual flight nurse treated group and a physician + flight nurse treated group, with two exceptions: the dual flight nurse group initially had a longer response time, while later the physician + flight nurse group had 15% longer on scene times. The other studies25, 26, 28 reported similar non-statistically significant times when comparing different crew compositions.

***Clinical interventions and procedures***

Baxt18 found that important procedures were not performed when indicated and ordered by medical directives (in 18/239 occasions) in survivors transported by a nurse and a paramedic. However, in ambulances with a flight nurse and a physician, this problem occurred only in 2/305 occasions. Furthermore, in patients who died, there were 9/19 occasions where medical protocols were not followed or clinical interventions were unsuccessfully performed in the flight nurse + flight paramedic treated group. On the other hand, there were no unsuccessful interventions or failures to follow protocols in the flight physician + flight nurse treated group. A second study19 found no statistical differences between numbers of procedures performed on scene, in flight, or on arrival to the ED between crews with physicians, and crews without physicians. Physicians, however, were more aggressive in using IV medications compared to non-physician crews. In a study by Schmidt21, German crews with a physician had a more aggressive approach to prehospital care with a higher rate of endotracheal intubation (p<0.001) and needle or tube chest decompression (p<0.001). In this study, patients treated by this crew had a better survival.

Other quality indicators were reported in two studies. Klemenc-Ketis 29 demonstrated that crews with physicians had higher ratios of intubation/resuscitation and intubation/severe GCS when compared with non-physician crews. This quality marker was associated with more experienced and skilled physicians in HEMS crews. Resuscitations occurred in 42/833 operations and of these, 36 patients were intubated (87.8%). Out of 149 patients with GCS <9, 81.9% were intubated. The study found that TBI patients with GCS <9 were significantly more likely to be intubated by the most experienced and advanced physician-led crew (HEMS SL) compared to the three other physician-led HEMS. In a similar vein, the HEMS SL crew gained IV access more frequently and provided more aggressive oxygen therapy. In the second study, Ben Housel22 addressed similar quality indicators. The author found no statistical difference in rate of IV or airway procedures between a dual flight nurse and a resident physician + flight nurse crew. In this study, the addition of an emergency medicine resident physician did not affect adversely quality indicators.

Garner25 reported a significantly higher proportion of blood transfusions (28/67 or 42% of patients, p<0.001), intubations (34/67 or 51% of patients, p<0.001), and chest decompressions 8/67 or 12%, p<0.01) in crew configurations with physicians. The author also identified occasions where physicians performed interventions in adverse situations: an arterial line placed in an entrapped patient; endotracheal intubations prior to patient extrications. They also reported an unrecognized esophageal intubation in the paramedic group and none in the physician group. The study reported that 2/67 patients treated by physicians were in cardiorespiratory arrest on scene. In both cases, the patients achieved return of spontaneous circulation but then succumbed to their injuries en route. In another study29 that interviewed team members, it was felt that a physician’s presence was not clinically beneficial in 77% of missions flown. The same study reported that the most common interventions performed were rapid sequence induction (28/62), administration of analgesia/sedation/blood products (21/62), chest drain or thoracostomy (3/62) and pronouncing death (4/62).