WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

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Clinical question.

In adult cardiac arrest (prehospital) (P), does the performance of ALS procedures by experienced physicians (I) as opposed to standard care (without physicians) (C), improve outcome (O) (eg. ROSC, survival)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention / Therapy

State if this is a proposed new topic or revision of existing worksheet: New Topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No Conflict

Search strategy (including electronic databases searched).

Last search 5-September-2009
Searched PubMed (1950-2009)

#1	Search heart arrest	34840
#2	Search experienced provider	488
#3	Search #1 AND #2	1
#5	Search physician	288836
#6	Search physician heart arrest	851
#7	Search physician heart arrest Limits: Clinical Trial, Randomized Controlled Trial	60
#8	Search physician paramedic Limits: Clinical Trial, Randomized Controlled Trial	113
#9	Search physician paramedic	5063
#10	Search Resuscitation physician	3037
#11	Search Resuscitation physician Limits: Clinical Trial, Randomized Controlled Trial	189

<REVIEWED RESULTS OF #7 AND #11 FOR RELEVANT ARTICLES>

Searched OVID (1950-2008)

#1	physician.mp. or Physicians/	(180694)
#2	Resuscitation/ or resuscitation.mp. or Cardiopulmonary Resuscitation/	(38860)
#3	1 and 2	(1532)
#4	paramedic.mp. or Allied Health Personnel/ (9901)	
#5	4 and 3	(61)

<REVIEWED RESULTS OF #5 FOR RELEVANT ARTICLES>

Searched EMBASE (<1950-2008)

#1	('heart'/exp OR 'heart') AND arrest AND ('physician'/exp OR 'physician') AND ('paramedic' OR 'paramedic') AND [humans]/lim	(32)

<REVIEWED RESULTS OF #1 FOR RELEVANT ARTICLES>

Compared with personal library of authors.

- State inclusion and exclusion criteria

1. Excluded studies of manikins and simulators
2. Excluded studies of traumatic resuscitation
3. Included studies of patients with outcomes
4. Included studies with comparison of physicians and other providers (even historical controls)

Included English and non-English.

- Number of articles/sources meeting criteria for further review: 31 (14 LOE2; 7 LOE3; 7 LOE4; 3 LOE5)

Summary of evidence

Evidence Supporting Clinical Question

Good			**Lafuente-Lafuente 2004, 2751 - D**	**Arntz 2008, 180 – C Bottiger 1999, 674 -C Lossius 2002, 771 - C**	**Timmerman 2006, 179 – E (intubations)**
Fair		**Kirves 2007, 75 – E Mitchell 1997, 225 -A Soo 1999, 47 - C**	**Bottiger 1999, 674 – C Frandsen 1991, 256 - D Spiria 2000, 469 - C**		
Poor		**Dickinson 1997, 132 - C**	**Fischer 2003, 630 - C**	**Bell 2006, 389 – E Bjornsson 2006, 591 - C**	
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

Evidence Neutral to Clinical question

Good		**Olasveengen 2009, 1248 – B,C**			**Nichol 2008, 1423 - C**
Fair		**Estner 2007, 792 – C Frandsen 1991, 256 - D Gottschalk 2002, 15 - C Hampton 1977, 526 – C Schneider 1994, 197 – C,D Schneider 1994, 207 – E; Soo 1999, 535 - C**	**Lewis 1979, 1902 - C**	**Holler 2007, 23 – C Wahlen 2003, 27 – E**	**Suominen 1997, 260 – D (pediatric)**
Poor		**Dickinson 1997, 132 – B Eisenburger 2001, 39 - C Yen 2006, 1001 – C, D**	**Silfvast 1996, 101 - C**		
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

Evidence Opposing Clinical Question

Good					
Fair		**Yen 2006, 1001 – B**			
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Animal studies

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

The principle limitation of the available data is lack of head-to-head comparison of different levels of provider. The conclusion that physician-based care is superior relies largely on comparisons between different systems (Fransden 1991, 256; Hampton 1977, 526). It is unknown how many other factors differ between those systems besides the use of physician rescuers. Differences in outcomes between systems has been well-documented in prospective databases (Nichol 2008, 1423).

The studies that have introduced paramedics into systems to replace physicians have been neutral, or have even noted a trend towards better survival with paramedics. This latter result likely is a result of the fact that investigators were seeking to validate the introduction of paramedics.

The studies that have introduced physicians into systems and noted improvement generally have made the introduction as part of an overall quality-improvement process. Therefore, it remains impossible to account for the independent effect of physician-providers.

The best comparison to date comes from Oslo (Olasveengen 2009, 1248) where a physician-manned ambulance is on-duty for teaching/training in parallel with other paramedic-manned ambulances. In that system, where dispatch is based only on current location of the ambulance, there is little difference in outcome between physician and paramedic responses.

One pseudo-randomized, prospective study assigned 65 patients to physician or paramedic care on alternate days (LOE 2) (Hampton 1977, p 526). This study had lower quality only because not every case was randomized: there was some triage of low-risk patients. This study shows a trend towards superior survival with physician care, but the difference was not significant.

	Physician	No-MD
Admitted to Hospital	47%	17%
Discharged	16%	4.3%

One case-series (LOE4) reported OOHCA patients treated by physicians and receiving thrombolysis (Arntz 2008, p 180). The one-third of STEMI/LBBB patients had higher survival when given thrombolysis in the field. Authors argue that the ability of physicians to select proper patient for thrombolysis makes this therapy effective. This argument is circular, since the selected patients may have had better prognosis prior to treatment.

A comparative study (LOE3, poor) described the structure and resource use of two cities (Fischer 2003, p 630) without formal attempts to adjust for other differences between the patient populations. CPR attempts in the physician-based system (Bonn) resulted in 14.7% survival to hospital discharge versus the paramedic-based system (Birmingham) with 4% survival to hospital discharge. (Data for CPR survival rates were taken from Fischer 1997 Resuscitation 33:233-243; Resuscitation and Herlitz 1999 Resuscitation 41:121-131.)

A small case series of pediatric cardiac arrests (LOE4), reported low survival rates in a physician-response system (Suominen 1997, p260). The authors concluded that the structure of their system was not better than paramedic-based systems reported in the literature.

Several studies compared performance on various procedures between physician and paramedic-based systems. A retrospective series (LOE4) found that physician presence on scene was associated with greater likelihood of compliance with guidelines (Kirves 2007, p75). Subsequently, compliance with guidelines as associated with greater likelihood of discharge from hospital. Physician presence during resuscitation was not related directly to hospital discharge, and the paper is unclear whether physician presence had no relationship or simply was excluded from the multivariable model.

In other series (LOE4), authors note that physicians can provide advance diagnostic skill (Arntz 2008, p180), or perform more advanced procedures, especially airway-related procedures (Lossius 2002, p771). In contrast, another series of patients within a single system were treated by EMT-Ds and others were treated by physicians (LOE3) (Schneider 1994, p 207; Schneider 1994, p 197). Physicians were faster at obtaining ECG diagnosis (36 seconds), but slower to deliver defibrillation (28 seconds). This difference was not thought to be significant. Primarily because of faster response time, paramedics were able to defibrillate a larger proportion of patients within 12 minutes compared to

physicians, restore pulses faster, and reduce epinephrine requirements. This speed advantage of paramedics over physicians has been noted in other series (LOE4) (Wahlen 2003, p 27).

Differences in patient outcome are more difficult to demonstrate. One study in which EMT-D and physicians were dispatched to all calls, compared who arrived on scene first (paramedic or physician) (LOE2) (Schneider 1994, p 197). Overall survival to discharge was 25% (EMT-Ds arrive first) and 24% (Physicians first). A prospective study conducted in Taipei, assigned one region to receive EMT-based care, whereas the remainder maintained physician-based care (Pseudo-randomized, LOE2) (Yen 2006, p 1001). EMT-based cases survived to admission more than physician-treated cases (37.2% vs. 14.8%). There was a trend (p=0.09) for EMT cases to survive to discharge more than physician cases (9.3% vs. 2.6%). However, all survivors in this system were neurologically "vegetative", making it unclear how to extrapolate to other regions. Negligible differences in survival to hospital discharge after VF (physician 6% vs. paramedic 8.5%) were noted in an older system where the physician-staffed ambulance was replaced with paramedics (LOE3) (Lewis 1979, p 1902)

In a meta-analysis of active compression-decompression (ACD) CPR, survival was tabulated according to physician-based teams or paramedic-based teams, on the assumption that the level of training might affect performance of the intervention (Lafuente-Lauente, 2004, pCD002751). The survival to hospital discharge with ACD or standard CPR can be compared between these teams, with the caveat that the data are collected from systems separated in space and time (LOE3). These data point to higher survival rates in the physician-based teams for both ACD-CPR and standard-CPR.

Total Subjects = 3412

Survival to Hospital Discharge

Physician teams (4 studies)

	ACD CPR	Standard CPR	Total
mortality	329/372	336/365	665/737
mortality%	88.4%	92.1%	90.2%
survival%	11.6%	7.9%	9.8%

Non-Physician teams (5 studies)

	ACD CPR	Standard CPR	Total
mortality	1207/1280	1321/1395	2528/2675
mortality%	94.3%	94.7%	94.5%
survival%	5.7%	5.3%	5.5%

Acknowledgements:
This worksheet was combined from worksheets by Joe Ornato and Bernd Bottiger, with subsequent help from Michael Bernhard, with all authors contributing equally to the Consensus on Science.

Citation List

Arntz HR, Wenzel V, Dissmann R, Marschalk A, Breckwoldt J, Müller D. Out-of-hospital thrombolysis during cardiopulmonary resuscitation in patients with high likelihood of ST-elevation myocardial infarction. Resuscitation. 2008 Feb;76(2):180-4. Epub 2007 Aug 28.

Bell A, Lockey D, Coats T, Moore F, Davies G. Physician Response Unit -- a feasibility study of an initiative to enhance the delivery of pre-hospital emergency medical care. Resuscitation. 2006 Jun;69(3):389-93.

Björnsson HM, Marelsson S, Magnusson V, Sigurdsson G, Thornorgeirsson G. [Prehospital cardiac life support in the Reykjavík area 1999-2002] Laeknabladid 2006; 92(9): 591-7.

Böttiger BW, Grabner C, Bauer H, Bode C, Weber T, Motsch J, Martin E. Long term outcome after out-of-hospital cardiac arrest with physician staffed emergency medical services: the Utstein style applied to a midsized urban/suburban area. Heart. 1999

Dec;82(6):674-9.

Dickinson ET, Schneider RM, Verdile VP. The impact of prehospital physicians on out-of-hospital nonasystolic cardiac arrest. Prehosp Emerg Care 1997; 1: 132-135

Eisenburger P, Czappek G, Sterz F, Vergeiner G, Losert H, Holzer M, Laggner AN. Cardiac arrest patients in an alpine area during a six year period. Resuscitation 2001; 51:39-46

Estner HL, Günzel C, Ndrepepa G, William F, Blaumeiser D, Rupprecht B, Hessling G, Deisenhofer I, Weber MA, Wilhelm K, Schmitt C, Schömig A. Outcome after out-of-hospital cardiac arrest in a physician-staffed emergency medical system according to the Utstein style. Am Heart J 2007; 153(5): 792-9.

Fischer, M. Krep, H. Wierich, D. Heister, U. Hoeft, A. Edwards, S. Castrillo-Riesgo, L G. Krafft, T. [Comparison of the emergency medical services systems of Birmingham and Bonn: process efficacy and cost effectiveness]. [German] Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 38(10):630-42, 2003 Oct.

Frandsen F, Nielsen JR, Gram L, Larsen CF, Jørgensen HR, Hole P, Haghfelt T. Evaluation of intensified prehospital treatment in out-of-hospital cardiac arrest: survival and cerebral prognosis. The Odense ambulance study. Cardiology 1991; 79:256-264.

Gottschalk A, Burmeister MA, Freitag M, Cavus E, Standl T. Influence of early defibrillation on the survival rate and quality of life after CPR in prehospital emergency medical service in a German metropolitan area. Resuscitation 2002; 53(1): 15-20.

Hampton, J R. Dowling, M. Nicholas, C. Comparison of results from a cardiac ambulance manned by medical or non-medical personnel. Lancet. 1(8010):526-9, 1977 Mar 5.

Holler NG, Mantoni T, Nielsen SL, Lippert F, Rasmussen LS. Long-term survival after out-of-hospital cardiac arrest. Resuscitation 2007; 75:23-28

Kirves H, Skrifvars MB, Vähäkuopus M, Ekström K, Martikainen M, Castren M. Adherence to resuscitation guidelines during prehospital care of cardiac arrest patients. : Eur J Emerg Med. 2007 Apr;14(2):75-81.

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Lewis, R P. Stang, J M. Fulkerson, P K. Sampson, K L. Scoles, A. Warren, J V. Effectiveness of advanced paramedics in a mobile coronary care system. JAMA. 241(18):1902-4, 1979 May 4.

Lossius HM, Søreide E, Hotvedt R, Hapnes SA, Eielsen OV, Førde OH, Steen PA. Prehospital advanced life support provided by specially trained physicians: is there a benefit in terms of life years gained? Acta Anaesthesiol Scand. 2002 Aug;46(7):771-8.

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Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, Davis D, Idris A, Stiell I; Resuscitation Outcomes Consortium Investigators.Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA. 2008 Sep 24;300(12):1423-31.

Olasveengen TM, Lund-Kordahl I, Steen PA, Sunde K. Out-of hospital advanced life support with or without a physician: Effects on quality of CPR and outcome. Resuscitation. 2009 Nov;80(11):1248-52

Schneider T, Mauer D, Diehl P, Eberle B, Dick W. Quality of on-site performance in prehospital advanced cardiac life support (ACLS). Resuscitation. 1994 May;27(3):207-13.

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Silfvast, T. A. Ekstrand. The effect of experience of on-site physicians on survival from prehospital cardiac arrest. Resuscitation 1996; 31(2): 101-5.

Soo LH, Gray D, Young T, Skene A, Hampton JR. Influence of ambulance crew's length of experience on the outcome of out-of-hospital cardiac arrest. Eur Heart J. 1999 Apr;20(7):535-40.

Soo LH, Gray D, Young T, Huff N, Skene A, Hampton JR. Resuscitation from out-of-hospital cardiac arrest: is survival dependent on who is available at the scene? Heart 1999; 81(1): 47-52.

Sipria A, Talvik R, Kõrgvee A, Sarapuu S, Oöpik A. Out-of-hospital resuscitation in Tartu: effect of reorganization of Estonian EMS system. Am J Emerg Med 2000; 18: 469-473.

Suominen P. Korpela R. Kuisma M. Silfvast T. Olkkola KT. Paediatric cardiac arrest and resuscitation provided by physician-staffed emergency care units. Acta Anaesthesiologica Scandinavica. 41(2):260-5, 1997 Feb.

Timmermann A, Eich C, Russo SG, Natge U, Bräuer A, Rosenblatt WH, Braun U. Prehospital airway management: a prospective evaluation of anaesthesia trained emergency physicians. Resuscitation 2006; 70: 179-185

Wahlen, B M. Wolcke, B. Schneider, T. Thierbach, A. [Initial medical treatment by paramedics in combined first aid operations of paramedics and emergency physicians]. [German] Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 38(1):27-31, 2003 Jan.

Yen ZS, Chen YT, Ko PC, Ma MH, Chen SC, Chen WJ, Lin FY. Cost-effectiveness of different advanced life support providers for victims of out-of-hospital cardiac arrests. J Formos Med Assoc. 2006 Dec;105(12):1001-7.

TABLE

			Outcomes*		
	Design	**N**	**Physician**	**Non-Physician**	
Lafuente 2002	ACD CPRR Metanalysis	3412	**9.8%**	5.5%	discharge
Fischer 2003	Compare Two Cities	4298	**14.7%**	4%	discharge
Lewis 1979	Before-After	132	25%	28%	admit
	(excludes asystole)		22%	24.5%	discharge
Schneider 1994	Pseudo-Randomized (VF only)	159	24%	25%	discharge / neuro
Hampton 1977	Pseudo-Randomized	65	**47%**	17%	admit
	(alternate days)		**16%**	4.3%	discharge
Yen 2006	Before-After	158	14.8%	**37.2%**	admit
			2.6%	**9.3%**	discharge
			0%	0%	neuro

Arntz HR, Wenzel V, Dissmann R, Marschalk A, Breckwoldt J, Müller D.
Out-of-hospital thrombolysis during cardiopulmonary resuscitation in patients with high likelihood of ST-elevation myocardial infarction.
Resuscitation. 2008 Feb;76(2):180-4. Epub 2007 Aug 28.

<This study reports the case-series of OOHCA patients treated by physicians and receiving thrombolysis. The one-third of STEMI/LBBB patients had higher survival when given thrombolysis in the field. Authors argue that the ability of physicians to select proper patient for thrombolysis makes this therapy effective. This argument is circular, since the selected patients may have had better prognosis prior to treatment.
SUPPORT: Departmental
IMPRESSION / QUALITY: Fair. Not randomized. Not really comparing provider performance, because thrombolysis is outside the scope of paramedic practice.
CONCLUSION: Physicians can perform procedures and decision-making outside the scope of paramedic practice.
LOE 4. Supportive. Fair >

Bell A, Lockey D, Coats T, Moore F, Davies G.
Physician Response Unit -- a feasibility study of an initiative to enhance the delivery of pre-hospital emergency medical care.
Resuscitation. 2006 Jun;69(3):389-93.

<Comment - does not adequately describe the services offered by the EMS system when a Physician Response Unit (PRU) was not present. Not a randomized trial. Physicians on the PRU administered more therapies than would have been given by the standard EMS unit, but there is no data on whether outcome was improved in cardiac arrest patients. Conclusion - this paper is mainly descriptive of the PRU services and is weakly supportive of the presence of physicians on EMS ambulances based on the administration of therapies outside of current EMS ambulance protocols.
LOE 4. Poor quality. Supportive evidence. >

Björnsson HM, Marelsson S, Magnusson V, Sigurdsson G, Thornorgeirsson G.
[Prehospital cardiac life support in the Reykjavík area 1999-2002]
Laeknabladid 2006; 92(9): 591-7.
[Article in Icelandic – Abstract only reviewed]

<Comment - not a randomized trial. No control group. Mainly descriptive. LOE 4.>

Böttiger BW, Grabner C, Bauer H, Bode C, Weber T, Motsch J, Martin E.
Long term outcome after out-of-hospital cardiac arrest with physician staffed emergency medical services: the Utstein style applied to a midsized urban/suburban area.
Heart. 1999 Dec;82(6):674-9.

<The data about the system is a case-series reporting good outcomes for a physician-based system. Most informative part of paper is comparison with other systems reported in literature (not a formal metanalysis, but a review of literature). The reports from physician-based systems tend to have higher survival to discharge.
LOE 3. Fair. Suportive of physicians-based EMS.>

Dickinson ET, Schneider RM, Verdile VP.
The impact of prehospital physicians on out-of-hospital nonasystolic cardiac arrest.
Prehosp Emerg Care 1997; 1: 132-135

<LOE 2. Poor, given very small (underpowered). Neutral for survival of event. Positive to better survival to discharge in physician-staffed than in paramedic-based EMS.
Retrospective, nonrandomized single EMS system study comparing the outcome in physician-staffed (group 1) vs. ALS paramedic (group 2) based EMS on out-of-hospital nontraumtic cardiac arrest in United states. Underpowered. Out of 80 patients suffering cardiac arrest, 49 patients meet inclusion criteria, from this 9 in group 1 and 40 in group 2. Patient characteritics (age: 69.9 vs. 67.5 years), response variables (response time: 6.6 vs. 5.1 min, scene time: 29 vs. 29 min), rate of bystander CPR (22 vs. 20%), initial ECG rhythm (ventricular fibrillation 56 vs. 55%, PEA 33 vs. 37%, asystole 11 vs. 8%), and time of first defibrillation (5.0 vs 4.1 min) were not significant different in group 1 vs. 2. The pharmacological concept in the group 1 was different to group 2 with respecet to drug dosages per minutes (0.62 vs. 0.34, p<0.03). ROSC (67 vs. 30%, p<0.07) was not statistical significant different, however, survival to discharge (44% vs. 5%, p<0.009) was significant different.
Limitation: Study does not report the incidence of ALS procedures performeed and the associated neurological outcome in each group.>

Eisenburger P, Czappek G, Sterz F, Vergeiner G, Losert H, Holzer M, Laggner AN.
Cardiac arrest patients in an alpine area during a six year period.
Resuscitation 2001; 51:39-46

<LOE 2. Poor. Underpowered. Neutral for better outcome in VF/VT defibrillated by EMT vs. physicians. Prospective, descriptive observational study, comparison of defibrillation effect by EMT vs. by physicians (P) over a six-year period. Due to country´s legislation a prospective controlled trial could not be peformed. Study population n=338, outcome in patients with VF/VT in 1st ECG and defibrillated by EMT (n=13) vs. P (n=105): ROSC 54 vs. 45%, > 24 h survival 39 vs. 31%, survival to hospital discharge: 23 vs. 22%, 1 year survival: 19 vs. 8%. EMT with defibrillation (AED) is not better than defibrillation by physicians in an alpine area. Limitation: Alpine region. 14 minutes in mean up to arrival of physicians.>

Estner HL, Günzel C, Ndrepepa G, William F, Blaumeiser D, Rupprecht B, Hessling G, Deisenhofer I, Weber MA, Wilhelm K, Schmitt C, Schömig A.
Outcome after out-of-hospital cardiac arrest in a physician-staffed emergency medical system according to the Utstein style.
Am Heart J 2007; 153(5): 792-9.

<Comment - case control series, not randomized. First unit (EMT or MD staffed) on scene provided ALS initially. No difference in survival to discharge. Initiation of CPR by an MD (as opposed to an EMT) was not an independent predictor of survival to discharge.
LOE 2. Fair quality. Neutral evidence.>

Fischer M. Krep H. Wierich D. Heister U. Hoeft A. Edwards S. Castrillo-Riesgo LG. Krafft T.
[Comparison of the emergency medical services systems of Birmingham and Bonn: process efficacy and cost effectiveness]. [German]
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 2003; 38(10):630-42

<This study compared the structure and resource use of two cities. CPR attempts in the physician-based system (Bonn) resulted in 14.7% survival to hospital discharge versus the paramedic-based system (Birmingham) with 4% survival to hospital discharge. Data for CPR survival rates were taken from Fischer 1997 Resuscitation 33:233-243; Resuscitation and Herlitz 1999 Resuscitation 41:121-131.
SUPPORT: None Listed
IMPRESSION / QUALITY: Weak design with comparison of concurrent groups (LOE 2) in that comparison is made of two systems rather than head-to-head comparison, and the analysis does not account or adjust for other aspects of the systems or population. Source of some data (Herlitz 1999) warns explicitly that non-uniform data collection should cast doubt on system-to-system comparisons.
CONCLUSION: Survival to hospital discharge is higher after OOHCA in systems using physician-staffed ambulances compared to paramedic-staffed ambulances.
LOE2. Poor (many uncontrolled confounders). Supportive
>

Frandsen F, Nielsen JR, Gram L, Larsen CF, Jørgensen HR, Hole P, Haghfelt T.
Evaluation of intensified prehospital treatment in out-of-hospital cardiac arrest: survival and cerebral prognosis. The Odense ambulance study.
Cardiology 1991; 79:256-264.

LOE 3. Fair. Supporting; LOE2. Fair. Opposed. Positive to better survival in physician-staffed than in paramedic-based EMS. Staffing strategies were tried consecutively, not concurrently in one area. Intermediate paramedic-based system in another area had results superior to physician in the first area. (LOE2)
Prospective nonrandomized investigation comparing the outcome in basic EMS, specially trained paramedics and physician-staffed EMS in Denmark. Out of 393 patients suffered from ozt-of-hospital cardiac arrest, 160 were treated by basic EMS, 148 by intermediate and 85 by physicians. From the 160 patients treated by basic EMS, 133 patients died at scene (83.1%), 27/160 (16.9%) survived to hospital admission and 5% suvived to hospital discarge with cerebral status (good:poor) 1:4. From the 148 patients treated by intermnediate, 134 patients died at scene (90.5%), 14/148 (9.5%) survived to hospital admission and 1.4% suvived to hospital discarge with cerebral status (good:poor) 0:1. From the 85 patients treated by physicians, 60 patients died at scene (70.6%), 25/148 (29.4%) survived to hospital admission and 11 patiemts (12.9%) suvived to hospital discarge with cerebral status (good:poor) 9:4. The survival rate of patients treated by physicians were significant better ($p<0.001$) than in patients treated by paramedics or basic EMS. The survival rate of patients treated by basic EMS did not differ significantly to patients treated by paramedics. The authors concluded: "In the present prospective investigation we found significant better figures of survival (13%) when doctors participated in the prehospital treating of CA." and "…, with a collaborating doctor nine times of the OHCA patients will survive with a good cerevral function, whereas the number will remain unchanged concerning the patients with cerebral dysfunction."
Limitation: Study does not report the incidence of ALS procedures performeed and the associated neurological outcome in each group.

Gottschalk A, Burmeister MA, Freitag M, Cavus E, Standl T.
Influence of early defibrillation on the survival rate and quality of life after CPR in prehospital emergency medical service in

a German metropolitan area.
Resuscitation 2002; 53(1): 15-20.

<Comment - small case control series, not specifically stated to be a randomized comparison. EMTs who could defibrillate with AEDs prior to MD unit arrival improved ROSC prior to MD arrival, but there was no difference in survival to hospital discharge or at 6 months.
LOE 2. Fair quality. Neutral evidence for survival. >

Hampton JR. Dowling M. Nicholas C.
Comparison of results from a cardiac ambulance manned by medical or non-medical personnel.
Lancet. 1(8010):526-9, 1977 Mar 5.

<Prospective design! LOE 2 with some limit on quality only because not every case was randomized: there was some triage of low-risk patients.

Hampton	**Pseudo-Randomized**	**N=65**	**47%**	**17%**	**admit**
	(alternate days)		**16%**	**4.3%**	**discharge**

SUPPORT: Not listed.
IMPRESSION / QUALITY: Fair in that there was evidence of bias in assignment of subjects.
CONCLUSION: No significant difference in mortality, but a trend towards better survival in the physician-based response.
LOE2 >

Holler NG, Mantoni T, Nielsen SL, Lippert F, Rasmussen LS.
Long-term survival after out-of-hospital cardiac arrest.
Resuscitation 2007; 75:23-28

<LOE 4. Fair. Neutral for survival rate after 1, 3, 5, and 10 years in comparison to other systems (paramedic and physician-staffed EMS).
Prospective study in a physician (from the field of anaesthesiology)-staffed EMS in Copenhagen, Denmark: ROSC 32.5%, admission to hospital 30,7%, survival to hospital discharge: 8.7% (n=95). Out of 94 patients: Survival after 1 year 87%, after 3 years 73%, after 5 years 65%, after 10 years 46%. Survival rates at different time points seems to be comparable with other published data (predominatly in EMS that were not physician-staffed). Long term survival seems to be comparable with survival after STEMI (46%). Limitation: No direct comparison to paramedic based EMS.>

Kirves H, Skrifvars MB, Vähäkuopus M, Ekström K, Martikainen M, Castren M.
Adherence to resuscitation guidelines during prehospital care of cardiac arrest patients.
Eur J Emerg Med. 2007 Apr;14(2):75-81.

<This study retrospectively rated compliance with post-resuscitation care guidelines in several related sytems. Physician presence on scene was associated with greater likelihood of compliance with guidelines. Subsequently, compliance with guidelines as associated with greater likelihood of discharge from hospital. Physician presence during resuscitation was not related directly to hospital discharge, and I cannot tell if it had no relationship or simply was excluded from the multivariable model.
SUPPORT: None Listed
IMPRESSION/QUALITY: Retrospective, observational. LOE 2. Rate as Fair for this question since statistical analysis does not let me assess whether the independent effect of physician was addressed.
CONCLUSION: Physician presence on scene for post-resuscitation care is associated with greater likelihood of compliance with guidelines, and guideline compliance is associated with survival to hospital discharge.
LOE 2. Only outcome of compliance with guidelines assessed statistically. Supportive for compliance (E) >

Lafuente-Lafuente C. Melero-Bascones M.
Active chest compression-decompression for cardiopulmonary resuscitation.
Cochrane Database of Systematic Reviews. (2):CD002751, 2004.

<In this meta-analysis, the authors identified studies testing ACD CPR that used (1) paramedic-only teams (n=5 studies) and (2) teams including physicians (n=4 studies). There were no trials that compared these team configurations head-to-head. In the meta-analysis, the effect size of ACD CPR did not differ between team configurations. There was a NON-SIGNIFICANT

trend for ACD CPR to result in greater neurological impairment when administered by paramedic-only teams, that was not apparent when administered by teams with physicians. The total survival rates for physician-based teams and paramedic-based teams can be tabulated:

Total Subjects =3412

Survival to Hospital Discharge

Physician teams (4 studies)

	ACD CPR	Standard CPR	Total
mortality	329/372	336/365	665/737
mortality%	88.4%	92.1%	90.2%
survival%	11.6%	7.9%	9.8%

(5 studies)

Non-Physician teams

	ACD CPR	Standard CPR	Total
mortality	1207/1280	1321/1395	2528/2675
mortality%	94.3%	94.7%	94.5%
survival%	5.7%	5.3%	5.5%

SUPPORT: Unite de Recherche Therapeutique, Hopital Lariboisiere, Paris, France; Complejo Hospitalario de Albacete, Spain.
IMPRESSION/QUALITY: Stretches the limit of experimental design to test this question. For this question LOE 3, because the comparisons are between systems that are not concurrent. Excellent methodology.
CONCLUSION: No evidence that effect of ACD-CPR is enhanced by physician-teams compared to paramedic-only teams. Raw numbers show better survival to discharge in physician-teams (9.8% vs. 5.5%), though the analysis and studies were not designed to look at that variable.
LOE3. Supportive for survival (C)>

Lewis RP. Stang JM. Fulkerson PK. Sampson KL. Scoles A. Warren JV.
Effectiveness of advanced paramedics in a mobile coronary care system.
JAMA. 241(18):1902-4, 1979 May 4.

<Before and after design (LOE3). Physician MICU was phased out and replaced by paramedic-staffed ambulance. Survival did not differ significantly between intervals. Survival from VF was 6% in MD-phase and 8.5% in medic phase.
SUPPORT: National Institutes of Health; Ohio Chapter of American Heart Association.
IMPRESSION/QUALITY: Fair, given that this observation reports on a system change, and was not designed as an actual study.
CONCLUSION: No difference in paramedic and physician systems.
LOE 3. Neutral
>

Lossius HM, Søreide E, Hotvedt R, Hapnes SA, Eielsen OV, Førde OH, Steen PA.
Prehospital advanced life support provided by specially trained physicians: is there a benefit in terms of life years gained?
Acta Anaesthesiol Scand. 2002 Aug;46(7):771-8.

<This case series reports an analysis of whether the physician had value-added for the care of each patient. An estimate of life-years gained is then made, but there is really no comparions group.
SUPPORT: Norwegian Ministry of Health and Social Affairs; Norwegian Air Ambulance Foundation; Laerdal Foundation for Acute Medicine.
IMPRESSION/QUALITY: Case-series; Detailed analyses of each case; Excellent.
CONCLUSION: Illustrates potential advantages of advanced provider;
LOE4. Supportive.
>

Mitchell RG, Brady W, Guly UM, Pirrallo RG, Robertson CE.
Comparison of two emergency response systems and their effect on survival from out of hospital cardiac arrest.
Resuscitation 1997; 35: 225-229

<LOE 2. Fair. Positive to better survival in physician-staffed than in paramedic-based EMS systems.

Prospective comparison of a paramedic-based EMS (Milwaukee, USA) and a physician-staffed EMS system (Edingburgh, UK). From 306 patients suffering a cardiac arrest in Edingburgh, UK, 116 (37.7%) had ROSC in comparison to 225/732 (31.1%) patients suffering a cardiac arrest in Milwaukee, USA (p<0.05). The percentage of patients admitted to hospital did not differ significantly between the UK and USA system (25.5% vs. 22.0%), but the percentage of patients survive to hospital discharge did differ significantly between the both systems (12.4% vs. 7.2%, p<0.01). However, the wittnessed by bystander between both systems (65.7% vs. 25%, p<0.001) differ significantly. The authors stated that "The main reason for this improvement appear to be attributable to the greater number of patients whose cardiac arrest was witnessed and in whom bystander CPR was performed. Limitation: Study does not report the incidence of ALS procedures performed and the associated neurological outcome in each group. It´s remain unclear, whether the improvement in survival rate is due to different basic characteristis more than the different EMS system.>

Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, Davis D, Idris A, Stiell I; Resuscitation Outcomes Consortium Investigators.
Regional variation in out-of-hospital cardiac arrest incidence and outcome.
JAMA. 2008 Sep 24;300(12):1423-31.

<<COMMENT: LOE5 – not directly addressing question. Used to illustrate that variation in survival across systems is greater in magnitude than the variations cited in other papers comparing physician-staffed to non-physician systems.>>

Olasveengen TM, Lund-Kordahl I, Steen PA, Sunde K.
Out-of hospital advanced life support with or without a physician: Effects on quality of CPR and outcome.
Resuscitation. 2009 Nov;80(11):1248-52

<Detailed data collection in system. Physician vs. no-physician based on location of ambulance at time of call. No difference in survival of event or survival to discharge.
LOE 2. Neutral for physician.>

Schneider T, Mauer D, Diehl P, Eberle B, Dick W.
Quality of on-site performance in prehospital advanced cardiac life support (ACLS).
Resuscitation. 1994 May;27(3):207-13.

< Within a single system, some cases were treated by EMT-Ds and some were treated by physicians. Physicians were faster at obtaining ECG diagnosis (36 seconds), but slower to deliver defibrillation (28 seconds).
SUPPORT: Laerdal and PhysioControl provided defibrillators for systems.
IMPRESSION: Non-randomized, before and after study. Primarily, compared timing of performance of defibrillation and other key variables within same system after introduction of EMT-Ds.
CONCLUSION: Paramedics and physicians differ slightly in the speed of performance of specific tasks (ECG diagnosis and defibrillation), but the differences are small enough that they may be clinically irrelevant.
LOE 2 for procedures (E) / Does not address patient outcomes..
>

Schneider T, Mauer D, Diehl P, Dick W, Brehmer F, Juchems R, Kettler D, Kleine-Zander R, Klingler H, Rossi R, et al.
Early defibrillation by emergency physicians or emergency medical technicians? A controlled, prospective multi-centre study.
Resuscitation. 1994 May;27(3):197-206.

< Within several systems, some VF cases were treated by EMT-Ds and some were treated by EMTs. All subjects ultimately received ACLS by physicians. Paramedics were able to defibrillate a larger proportion of patients within 12 minutes compared to physicians, restore pulses faster, and reduce epinephrine requirements. Overall survival to discharge was 25% (EMT-Ds) and 24% (Physicians). These were not different. Trend towards better neurological outcome with EMT-Ds (CPC1: 65% vs. 58%), but also not significant.
SUPPORT: None listed; Extrapolate that from other Schneider paper that Laerdal and PhysioControl provided defibrillators for systems.
IMPRESSION/QUALITY: Prospective study with assignment to study group based on training of nearest ambulance crew. Compared performance within same systems. Faire for this question, because all subjects may ultimately cross-over to other group.
CONCLUSION: No difference in survival to discharge between paramedic and physician-based services. However, EMT-Ds does result in less epinephrine requirement, faster defibrillation, and faster ROSC.
LOE 2 (pseudo-randomized). Neutral for survival, neurological outcome. No conclusion about times and process, because that was directly related to reason for assignment to groups.>

Silfvast, T. A. Ekstrand.
The effect of experience of on-site physicians on survival from prehospital cardiac arrest.
Resuscitation 1996; 31(2): 101-5.

<Comment - compares different phases of MDs (before and after). LOE 3. Neutral for survival.>

Sipria A, Talvik R, Kõrgvee A, Sarapuu S, Oöpik A.
Out-of-hospital resuscitation in Tartu: effect of reorganization of Estonian EMS system.
Am J Emerg Med 2000; 18: 469-473.

<<LOE 3. Fair. Positive for ROSC and survival to hospital discharge comparing a physician-staffed with an EMS system without physicians. Before-and-after-study of a re-organization of an EMS system in Estonia. Before 1994, equipment and training for the Estonian ambulance straff were very poor. In 1994, the system was re-organizated and experienced anesthesiologists came from an ICU to the EMS system. From 1993-1994 (before), 85 patients were treated after cardiac arrest, with ROSC in 12 (32.5%) and survival to hospital discharge in 3 patients (7.5%). After re-organization of the EMS system with physicians in 1995/1996 142 patients suffering from cardiac arrest were treated, with ROSC in 27 patients (44.3%) and survival to hospital discharge in 7 patients (11.5%). In 1997/1998 141 patients suffering from cardiac arrest were treated, with ROSC in 41 patients (58.6%) and survival to hospital discharge in 18 patients (25.7%). The re-organization of the EMS system with physician staffed MICU leads to a significant improvement in ROSC and survival rate. Limitation: Retrospective evaluation of the data before 1994. Neurological outcome in each group were not reported.>>

Soo LH, Gray D, Young T, Skene A, Hampton JR.
Influence of ambulance crew's length of experience on the outcome of out-of-hospital cardiac arrest.
Eur Heart J. 1999 Apr;20(7):535-40.

< LOE2. Neutral for survival. Only post-hoc testing supported more experienced crews. First-line statistics were all NS. >

Soo LH, Gray D, Young T, Huff N, Skene A, Hampton JR.
Resuscitation from out-of-hospital cardiac arrest: is survival dependent on who is available at the scene?
Heart 1999; 81(1): 47-52.

<Comment – Fair, because compares who was on-scene rather than who is present as part of organized EMS response. LOE 2. Supportive for health professional on scene. >

Suominen P. Korpela R. Kuisma M. Silfvast T. Olkkola KT.
Paediatric cardiac arrest and resuscitation provided by physician-staffed emergency care units.
Acta Anaesthesiologica Scandinavica. 1997; 41(2):260-5.

<Observational report of survival in their physician-staffed system over 10 year period. Overall discharged alive was similarly poor as for other reports from paramedic-based systems. Physicians were able to withhold treatment in some futile cases (where paramedic protocols might have required resuscitation attempts.
SUPPORT: ?????
IMPRESSION: Observational case-series only. No control. Pediatric only. Small series.
CONCLUSION: Physician-staffed response does not improve survival to hospital discharge in pediatric OOHCA.
Neutral LOE5 for this question since Pediatric. >

Timmermann A, Eich C, Russo SG, Natge U, Bräuer A, Rosenblatt WH, Braun U.
Prehospital airway management: a prospective evaluation of anaesthesia trained emergency physicians.
Resuscitation 2006; 70: 179-185

<Prospective, observational study, anaesthesiologists staffed ground and air based german EMS. Successful intubation of the trachea in 1106 patients: 98% in the prehospital setting. Intubations of the trachea failed in patients suffering from cardiac arrest (n=491) only in 1.6%.
LOE 5. Good. Positive for high success rate in intubation of the trachea performed by physicians.>

Wahlen BM. Wolcke B. Schneider T. Thierbach A.
[Initial medical treatment by paramedics in combined first aid operations of paramedics and emergency physicians].

[German]
Anasthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie. 2003; 38(1):27-31.

<In this observational study, the proportion of correct completion of medical procedures was reported for paramedics. All patients ultimately received physician care when mobile ICU arrived. The paramedics completed a large number of procedures correctly (76-95%) and did so during the first 3-5 minutes, thereby providing faster service than the more highly trained crew.
SUPPORT: None listed.
IMPRESSION: Observational only. Measured procedure completion and not patient outcomes. Fair, because rating of procedure performance is loosely defined.
CONCLUSION: Paramedics can complete medical procedures correctly a large proportion of the time, and can be deployed more quickly than physician-staffed units.
LOE4. Neutral for physician-based system for procedures only. >

Yen ZS, Chen YT, Ko PC, Ma MH, Chen SC, Chen WJ, Lin FY.
Cost-effectiveness of different advanced life support providers for victims of out-of-hospital cardiac arrests.
J Formos Med Assoc. 2006 Dec;105(12):1001-7.

<This prospective study conducted in a single city, assigned one region to receive EMT-based care, whereas the remainder maintained physician-based care (Psuedorandomized = LOE2).
SUPPORT: Department of Health, Taiwan.
IMPRESSION/QUALITY: Prospective comparison directly related to question interest. Assignment by regions rather than randomized. LOE 2. Not blinded, and only pseudo-randomized. Background survival rate of 1.4% suggests an EMS system that is qualitatively different from mature North American and European Systems.
CONCLUSION: EMT-based cases survived to admission more than physician-treated cases (37.2% vs. 14.8%) (p<0.01) (Evidence opposing MD). There was a trend (p=0.09) for EMT cases to survive to discharge more than physician cases (9.3% vs. 2.6%) (Evidence neutral for MD). All cases were neurologically "vegetative" (neutral for neurological outcome). LOE 2 (pseudo-randomized). >

OTHER PAPERS NOT INCLUDED AFTER REVIEW

Gries A, Zink W, Bernhard M, Messelken M, Schlechtriemen T.
Realistic assessment of the physician-staffed emergency services in Germany.
Anaesthesist. 2006 Oct;55(10):1080-6.

<Survery of EMS physicians points out the relatively low volume of some procedures within EMS practice. Argument is made about skills retention in low-volume settings.
SUPPORT: ADAC Air Rescue and State Medical Association provided data.
IMPRESSION / QUALITY: Survey. No data about effectiveness.
CONCLUSION: Do not include in evidence evaluation, because no study of patient outcomes or evaluation of provider performance. Opinions only.
DO NOT INCLUDE – NO DATA ABOUT PATIENTS
>

Kuisma M, Määttä T
Out-of-hospital cardiac arrests in Helsinki: Utstein style reporting.
Heart. 1996 Jul;76(1):18-23.

<Utstein report about a system that uses Mobile ICU – no comparisons made>

Lecky F., Bryden D., Little R., Tong N., Moulton C.
Emergency intubation for acutely ill and injured patients
Cochrane Database of Systematic Reviews 2008 -:2 Article Number CD001429

<NO COMPARISONS OF PHYSICIAN TO OTHER PROVIDERS>

Lees M., Elcock M.
Safety of interhospital transport of cardiac patients and the need for medical escorts

EMA - Emergency Medicine Australasia 2008 20:1 (23-31)

<INTERESTING ANALYSIS BUT NOT FOCUSSED ON RESUSCITATION>

<<FOLLOWUP REPORT –
Lewis RP, Stang JM, Warren JV
The role of paramedics in resuscitation of patients with prehospital cardiac arrest from coronary artery disease.
Am J Emerg Med. 1984 May;2(3):200-3.

>>
<IMPRESSION: Observational case report of one system. Only control is prior report by Lewis 1979.
SUPPORT: National Institutes of Health; Ohio Chapter of American Heart Association.
CONCLUSION: Replacement of physician-responders with paramedics caused no decline in survival to discharge after OOHCA in one city. Probably should not list this report as separate data from Lewis 1979, because the same control cases appear in both.
DO NOT INCLUDE
>>

Ohshige K, Shimazaki S, Hirasawa H, Nakamura M, Kin H, Fujii C, Okuchi K, Yamamoto Y, Akashi K, Takeda J, Hanyuda T, Tochikubo O.
Evaluation of out-of-hospital cardiopulmonary resuscitation with resuscitative drugs: a prospective comparative study in Japan.
Resuscitation 2005; 66(1): 53-61.

<Comment - Not on target for the question at hand. More a drug vs no drug study than comparison of similar therapy by MDs vs. EMT/paramedics. DO NOT INCLUDE.>

Rittenberger J.C., Hostler D.P., Tobin T., Gaines J., Callaway C.W.
Predictors of ROSC in witnessed aeromedical cardiac arrests
Resuscitation 2008 76:1 (43-46)

<NO ANALYSIS BY CREW CONFIGURATION – INSUFFICIENT NUMBER TO MAKE COMPARISON>

Skogvoll E., Sangolt G.K., Isern E., Gisvold S.E.
Out-of-hospital cardiopulmonary resuscitation: a population-based Norwegian study of incidence and survival.
Eur J Emerg Med 1999 6:4 (323-330)

<NO COMPARISONS OF PHYSICIAN, BUT OVERALL SYSTEM PERFORMANCE SIMILAR TO OTHERS>