

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

Worksheet author(s)

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Clinical question.

BLS-014B: What is the incidence, prevalence, etiology of cardiopulmonary arrest in-hospital and out-of-hospital?

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

No, just epidemiology

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

Part revision of existing worksheet / new subquestion

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet?

no

Search strategy (including electronic databases searched).

"out-of-hospital" or "pre-hospital" and heart arrest and incidence and epidemiology and Utstein (87)

"out-of-hospital" or "pre-hospital" and heart arrest and incidence and epidemiology (863)

"out-of-hospital" or "pre-hospital" and heart arrest and etiology epidemiology and Utstein (25)

"out-of-hospital" or "pre-hospital" and heart arrest and etiology epidemiology (327)

These searches were done in Medline and Embase

To ensure global coverage, we used additional search terms "Asia" (91), "South America"(5), "Africa"(5), "Australia"(102). All articles written in English were considered for inclusion.

• State inclusion and exclusion criteria

Inclusion:

Population based study including all consecutive OHCA during a period >6months.

Exclusion:

Non – clinical studies (animal / mathematical models)

Not population-based studies

Pediatric patients only

Top down data collection

Reviews or summaries of other studies.

Full article not available online and/or in English

In-hospital studies

Subgroups reported only

Multiple articles published by the same author on same patients.

Studies on Sudden Cardiac Death that do not include OHCA survivors.

Exclusion incidence:

Study group ≠ population and reported incidence is not corrected

Exclusion etiology:

Etiology not recorded for all patients (e.g. only for hospitalized patients)

Given the workload of the worksheet, I only studied the out-of-hospital cardiopulmonary arrest group, not the in-hospital cardiac arrest group. Also, I did not include pediatric only studies in my search. However, pediatric patients have been included in studies that did not have an age limit.

Given the nature of the question, the supporting evidence can best be described as "neutral" with level of evidence 5 (other endpoint).

• Number of articles/sources meeting criteria for further review:

79

Summary of evidence

Evidence Supporting Clinical Question

Good					
Fair					
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

Evidence Neutral to Clinical question

Good				Becker LB, 1993, p600 Cheung W, 2006, p321 Chugh SS, 2004, p 1268 de Vreede-Swagemakers JJ, 1997, p1500 Finn JC, 2001, p247 Moore MJ, 2006, p311 Nichol G, 2008, p1423 Skogvoll E, 1999, p323	
Fair				Bachman JW, 1986, 477 Böttiger BW, 1999, p674 Capucci A, 2002, p1065 Crone PD, 1995, p297 Dickinson ET, 1997, p132 Eisenberg MS, 1988, p319 Eng Hock Ong M, 2003, p427 Estner HL, 2007, p792 Fabbri A, 2006, p180 Fischer M, 1997, p233 Garza AG, 2009, p 2597 Giraud F, 1996, p19 Goudevenos, 1995, p67 Grmec S, 2009, p7 Gruska M, 2005, p107 Hayashi H, 2005, p49 Hess EP, 2007, p200 Hollenberg J, 2008, p389 Hu SC, 1994, p491 Iwami T, 2007, 2900 Jasinskas, 2007, p789 Jennings PA, 2006, p135 Kämäräinen A, 2007, p235 Kass LE, 1994, p17 Kentsch M, 2000, p177 Kette F, 2007, p52 Kuilman M, 1999, p25 Kuisma M, 1996, p18 Layon AJ, 2003, p59 Muraoka H, 2006, p827 Nishiuchi T, 2003, p329 Olasveengen TM, 2009, p407 Rea TD, 2003, p494 Roth R, 1984, p237 Rudner R, 2004, p315 Shariki T, 2009, p489 Sipria A, 2006, p14 Soo LH, 1999, p47 Steinmetz J, 2008, p908 Stueven HA, 1989, p251 Tadel S, 1998, p169 Vaillancourt C, 2004, p1081 Waalewijn RA, 1998, p175 Westfal RE, 1996, p364 Weston CF, 1997, p27 Woodall J, 2007, p134	
Poor				Baker PW, 2008, p424 Bobrow BJ, 2008, p381 Callaham M, 1996, p638 Chu K, 1998, p478 Davis DP, 2007, p44 Dowie R, 2003, p173 Dunne RB, 2007, p59 Eckstein M, 2005, p504 Fairbanks RJ, 2007, p415 Groh WJ, 2001, p324 Jackson RE, 1997, p540 Joyce SM, 1998, p13 Kellerman AL, 1993, p1433 Mosesso VN Jr, 1998, p200 Myerburg RJ, 2002, p1058 Pepe PE, 1993, p1838 Pleskot M, 2006, p209 Polentini MS, 2006, p52	

				Rainer TH, 1995, p33 Sekimoto M, 2001, p153 Szczygiel M, 1981, p566 Valenzuela TD, 1997, p3308 Weydahl PG, 1999, p103 White RD, 1998, p145 Wright D, 1990, p600	
	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					
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:

Developing a single global incidence of cardiac arrest has been a challenge, because of multiple methodological methods of measuring this. Differences exist primarily because of definition of patient populations. Although the Utstein guidelines are clear about what elements to report during resuscitation, the guidelines do not specify a specific patient population. Populations include non-traumatic cardiac arrests, definite cardiac cause arrest, cardiac and unknown cause of arrest. The most common patient population/etiologies include:

- 1) Out-of-hospital cardiac arrest
- 2) Patients in out-of-hospital cardiac arrest considered for resuscitation
- 3) Patients in out-of-hospital cardiac arrest resuscitated
- 4) Patients resuscitated with an OHCA of cardiac cause
- 5) 1, 2, 3 and 4 corrected for age and gender

These populations are not identical and those incidences calculated from them are not comparable.

The Table in the appendix below summarizes the literature with respect to population studied, and calculated incidence.

I would suggest to rephrase Utstein guidelines, not only focusing on what patients are included for survival analysis, but also which ones are excluded and why. Perhaps a definition should be added on "considered for resuscitation". Who is considering if patients need to be resuscitated, and at what point in time?

Using the same denominator for all incidence calculations should make the data more comparable, and perhaps make the outcomes more similar.

Population estimates

The population published in the article was corrected for the adult census population of the area if the adult population was not described (for European areas, <http://epp.eurostat.ec.europa.eu/>; for North American areas, <http://www.census.gov/>; for Asian areas, <http://www.e-stat.go.jp/>; for Australian areas, <http://www.censusdata.abs.gov.au>). However, cities can have a fluctuating population at risk due to daytime commuters and visitors. We could have overestimated the incidence if patients who do not live in the study area were not excluded or have underestimated the incidence if the study area had a larger daytime population.

The incidence of out-of-hospital cardiac arrest

Incidences describing adult population only and populations without an age limit (i.e., both adults and children) were calculated and averaged separately. Calculated incidences were weighed according to the size of the study population and reported in mean (\pm standard deviation). The percentage of cases in which CPR was initiated was calculated by dividing the number of cases that were resuscitated by the number of patients considered for resuscitation within the same study. The incidence of cardiac etiology was calculated by dividing the number of resuscitated patients with cardiac cause by the number of resuscitated patients within the same study. Mean incidences between adult-only and all age studies were compared with an unpaired Student T test.

The following table shows the average crude incidence for adult cases and cases of all ages (pediatric and adult).

	All ages included		Adult only	P-value
	Mean	(SD)	Mean (SD)	
Incidence out-of-hospital cardiac arrest (n=5)	82.9	(21.4)	213.1 (177)	0.24
Incidence patients considered for CPR (n=34)	76.3	(35.7)	95.9 (30.5)	0.04
Incidence arrest with CPR initiated (n=55)	41.5	(18.4)	64.2 (19.9)	<0.001
Incidence arrest with CPR initiated, cardiac cause (n=87)	40.5	(17.1)	61.8 (37.7)	0.008
Adjusted incidence arrest with CPR initiated, cardiac cause (n=14)	56.6	(13.7)	84.7 (58.8)	0.27
Percentage CPR initiated (n=43)	72.3	(20.4)	68.9 (25.6)	0.63
Percentage cardiac etiology (n=48)	71.8	(12.4)	72.0 (11.8)	0.94

Comparisons between continents

There was no significant difference between Europe, North America, Asia and Australia for the average year the study was performed, the incidence of OHCA (P=0.87) or the incidence of patients in whom resuscitation was attempted with all causes of the arrest (P=0.23). The continents did differ significantly for incidence of patients with OHCA considered for resuscitation (P<0.001). The incidence was lower in Asia (55.0) than the other three continents (86.4 in Europe, 93.7 in North America, and 112.9 in Australia), but there was no difference among the

other three continents. The incidence of patients in OHCA with presumed cardiac cause in whom resuscitation was attempted was higher in North America (57.8) than in the other three continents (35.3 in Europe, 32.3 in Asia, and 44.0 in Australia; $P<0.001$), and there was no difference among the other continents. The percentage of OHCA with cardiac etiology was significantly lower in Asia (66%) than in North America (78%; $P=0.003$) and Australia (82%; $P=0.001$). The percentage of patients for whom CPR was initiated was significantly lower in Australia (46%) than in the other continents (61% in Europe, 72% in North America, and 96% in Asia; $P<0.001$) and lower in Europe than in Asia ($P<0.001$).

Acknowledgements:

I am very grateful to dr. Mickey Eisenberg (Seattle, WA) who helped create order in the chaos of literature. I greatly appreciate prof Jan Tijssen for his indispensable cooperation in the data analysis.

Appendix

Table. The incidence of out-of-hospital cardiac arrest per study region at five levels, calculated by the worksheet author.

Setting	Article	Study period	Time span (months)	Study population	Inc OHCA*	Inc considered for CPR [†]	Inc considered for CPR, cardiac cause [‡]	Inc CPR initiated [§]	Inc CPR initiated, cardiac cause	% CPR initiated	% cardiac cause	Included age [#]
<i>Europe</i>												
Vienna, Austria ²⁹	Gruska M, 2005, p107	1995-1996	24	1 508 120					49.7			all
East Bohemian region, Czech Republic ⁵⁶	Pleskot M, 2006, p209 Steinmetz J, 2008, p908	2002-2004	29	1 236 000		24.0		19.2	18.7	80%	98%	all
Copenhagen, Denmark ⁶⁷		2004-2007	30	593 000				53.4	28.3	72%	53%	all
London, England ¹⁵	Dowie R, 2003, p173	1997-1998	12	8 000 000					47.0			all
Nottinghamshire, England ⁶⁶	Soo LH, 1999, p47	1991-1994	48	1 000 000		155.7		52.4	38.7	34%	74%	all
West Yorkshire, England ⁷⁹	Wright D, 1990, p600	1987-1989	21	1 644 689**					41.6			≥18
Estonia ⁶⁴	Sipria A, 2006, p14	1999-2002	48	1 370 000		80.0		38.5	25.9	48%	67%	all
Helsinki, Finland ⁴⁵	Kuisma M, 1996, p18 Kämäräinen A, 2007, p235	1994	12	516 000		173.6		66.7	49.4	38%	74%	all
Tampere, Finland ³⁹		2004-2005	12	203 000		94.1		45.8	35.5	49%	77%	all
Saint-Etienne, France ²⁵	Giraud F, 1996, p19	1991-1992	12	571 191		66.5		41.0	19.8	62%	48%	all
Bonn, Germany ²³	Fischer M, 1997, p233	1989-1992	48	240 000		62.7		55.2	48.3	88%	88%	all
Dachau, Germany ¹⁹	Estner HL, 2007, p792 Böttiger BW, 199, p674	2000-2006	72	134 019		101.2		67.0	51.2	66%	76%	all
Heidelberg, Germany ⁵		1992-1994	36	330 000		76.3		51.7	34.1	68%	66%	all
Stralsund, north-east Germany ⁴²	Kentsch, 2000, p177	1984-1988	60	75 000					14.1			all
Stralsund, north-east Germany ⁴²	Kentsch, 2000, p177 Goudevenos JA 1995, p67	1991-1997	84	63 000					61.9			all
Ioannina area, Greece ²⁶		1990-1993	42	160 000	53.4							30- 70
Forli, Italia ²⁰	Fabbri A, 2006, p180	1994-2004	126	138 510**		111.3	68.6	68.6	58.0	62%	84%	≥18
Piacenza region, Italy ⁷	Capucci, 2002, p1065	1999-2001	22,8	173 114				107.6				all
Pordenone province, Italy ⁴³	Kette F, 2007, p52	2003-2004	13	290 229		166.0		78.6	61.7	47%	79%	all
Belfast, Ireland ⁴⁷	Moore MJ, 2006, p311 Jasinskas N, 2007, p789	2003-2004	12	376 722				79.6				all
Kaunas city, Lithuania ³⁶		2005	12	360 627				20.0	17.2		86%	all
Amsterdam, the Netherlands ⁷³	Waalewijn RA, 1998, p175	1995-1997	27	1 300 000		57.6		43.9	35.8	76%	81%	all
Maastricht, the Netherlands ¹³	Swagemakers JJ, 1997, p1500	1991-1994	48	132 762	97.0				44.6			20- 75
Rotterdam, the Netherlands ⁴⁴	Kuilman M, 1999, p25 Olasveengen TM, 2009, p407 Weydahl PG, 1999, p103	1988-1994	84	598 694					21.4			all
Oslo, Norway ⁵³		2003-2007	36	436 265**				70.1	48.5		69%	≥18
Ostfold county, Norway ⁷⁶	Skogvoll E, 1999, p163	1997	12	241 151				70.5	67.6		96%	all
Trondheim, Norway ⁶⁵		1990-1994	48	154 000				85.6	71.8		84%	all
Katowice, Poland ⁶¹	Rudner R, 2004, p315	2001-2002	12	338 000		114.8		55.6	43.5	48%	78%	all
Edinburgh, Scotland ⁵⁸	Rainer TH, 1995, p33	1991	12	659 545**					45.0			≥13
Glasgow, Scotland ⁵⁸	Rainer TH, 1995, p33	1991	12	171 290**					92.9			≥13

Ljubljana, Slovenia ⁷⁰	Tadel S, 1998, p169	1995-1997	36	397 306	81.0	38.1	28.3	47%	74%	all
Maribor, Slovenia ²⁷	Grmec S, 2009, p7 Hollenberg J, 2008, p389	1998-2007	108	158 800*	82.1	55.1	36.9	67%	67%	≥18
70% of Sweden ³²		1992-2005	168	8 900 000		31.0	21.3		69%	all
South Glamorgan, Wales ⁷⁵	Weston CF, 1997, p27	1989-1992	81.85	400 000		35.0	26.9		77%	all
<i>North America</i>										
Edmonton, Alberta Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	616 741			55.3			all
British Colombia, Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	3 282 061			59.4			all
Vancouver, Canada ⁵¹	Nichol G, 2008, p1423 Vaillancourt C, 2004, p1081	2006-2007	12	2 779 373	85.4		58.8			all
Nova Scotia, Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	899 942			52.9			all
Burlington Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	129 575			61.7			all
Cambridge Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	92 772			64.7			all
Kingston Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	56 597			118.4			all
Kitchener/Waterloo Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	239 463			47.2			all all
London Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	311 620			69.0			all
Niagra Falls Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	75 399			71.6			all
Oakville Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	114 670			39.2			all
Ottawa Ontario Canada ⁵¹	Nichol G, 2008, p1423 Vaillancourt C, 2004, p1081	2006-2007	12	4 030 696	73.6		45.6			all all
Peterboroug Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	68 379			46.8			all
St Catherines Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	129 300			65.7			all
Sarnia Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	74 167			76.9			all
Sudbury Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	92 884			62.4			all
Thunder Bay Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	113 964			68.4			all
Toronto, Ontario Canada ⁵¹	Nichol G, 2008, p1423 Vaillancourt C, 2004, p1081	2006-2007	12	5 627 021	91.6		53.2			all all
Windsor/Tecumseh Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	201 930			49.0			all
provincial average Ontario Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	2 352 473			59.3			all
Montreal Metro, Quebec Canada ⁷¹	Vaillancourt C, 2004, p1081	2002	12	2 140 000			52.6			all
Alabama ⁵¹	Nichol G, 2008, p1423	2006-2007	12	644 701	110.9		41.4			all
Alachua County, FL ⁴⁶	Layon AJ, 2003, p59 Moeso VN Jr, 1998,	1998	12	211 403	79.0	72.8	68.6	92%	94%	all all
Allegheny County, PE ⁴⁸	p200 Bobrow BJ, 2008,	1990-1995	61	145 000		70.5				all
Arizona ⁴	p381 Becker LB, 1993,	2005-2006	15	5 500 000		21.6	16.1		74%	all
Chicago, IL ³	p600	1987-1988	24	1 993 893**			161.8			≥17
Dallas ⁵¹	Nichol G, 2008, p1423	2006-2007	12	1 989 357	123.8		63.6			all

Delaware County, IN ²⁸	Groh WJ, 2001, p324	1995-1996	24	89 866**			72.3			≥18
Detroit, MI ¹⁶	Dunne RB, 2007, p59	2002	6	654 550**	164.4		148.8			≥18
Hamilton County, IN ²⁸	Groh WJ, 2001, p324	1995-1996	24	109 123**			39.9			≥18
Houston, TX ⁵⁵	Pepe PE, 1993, p1838	1989-1990	24	1 305 000**			92.1			≥18
Howard County, IN ²⁸	Groh WJ, 2001, p324	1995-1996	24	63 275**			49.0			≥18
Iowa ⁵¹	Nichol G, 2008, p1423	2006-2007	12	1 015 347	101.2		55.6			all
Johnson County, KS ⁶⁹	Szczygiel M, 1981, p566	1978-1979	24	256 259		67.5	61.5	91%		all
Kansas City, MO ²⁴	Garza AG, 2009, p2597	2003-2007	48	350 848**		141.4	108.2	77%		≥18
King County WA ⁵⁹	Rea TD, 2003, p494	2000	24	2 000 000	92.6	35.7	20.2			all
Los Angeles, CA ¹⁷	Eckstein M, 2005, p504	2000-2001	12	2 569 000**		78.7	66.2	84%		≥18
Memphis, TE ⁴¹	Kellerman AL, 1993, p1433	1989-1992	39	440 053**			74.7			≥18
Miami-Dade County, FL ⁵⁰	Myerburg RJ, 2002, p1058	1997-2001	49	1 181 612			15.3			all
3 southeastern Michigan counties ⁹	Chu K, 1998, p478	1991-1994	48	1 065 400**			46.1			≥18
Milwaukee, WI ⁶⁸	Stueven HA, 1989, p251	1973-1983	120	939 000	60.0		44.9	75%		all
Milwaukee, WI ⁵⁷	Polentini MS, 2006, p52	1992-2002	132	678 300**	256.2		85.2			≥21
Milwaukee, WI ⁵¹	Nichol G, 2008, p1423	2006-2007	12	940 164			85.2			all
Northeastern Minnesota ¹	Bachman JW, 1986, 477	1982-1984	24	200 000			145.8	128.0	88%	all
Multnomah County, Oregon ¹⁰	Chugh SS, 2004, p1268	2002-2003	12	660 486	53,4		35.9			all
New York City, NY ⁷⁴	Westfal RE, 1996, p364	1986-1993	96	97 024**		62.0	52.3	84%		≥18
Oakland County, MI ³⁵	Jackson RE, 1997, p540	1989-1993	54	763 000**			82.3			≥19
Olmsted County MN ³¹	Hess EP, 2007, p200	1995-2005	132	133 283	54.3	28.2	22.1	52%	78%	all
Pittsburgh, PE ⁶⁰	Roth R, 1984, p237	1979-1980	6	627 000	181.5	80.4	59.6	44%	74%	all
Pittsburgh, PE ⁵¹	Nichol G, 2008, p1423	2006-2007	12	935 967	130.0		61.4			all
Portland ⁵¹	Nichol G, 2008, p1423	2006-2007	12	1 751 119	75.4		45.3			all
Rochester, MN ⁷⁷	White RD, 1998, p145	1990-1997	84	74 511			47.2			≥18
Rochester, NY ²¹	Fairbanks RJ, 2007, p415	1998-2001	48	158 180**	186.0	150.1	96.6	81%	64%	≥18
Salt Lake City, UT ³⁸	Joyce SM, 1998, p13	1992-1994	36	122 240**			87.8			≥18
San Diego, CA ¹²	Davis DP, 2007, p44	2001-2002	18	1 300 000			58.5			all
San Francisco, CA ⁶	Callaham M, 1996, p638	1992-1993	10,4	653 059**			70.8			≥18
Seattle, WA ⁵¹	Nichol G, 2008, p1423	2006-2007	12	1 666 978	140.9		70.2			all
Town of Colonie, NY ¹⁴	Dickinson ET, 1997, p132	1994	12	76 500		104.6	95.4	91%		all
Tucson, AZ ⁷²	Valenzuela TD, 1997, p3308	1988-1993	72	312 910**			35.4			≥18
York-Adams counties, PA ⁴⁰	Kass LE, 1994, p17	1988-1989	24	410 000	87.0	87.0	73.0	100%	84%	all

Asia

80% of Israel ¹⁸	Eisenberg MS, 1988, p319	1984-1985	24	3 287 000	58.8	54.7	45.6	93%	83%	all
Akita, Japan ⁶²	Sekimoto M, 2001, p153	1995-1998	36	316 000	98.4	67.3	26.2	68%	39%	all
Itsumo, Japan ⁶²	Sekimoto M, 2001, p153	1998-1999	24	128 000	52.3	31.3	15.6	60%	50%	all
Okayama city, Japan ³⁰	Hayashi H, 2005, p49	2003-2004	12	647 879		56.0	27.6		49%	all
Osaka, Japan ⁵²	Nishiuchi T, 2003, p329	1998-1999	12	8 832 606	57.1	55.1	34.5	97%	63%	all
Osaka, Japan ³⁴	Iwami T, 2007, 2900	1998-2003	60	7 257 500**	67.1	64.6	37.8	96%	58%	≥18
Otsu, Japan ⁶²	Sekimoto M, 2001, p153	1997-1998	24	306 000	66.5	49.2	25.5	74%	52%	all
Takatsuki City, Japan ⁴⁹	Muraoka H, 2006, p827	1999-2004	72	360 000		50.6				all
Yamaguchi, Japan ⁶³	Shariki T, 2009, p489	2002-2008	72	142 000	83.1					all
Singapore ⁵⁴	Ong ME, 2003, p427	2001-2002	7	4 100 000	20.9	20.9	14.7	100%	70%	all
Tai Pei, Taiwan ³³	Hu SC, 1994, p491	1992-1993	10	2 700 000		28.4	24.6		87%	all
<i>Australia</i>										
Adelaide, Australia ²	Baker PW, 2008, p424	2005-2007	25	1 214 875**	128.2	55.3		43%		≥18
Perth, Western Australia ²²	Finn JC, 2001, p247	1996-1999	48	1 079 381**	85.0	34.9	29.5	41%	84%	≥16
Queensland, Australia ⁷⁸	Woodall J, 2007, p134	2000-2002	36	2 887 709**	102.0	53.5	39.8	52%	74%	≥18
Sydney, Australia ⁸	Cheung W, 2006, p321	2004-2005	12	3 993 000			50.4			all
Victoria, Australia ³⁷	Jennings PA, 2006, p135	2002-2003	24	3 587 963**	125.1	55.2	46.4	44%	84%	≥17
Auckland, New Zealand ¹¹	Crone PD, 1995, p297	1991-1993	36	935 000		41.9	38.1		91%	all

South America

none found

Africa

none found

Inc defines incidence; OHCA defines out-of-hospital cardiac arrest; CPR defines cardiopulmonary resuscitation.

* Incidence OHCA: all patients who have suddenly died outside the hospital plus those who have been resuscitated

† Incidence considered for CPR: patients with an out-of-hospital cardiac arrest for whom bystanders have called the local emergency number

‡ Incidence considered for CPR, cardiac cause: patients with an out-of-hospital cardiac arrest of suspected cardiac cause for whom bystanders have called the local emergency number

§ Incidence CPR initiated: patients with an out-of-hospital cardiac arrest in whom resuscitation efforts were attempted

|| Incidence CPR initiated, cardiac cause; patients with an out-of-hospital cardiac arrest of suspected cardiac cause in whom resuscitation efforts were attempted

Age: the age range of patients included in the study

** The population published in the article has been corrected for the adult census population of the area (for European areas, <http://epp.eurostat.ec.europa.eu/>; for North American areas, <http://www.census.gov/>; for Asian areas, <http://www.e-stat.go.jp/>; for Australian areas, <http://www.censusdata.abs.gov.au>).

Citation list

1. Bachman JW, McDonald GS, O'Brien PC. A study of out-of-hospital cardiac arrests in northeastern Minnesota. JAMA. 1986; 256:477-483.

LOE4, neutral, fair

2. Baker PW, Conway J, Cotton C, Ashby DT, Smyth J, Woodman RJ, Grantham H; Clinical Investigators. Defibrillation or cardiopulmonary resuscitation first for patients with out-of-hospital cardiac arrests found by paramedics to be in ventricular fibrillation? A randomised control trial. Resuscitation. 2008; 79:424-431.

LOE4, neutral, fair

3. Becker LB, Han BH, Meyer PM, Wright FA, Rhodes KV, Smith DW, Barrett J. Racial differences in the incidence of cardiac arrest and subsequent survival. The CPR Chicago Project. N Engl J Med. 1993; 329:600-606.

LOE4, neutral, good

Although incidence rates were corrected for US Census population, they were corrected for total population. The data collected only included adults.

4. Bobrow BJ, Vadeboncoeur TF, Clark L, Chikani V. Establishing Arizona's statewide cardiac arrest reporting and educational network. Prehosp Emerg Care. 2008; 12:381-387.

LOE4, neutral, poor

5. 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; 82: 674-679.

Abstract

LOE4, neutral, fair

6. Callaham M, Madsen CD. Relationship of timeliness of paramedic advanced life support interventions to outcome in out-of-hospital cardiac arrest treated by first responders with defibrillators. Ann Emerg Med. 1996; 27:638-648.

LOE4, neutral, poor

Median age was 35.8 years, yet there was no correction for the limit.

Definition of cardiac cause: nontraumatic normothermic cardiac arrests only.

7. Capucci A, Aschieri D, Piepoli MF, Bardy GH, Ionomu E, Arvedi M. Tripling survival from sudden cardiac arrest via early defibrillation without traditional education in cardiopulmonary resuscitation. Circulation. 2002; 106:1065-1070.

LOE4, neutral, fair

8. Cheung W, Flynn M, Thanakrishnan G, Milliss DM, Fugaccia E. Survival after out-of-hospital cardiac arrest in Sydney, Australia. Crit Care Resusc. 2006; 8:321-327.

LOE4, neutral, good

The study reported age-standardised incidence of OHCA.

9. Chu K, Swor R, Jackson R, Domeier R, Sadler E, Basse E, Zaleznak H, Gitlin J. Race and survival after out-of-hospital cardiac arrest in a suburban community. *Ann Emerg Med.* 1998; 31:478-482.

LOE4, neutral, poor

Criteria for primary cardiac origin: “no known traumatic event, drowning, electrocution, drug overdose, primary airway obstruction.” Other non-traumatic causes were not excluded.

10. Chugh SS, Jui J, Gunson K, Stecker EC, John BT, Thompson B, Ilias N, Vickers C, Dogra V, Daya M, Kron J, Zheng ZJ, Mensah G, McAnulty J. Current burden of sudden cardiac death: multiple source surveillance versus retrospective death certificate-based review in a large U.S. community. *J Am Coll Cardiol.* 2004; 44:1268-1275.

LOE4, neutral, good

Also included all SCD cases.

11. Crone PD. Auckland Ambulance Service cardiac arrest data 1991-3. *N Z Med J.* 1995; 108:297-299.

LOE4, neutral, fair

12. Davis DP, Fisher R, Aguilar S, Metz M, Ochs G, McCallum-Brown L, Ramanujam P, Buono C, Vilke GM, Chan TC, Dunford JV. The feasibility of a regional cardiac arrest receiving system. *Resuscitation.* 2007; 74:44-51.

LOE4, neutral, poor

Patients with suspected narcotic overdose, traumatic arrest, drowning, or choking were considered non cardiac and excluded. Four patients who were declared dead on scene retrieved ROSC? How dead were the others that were declared “dead on scene”?

13. de Vreede-Swagemakers JJ, Gorgels AP, Dubois-Arbouw WI, van Ree JW, Daemen MJ, Houben LG, Wellens HJ. Out-of-hospital cardiac arrest in the 1990's: a population-based study in the Maastricht area on incidence, characteristics and survival. *J Am Coll Cardiol.* 1997; 30:1500-1505.

LOE4, neutral, good

Adjusted incidence was calculated, accounting for the upper and lower age limit. Also one of the few studies that include all OHCA cases.

14. 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.

LOE4, neutral, fair

15. Dowie R, Campbell H, Donohoe R, Clarke P. 'Event tree' analysis of out-of-hospital cardiac arrest data: confirming the importance of bystander CPR. *Resuscitation.* 2003; 56:173-181.

LOE4, neutral, poor

No (Utstein) information is given on exclusion criteria or how many were excluded. Positive note: population did account for commuting population: "... serves almost 8 million people, around 7 million of whom live in Greater London and a million who travel into the city daily as commuters or tourists."

16. Dunne RB, Compton S, Zalenski RJ, Swor R, Welch R, Bock BF. Outcomes from out-of-hospital cardiac arrest in Detroit. *Resuscitation*. 2007; 72:59-65.

LOE4, neutral, poor

Retrospective study, based on EMS runsheets. Nontraumatic arrests only (probably based on runsheet, not verified onsite). Other non cardiac cause arrests were not excluded.

17. Eckstein M, Stratton SJ, Chan LS. Cardiac Arrest Resuscitation Evaluation in Los Angeles: CARE-LA. *Ann Emerg Med*. 2005; 45:504-509.

LOE4, neutral, poor

Population is not corrected for age.

Patients OHCA were considered presumed cardiac cause unless the arrest was caused by trauma, drug overdose, drowning, or burns and incineration. Other non cardiac cause arrests were not excluded.

18. Eisenberg MS, Hadas E, Nuri I, Applebaum D, Roth A, Litwin PE, Hallstrom A, Nagel E. Sudden cardiac arrest in Israel: factors associated with successful resuscitation. *Am J Emerg Med*. 1988; 6:319-323.

LOE4, neutral, fair

19. 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; 153:792-799.

LOE4, neutral, fair

20. Fairbanks RJ, Shah MN, Lerner EB, Ilangovan K, Pennington EC, Schneider SM. Epidemiology and outcomes of out-of-hospital cardiac arrest in Rochester, New York. *Resuscitation*. 2007; 72:415-424.

LOE4, neutral, poor

The median age of the population is 31, yet there is no correction for age limit. Incidences calculated by the worksheet author are bound to differ if adult population was used.

21. Fabbri A, Marchesini G, Spada M, Iervese T, Dente M, Galvani M, Vandelli A. Monitoring intervention programmes for out-of-hospital cardiac arrest in a mixed urban and rural setting. *Resuscitation*. 2006; 71:180-187.

LOE4, neutral, fair

22. Fairbanks RJ, Shah MN, Lerner EB, Ilangovan K, Pennington EC, Schneider SM. Epidemiology and outcomes of out-of-hospital cardiac arrest in Rochester, New York. *Resuscitation*. 2007; 72:415-424.

LOE4, neutral, poor

The median age of the population is 31, yet there is no correction for age limit. Incidences calculated by the worksheet author are bound to differ if adult population was used.

23. Finn JC, Jacobs IG, Holman CD, Oxe HF. Outcomes of out-of-hospital cardiac arrest patients in Perth, Western Australia, 1996-1999. *Resuscitation*. 2001; 51:247-255.

LOE4, neutral, good

Adult only study, the incidence was adjusted for adult population.

24. Fischer M, Fischer NJ, Schüttler J. One-year survival after out-of-hospital cardiac arrest in Bonn city: outcome report according to the 'Utstein style'. *Resuscitation*. 1997; 33:233-243.

LOE4, neutral, fair

25. Garza AG, Gratton MC, Salomone JA, Lindholm D, McElroy J, Archer R. Improved patient survival using a modified resuscitation protocol for out-of-hospital cardiac arrest. *Circulation*. 2009; 119:2597-605.

LOE4, neutral, fair

26. Giraud F, Rasclé C, Guignand M. Out-of-hospital cardiac arrest. Evaluation of one year of activity in Saint-Etienne's emergency medical system using the Utstein style. *Resuscitation*. 1996; 33:19-27.

LOE4, neutral, fair

27. Goudevenos JA, Papadimitriou ED, Papathanasiou A, Makis AC, Pappas K, Sideris DA. Incidence and other epidemiological characteristics of sudden cardiac death in northwest Greece. *Int J Cardiol*. 1995; 49:67-75.

LOE4, neutral, fair

28. Groh WJ, Newman MM, Beal PE, Fineberg NS, Zipes DP. Limited response to cardiac arrest by police equipped with automated external defibrillators: lack of survival benefit in suburban and rural Indiana--the police as responder automated defibrillation evaluation (PARADE). *Acad Emerg Med*. 2001; 8:324-330.

LOE4, neutral, poor

Imprecise the time span of the study given: "1995, 1996".

29. Gruska M, Gaul GB, Winkler M, Levnaic S, Reiter C, Voracek M, Kaff A. Increased occurrence of out-of-hospital cardiac arrest on Mondays in a community-based study. *Chronobiol Int*. 2005;22:107-120.

LOE4, neutral, fair

30. Hayashi H, Ujike Y. Out-of hospital cardiac arrest in Okayama city (Japan): outcome report according to the "Utstein Style". *Acta Med Okayama*. 2005; 59:49-54.

LOE4, neutral, fair

31. Hess EP, Campbell RL, White RD. Epidemiology, trends, and outcome of out-of-hospital cardiac arrest of non-cardiac origin. *Resuscitation*. 2007; 72:200-206.

LOE4, neutral, fair

32. Hollenberg J, Herlitz J, Lindqvist J, Riva G, Bohm K, Rosenqvist M, Svensson L. Improved survival after out-of-hospital cardiac arrest is associated with an increase in proportion of emergency crew--witnessed cases and bystander cardiopulmonary resuscitation. *Circulation*. 2008; 118:389-396.

LOE4, neutral, fair

33. Hu SC. Out-of-hospital cardiac arrest in an Oriental metropolitan city. *Am J Emerg Med*. 1994; 12:491-494.

LOE4, neutral, fair

34. Iwami T, Kawamura T, Hiraide A, Berg RA, Hayashi Y, Nishiuchi T, Kajino K, Yonemoto N, Yukioka H, Sugimoto H, Kakuchi H, Sase K, Yokoyama H, Nonogi H. Effectiveness of bystander-initiated cardiac-only resuscitation for patients with out-of-hospital cardiac arrest. *Circulation*. 2007; 116:2900-2907.

LOE4, neutral, fair

35. Jackson RE, Swor RA. Who gets bystander cardiopulmonary resuscitation in a witnessed arrest? *Acad Emerg Med*. 1997; 4:540-544.

LOE4, neutral, poor

Non cardiac cause exclusion criteria: drug overdose, a known traumatic event, electrocution, or primary airway obstruction. Other non-cardiac causes were not excluded.

36. Jasinskas N, Vaitkaitis D, Pilvinis V, Jancaityte L, Bernotiene G, Doboziuskas P. The dependence of successful resuscitation on electrocardiographically documented cardiac rhythm in case of out-of-hospital cardiac arrest. *Medicina (Kaunas)*. 2007; 43:798-802.

LOE4, neutral, fair

37. Jennings PA, Cameron P, Walker T, Bernard S, Smith K. Out-of-hospital cardiac arrest in Victoria: rural and urban outcomes. *Med J Aust*. 2006; 185:135-139.

LOE4, neutral, fair

Imprecise time span: January 2002 and December 2003. Unknown causes were excluded (-> non traumatic).

38. Joyce SM, Davidson LW, Manning KW, Wolsey B, Topham R. Outcomes of sudden cardiac arrest treated with defibrillation by emergency medical technicians (EMT-Ds) or paramedics in a two-tiered urban EMS system. *Prehosp Emerg Care*. 1998; 2:13-17.

LOE4, neutral, poor

Exclusion criteria used were: obvious noncardiac cause (e.g., trauma, drowning, overdose, electrocution, asthma attack), or pre-existing chronic illness that might be expected to cause cardiac arrest [e.g., terminal cancer, end-stage renal failure, end-stage chronic obstructive pulmonary disease, sepsis, AIDS]. Unknown causes added to cardiac cause?

Population was 160,000, but working population was 350,000.

39. Kämäräinen A, Virkkunen I, Yli-Hankala A, Silfvast T. Presumed futility in paramedic-treated out-of-hospital cardiac arrest: an Utstein style analysis in Tampere, Finland. *Resuscitation*. 2007; 75:235-243.

LOE4, neutral, fair

40. Kass LE, Eitel DR, Sabulsky NK, Ogden CS, Hess DR, Peters KL. One-year survival after prehospital cardiac arrest: the Utstein style applied to a rural-suburban system. *Am J Emerg Med*. 1994; 12:17-20.

LOE4, neutral, fair

41. Kellermann AL, Hackman BB, Somes G. Predicting the outcome of unsuccessful prehospital advanced cardiac life support. *JAMA*. 1993; 270:1433-1436.

LOE4, neutral, poor

Patients were victims of out-of-hospital cardiac arrest due to heart disease, definition is lacking

42. Kentsch M, Schlichting H, Mathes N, Rodemerk U, Ittel TH. Out-of-hospital cardiac arrest in north-east Germany: increased resuscitation efforts and improved survival. *Resuscitation*. 2000; 43:177-183.

LOE4, neutral, fair

43. Kette F, Pellis T; Pordenone Cardiac Arrest Cooperative Study Group (PACS). Increased survival despite a reduction in out-of-hospital ventricular fibrillation in north-east Italy. *Resuscitation*. 2007; 72:52-58.

LOE4, neutral, fair

44. Kuilman M, Bleeker JK, Hartman JA, Simoons ML. Long-term survival after out-of-hospital cardiac arrest: an 8-year follow-up. *Resuscitation*. 1999; 41:25-31.

LOE4, neutral, fair

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

LOE4, neutral, fair

46. Layon AJ, Gabrielli A, Goldfeder BW, Hevia A, Idris AH. Utstein style analysis of rural out-of-hospital cardiac arrest [OOHCA]: total cardiopulmonary resuscitation (CPR) time inversely correlates with hospital discharge rate. *Resuscitation*. 2003; 56:59-66.

LOE4, neutral, fair

47. Moore MJ, Glover BM, McCann CJ, Cromie NA, Ferguson P, Catney DC, Kee F, Adgey AA. Demographic and temporal trends in out of hospital sudden cardiac death in Belfast. *Heart*. 2006; 92:311-315.

LOE4, neutral, good

Describes incidence adjusted for European male and female population. Unfortunately not also 1 incidence for total population is given – makes is easier to compare.

48. Mosesso VN Jr, Davis EA, Auble TE, Paris PM, Yealy DM. Use of automated external defibrillators by police officers for treatment of out-of-hospital cardiac arrest. *Ann Emerg Med*. 1998; 32:200-207.

LOE4, neutral, poor

The paper describes OHCA of cardiac cause as ‘nontraumatic’ cases. Definition of ‘nontraumatic’ is lacking.

49. Muraoka H, Ohishi Y, Hazui H, Negoro N, Murai M, Kawakami M, Nishihara I, Fukumoto H, Morita H, Hanafusa T. Location of out-of-hospital cardiac arrests in Takatsuki City: where should automated external defibrillator be placed. *Circ J*. 2006; 70:827-831.

LOE4, neutral, fair

50. Myerburg RJ, Fenster J, Velez M, Rosenberg D, Lai S, Kurlansky P, Newton S, Knox M, Castellanos A. Impact of community-wide police car deployment of automated external defibrillators on survival from out-of-hospital cardiac arrest. *Circulation*. 2002; 106:1058-1064.

LOE4, neutral, poor

Inclusion: loss of consciousness, not anticipated by prior clinical or hemodynamic status, in the absence of trauma or other exogenous influences as a definable precipitating event. What defines prior clinical status? Are those patients with a heart condition or terminal disease? What about non-cardiac endogenous influences?

51. 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; 300:1423-1431.

LOE4, neutral, good

The paper presents incidence rates adjusted for age and gender of census population. Flow of data exclusion is clearly described.

52. Nishiuchi T, Hiraide A, Hayashi Y, Uejima T, Morita H, Yukioka H, Shigemoto T, Ikeuchi H, Matsusaka M, Iwami T, Shinya H, Yokota J. Incidence and survival rate of bystander-witnessed out-of-hospital cardiac arrest with cardiac etiology in Osaka, Japan: a population-based study according to the Utstein style. *Resuscitation*. 2003; 59:329-335.

LOE4, neutral, fair

53. Olasveengen TM, Samdal M, Steen PA, Wik L, Sunde K. Effect of implementation of new resuscitation guidelines on quality of cardiopulmonary resuscitation and survival. *Resuscitation*. 2009; 80:407-411.

LOE4, neutral, fair

54. Ong ME, Ng FS, Anushia P, Tham LP, Leong BS, Ong VY, Tiah L, Lim SH, Anantharaman V. Comparison of chest compression only and standard cardiopulmonary resuscitation for out-of-hospital cardiac arrest in Singapore. *Resuscitation*. 2008; 78:119-126.

LOE4, neutral, poor

Exclusion: traumatic arrests, including choking, suffocation, traffic accidents, falls, drowning, poisoning, and other injury. Other non cardiac causes were not excluded.

55. Pepe PE, Levine RL, Fromm RE Jr, Curka PA, Clark PS, Zachariah BS. Cardiac arrest presenting with rhythms other than ventricular fibrillation: contribution of resuscitative efforts toward total survivorship. *Crit Care Med*. 1993; 21:1838-1843.

LOE4, neutral, poor

Cases were excluded if in case of trauma, drugs, airway obstruction, submersion or primary respiratory illness. Other non-cardiac causes seemed to be included.

56. Pleskot M, Babu A, Kajzr J, Kvasnicka J, Stritecky J, Cermakova E, Mestan M, Parizek P, Tauchman M, Tusl Z, Perna P. Characteristics and short-term survival of individuals with out-of-hospital cardiac arrests in the East Bohemian region. *Resuscitation*. 2006; 68: 209-220.

LOE4, neutral, poor

Population given does not account for age limit. Probable cardiac cause includes unknown cause. Hard to follow exclusion tree: 718 were considered for CPR by dispatcher, exclusion criteria are given, CPR was attempted in 574 cases, then 560 are resuscitated with cardiac cause. Unclear why there is a discrepancy between CPR attempt with exclusion criteria and included cardiac cause cases.

57. Polentini MS, Pirrallo RG, McGill W. The changing incidence of ventricular fibrillation in Milwaukee, Wisconsin (1992-2002). *Prehosp Emerg Care*. 2006; 10:52-60.

LOE4, neutral, poor

No precise timeframe: 1992-2002. Population not adjusted for age limit.

58. Rainer TH, Gordon MW, Robertson CE, Cusack S. Evaluation of outcome following cardiac arrest in patients presenting to two Scottish emergency departments. *Resuscitation*. 1995; 29:33-39.

LOE4, neutral, poor

Limited, yet specific exclusion criteria for cardiac cause: poisoning, near drowning and pregnancy. This makes 'cardiac cause' OHCA broadly defined and not well comparable to other studies that reported cardiac cause arrest.

59. Rea TD, Eisenberg MS, Becker LJ, Lima AR, Fahrenbruch CE, Copass MK, Cobb LA. Emergency medical services and mortality from heart disease: a community study. *Ann Emerg Med*. 2003; 41:494-499.

LOE4, neutral, fair

60. Roth R, Stewart RD, Rogers K, Cannon GM. Out-of-hospital cardiac arrest: factors associated with survival. *Ann Emerg Med.* 1984; 13:237-243.

LOE4, neutral, fair

61. Rudner R, Jalowiecki P, Karpel E, Dziurdzik P, Alberski B, Kawecki P. Survival after out-of-hospital cardiac arrests in Katowice (Poland): outcome report according to the "Utstein style". *Resuscitation.* 2004; 61:315-325.

LOE4, neutral, fair

62. Sekimoto M, Noguchi Y, Rahman M, Hira K, Fukui M, Enzan K, Inaba H, Fukui T. Estimating the effect of bystander-initiated cardiopulmonary resuscitation in Japan. *Resuscitation.* 2001; 50:153-160.

LOE4, neutral, poor

Imprecise time frame of data collection: "1995-1998, 1997-1998, 1998-1999".

The definition for the cases of OHCA of presumed cardiac etiology was "conformed to the Utstein style".

63. Shiraki T, Osawa K, Suzuki H, Yoshida M, Takahashi N, Takeuchi K, Tanakaya M, Kohno K, Saito D. Incidence and outcomes of out-of-hospital cardiac arrest in the eastern part of Yamaguchi prefecture. *Int Heart J.* 2009; 50:489-500.

LOE4, neutral, fair

64. Sipria A, Novak V, Veber A, Popov A, Reinhard V, Slavin G. Out-of-hospital resuscitation in Estonia: a bystander-witnessed sudden cardiac arrest. *Eur J Emerg Med.* 2006; 13:14-20.

LOE4, neutral, fair

65. Skogvoll E, Sangolt GK, Isern E, Gisvold SE. Out-of-hospital cardiopulmonary resuscitation: a population-based Norwegian study of incidence and survival. *Eur J Emerg Med.* 1999; 6:323-330.

LOE4, neutral, good

The article presents adjusted incidences, clearly shows what the denominators of the calculations are.

66. 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; 81:47-52.

LOE4, neutral, fair

67. Steinmetz J, Barnung S, Nielsen SL, Risom M, Rasmussen LS. Improved survival after an out-of-hospital cardiac arrest using new guidelines. *Acta Anaesthesiol Scand.* 2008; 52:908-913.

LOE4, neutral, fair

68. Stueven HA, Waite EM, Troiano P, Mateer JR. Prehospital cardiac arrest--a critical analysis of factors affecting survival. *Resuscitation*. 1989; 17:251-259.
- LOE4, neutral, fair*
69. Szczygiel M, Wright R, Wagner E, Holcomb MS. Prognostic indicators of ultimate long-term survival following advanced life support. *Ann Emerg Med*. 1981; 10:566-570.
- LOE4, neutral, poor*
Only OHCA caused by trauma were excluded to define 'cardiac cause'.
70. Tadel S, Horvat M, Noc M. Treatment of out-of-hospital cardiac arrest in Ljubljana: outcome report according to the 'Utstein' style. *Resuscitation*. 1998; 38:169-176.
- LOE4, neutral, fair*
71. Vaillancourt C, Stiell IG; Canadian Cardiovascular Outcomes Research Team. Cardiac arrest care and emergency medical services in Canada. *Can J Cardiol*. 2004; 20:1081-1090.
- LOE4, neutral, fair*
72. Valenzuela TD, Roe DJ, Cretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model. *Circulation*. 1997; 96:3308-3313.
- LOE4, neutral, poor*
Population not corrected for age limit. Imprecise study time: "data were collected from 1988 through 1993". Clear definition of cardiac cause arrest: "Cases in which the cardiac arrest was the result of a suicide, drowning, electrocution, hanging, suffocation, known terminal illness, drug overdose, or sudden infant death syndrome were not considered."
73. Waalewijn RA, de Vos R, Koster RW. Out-of-hospital cardiac arrests in Amsterdam and its surrounding areas: results from the Amsterdam resuscitation study (ARREST) in Utstein style. *Resuscitation*. 1998; 38:157-167.
- LOE4, neutral, fair*
74. Westfal RE, Reissman S, Doering G. Out-of-hospital cardiac arrests: an 8-year New York City experience. *Am J Emerg Med*. 1996; 14:364-368.
- LOE4, neutral, fair*
75. Weston CF, Wilson RJ, Jones SD. Predicting survival from out-of-hospital cardiac arrest: a multivariate analysis. *Resuscitation*. 1997; 34:27-34.
- LOE4, neutral, fair*
76. Weydahl PG, Stoen AM, Jorgensen B, Arnulf V, Steen PA. Utstein registration used as a tool in organisational development. *Resuscitation*. 1999; 40:103-106.

LOE4, neutral, poor

No start or end date of the study is given, just that it was performed in '1997'. Unclear what is meant by cardiac cause of the arrest.

77. White RD, Hankins DG, Bugliosi TF. Seven years' experience with early defibrillation by police and paramedics in an emergency medical services system. *Resuscitation*. 1998; 39:145-151.

LOE4, neutral, poor

Timeline is not precise: November 1990 through to November 1997. Patient inclusion: "atraumatic cardiac arrest of documented or presumed cardiac cause."

78. Woodall J, McCarthy M, Johnston T, Tippet V, Bonham R. Impact of advanced cardiac life support-skilled paramedics on survival from out-of-hospital cardiac arrest in a statewide emergency medical service. *Emerg Med J*. 2007; 24:134-138.

LOE4, neutral, fair

79. Wright D, Bannister J, Ryder M, Mackintosh AF. Resuscitation of patients with cardiac arrest by ambulance staff with extended training in West Yorkshire. *BMJ*. 1990; 301:600-602.

LOE4, neutral, poor

Exclusion criteria: "Victims of trauma, suffocation, and drowning were not included." Utstein template criteria are more explicit: "An arrest is presumed to be of cardiac aetiology unless it is known or likely to have been caused by trauma, submersion, drug overdose, asphyxia, exsanguination, or any other noncardiac cause as best determined by rescuers." Therefore, the number of cases given probably also includes non-cardiac causes.