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

**Worksheet author(s)**

<table>
<thead>
<tr>
<th>Jocelyn Berdowski</th>
<th>Date Submitted for review:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 Jan 2010</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Good</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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, p1268
  - 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
- Fabbi A, 2006, p180
- Fischer M, 1997, p233
- Garza AG, 2009, p2597
- Giraud F, 1996, p19
- Goudevenos, 1995, p67
- Grmec S, 2009, p7
- Gruska M, 2005, p107
- Hayashi H, 2005, p49
- Hollenberg J, 2008, p389
- Hu SC, 1994, p491
- Iwami T, 2007, p2900
- 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
- Sharrick 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
- 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
- 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
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of evidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Good</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of evidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 no 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 (±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).

<table>
<thead>
<tr>
<th></th>
<th>All ages included</th>
<th>Adult only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence out-of-hospital cardiac arrest (n=5)</td>
<td>82.9 (21.4)</td>
<td>213.1 (177)</td>
</tr>
<tr>
<td>Incidence patients considered for CPR (n=34)</td>
<td>76.3 (35.7)</td>
<td>95.9 (30.5)</td>
</tr>
<tr>
<td>Incidence arrest with CPR initiated (n=55)</td>
<td>41.5 (18.4)</td>
<td>64.2 (19.9)</td>
</tr>
<tr>
<td>Incidence arrest with CPR initiated, cardiac cause (n=87)</td>
<td>40.5 (17.1)</td>
<td>61.8 (37.7)</td>
</tr>
<tr>
<td>Adjusted incidence arrest with CPR initiated, cardiac cause (n=14)</td>
<td>56.6 (13.7)</td>
<td>84.7 (58.8)</td>
</tr>
<tr>
<td>Percentage CPR initiated (n=43)</td>
<td>72.3 (20.4)</td>
<td>68.9 (25.6)</td>
</tr>
<tr>
<td>Percentage cardiac etiology (n=48)</td>
<td>71.8 (12.4)</td>
<td>72.0 (11.8)</td>
</tr>
</tbody>
</table>

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 indispensible 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.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Article</th>
<th>Study period</th>
<th>Time span (months)</th>
<th>Study population</th>
<th>Inc OHCA*</th>
<th>Inc considered for CPR†</th>
<th>Inc CPR initiated§</th>
<th>% CPR initiated</th>
<th>% CPR cardiac cause</th>
<th>Included age#</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Europe</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vienna, Austria*20</td>
<td>Gruska M, 2005, p107</td>
<td>1995-1996</td>
<td>24</td>
<td>1 508 120</td>
<td>49.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Bohemian region, Czech Republic26</td>
<td>Pleskot M, 2006, p209</td>
<td>2002-2004</td>
<td>29</td>
<td>1 236 000</td>
<td>24.0</td>
<td></td>
<td>19.2</td>
<td>18.7</td>
<td>80%</td>
<td>98%</td>
</tr>
<tr>
<td>Copenhagen, Denmark57</td>
<td>Pleskot M, 2006, p209, Steinmetz J, 2008, p908</td>
<td>2004-2007</td>
<td>30</td>
<td>593 000</td>
<td>53.4</td>
<td></td>
<td>28.3</td>
<td>72%</td>
<td>53%</td>
<td></td>
</tr>
<tr>
<td>Nottinghamshire, England66</td>
<td>Soo LH, 1999, p47</td>
<td>1991-1994</td>
<td>48</td>
<td>1 000 000</td>
<td>155.7</td>
<td></td>
<td>52.4</td>
<td>38.7</td>
<td>34%</td>
<td>74%</td>
</tr>
<tr>
<td>West Yorkshire, England79</td>
<td>Wright D, 1990, p600</td>
<td>1987-1989</td>
<td>21</td>
<td>1 644 689**</td>
<td>41.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≥18</td>
</tr>
<tr>
<td>Estonia84</td>
<td>Sipria A, 2006, p14</td>
<td>1999-2002</td>
<td>48</td>
<td>1 370 000</td>
<td>80.0</td>
<td></td>
<td>38.5</td>
<td>25.9</td>
<td>48%</td>
<td>67%</td>
</tr>
<tr>
<td>Helsinki, Finland45</td>
<td>Kuismäki M, 1996, p18</td>
<td>1994</td>
<td>12</td>
<td>516 000</td>
<td>173.6</td>
<td></td>
<td>66.7</td>
<td>49.4</td>
<td>38%</td>
<td>74%</td>
</tr>
<tr>
<td>Tampere, Finland36</td>
<td>Kämäräinen A, 2007, p235</td>
<td>2004-2005</td>
<td>12</td>
<td>203 000</td>
<td>94.1</td>
<td></td>
<td>45.8</td>
<td>35.5</td>
<td>49%</td>
<td>77%</td>
</tr>
<tr>
<td>Saint-Etienne, France75</td>
<td>Giraud F, 1996, p19</td>
<td>1991-1992</td>
<td>12</td>
<td>571 191</td>
<td>66.5</td>
<td></td>
<td>41.0</td>
<td>19.8</td>
<td>62%</td>
<td>48%</td>
</tr>
<tr>
<td>Bonn, Germany73</td>
<td>Fischer M, 1997, p233</td>
<td>1989-1992</td>
<td>48</td>
<td>240 000</td>
<td>62.7</td>
<td></td>
<td>55.2</td>
<td>48.3</td>
<td>88%</td>
<td>88%</td>
</tr>
<tr>
<td>Dachau, Germany19</td>
<td>Estner HL, 2007, p792</td>
<td>2000-2006</td>
<td>72</td>
<td>134 019</td>
<td>101.2</td>
<td></td>
<td>67.0</td>
<td>51.2</td>
<td>66%</td>
<td>76%</td>
</tr>
<tr>
<td>Heidelberg, Germany8</td>
<td>Böttiger BW, 1999, p674</td>
<td>1992-1994</td>
<td>36</td>
<td>330 000</td>
<td>76.3</td>
<td></td>
<td>51.7</td>
<td>34.1</td>
<td>68%</td>
<td>66%</td>
</tr>
<tr>
<td>Stralsund, north-east Germany42</td>
<td>Kentsch, 2000, p177</td>
<td>1984-1988</td>
<td>60</td>
<td>75 000</td>
<td>14.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stralsund, north-east Germany42</td>
<td>Kentsch, 2000, p177</td>
<td>1991-1997</td>
<td>84</td>
<td>63 000</td>
<td>61.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ioannina area, Greece26</td>
<td>Goudevenos JA 1995, p67</td>
<td>1990-1993</td>
<td>42</td>
<td>160 000</td>
<td>53.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30-70</td>
</tr>
<tr>
<td>Forli, Italia20</td>
<td>Fabbri A, 2006, p180</td>
<td>1994-2004</td>
<td>126</td>
<td>138 510**</td>
<td>111.3</td>
<td>68.6</td>
<td>68.6</td>
<td>58.0</td>
<td>62%</td>
<td>84%</td>
</tr>
<tr>
<td>Piacenza region, Italy7</td>
<td>Capucci, 2002, p1065</td>
<td>1999-2001</td>
<td>22.8</td>
<td>173 114</td>
<td>107.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pordenone province, Italy43</td>
<td>Kette F, 2007, p52</td>
<td>2003-2004</td>
<td>13</td>
<td>290 229</td>
<td>166.0</td>
<td></td>
<td>78.6</td>
<td>61.7</td>
<td>47%</td>
<td>79%</td>
</tr>
<tr>
<td>Kaunas city, Lithuania36</td>
<td>Jasinskas N, 2007, p789</td>
<td>2005</td>
<td>12</td>
<td>360 627</td>
<td>20.0</td>
<td></td>
<td>17.2</td>
<td>86%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amsterdam, the Netherlands73</td>
<td>de Vreede-Swagemakers JJ, 1997, p1500</td>
<td>1995-1997</td>
<td>27</td>
<td>1 300 000</td>
<td>57.6</td>
<td></td>
<td>43.9</td>
<td>35.8</td>
<td>76%</td>
<td>81%</td>
</tr>
<tr>
<td>Maastricht, the Netherlands33</td>
<td>Kuilman M, 1999, p25</td>
<td>1991-1994</td>
<td>48</td>
<td>132 762</td>
<td>97.0</td>
<td></td>
<td>44.6</td>
<td></td>
<td>20-75</td>
<td></td>
</tr>
<tr>
<td>Rotterdam, the Netherlands44</td>
<td>Kooyman L, 1999, p25</td>
<td>1988-1994</td>
<td>84</td>
<td>598 694</td>
<td>21.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oslo, Norway53</td>
<td>Olausvaengen TM, 2009, p407</td>
<td>2003-2007</td>
<td>36</td>
<td>436 265**</td>
<td>70.1</td>
<td></td>
<td>48.5</td>
<td>69%</td>
<td></td>
<td>≥18</td>
</tr>
<tr>
<td>Ostfold county, Norway76</td>
<td>Weydahl PG, 1999, p103</td>
<td>1997</td>
<td>12</td>
<td>241 151</td>
<td>70.5</td>
<td></td>
<td>67.6</td>
<td>96%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trondheim, Norway65</td>
<td>Skogvol E, 1999, p163</td>
<td>1990-1994</td>
<td>48</td>
<td>154 000</td>
<td>85.6</td>
<td></td>
<td>71.8</td>
<td>84%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katowice, Poland61</td>
<td>Rudner R, Forli, 2004, p315</td>
<td>2001-2002</td>
<td>12</td>
<td>338 000</td>
<td>114.8</td>
<td></td>
<td>55.6</td>
<td>43.5</td>
<td>48%</td>
<td>78%</td>
</tr>
<tr>
<td>Edinburgh, Scotland58</td>
<td>Rainer TH, 1995, p33</td>
<td>1991</td>
<td>12</td>
<td>659 545**</td>
<td>45.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≥13</td>
</tr>
<tr>
<td>Glasgow, Scotland48</td>
<td>Rainer TH, 1995, p33</td>
<td>1991</td>
<td>12</td>
<td>171 290**</td>
<td>92.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≥13</td>
</tr>
<tr>
<td>Location</td>
<td>Source</td>
<td>Year(s)</td>
<td>Population</td>
<td>Male Death Rate</td>
<td>Female Death Rate</td>
<td>Population at Risk</td>
<td>Cancer Mortality Rate</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------</td>
<td>---------------</td>
<td>------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maribor, Slovenia</td>
<td>Grmec S, 2009, p7</td>
<td>1998-2007</td>
<td>108</td>
<td>158,800*</td>
<td>82.1</td>
<td>55.1</td>
<td>36.9</td>
<td>67%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% of Sweden</td>
<td>Hollenberg J, 2008, p389</td>
<td>1992-2005</td>
<td>168</td>
<td>8,900,000</td>
<td>31.0</td>
<td>21.3</td>
<td>69%</td>
<td>all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Glamorgan, Wales</td>
<td>Weston CF, 1997, p27</td>
<td>1989-1992</td>
<td>81.85</td>
<td>400,000</td>
<td>35.0</td>
<td>26.9</td>
<td>77%</td>
<td>all</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edmonton, Alberta Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>616,741</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>British Colombia, Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>3,282,061</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vancouver, Canada</td>
<td>Nichol G, 2008, p1423</td>
<td>2006-2007</td>
<td>12</td>
<td>2,779,373</td>
<td>85.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchener/Waterloo Ontario</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>239,463</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niagra Falls Ontario Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>75,399</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St Catherenes Ontario Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>129,300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudbury Ontario Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>92,884</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thunder Bay Ontario Canada</td>
<td>Vaillancourt C, 2004, p1081</td>
<td>2002</td>
<td>12</td>
<td>113,964</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Montreal Metro, Quebec Canada</td>
<td>2002</td>
<td>12</td>
<td>2,352,473</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alachua County, FL</td>
<td>Layon AJ, 2003, p59</td>
<td>1998</td>
<td>12</td>
<td>211,403</td>
<td>79.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dallas</td>
<td>Nichol G, 2008, p1423</td>
<td>2006-2007</td>
<td>12</td>
<td>1,989,357</td>
<td>123.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Author</td>
<td>Year</td>
<td>Population</td>
<td>Case Fatality</td>
<td>Death Rate</td>
<td>Age</td>
<td>Notes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------</td>
<td>------------</td>
<td>------------</td>
<td>---------------</td>
<td>------------</td>
<td>-----</td>
<td>------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delaware County, IN</td>
<td>Groh WJ</td>
<td>1995-1996</td>
<td>24</td>
<td>89 866**</td>
<td>72.3</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>Dunne RB</td>
<td>2002</td>
<td>6</td>
<td>654 550**</td>
<td>164.4</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamilton County, IN</td>
<td>Groh WJ</td>
<td>1995-1996</td>
<td>24</td>
<td>109 123**</td>
<td>39.9</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Houston, TX</td>
<td>Pepe PE</td>
<td>1989-1990</td>
<td>24</td>
<td>1 305 000**</td>
<td>92.1</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Howard County, IN</td>
<td>Groh WJ</td>
<td>1995-1996</td>
<td>24</td>
<td>63 275**</td>
<td>49.0</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iowa</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 015 347</td>
<td>101.2</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Johnson County, KS</td>
<td>Groh WJ</td>
<td>1995-1996</td>
<td>24</td>
<td>109 123**</td>
<td>39.9</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas City, MO</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>940 164</td>
<td>85.2</td>
<td>≥21</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>King County WA</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>935 967</td>
<td>130.0</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 751 119</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memphis, TE</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 666 978</td>
<td>140.9</td>
<td>74.7</td>
<td>84%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miami-Dade County, FL</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>940 164</td>
<td>130.0</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>935 967</td>
<td>130.0</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milwaukee, WI</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 751 119</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York City, NY</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 666 978</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oakland County, Mi</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>935 967</td>
<td>130.0</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olmsted County MN</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 751 119</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pittsburgh, PE</td>
<td>Nathanson SM</td>
<td>1995-1996</td>
<td>24</td>
<td>89 866**</td>
<td>72.3</td>
<td>81%</td>
<td>84%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>Nathanson SM</td>
<td>1995-1996</td>
<td>24</td>
<td>89 866**</td>
<td>72.3</td>
<td>81%</td>
<td>84%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 751 119</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rochester, MN</td>
<td>White RD</td>
<td>1990-1997</td>
<td>84</td>
<td>74 511</td>
<td>47.2</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rochester, NY</td>
<td>Williams JD</td>
<td>1990-1997</td>
<td>84</td>
<td>74 511</td>
<td>47.2</td>
<td></td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt Lake City, UT</td>
<td>Joyce SM</td>
<td>1992-1994</td>
<td>36</td>
<td>122 240**</td>
<td>87.8</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>Davis DP</td>
<td>2001-2002</td>
<td>18</td>
<td>1 300 000</td>
<td>58.5</td>
<td>all</td>
<td>84%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>Callahan AM</td>
<td>1992-1993</td>
<td>10.4</td>
<td>653 059**</td>
<td>70.8</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>Nichol G</td>
<td>2006-2007</td>
<td>12</td>
<td>1 666 978</td>
<td>140.9</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Town of Colonie, NY</td>
<td>Callahan AM</td>
<td>1992-1993</td>
<td>10.4</td>
<td>653 059**</td>
<td>70.8</td>
<td>≥18</td>
<td>all</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucson, AZ</td>
<td>Kass LE</td>
<td>1988-1989</td>
<td>24</td>
<td>410 000</td>
<td>87.0</td>
<td>87.0</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>York-Adams counties, PA</td>
<td>Kass LE</td>
<td>1988-1989</td>
<td>24</td>
<td>410 000</td>
<td>87.0</td>
<td>87.0</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country/City</td>
<td>Study Ref.</td>
<td>Year Range</td>
<td>Population</td>
<td>Incidence</td>
<td>Age</td>
<td>Bystanders</td>
<td>Cause</td>
<td>Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
<td>-----</td>
<td>------------</td>
<td>-------</td>
<td>----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80% of Israel</td>
<td>Eisenberg MS, 1988, p319 Sekimoto M, 2001, p153</td>
<td>1984-1985</td>
<td>24</td>
<td>3 287 000</td>
<td>58.8</td>
<td>54.7</td>
<td>45.6</td>
<td>93%</td>
<td>83%</td>
<td>all</td>
</tr>
<tr>
<td>Akita, Japan</td>
<td>Sekimoto M, 2001, p153</td>
<td>1995-1998</td>
<td>36</td>
<td>316 000</td>
<td>98.4</td>
<td>67.3</td>
<td>26.2</td>
<td>68%</td>
<td>39%</td>
<td>all</td>
</tr>
<tr>
<td>Itsumo, Japan</td>
<td>Sekimoto M, 2001, p153</td>
<td>1998-1999</td>
<td>24</td>
<td>128 000</td>
<td>52.3</td>
<td>31.3</td>
<td>15.6</td>
<td>60%</td>
<td>50%</td>
<td>all</td>
</tr>
<tr>
<td>Okayama city, Japan</td>
<td>Hayashi H, 2005, p49 Nishiuchi T, 2003, p329</td>
<td>2003-2004</td>
<td>12</td>
<td>647 879</td>
<td>56.0</td>
<td>50.0</td>
<td>27.6</td>
<td>49%</td>
<td>all</td>
<td></td>
</tr>
<tr>
<td>Osaka, Japan</td>
<td>Nishiuchi T, 2003, p329</td>
<td>1998-1999</td>
<td>12</td>
<td>8 832 606</td>
<td>57.1</td>
<td>55.1</td>
<td>34.5</td>
<td>97%</td>
<td>63%</td>
<td>all</td>
</tr>
<tr>
<td>Osaka, Japan</td>
<td>Iwami T, 2007, 2900 Sekimoto M, 2001, p153</td>
<td>1998-2003</td>
<td>60</td>
<td>7 257 500**</td>
<td>67.1</td>
<td>64.6</td>
<td>37.8</td>
<td>96%</td>
<td>58%</td>
<td>≥18</td>
</tr>
<tr>
<td>Otsu, Japan</td>
<td>Muraoka H, 2006, p827</td>
<td>1997-1998</td>
<td>24</td>
<td>306 000</td>
<td>66.5</td>
<td>49.2</td>
<td>25.5</td>
<td>74%</td>
<td>52%</td>
<td>all</td>
</tr>
<tr>
<td>Takatsuki City, Japan</td>
<td>Shariki T, 2009, p489</td>
<td>2002-2008</td>
<td>72</td>
<td>142 000</td>
<td>83.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yamaguchi, Japan</td>
<td>Ong ME, 2003, p427</td>
<td>2001-2002</td>
<td>7</td>
<td>4 100 000</td>
<td>20.9</td>
<td>20.9</td>
<td>14.7</td>
<td>100%</td>
<td>70%</td>
<td>all</td>
</tr>
<tr>
<td>Singapore</td>
<td>Hu SC, 1994, p491</td>
<td>1992-1993</td>
<td>10</td>
<td>2 700 000</td>
<td>28.4</td>
<td>24.6</td>
<td>87%</td>
<td>all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sydney, Australia</td>
<td>Baker PW, 2008, p424</td>
<td>2005-2007</td>
<td>25</td>
<td>1 214 875**</td>
<td>128.2</td>
<td>55.3</td>
<td>43%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melbourne, Australia</td>
<td>Finn JC, 2001, p247</td>
<td>1996-1999</td>
<td>48</td>
<td>1 079 381**</td>
<td>85.0</td>
<td>34.9</td>
<td>29.5</td>
<td>41%</td>
<td>84%</td>
<td>≥16</td>
</tr>
<tr>
<td>Queensland, Australia</td>
<td>Woodall J, 2007, p134</td>
<td>2000-2002</td>
<td>36</td>
<td>2 887 709**</td>
<td>102.0</td>
<td>53.5</td>
<td>39.8</td>
<td>52%</td>
<td>74%</td>
<td>≥18</td>
</tr>
<tr>
<td>Sydney, Australia</td>
<td>Cheung W, 2006, p321</td>
<td>2004-2005</td>
<td>12</td>
<td>3 993 000</td>
<td>50.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victoria, Australia</td>
<td>Jennings PA, 2006, p135</td>
<td>2002-2003</td>
<td>24</td>
<td>3 587 963**</td>
<td>125.1</td>
<td>55.2</td>
<td>46.4</td>
<td>44%</td>
<td>84%</td>
<td>≥17</td>
</tr>
<tr>
<td>Auckland, New Zealand</td>
<td>Crone PD, 1995, p297</td>
<td>1991-1993</td>
<td>36</td>
<td>935 000</td>
<td>41.9</td>
<td>38.1</td>
<td>91%</td>
<td>all</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** 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
Citation list


   LOE4, neutral, fair


   LOE4, neutral, fair


   LOE4, neutral, good

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


   LOE4, neutral, poor


   Abstract

   LOE4, neutral, fair


   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.


   LOE4, neutral, fair

LOE4, neutral, good
The study reported age-standardised incidence of OHCA.


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.


LOE4, neutral, good
Also included all SCD cases.


LOE4, neutral, fair


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”?


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.


LOE4, neutral, fair


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.”


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.


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.


LOE4, neutral, fair


LOE4, neutral, fair


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.


LOE4, neutral, fair

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.


LOE4, neutral, good
Adult only study, the incidence was adjusted for adult population.


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, poor
Imprecise the time span of the study given: “1995, 1996”.


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, fair


LOE4, neutral, fair


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.


LOE4, neutral, fair


LOE4, neutral, fair
Imprecise time span: January 2002 and December 2003. Unknown causes were excluded (-> non traumatic).

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.


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


LOE4, neutral, fair


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.


LOE4, neutral, poor

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


LOE4, neutral, fair


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?


LOE4, neutral, good

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


LOE4, neutral, fair

*LOE4, neutral, fair*


*LOE4, neutral, poor*

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


*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.


*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.


*LOE4, neutral, poor*


*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.


   LOE4, neutral, fair


   LOE4, neutral, poor
   Only OHCA caused by trauma were excluded to define ‘cardiac cause’.


   LOE4, neutral, fair


   LOE4, neutral, fair


   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.”


   LOE4, neutral, fair


   LOE4, neutral, fair


   LOE4, neutral, fair

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.


LOE4, neutral, poor
Timeline is not precise: November 1990 through to November 1997. Patient inclusion: “atraumatic cardiac arrest of documented or presumed cardiac cause.”


LOE4, neutral, fair


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.