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

**Worksheet author(s)**
Franklin HG BRIDGEWATER

**Date Submitted for review:**
20 October 2009

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**Clinical question.**

“In providers (lay or HCP) (P), does undertaking CPR/AED training/performance of actual CPR or usage of an AED (I) compared with no such training/performance (C) increase harm (e.g. infection or other adverse events) (O)?”

**Is this question addressing an intervention/therapy, prognosis or diagnosis?**
The question addresses an intervention/therapy.

**State if this is a proposed new topic or revision of existing worksheet:**
International guidelines for resuscitation published in 2005 recognized the essential link between cardiopulmonary resuscitation (CPR) and defibrillation with an automated external defibrillator (AED) as elements of basic life support (Anonymous, 2005, IV1) (Handley, 2005, S7). The remote possibility of disease transmission from CPR was noted together with a fire hazard associated with the use of an AED (Anonymous, 2005, IV1). This worksheet will address the question posed above. It will include and utilize the data submitted on the subject to the 2005 International Consensus on CPR and ECC Science with Treatment Recommendations (Bridgewater, 2005, Bridgewater, 2005) and review data available from January 2004 until January 2009 relating to both the training for, and the performance of, CPR.

**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).**

Search 1
EBM 1980-2008 Week 39
a. 1. Intervention - CPR and Training
   (Resuscitation/ OR cardiopulmonary arrest/ or heart arrest/ OR cardio?pulmonary resuscitation.mp. OR cardiac life support.mp. OR heart arrest.mp. OR resuscitat*.mp. OR cpr.mp. OR basic life support.mp.) AND (PARAMEDICAL EDUCATION/ or CONTINUING EDUCATION/ or ATHLETIC TRAINING EDUCATION/ or EDUCATION PROGRAM/ or RESEARCH BASED NURSING EDUCATION/ or RESIDENCY EDUCATION/ or INTERDISCIPLINARY EDUCATION/ or ALLIED HEALTH EDUCATION/ or EMERGENCY MEDICAL SERVICES EDUCATION/ or ADULT EDUCATION/ or OCCUPATIONAL THERAPY EDUCATION/ or EDUCATION/ or CLINICAL EDUCATION/ or NURSING EDUCATION/ or VOCATIONAL EDUCATION/ or CONTINUING EDUCATION PROVIDER/ or PATIENT EDUCATION/ or MEDICAL EDUCATION/ or HEALTH EDUCATION/ or SCHOOL HEALTH EDUCATION/ or education program/ or in service training/ or teaching/ or learning/ or course*.mp. OR educat*.mp. OR teach*.mp. OR learn*.mp. OR patient simulat*.mp. OR manikin*.mp. OR anatomic model*.mp. OR taught.mp. OR instruct*.mp. OR mannequin*.mp. OR simulat*.mp. OR dummy.mp.) 6065
   2. Outcome
   safety/ OR RISK MANAGEMENT/ or INFECTION RISK/ or RISK/ OR infection/ or communicable disease/ or cross infection/ or Disease Transmission/ OR "General Aspects of Disease"/ OR (wounds and injuries).mp. OR (THORAX INJURY/ or INTESTINE INJURY/ or TRACHEA INJURY/ or ACCIDENTAL INJURY/ or LUNG INJURY/ or SPLEEN INJURY/ or LIVER INJURY/ or BRONCHUS INJURY/ or MUSCULOSKELETAL INJURY/ or SHOULDER INJURY/ or TISSUE INJURY/ or NEEDLESTICK INJURY/ or NERVE INJURY/ or CERVICAL SPINE INJURY/ or DUODENUM INJURY/ or INJURY/ or NECK INJURY/ or DIAPHRAGM INJURY/ or ROTATOR CUFF INJURY/ or SKIN INJURY/ or HEART INJURY/ or ELBOW INJURY/ or HEART MUSCLE INJURY/ or ARM INJURY/ or PERIPHERAL NERVE INJURY/ or ESOPHAGUS INJURY/ or CAROTID ARTERY INJURY/ or LIMB INJURY/ or SOFT TISSUE INJURY/) OR Mental Stress/ OR Infection Control/ OR Risk Factor/ OR Virus Infection/ OR Bacterial Infection/ OR Communicable Disease/ OR safe*.mp. OR risk*.mp. OR disease*.mp. OR adverse.mp. OR pathogen*.mp. OR hazard*.mp. OR stress*.mp. OR harm*.mp. OR infect*.mp. OR infect*.mp. OR injur*.mp. OR contamina*.mp. 4202077
   3. CPR AND Outcome 23883
   4. CPR AND Training AND Outcome 3419
   5. CPR NOT Training 37045
   6. CPR NOT Training AND Outcome 204264
   7. Population
   exp health care personnel/ or health auxiliary/ or nursing home personnel/ or hospital physician/ or medical staff/ or resident/ or medical personnel/ or medical student/ or physician/ or paramedical personnel/ or nonmedical occupations/ OR Nurse/ OR Emergency Health Service/ or Health Care Personnel/ or Emergency Medicine/ or Rescuer Personnel/ or Emergency Medicine/ or bystander.mp. OR rescuer.mp. OR first aider.mp. OR (Paramedical Personnel/ or first responder.mp. or Emergency Health Service/ or Fire Fighter/) OR Voluntary Worker/ or lay.mp. OR laiety.mp. 288389
   8. CPR NOT Training AND Outcome AND Population 2090
   9. CPR NOT Training AND Outcome AND Population (human & English) 1722
   10. CPR AND Training AND Outcome AND Population 804
   This search was repeated subsequently with a total of 862 articles. All abstracts were reviewed.
   b. Twenty six articles were retrieved. **Five** were deemed relevant for inclusion. Two articles were noted to have already been detailed in the C2005 worksheet.
Search 2
PubMed
a. Search using the following terms
(((Cardiopulmonary resuscitation)[MeSH Terms] OR ([cardiopulmonary][All Fields] AND [resuscitation][All Fields]) OR "cardiopulmonary resuscitation"[All Fields]) AND [education][Subheading] OR "education"[All Fields] OR [educational status][MeSH Terms] OR ([educational][All Fields] AND [status][All Fields]) OR "educational status"[All Fields] OR [education][All Fields] OR [education][MeSH Terms] AND ([adverse effects][All Fields]) OR "adverse effects"[All Fields])

Translations:
Cardiopulmonary resuscitation  "cardiopulmonary resuscitation"[MeSH Terms] OR ([cardiopulmonary][All Fields] AND [resuscitation][All Fields]) OR "cardiopulmonary resuscitation"[All Fields]
Education "education"[Subheading] OR [education][All Fields] OR [educational status][MeSH Terms] OR ([educational][All Fields] AND [status][All Fields]) OR "educational status"[All Fields] OR [education][All Fields] OR [education][MeSH Terms]
Adverse effects [adverse effects][Subheading] OR ([adverse][All Fields] AND "effects"[All Fields]) OR "adverse effects"[All Fields]

This search produced a total of 55 articles.
b. All abstracts were reviewed. Eleven articles were retrieved. Two were finally relevant. Two others had been detailed in the worksheet for C2005.

Search 3
OVID forward search
http://www.americanheart.org/downloadable/heart/1105481470691i.traineeadverse.fhb.11dec04Final.pdf (accessed 2 February 2009) and

This produced 110 references
b. Search Ovid Advanced Search -Ovid MEDLINE(R) 1950 to November Week 3 2008 for each reference

This located 99 of the 110 references
b. Find citing articles for each of those 99 retrieved references
Twenty five references had not been cited again. Of the seventy four references cited subsequently, thirty four articles published before 2004 had been cited 291 times and forty articles published after 2004 had been cited 147 times
c. Review titles and abstracts of 147 articles after 2004. Fourteen articles were retrieved. Four were considered relevant.

Search 4
References cited by articles retrieved from Searches 2 and 3 were scanned. Twenty references were retrieved. Six were relevant. Four others had been detailed in C2005.

Search 5
Individual articles encountered in the search process were assessed and retrieved when considered appropriate. Fifteen references were finally deemed relevant.

Search 6
On 25 September 2009, the strategy of Search 1 was repeated. One hundred and forty one new articles were retrieved for a period commencing prior to the date of Search 1 first being conducted. Titles were reviewed and possibly relevant abstracts read. Articles incidentally encountered were reviewed and associated references retrieved. Five references were added to the data base.

Search 7
On 25 September 2009, the search strategy for Search 2 was repeated. Three new articles were retrieved for a period commencing prior to the date of Search 2 first being conducted. Titles were reviewed and possibly relevant abstracts read. No references were relevant.

Search 8
On 20 October, 2009, notification was received of a relevant article in press. This cited two further relevant articles. Three articles were added to the reference base.

• State inclusion and exclusion criteria:

Types of studies
Peer-reviewed studies indexed in PubMed and EMBASE were included for review. Where appropriate, additional relevant non-peer-reviewed published material in the form of letters, conference material, commentary, editorials and abstracts were included as background information.

Participants
Surgeons, surgical trainees (residents), physicians, allied health professionals, paramedical staff, nurses, medical students, or other people involved in CPR.

Only studies that reported on CPR/AED training, or reported on the performance of CPR/AED were included.

New intervention
CPR/AED training, or CPR/AED performance.

Comparative intervention
No CPR/AED training.

Outcomes
Studies that reported the following outcomes were included

Safety of the person performing CPR/AED which could include, but not be limited to Infection /injury.

Searches were conducted without language restriction. Foreign language papers were subsequently excluded unless the findings provided additional information over that reported in well designed studies published in the English language.
Articles were selected if the title or abstract contained information on CPR/AED. All study types were considered for inclusion. Articles were retrieved if they were judged to possibly meet the inclusion criteria. The researcher applied the selection criteria. In some cases, when the full text of the article was retrieved, closer examination revealed that it did not meet the inclusion criteria specified by the protocol. Consequently, these papers were not used to formulate the evidence base for the systematic review.

The reviewer noted that citations identified in the C2005 searching were not identified in the 2008 searching. There are reasons to account for this. Firstly, the searching performed in C2005 was more ad hoc than the systematic search recently performed. Hence, the reviewer may have searched opportunistically for a variety of text words which were not included in the 2008 searching. Secondly, the medical subject headings (MeSH) are revised annually by the National Library of Medicine. It may be that some of the MeSH searches performed in 2005 were invalid in the 2008 searching, and it cannot be assumed that automatic mapping captured the new MeSH.

Most of data retrieved did not meet the requirements of the present definitions for Levels of Evidence. Such data was necessarily placed at the lowest Level of Evidence i.e. LOE5.

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


Articles retrieved after C2005 Articles retrieved in final search before submission.
<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Evidence Supporting Lack of Harm of CPR/AED Training/Implementation</th>
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<tbody>
<tr>
<td><strong>Good</strong></td>
<td><em>(Ingram, 2006, 89)</em> HQS</td>
</tr>
<tr>
<td></td>
<td><em>(Riegel, 2006, 98)</em> HQS</td>
</tr>
<tr>
<td></td>
<td><em>(Anonymous, 2000, 29)</em> JPQRST</td>
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<td></td>
<td><em>(Anonymous, 2005, IV)</em> JPQRST</td>
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<td><em>(Anonymous, 2005, IV)</em> JPQRST</td>
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<td></td>
<td><em>(Anonymous, 2005, IV)</em> JPQRST</td>
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<tr>
<td></td>
<td><em>(Bridgewater, 2005)</em> G(Evb) JPQRST</td>
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<tr>
<td></td>
<td><em>(Mejicano, 1998, 813)</em> G(Evb) T</td>
</tr>
<tr>
<td></td>
<td><em>(Osterholm, 1979, 1263)</em> HPT</td>
</tr>
<tr>
<td></td>
<td><em>(Schratter, 2007, 420)</em> IQR</td>
</tr>
<tr>
<td></td>
<td><em>(Sepkowitz, 1996, 826)</em> Sepkowitz, 1996, 917* G(Evb) T</td>
</tr>
<tr>
<td><strong>Fair</strong></td>
<td><em>(Hallstrom, 2004, 637)</em> HQRS</td>
</tr>
<tr>
<td></td>
<td><em>(Dracup, 1997, 1434)</em> HPS</td>
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<td></td>
<td><em>(Moser, 2000, 270)</em> HPS</td>
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<td></td>
<td><em>(Moser, 1999, 326)</em> HPS</td>
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<td><em>(Sigsbee, 1990, 662)</em> HPS</td>
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<td></td>
<td><em>(Anonymous, 1978, 247)</em> HPT</td>
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<tr>
<td></td>
<td><em>(Anonymous, 1979, 3)</em> Axelsson, 1998, 13)* LQ</td>
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<tr>
<td></td>
<td><em>(Glaser, 1985, 1653)</em> HPT</td>
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<td></td>
<td><em>(Lloyd, 2008, 2510)</em> HQS</td>
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<td></td>
<td><em>(McCray, 1986, 1127)</em> HT</td>
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<td></td>
<td><em>(McDaniel, 1988, 2029)</em> HPS</td>
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<tr>
<td></td>
<td><em>(McLauchlan, 1992, 7)</em> HPS</td>
</tr>
<tr>
<td></td>
<td><em>(Marcus, 1988, 1118)</em> HT</td>
</tr>
<tr>
<td></td>
<td><em>(Miller, 1982)</em> LPR</td>
</tr>
<tr>
<td></td>
<td><em>(Peberdy, 2006, 59)</em> HQRS</td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td><em>(Cappato, 2006, 553)</em> HQRST</td>
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<tr>
<td></td>
<td><em>(Messmer, 1993, 217)</em> HPS</td>
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<tr>
<td></td>
<td><em>(Page, 2000, 1210)</em> HPS</td>
</tr>
<tr>
<td></td>
<td><em>(Capucci, 2003, 12)</em> HQRST</td>
</tr>
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</table>

1 2 3 4 5

* Level of Evidence
## Evidence Neutral to Lack of Harm of CPR/AED Training/Implementation

<table>
<thead>
<tr>
<th>Level of Evidence</th>
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<th>Poor</th>
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</tbody>
</table>

### Good Evidence

* (Hosmans, 2008, 216) IQR  
* (Cheung, 2009) HQRS  
(Anonymous, 1990, 1) JT  
(Ballard, 1986, 198) LQJ  
(Bass, 1994, 1359) G(Narr) T  
(Berumen, 1983, 253) NQJ  
* (Chalumeau, 2005, e29) HT  
(Christian, 2004, 287) HT  
(Clements, 2003, 379) HQR  
(Cohen, 1985, 136) NPT  
(Davis, 1979, 593) NQ  
* (Dickinson, 2008, 489) HQR  
(Edwards, 2001, 378) L  
(Feldman, 1972, 1107) G(Narr)  
(Figura, 1996) HQT  
(Finkelhor, 1980, 650) HQT  
(Gamble, 2001, 157) G(Narr) QJ  
(Gilston, 1979, 694) NQ  
(Greenberg, 1983, 194) HNP  
(Heiman, 1965, 1035) HQT  
(Hendricks, 1980, 257) HQT  
(Jacobson, 1976, 1053) MT  
(Khan, 1979, 2701) JPT  
*(Lechleuthner, 1995, 253) HQR  
(Lonergan, 1981, 793) IR  
(McCabe, 1997, 48K) G  
(Salzer, 1983, 195) NQ  
(Shimokawa, 2001, 290) HQR  
(Steinhoff, 2001, 159) HQT  
*(Sullivan, 2008, e712; author reply e713) NQR  
(Sullivan, 2000, 64) HPR  
* (Siniorakis, 2009, 293) HQR  
* (Theodorou, 2003, 677) HQR  
(Todd, 1980, 331) HQT  
(Vaiztzeucla, 1991, 90) HQT  
(Walker, 2001, 179) IR  
*(Thierbach, 2005, e29) HT  
*(Thierbach, 2003, 269) IQR  

### Fair Evidence

(Genest, 1990, 305) HQS  
(Laws, 2001, 76) HQS  
(Mannis, 1984, 64) HPT  
(Stacey, 2004, 75) HQR  
* (Thierbach, 2005, 185, Thierbach, 2003, 269) IQR  

### Poor Evidence

(Genest, 1991) HQS  

### Level of Evidence

- **Italics** - Animal studies  
- **G(Narr)** - Review (Narrative)  
- **G(Evb)** - Review (Evidence-based)  
- **H** - Clinical report  
- **I** - Laboratory report  
- **J** - Guidelines  
- **K** - News report  
- **L** - Survey  
- **M** - Educational material  
- **N** - Correspondence  
- **O** - Position Statement  
- **P** - CPR Training  
- **Q** - CPR Performance  
- **R** - Adverse physical effect  
- **S** - Adverse psychological effect  
- **T** - Disease transmission  
- *** = References added after 2005 submission**
## Evidence Opposing Lack of Harm of CPR/AED Training/Implementation

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<th>Level of Evidence</th>
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</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

F = Other effect  
G(Narr) = Review (Narrative)  
G(Evb) = Review (Evidence-based)

H = Clinical report  
I = Laboratory report  
J = Guidelines

K = News report  
L = Survey  
M = Educational material

N = Correspondence  
O = Position Statement  
P = CPR Training

Q = CPR Performance  
R = Adverse physical effect  
S = Adverse psychological effect

T = Disease transmission  
* = References added after 2005 submission
1. **ADVERSE PHYSICAL EVENTS**

Reported adverse physical effects have included myocardial infarction (Memon, 1982, 322), chest pain, allergic reaction, malaise (Greenberg, 1983, 194), pneumothorax (Sullivan, 2000, 64), interosseous nerve palsy (Shimokawa, 2001, 290), hyperventilation (Thierbach, 2003, 269) *(Thierbach, 2005, 185), hypocarbia (Walker, 2001, 179) and back injury *(Cheung, 2009) *(Jones, 2004, 63) *(Jones, 2005, 332). The concerns of Thierbach et al. and Walker & Liddle were addressed in Part 4: Adult Basic Life Support of the ILCOR/AHA Guidelines in 2005 *(Anonymous, 2005, IV1). Peberdy *(Peberdy, 2006, 59), detailing adverse effects associated with the PAD trial *(Hallstrom, 2004, 637), reported a single adverse physical event – a pulled muscle – in 239 events. Some data, based on a series of six physicians (aged 25-40 years) performing single-person CPR on a manikin, suggest that CPR might provoke ischemic symptoms in a rescuer with coronary artery disease (Lonergan, 1981, 793). Ingram et al. *(Ingram, 2006, 89), in studying psychological aspects of CPR training in cardiac rehabilitation patients, were aware of the physical nature of CPR training and advised participants accordingly and had resuscitation equipment available but there is no mention of its usage. Macauley *(Macauley, 1978, 17) reported on a CPR program which included a significant number of trainees with physical disabilities. One trainee developed tachypnoea after CPR practice and was found to have known (but undeclared) ischaemic heart disease. Poisoning is a potential problem rarely reported *(Koks, 2002, 740) *(Berumen, 1983, 253).

2. **SCREENING TRAINEES**

Memon, *(Memon, 1982, 322)*, on the basis of a fatal myocardial infarct following CPR training, expressed an opinion that any person with known ischaemic heart disease should be excluded from participation in CPR training and that persons with risk factors for such should be asked to seek medical clearance before undertaking CPR training. Subsequently Greenberg (Greenberg, 1983, 194) noted a lack of risk awareness and ignorance of the physical nature of CPR training, and a “substantial” incidence of risk factors amongst CPR trainees. He had also observed an aggravation of pre-existing medical conditions in four cases. He suggested research into the physical demands of CPR, educating instructors in conducting a screening process before training and education of trainers and trainees in the risks associated with such activity. Salzer et al. (Salzer, 1983, 195), in partially addressing these suggestions, measured the energy expenditure of ten fit medical students while performing CPR. Their findings “tended to disconfirm (sic) our previous anxiety about CPR training in this test group.” Their practice was to advise potential trainees of the nature of the training to be undertaken and consequently advise them to assess, or have an assessment made, of their physical conditions prior to commencing CPR training.

3. **SIGNIFICANCE OF AEDS**

Defibrillation is part of BLS and automatic defibrillators (AEDs) are being more widely encountered in first responder and public access defibrillation settings. Data on the safety of AEDs in the first responder setting are limited. The earliest report of adverse effects is from 1990 *(Gibbs, 1990, 101)* while the most recent by Hoke at al. includes risk associated with intentional and accidental mis-use *(Hoke, 2009, 395). Cappato *(Cappato, 2006, 553) claims safety with no data while Capucci *(Capucci, 2003, 12) and Jorgensen *(Jorgenson, 2003, 225) describe an absence of adverse events while Page et al *(Page, 2000, 1210) conclude that their experience “suggests that there is no basis for concern”. While the PAD trial *(Hallstrom, 2004, 637) spoke simply of safety and efficacy with few adverse effects associated with the use of an AED, these are subsequently detailed by Peberdy et al. *(Peberdy, 2006, 59) who noted occasional significant but usually transient emotional distress in the trained first responder. One physical adverse event (a pulled muscle) was recorded. Peberdy’s data does not allow differentiation between AED usage and non-usage. Stress reactions associated with the PAD trial were further analysed by Riegel et al. *(Riegel, 2006, 98) – low levels of stress were noted but again there was no differentiation between AED usage and non-usage. There are reports of resuscitators receiving minor shocks from use of an AED, the most recent being *(Dickinson, 2008, 489), but no reports of clinically significant shocks. Miller reports a series of incidents with external defibrillation affecting rescuers, a bystander and a helicopter pilot (Miller, 1982). Following the orthodox teaching, Hosmans et al *(Hosmans, 2008, 216) demonstrated “unsafe” behaviour during AED use. However the value of minimal interruption to compressions during CPR led to a study considering the safety of a rescuer remaining in contact with a patient being shocked with modern defibrillation equipment. The unorthodox possibility of uninterrupted chest compressions during shock delivery was then strongly posited *(Kerber, 2008, 2435) *(Lloyd, 2008, 2510). Kerber wrote “The study by Lloyd et al. should lead the American Heart Association to consider a modification of the 2005 Guidelines: Chest compressions may be continued through defibrillation provided that self-adhesive pad electrodes are used and gloves are worn”. Sullivan suggested caution *(Sullivan, 2008, e712; author reply e713) while Perkins regarded the work as a landmark *(Perkins, 2008, 1). Simulation of defibrillation in a wet environment “did not show significant risk should circumstances demand it” *(Lyster, 2003, 307) Defibrillation associated with mild resuscitative hypothermia was considered in a laboratory setting using a pig model and an advanced surface cooling system using iced water. It was shown that defibrillation in this wet situation was safe and effective.
*{Schwattier, 2007, 420). Implanted cardioverter defibrillators have caused shocks by discharging during CPR. *{Lecheuthner, 1995, 253),(Clements, 2003, 379).*(Siniorakis, 2009, 293). In this context, there has been no report located of fire since that detailed by Theodorou *{Theodorou, 2003, 677).

4. PSYCHOLOGICAL EFFECTS

Nelson *{Nelson, 1979, 28) foresaw benefit in training in CPR for family members of cardiac patients. Some benefit was confirmed by McDaniell et al. *{McDaniel, 1988, 2029), Sigsbee *{Sigsbee, 1990, 662), and Moser and Dracup *{Moser, 2000, 270). CPR training had no adverse psychological effects for family members of patients with cardiac disease (Dracup, 1997, 1434) (McLauchlan, 1992, 7) (Moser, 1999, 326). MacLauchlan (McLauchlan, 1992, 7) taught CPR to high-risk patients with recurrent ventricular tachycardia and their relatives and, as noted above, Ingram *{Ingram, 2006, 89) has taught CPR to cardiac rehabilitation patients and relatives and both groups showed psychological benefit. Teaching mothers of cocaine-positive infants was deemed to be associated with an increase in the mother’s self-esteem *{Messmer, 1993, 217). Adverse effects of performing CPR have been noted. These have included negative feelings (Axelsson, 1996, 3, Axelsson, 1998, 13)], psychological stress (Gamble, 2001, 157), and critical incident stress (Laws, 2001, 76). Swanson refers to “serious consequences for emergency personnel who respond to a crisis” but accepts that “the paucity of data currently available prevents firm conclusions about the effects on emergency personnel and may not be relevant to more routine CPR attempts” (Swanson, 1993, 350). One study (Genest, 1990, 305) dealt with volunteer workers in unsuccessful attempts at CPR. Recognition of probable failure was not protective in itself and there was evidence of persisting psychological aftereffects with no respondent being entirely free from unbidden recollections of the experience. Peberdy et al.*{Peberdy, 2006, 59) noted minor adverse psychological effects from the PAD trial and Riegel et al. *{Riegel, 2006, 98), assessing the stress on lay responders in the same trial, concluded that “low levels of stress were reported”. Cheung et al. *{Cheung, 2009) describe one psychological injury arising from participation in a MET response.

5. DISEASE TRANSMISSION

Isolated cases of confirmed disease transmission to the rescuer/trainee exist. These include Salmonella infantis (Ahmad, 1990, 787), PVL-producing Staphylococcus aureus *{Chalumeau, 2005, e29), SARS-CoV (Christian, 2004, 287), four of meningococcal disease (Feldman, 1972, 1107), herpes simplex (Finkelhor, 1980, 650) (Hendricks, 1980, 257), Mycobacterium tuberculosis (Heilmann, 1965, 1035), shigella (Todd, 1980, 331) and Streptococcus pyogenes (Valenzuela, 1991, 90) while performing CPR and herpes simplex while training (Mannis, 1984, 64). Mejicano mentions a case of Helicobacter pylori transmission (Mejicano, 1998, 813) but this is an example of resuscitator-to-patient transmission (Figura, 1996) while two cases (Neiman, 1982, 813, Nicklin, 1980, 2046) are dubious. Tarantola *{Tarantola, 2006, 367) conducted a review of pathogens transmitted by occupational exposure: only one from that report related to CPR (Valenzuela, 1991, 90). In the absence of high risk activities such as cannulation, there has been no reported case of transmission of HepB, HepC, HIV or cytomegalovirus during either the performance of or training for CPR. In circumstances conducive to disease transmission, it has not occurred (Anonymous, 1978, 247) (Glaser, 1985, 1653) (Osterholm, 1979, 1263) (Perras, 1980, 118) (Saviteer, 1985, 1606). Over a 22 year period, the New York City Fire Department had no record of disease transmission through rescue breathing but there are no details provided of the number resuscitated in this period (Cutler, 1979, 1074). A critical examination of the data assigning risks to mouth-to-mouth resuscitation is important (Deetz, 1979, 912). There is a continuing need for accurate reporting of such adverse effects. Bierens presenting the rational approach for the risk of transmission of the AIDS virus concludes that the risk of sero-conversion due to CPR is about one per million resuscitations in the highest risk group and less than one per billion resuscitations in the group most often resuscitated. He states that volunteer life-savers “should know that if there is no blood visible, or if there is no open wound in the mouth of the rescuer, no blood-blood contact and thus no sero-conversion is possible even when the victim is sero-positive (Bierens, 1996, 185). A puncture wound during the performance of CPR from a sternotomy wire (Steinhoff, 2001, 159) highlighted the risk of disease transmission. Vaccination against hepatitis B is proposed for those with an occupational risk of exposure and disease transmission (Anonymous, 1990, 670) but it must be noted that, in this context, CPR has not been implicated in the transmission of this disease.

6. ROLE OF BARRIER DEVICES

As early as 1965 (Heilmann, 1965, 1035) as a result of a case of TB transmission, it was suggested that some form of protection was needed to avoid the need for mouth-to-mouth contact when performing CPR. This concern remained in 1985 (Cohen, 1985, 136) and subsequently various guidelines and authors advocated their use (Nickalls, 1986, 1350) (Anonymous, 1987, 1S, Anonymous, 1989, 2714) (Baskett, 1993, 1) (Bierens, 1996, 185) (Hendricks, 1980, 257) accepting that their efficacy had not been demonstrated conclusively (Anonymous, 1990, 670). Some data suggested that certain devices possibly afforded protection against bacterial transmission (Blenkham, 1990, 151) (Cydukla, 1991, 317). Both Sun (Sun, 1995, 205) and Mejicano (Mejicano, 1998, 813) reiterate the advice that such devices should be used despite no additional evidence of their efficacy in reducing disease transmission; there continues to be no data showing that these devices reduce disease transmission.
7. MANIKIN DISINFECTION

Early assessment of the efficacy of the technique of manikin disinfection focused on bacteria (Hudson, 1983, 485) and later assessments on viruses (Mannis, 1984, 64) (Hudson, 1984, 1108) (Cavagnolo, 1985, 456) (Corless, 1992, 1542). While these data show that the techniques of disinfection assessed are effective, there are no data confirming a consequent reduction in disease transmission.

8. POST-EXPOSURE MANAGEMENT

A rescuer who has given mouth-to-mouth ventilation to a patient with pulmonary tuberculosis should have serial tuberculin skin testing and should be offered prophylaxis if conversion occurs (Bass, 1994, 1359) (Mejicano, 1998, 813). Post exposure prophylaxis for Hepatitis B is only advocated for accidental percutaneous or per-mucosal exposure to HBsAg-positive blood (Anonymous, 1990, 1). For Neisseria meningitidis, antimicrobial prophylaxis is recommended for anyone directly exposed to the patient’s oral secretions (e.g. through mouth-to-mouth resuscitation, endotracheal intubation, or endotracheal tube management). Rifampicin has been the drug of choice but ciprofloxacin or ceftriaxone are reasonable alternatives (Achong, 1979, 1025, Jacobson, 1976, 1053) (Anonymous, 1997, 1). The Centers for Disease Control Cooperative Needle-stick Surveillance Groups abandoned follow-up on health care workers exposed to saliva and other non-blood fluids from patients with HIV because none of 106 workers followed up for more than one year sero-converted (Cummins, 1989, 2732) (Marcus, 1988, 1118).

Acknowledgements:
Dr Peter Morley was always helpful and provided sound guidance, advice and encouragement. Guy Maddern, RP Jepson Professor of Surgery, The University of Adelaide, South Australia, provided access to retrieval facilities and staff at ASERNIP-S. Caryn Perera, Research Officer, ASERNIP-S helped in developing the prime search strategy and Sheona Page, Clinical Trial Coordinator, University of Adelaide, retrieved articles with alacrity and skill. Dr Chris Zeitz, Dr Ross Philpot and Marija Juraja RN, from The Queen Elizabeth Hospital, Woodville, South Australia, reviewed relevant aspects of the worksheet.

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Citation List

References added subsequent to the 2005 submission are indicated by an asterisk (*)
Those added prior to final submission are highlighted in blue.

NQT

In response to (Davies, 1979, 593), Achong advocates an aggressive in hospital IV antibiotic regime for resuscitators exposed to N. meningitidis by mouth-to-mouth contact.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral

G(Narr) T

Reports (Heilman, 1965, 1035) (Davis, 1978, 214, Feldman, 1972, 1107) (Osterholm, 1979, 1263) (Perras, 1980, 118) (Khan, 1979, 2701) and concludes that "the seemingly very small risk of transmission of infection from patient to operator during mouth-to-mouth resuscitation is no reason to abandon mouth-to-mouth resuscitation. However, more frequent documentation of the outcome of such contacts with patients harbouring various infections would allow a better appreciation of the risks involved."
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

EHQ

Case report of transmission of salmonella infantis by mouth-to-mouth resuscitation.
Level of Evidence: 5
Quality of evidence: Poor
Nature of Evidence: Supportive

HPT

Recounts two incidents with exposure of 34 people in which transmission of Hepatitis B did not occur. It concludes "the risk of transmission of hepatitis B as a result of indirect oral contact with HBsAg-positive saliva appears to be small."
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive

A statement of recommendations from the Australian Resuscitation Council Newsletter.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NOT AVAILABLE AND NOT ASSESSED IN EVIDENCE


JT
Pages 2926-2928 cover “Safety in training for and providing CPR”. It addresses in detail the matter of disease transmission but maintains a supportive stance for CPR. There is no mention of other hazards.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


JT
This document is the basis for Universal Precautions. It states “Although saliva has not been implicated in HIV transmission, to minimize the need for emergency mouth-to-mouth resuscitation, mouth pieces, resuscitation bags, or other ventilation devices should be available for use in area in which the need for resuscitation is predictable.”
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


JT

Provides guidelines for
- Rescuers with known or suspected infections
- Rescuers with a duty to provide CPR
- The layperson
- CPR training for infected individuals
- Individuals unable to complete a CPR course

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


JT

*Notes no transmission of HBV or HIV infection but the risk of other infectious diseases is stated. They advocate disposable resuscitation equipment and ancillary airway devices.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


*Refers to 12. below.*

**NOT RELEVANT AND NOT ASSESSED IN EVIDENCE**


**JT**

*In the context of HBV infection:*

- *It is proposed that persons with occupational risk be vaccinated pre-exposure.*
- *Post exposure prophylaxis is advocated for “accidental percutaneous or per-mucosal exposure to HBsAg-positive blood.”*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


**O**

*Refers to evidence for lack of transmissibility of HIV/AIDS and Hep B by saliva but notes spread of viral respiratory infections by M-M CPR. It accepts that “the value of CPR outweighs the small, theoretical risk of disease transmission.” It advocates ready access to mechanical ventilation or barrier devices accepting that their efficacy has not been demonstrated conclusively (in 1990). Concludes that “the value of CPR outweighs the small, theoretical risk of disease transmission”.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

**Anonymous.** Guidelines for cardiopulmonary resuscitation and emergency cardiac care, Emergency Cardiac Care Committee and Subcommittees, American Heart Association Part. II. Adult basic life support (See Comment). JAMA 1992; 268:2195-7. (Anonymous, 1992, 2195)

**JT**
Provides recommendations for control of disease transmission during CPR training and outlines practices espoused for the performance of CPR.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NOT RELEVANT AND NOT ASSESSED IN EVIDENCE


JT

Antimicrobial prophylaxis is recommended for anyone directly exposed to the patient's oral secretions (e.g. through mouth-to-mouth resuscitation, endotracheal intubation, or endotracheal tube management). Rifampicin has been the drug of choice but ciprofloxacin or ceftriaxone are reasonable alternatives.

Level of Evidence: 5
Quality of evidence: Fair
Evidence: Supportive


K

Report of (Becker, 1997, 2102) Includes quotation from Cummins RO “Don’t worry about disease – worry about saving the person’s life”

Level of Evidence: 5
Quality of evidence: Fair
Nature of Evidence: Supportive


J

In contrast to (Handley, 1998, 67) the document describes general risks (traffic and other environmental factors) and the specific concerns about poisoning, the possible but rare event of disease transmission and the need for effective ancillary devices. It notes that “Resuscitation manikins have been shown not to be a source of infection.”

Level of Evidence: 5
Quality of evidence: Fair
Nature of Evidence: Supportive

The statement on page 60 referring to (Mejicano, 1998, 813) as a reference for transmission of Neisseria gonorrhoeae seems to be an error. Mejicano makes no reference to N. gonorrhoeae but only N. meningitidis.

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive


An extract from the major publication of “International Guidelines 2000 for CPR and ECC – A Consensus on Science” listed above. Pages 59-61 focus on disease transmission during both training for and performance of CPR.

Note the comment on error concerning transmission of N. gonorrhoeae in (Anonymous, 2000, 1).

Level of Evidence: 5
Quality of evidence: Good
Nature of Evidence: Supportive


The objective of this article is to review the literature on infectious diseases transmitted through mouth-to-mouth ventilation. The search for available scientific evidence for pre- and post-exposure prophylaxis has been made through searching the Medline database of articles published between 1990-1999. In addition to this, all the articles published between 1966-1999 in journals indexed to Index Medicus with the key word mouth-to-mouth ventilation or mouth-to-mouth ventilation, and cardiopulmonary resuscitation were reviewed. Conclusions were also based on a personal collection of articles, posters and relevant notes collected over the last few years.

This review adds no new data or material for the interval since that of (Mejicano, 1998, 813)

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

LQ

In considering the psychological reactions, 7% of the respondents indicated some negative feelings about the CPR process but only 0.5% were uncertain about starting CPR again.

Level of Evidence: 4
Quality of evidence: Fair
Nature of Evidence: Supportive


LQ

This survey includes some of the cases from (Axelsson, 1996, 3)1990-1994. The results of the two surveys were similar with this providing some insight concerning this negative psychological reaction.

Level of Evidence: 4
Quality of evidence: Fair
Nature of Evidence: Supportive


G(Narr) R

Simple reference made to “the need for protection of emergency responders”

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


LQT

A documentation of practice and hazards in the late 1970s and early 1980s. May overstate the case when saying the risk is considerable.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr) T

The discussion on risks of disease transmission refers to the known reported incidents and the lack of transmission of HBV and HIV/AIDS and the need for good cleaning techniques and practice in training sessions.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


G(Narr) T
A detailed document with no direct reference to CPR or the associated risks. Some value may be found by extrapolation in the section “Persons for whom preventive therapy is recommended.” Mejicano (Mejicano, 1998, 813) uses this reference to support his statement “a rescuer who has given mouth-to-mouth ventilation to a patient with pulmonary tuberculosis should have serial tuberculin skin testing and should be offered prophylaxis if conversion occurs.”

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr) T

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NQS
An almost unique case; since animal resuscitation was not excluded in the evidence review, the case highlights the environmental risks of exposure.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


GQT
Provides a rational approach to justify the statement that the risk of transmission of HIV is low i.e. “about one per million resuscitations in the highest risk group”.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

IT

An early assessment of the Resusci Face Shield (Laerdal Medical Limited).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NQT

The author disputes one aspect of the findings of (Cydulka, 1991, 317) but remains supportive of the concept that a face shield will "satisfy the concern of the general public and of health care personnel relating to possible infection risks during exhaled air resuscitation and afford protection against the transmission of saliva, blood, and respiratory droplets during mouth-to-mouth ventilation." Refers to (Blenkharn, 1990, 151).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


G(Evb) JPQRST

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive


G(Evb) JPQRST

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive


HQRST

The trial does not contain a no treatment arm for either CPR/AED. The quality of evidence is deemed poor on the criterion of safety. There is no data supporting the claim.

Level of Evidence: 4
Quality of Evidence: Poor
Nature of Evidence: Supportive


HQRST

Provides minimal support for the claim of safety in the programme but does state "no adverse consequences from AED use by lay personnel were observed". Again the quality is assessed on the criterion of demonstrated safety.

Level of Evidence: 4
Quality of Evidence: Poor
Nature of Evidence: Supportive


IPT

Supportive of existing (1985) disinfection procedures for manikins.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


HQT

Resuscitation involved intubation, BVM ventilation and chest compressions. Disease transmission confirmed but outcome for resuscitator not mentioned.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQRS

States that it is the first study to document the actual rates of injuries occurring to staff responding to MET calls. It addresses the injuries associated with CPR and, in this setting, performance of chest compressions is a significant risk factor.

Level of Evidence: 4
Quality of Evidence: Good
Nature of Evidence: Neutral

"Only one of nine workers involved met WHO criteria for SARS. The principle espoused to generate policy change is the chance that a SARS patient will suffer unwitnessed cardiopulmonary arrest or require emergency intubation and resuscitation-associated risks must be minimised."

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQR

Three paramedics and one doctor performed external cardiac massage on an arrested patient with an internal cardioverter defibrillator (ICD). During the process the ICD discharged five times. The paramedic not wearing latex gloves when the ICD discharged received a shock and “had to rest for over half an hour before being able to resume work”. Comparable with, and referred to by, (Siniorakis, 2009, 293)

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Neutral


NPT

The correspondents highlight the NRC 1984 Guidelines, express concern about transmission of viral diseases during training and the potential inadequacies of disinfection procedures, and advocate the use of an overlay mask.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


IPT

“Our data suggest that one should not refrain from CPR training out of fear of contracting HIV infection”.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


GK

Editorial comment on [Anonymous, 1989 #7]. Notes that “CDC Cooperative Needlestick Surveillance Group has abandoned follow-up on health care workers exposed to saliva and other nonblood fluids from patients with HIV because none of 106 workers followed up for more than one year sero-converted.” [McCray, 1986 #195] [Marcus, 1988 #194] and that a patient infected with HBV remains the greatest infectious threat to CPR providers. [Anonymous, 1989 #191] This should be considered with [Glaser, 1985 #146]

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive
**Cutler SS.** Safety of mouth-to-mouth resuscitation. Lancet 1979; 2(8151):1074. (Cutler, 1979, 1074)

NQ

Documents the 22 year record of the New York City Fire Department of no disease transmission through rescue breathing. No details of number resuscitated in this period. Response to (Davies, 1979, 593) and (Gilston, 1979, 694).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


IQT

A technical assessment of ancillary equipment with one adverse finding being challenged by (Blenkharn, 1992, 624).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

**Davies JN.** Operator risk in mouth-to-mouth resuscitation. Lancet 1979; 2(8142):593. (Davies, 1979, 593)

NQ

Raises the question of disease transmission and refers to (Osterholm, 1979, 1263) but makes no contribution to the worksheet hypothesis.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr) PT

Cautionary concern about infectious disease transmission in the pre HIV/AIDS era.

Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Neutral


NPT

Emphasizes the need for careful analysis of reported cases of disease transmission.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

HQR

*Case report of staff member being shocked during defibrillation.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HPS

*The relevant component of this trial states “There were no significant differences in the emotional states of family members across the four groups.”*

Level of Evidence: 2
Quality of Evidence: Fair
Nature of Evidence: Supportive


HT

*Relates to disease transmission by corneal transplantation.*

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


G(Narr)

*Relates to occupational exposure to tuberculosis and the arguable need for the use of high efficiency particulate air (HEPA) respirators. No mention of CPR.*

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


L

*Short article focuses on the provision of equipment for cardiac arrests and proposes that resuscitation is a high risk situation and that the anaesthetist is particularly at risk. It claims to identify a potential hazard where facilities are provided on a selective rather than universal approach.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr)

*Reports “at least four cases (of meningococcal disease) have followed mouth-to-mouth resuscitation.”*

M

NOT RELEVANT AND NOT ASSESSED IN EVIDENCE


HQT

Case report of possible transmission of Helicobacter pylori infection - Professional provided mouth-to-mouth resuscitation on patient who’s “mouth was full of vomit”. Actually a case of disease transmission, Professional-to-patient.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral

Finkelhor RS, Lampman JH. Herpes simplex infection following cardiopulmonary resuscitation. JAMA 1980; 243(7):650. (Finkelhor, 1980, 650)

QHT

Case report of resuscitator developing herpetic stomatitis and paronychia after performing CPR on a patient with mouth ulcers from which herpes simplex virus was isolated.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr)QS

Suggests that CPR is highly stressful for the nursing staff and that this can be detrimental.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQS

It is notable that the study dealt with volunteer workers in unsuccessful attempts at CPR. Recognition of probable failure is not protective in itself. There was evidence of persisting psychological aftermaths with no respondent being entirely free from unbidden recollections of the experience.

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral

HQS

No conclusions can be made from this abstract. Attempt to pursue through University of Saskatchewan. burlock@duke.usask.ca Reply indicates authors cannot be traced.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


LPQR

An early report of adverse events with AEDs. Data was generated from two sources: a retrospective questionnaire from local county personnel and reports from a national data base included in the questionnaire period. It is not clear whether some reports have been duplicated or not.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NQ

Refers to (Heilman, 1965, 1035) and introduces the argument for ECM before EAR (in 1979?).
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HPT

This reinforces two other investigations suggesting that transmission under these circumstances is unlikely (Osterholm, 1979, 1263) (Anonymous, 1978, 247).
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive


HNP

In response to (Memon, 1982, 322), four specific incidents are noted.

- Left chest pain and SOB with preceding MI in a 48 yo male
- Recurrent mild anaphylaxis in a 28 yo female
- Chest pain with preceding angina in a 60 yo male
- Weakness, vertigo and altered mental state after 8 hr training course in a 25 yo female.

He notes students have periodically complained of symptoms characteristic of hyperventilation.

HQRS

*A detailed analysis of adverse effects is published separately as (Peberdy, 2006, 59). The report of AEs tallies to 8 and differentiates between AED and no AED but details are scant. Peberdy (Peberdy, 2006, 59) details seven but fails in not providing data to differentiate on the "AED versus no AED" question.*

Level of Evidence: 1
Quality of Evidence: Fair
Nature of Evidence: Supportive


J

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


JPQRST


Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


HQT

*Early advocate for ancillary devices in CPR to avoid the need for mouth-to-mouth resuscitation.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQT


Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


**K**

On the premise that trained personnel are reluctant to perform CPR because of fear of disease transmission, a city law was passed in January 2002 requiring all specified public places to have infection-control resuscitation equipment available.

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


**GPQR**

A recent systematic review of hazards for bystanders associated with the use of AEDs. *The definition/use of “bystanders” needs clarification*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


**IQR**

A comparison of semi-automatic and fully automated defibrillators which highlights an unexpectedly high incidence of “unsafe behaviour” which it is argued may be an “overestimate”. There is no control arm – two intervention arms (both AEDs) are compared. Hence its LOE.

Level of Evidence: 4
Quality of Evidence: Good
Nature of Evidence: Neutral or opposing
Industry Funding: Medtronics provided the training AEDs for use during the study period.


**IPT**

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


**IPT**

Level of Evidence: 5  
Quality of Evidence: Fair  
Nature of Evidence: Supportive  


HQS  
A trial of teaching CPR to cardiac patients in a rehabilitation program citing (McLauchlan, 1992, 7) as the only other relevant data on the subject. Recognising the potential for an adverse cardiac event, precautionary warnings were given and relevant medications and an AED with a trained operator were immediately available. There is no record of any adverse event. It is not clear whether the AHA Family and Friends Basic Life Support course included AED usage.  

Level of Evidence: 2  (Level 5 for adverse physical events as conclusion is by inference from the data)  
Quality of Evidence: Fair  
Nature of Evidence: Supportive  


MT  
Considers mouth-to-mouth a risk factor for transmission of meningococcal disease and therefore an indicator for prophylaxis.  
Level of Evidence: 5  
Quality of Evidence: fair  
Nature of Evidence: Neutral  


M  
NOT RELEVANT AND NOT ASSESSED IN EVIDENCE  

* Jones AY. Can cardiopulmonary resuscitation injure the back? (Jones, 2004, 63)  

LQR  
A retrospective questionnaire highlighting the frequency of back symptoms associated with performing CPR with adverse posturing among nurses.  
Level of Evidence: 4  
Quality of Evidence: fair  
Nature of Evidence: Opposing  

*Jones AY, Lee RY. Cardiopulmonary resuscitation and back injury in ambulance officers. (Jones, 2005, 332)  

LQR  
The same hypothesis as Jones at al. above (Jones, 2004, 63) applied to ambulance officers with the same outcome. It emphasises the occupational hazards of certain professional groups.  

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: opposing


HQS

A small trial with application of AED pads on thirteen occasions by “minimally trained first responders” and without reports of “injury or harm”.

Level of Evidence: 4
Quality of Evidence: Poor
Nature of Evidence: Supportive
Industry Funding: Non declared

*Kerber RE. "I'm clear, you're clear, everybody's clear": a tradition no longer necessary for defibrillation? Circulation 2008;117(19):2435-6. (Kerber, 2008, 2435)

O

An editorial comment on (Lloyd, 2008, 2510). The final paragraph states:

“The study by Lloyd et al. should lead the American Heart Association to consider a modification of the 2005 Guidelines: **Chest compressions may be safely continued through defibrillation provided that self-adhesive pad electrodes are used and gloves are worn.** Clinical experience will tell if injuries to patients or rescuers result when chest compression and defibrillation occur simultaneously; perhaps a registry of such injuries may be appropriate. The happy result of such a Guidelines change would be to advance the cause of achieving “effective” chest compressions during CPR: push hard, push fast, minimize interruptions.”

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

Khan AH, Roland FP, Carleton RA. Cardiopulmonary resuscitation—potential danger of cross-infection. JAMA 1979; 241(25):2701-2. (Khan, 1979, 2701)

IPT

The deposition of normal oral bacteria onto manikin surfaces during training was seen as indicative of potential disease transmission. Swapping roles for two-person CPR training was seen as particularly hazardous.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQR

It is noted that cholinesterase activity was not assayed in the two rescuers. While being treated as an OP poisoning, this has not been substantiated. How ever the potential can not be denied.
Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Neutral or opposing

Lambrew CT, Wynne N, Hume HA. Training mannequins an important source of transmission of hepatitis. Journal of the Maine Medical Association 1979; 70(1):44. (Lambrew, 1979, 44)

NPT
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


HQS
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQR
Proabably first case report of shock to rescuer from implanted defibrillator. Subsequently reported by Clements (Clements, 2003, 379) and Siniorakis (Siniorakis, 2009, 293)
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQS
This trial challenges the longstanding dogma of a mandatory “Stand Clear” by attending staff during defibrillation. If such a requirement was not necessary, significant interruption to the cardiac compressions would be avoided.
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive
Industry Funding: This study was funded with discretionary accounts of the Clinical Electrophysiology Research Program


IR
This is interesting in relationship to the question of teaching CPR to rehabilitating cardiac patients (Ingram, 2006, 89) (McLauchlan, 1992, 7)
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


IT

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


IQR

*Australian Resuscitation Council policy accepts defibrillation as an element of BLS (Handley, 1998, 67) describes BLS as not using other equipment but continues “The development of automated defibrillation (AED) has allowed minimally trained persons to extend their BLS skills.”*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


H PT

*One trainee became tachypnoeic after CPR practice and then declared a history of ischaemic heart disease.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


*NOT AVAILABLE AND NOT ASSESSED IN EVIDENCE*


HPT

*A report of two cases of possible disease transmission from the same training setting. Not proven by any means.*

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral


HT

*A later report of the same project as (McCray, 1986, 1127). Sixty of 1201 workers were exposed to blood by mucous-membrane contact. There is no statement that CPR was involved – only “various other procedures” are mentioned.*

Level of Evidence: 4
Quality of Evidence: Fair

G

*Emphasises occupational health and safety aspects of resuscitation but specifically refers to electrical hazards of cardioversion. The comments on chemical and environmental hazards omit mention of the poisoned/contaminated casualty.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HT

*A 1986 report of the same project as (Marcus, 1988, 1118).*

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive


HPS

*This trial reports the training of family members of cardiac patients in CPR and AED usage in 1988. This compares with teaching full basic life support (No AED) to both patients and family members by (McLauchlan, 1992, 7) and teaching CPR (? No AED) to cardiac patients and relatives by (Ingram, 2006, 89)*

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive


HPS

*This trial, associated with the training of cardiac patients and relatives in full basic life support (No AED), is cited by (Ingram, 2006, 89). (McDaniel, 1988, 2029) taught relatives CPR and AED usage.*

Level of Evidence: 3
Quality of evidence: Fair
Nature of Evidence: Supportive


G(Evb) T

*The conclusion may well be the proposal for this worksheet!*

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive


**HPR**

*Single case report of fatal myocardial infarction occurring during CPR training. Advocates that any persons with known ischaemic heart disease should be excluded from CPR training and that persons with risk factors for IHD should be assessed by a physician before CPR training.*


Level of Evidence: 5

Quality of Evidence: Poor

Nature of Evidence: Neutral


**HPS**

*The unexpected positive effect on the mother of CPR training is a subjective reporting by the investigators of observed behavioural change consequent to the project. There was no intent to observe this in the study protocol.*

Level of Evidence: 4

Quality of Evidence: Poor

Nature of Evidence: Supportive

**Miller LV, Brennan R.** Cardiac defibrillator use in potentially hazardous situations. Biomedical Sciences Instrumentation 1982; 18(pp 87-90). (Miller, 1982)

**LPR**

*Assuming defibrillation is part of BLS and CPR this paper is acceptable.*

*Sixty American Emergency Medical Services were surveyed by questionnaire. One hundred and twenty responses were obtained from 42 organisations. Thirteen reported one or more incidents of minor shocks to rescuers, a bystander and a helicopter pilot due to moisture, conductive structures or confining locations.*

Level of Evidence: 4

Quality of Evidence: Fair

Nature of Evidence: Supportive


**O**

*Editorial referring to [Anonymous, 1986 #193]*

Level of Evidence: 5

Quality of Evidence: Fair

Nature of Evidence: Supportive


**HPS**
Level of Evidence: 2
Quality of evidence: Fair
Nature of Evidence: Supportive


PSH
Level of Evidence: 2
Quality of evidence: Fair
Nature of Evidence: Supportive


HPT
Case report of single case of aphthous ulceration after a basic CPR course with a prediction of "voluminous literature of morbidity to practitioners of CPR on manikins".
Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Neutral


G(Narr) PS
Concluding Paragraph:
CPR training for families of cardiac patients could seemingly produce various reactions. It is quite possible that anxiety would be increased by the unpleasantness of the subject. Unconscious fears would surface. The feeling of responsibility to save a human life and then coping with the guilt in the event of failure may be too overwhelming. Perhaps for these reasons CPR courses for families of cardiac patients have not been offered routinely by in-patient or out-patient educational and rehabilitative programs. Consideration should be given to the positive benefits of providing CPR training risk group, such as potent reducing mortality from sudden death. Anxiety over a threat of sudden death could be mitigated by the acquisition of cognitive and technical skill. The ability to perform PR can serve as a valuable method of increasing the family's sense of control over unexpected, catastrophic events. For many people the guilt, frustration, and helplessness resulting from not knowing how to intervene when their loved one collapses could be far more overwhelming than if they tried and did not succeed. A patient may feel more secure knowing that his wife and/or children possess this skill.

An early publication on the potential psychological implications of training this group of people. No evidence provided.
Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Supportive


NQT
Strongly supports use of ancillary airway devices.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NPT

*Personal account of symptoms developing after a CPR training session*

Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Neutral


G(Narr) T

*A statement of contemporaneous thought in 1989.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

Osterholm MT, Bravo ER, Crosson JT, Polisky HF, Hanson M. Lack of transmission of viral hepatitis type B after oral exposure to HBsAg-positive saliva. British Medical Journal 1979; 2(6200):1263-4. (Osterholm, 1979, 1263)

HPT

*Assesses 21 hospital trainees who had taken part in CPR training with a person with HBsAg-positive saliva. Circumstances were highly suited to disease transmission if it was possible. It did not occur. Mandatory testing of all individuals for HBsAg before CPR training is thought unwarranted.*

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive


HQ

*Describes no adverse events with use of AEDs in first responder setting. Lacking data.*

Level of Evidence: 4
Quality of Evidence: Poor
Nature of Evidence: Supportive


HQRS

*This is a critical report arising from data accumulated during the PAD trial (Hallstrom, 2004, 637). The emphasis is on the role of the AED and its relationship to adverse effects. It would be valuable to be able to separate AEs related to use/none use of the AED. This is not possible.*

Level of Evidence: 4
Quality of Evidence: Poor
Nature of Evidence: Supportive
Industry Funding: Contract from National Heart, Lung and Blood Institute; and American Heart Association, Medtronic Incorporated, Guidant Foundation, Cardiac Science/Survivalink Inc, Philips Medical Systems and Laerdal Medical Corporation.


OQRST

This editorial discusses the possibility of enhancing the efficacy of CPR without increasing the risks to those performing CPR. It favours a strategy that reduces the duration of the pre-shock pause. It anticipates the possibility of compressions during shocking as foreshadowed by Lloyd et al. (Lloyd, 2008, 2510)

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

Author is supported by a Department of Health (UK) NIHR Clinician Scientist grant.


NOT AVAILABLE AND NOT ASSESSED IN EVIDENCE


NPT

On the basis that there is risk, albeit minuscule, of contracting a serious infection during training the author proposes that “the requirement that mouth-mask-mannequin practice and testing be a part of basic and advanced cardiac life support courses should be eliminated”.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Opposing


HQS

Like (Peberdy, 2006, 59), these data have also arisen from the PAD trial (Hallstrom, 2004, 637). It is most significant in that it relates to the performance of CPR and the use of an AED in contrast to training for these tasks. There is no distinction on the matter of AED versus no AED. It shows the response to an emergency situation.

Level of Evidence: 4
Quality of Evidence: Good
Nature of Evidence: Supportive


G(Narr)PQS

Adds no new information in texts or references

IT
Supportive of ancillary devices in airway management during CPR but mentions hazards of tubes.

NOT RELEVANT AND NOT ASSESSED IN EVIDENCE


NP
Subsequent to (Memon, 1982, 322) and (Greenberg, 1983, 194). All trainees who are asthmatic, diabetic, hypertensive, heavy smokers, obese, over the age of 45 or with pulmonary or cardiac disease are advised to have a medical assessment before undertaking the course.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


OT
Maintains that the AIDS virus is transmitted sexually, by injection or by birth and that other modes are extremely rare. Mentions saliva but not CPR.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


HNQT
A correspondence report of two nurses with documented mucous-membrane exposure to potentially infective saliva from a patient with AIDS-related complex without disease transmission providing further evidence that the risk of seroconversion after a point exposure to the oral secretions of an infected person is probably quite low.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


IQR
The acceptance of resuscitative mild hypothermia as a therapeutic ploy raised the question of the safety of defibrillation in a wet environment. The simulated study of (Lyster, 2003, 307) provided evidence that a wet environment did not create a significant risk associated with defibrillation. This study, in a laboratory setting, looks at the situation when a wet environment is allied with a device
used to induce mild hypothermia. The conclusion is similar to that of (Lyster, 2003, 307). The work of (Lloyd, 2008, 2510) is also relevant.

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Supportive
Industry Funding: None declared.


G(Evb) T

Excluding the item of blood-borne transmission, it is noted that there is no mention of disease transmission associated with CPR in the sections on Oral-Faecal Transmission or Direct Contact (pages 920-922).

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive


G(Evb) T

An extensive review, as required by the OBJECTIVE, fails to produce any reference to disease transmission during CPR.

Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Supportive


HQR

The palsy developed after 30 minutes of CPR. Spontaneous recovery did not occur. Exploration was necessary to determine the cause and provide relief.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral

**Sigsbee M, Geden EA.** Effects of anxiety on family members of patients with cardiac disease learning cardiopulmonary resuscitation. Heart Lung 1990;19(6):662-5. (Sigsbee, 1990, 662)

HPS

Benefit was confirmed for only one arm of the trial i.e. Family members of hospitalized patients.

Level of Evidence: 2
Quality of Evidence: Fair
Nature of Evidence: Supportive


IT
Questions the efficacy of a selection of particular face-shields in CPR.

*NOT RELEVANT AND NOT ASSESSED IN EVIDENCE*


HQR

Case report of rescuer (not wearing gloves) being shocked by an implantable cardioverter defibrillator. Minor physical injuries resulted. Comparable with (Clements, 2003, 379). Proposal that resuscitation of such patients should be considered in guideline preparation.

Level of Evidence: 5

Quality of Evidence: Fair

Nature of Evidence: Neutral


HQR

Strictly not CPR but the patient needed airway management and cardiac support with the associated risks of exposure of personnel to an organophosphate compound. (Koksal, 2002, 740) reports an OP poisoning with subsequent mouth-to-mouth resuscitation and the allied sequelae.

Level of Evidence: 4

Quality of Evidence: Fair

Nature of Evidence: Neutral


HQT

Level of Evidence: 5

Quality of Evidence: Fair

Nature of Evidence: Neutral


M

Highlights issues about cross-contamination and the use of manikins

Level of Evidence: 5

Quality of Evidence: Fair

Nature of Evidence: Supportive


HPR

Level of Evidence: 5

Quality of Evidence: Fair
Nature of Evidence: Neutral


NQR

A letter critical of Lloyd’s paper (Lloyd, 2008, 2510) on scientific grounds and advocating a “no change” stance in guidelines. Lloyd responds in the same journal “…we and the remainder of clinicians should stick to the guidelines.”

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral

**Sun D, Bennett RB, Archibald DW.** Risk of acquiring AIDS from salivary exchange through cardiopulmonary resuscitation courses and mouth-to-mouth resuscitation. Seminars in Dermatology 1995; 14(3):205-11. (Sun, 1995, 205)

G(Narr) PT

*Advocates teaching mouth-to-mouth ventilation performed with some form of barrier-device.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


G(Narr) QS

*Swanson refers to “serious consequences for emergency personnel who respond to a crisis” but accepts that “the paucity of data currently available prevents firm conclusions about the effects on emergency personnel and may not be relevant to more routine CPR attempts.”*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


G(Evb)T

*This article highlights the potential risk of disease transmission to HCWs but most recorded events have involved needle stick injuries with only one involving CPR (Valenzuela, 1991, 90). It also notes that “No new case of occupational infection with HIV has been documented in France since 1997”.*

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


HQR

Level of Evidence: 5
Quality of Evidence: Good
Nature of Evidence: Neutral


IQR
Recognising this matter, guidelines published in 2005 (Anonymous, 2005, IV1) recommended lower tidal volumes (6 to 7 mL/kg) and “regular rather than a deep breath”.
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral


IQR
Recognising this matter, guidelines published in 2005 (Anonymous, 2005, IV1) recommended lower tidal volumes (6 to 7 mL/kg) and “regular rather than a deep breath”.
Level of Evidence: 4
Quality of Evidence: Fair
Nature of Evidence: Neutral
Industry Funding: None declared.


HQT
The authors believe that the case confirms oral transmission of pathogenic bacteria during CPR in an emergency situation and refer to (Khan, 1979, 2701).
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


HQT
The fire-fighter ventilated the child with a B-V-M apparatus but his hands became covered with the child’s sputum. He later injured his right hand causing an abrasion.
Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


IR
This was substantiated in the later work of (Thierbach, 2003, 269) and (Thierbach, 2005, 185).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Neutral


G(Narr) T

In summary after considering mouth-to-mouth resuscitation and the fear of infectious diseases the conclusion is made that disease transmission (patient-to-professional) is more likely with tuberculosis than HIV and that "the benefit of basic life support for a patient in cardiopulmonary or respiratory arrest greatly outweighs the risk for secondary infection in the rescuer or the patient."

No unrecognised references or evidence are provided.

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive


NT

The author is critical of a preceding article (Yeager, 1990, 51) and refers to (Glaser, 1985, 1653).

Level of Evidence: 5
Quality of Evidence: Fair
Nature of Evidence: Supportive

Yeager M. Concerns about contagious disease prompt infection controls for CPR. [See comment]. Occupational Health & Safety 1990; 59(7):51-2. (Yeager, 1990, 51)

OPQS

Level of Evidence: 5
Quality of Evidence: Poor
Nature of Evidence: Neutral

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