

No. S207313

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IN THE SUPREME COURT OF THE STATE OF CALIFORNIA

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**ROSEMARY VERDUGO, mother, successor and heir of MARY ANN  
VERDUGO, Decedent and MICHAEL VERDUGO, brother of  
Decedent**

Plaintiffs/Appellants

v.

**TARGET STORES, a division of TARGET CORPORATION,  
a Minnesota corporation**

Defendant/Appellee.

SUPREME COURT  
FILED

JAN - 6 2014

Frank A. McGuire Clerk

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Following Certification of a Question of California Law from the U.S.  
Court of Appeals, Ninth Circuit, in Appeal No. 10-57008

Deputy

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**RESPONDENT'S SUPPLEMENTAL  
REQUEST FOR JUDICIAL NOTICE**

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## SUPPLEMENTAL REQUEST FOR JUDICIAL NOTICE

Pursuant to Evidence Code sections 452 and 459 and California Rules of Court, rules 8.252(a) and 8.520(g), respondent Target Stores hereby requests that this Court take judicial notice of the following documents, attached as Exhibits 1 through 5:

1. Notice of Entry of Judgment, *Cohen v. Hilton Hotels Corp.* (San Diego Super. Ct. Apr. 3, 2006, No. GIC 821664);
2. William Ginsburg, *Prepare To Be Shocked: The Evolving Standard of Care in Treating Sudden Cardiac Arrest* (1998) 16 Am. J. of Emergency Med. 315;
3. R. Rodrigues et al., *What A Back Blow Can Do* (2010) 81 Resuscitation S56;
4. A. Langhelle et al., *Airway Pressure With Chest Compressions Versus Heimlich Manoeuvre In Recently Dead Adults With Complete Airway Obstruction* (2000) 44 Resuscitation 105;
5. Steven H. Abman et al., *Emergency Treatment of Foreign-Body Obstruction of the Upper Airway in Children* (1984) 2 J. of Emergency Med. 7.

This motion for judicial notice is based on the accompanying Memorandum of Points and Authorities and the Declaration of Donald M. Falk.

## MEMORANDUM OF POINTS AND AUTHORITIES

This Court has the same ability as a trial court to take judicial notice of appropriate materials. (See Evid. Code § 459; *Smith v. Rae-Venter Law Group* (2002) 29 Cal.4th 345, 459.) Under sections 451 and 452 of the Evidence Code, the Court “may judicially notice a variety of matters” relevant to the legal question at hand. (*Mangini v. R.J. Reynolds Tobacco Co.* (1994) 7 Cal.4th 1057, 1063, overruled on other grounds by *In re Tobacco II Cases* (2007) 41 Cal.4th 1257.)

This case presents the following certified question from the United States Court of Appeals for the Ninth Circuit: “Under what circumstances, if ever, does the common law duty of a commercial property owner to provide first aid to invitees require the availability of an Automated External Defibrillator (‘AED’) for cases of Sudden Cardiac Arrest?” Target requests that the Court take judicial notice of the documents described below, which are pertinent to the Court’s resolution of that question. None of the exhibits for which Respondent requests judicial notice were noticed in the federal court proceedings; all pertain to matters occurring before judgment. (California Rules of Court, rule 8.252(a)(1).) The exhibits’ authenticity is supported by the Declaration of Donald M. Falk, one of Target’s attorneys. (See *People v. Connor* (2004) 115 Cal.App.4th 669, 681; *Whaley v. Sony Computer America, Inc.* (2004) 121 Cal.App.4th 479, 487.)

1. Exhibit 1 is a Notice of Entry of Judgment in *Cohen v. Hilton Hotels Corp.* (Super. Ct. Apr. 3, 2006) No. GIC 821664, a case discussed in the brief of *amici curiae* Bobbi Cohen et al. (“Cohen brief”). This court may “take judicial notice” both “of the existence of” the judgment and “the truth of [the] result[ it] reached.” (*In re Vicks* (2013) 56 Cal.4th 274, 314 (internal quotation marks and emphasis omitted); see also Evid. Code § 452(d).)

2. Exhibit 2 is a scholarly article concerning sudden cardiac arrest and AEDs cited in the Cohen brief. This article includes relevant “viewpoints and generalized statements about the state of the world” that serve “as an aid to the court’s work of interpreting, explaining and forming the law.” (*Cabral v. Ralphs Grocery Co.* (2011) 51 Cal.4th 764, 775 fn.5.)

3. Exhibits 3 through 5 are scholarly articles concerning medical treatments for choking. Because these articles demonstrate ongoing changes in the treatment of medical emergencies, they also provide pertinent “viewpoints and generalized statements about the state of the world” that will “aid ... the court’s work of interpreting, explaining and forming the law.” (*Cabral*, 51 Cal.4th at 775 fn.5).

Respondent requests judicial notice of these articles only out of an abundance of caution and in order to make their contents more conveniently available to the Court. Because these articles have been published, judicial notice is not required: “Citation to the material is sufficient.” *Quelimane*

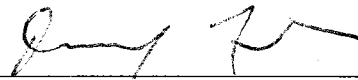
*Co. v. Stewart Title Guaranty Co.*, (1998) 19 Cal.4th 26, 46 fn. 9 [“A request for judicial notice of published material is unnecessary.”]). To the extent necessary, however, the articles may also be judicially noticed. (See, e.g., *Gavin W. v. YMCA of Metropolitan L.A.* (2003) 106 Cal.App.4th 662, 672 n.6 [taking notice of research articles providing relevant background in a negligence action].)

### CONCLUSION

For the foregoing reasons, Respondent Target Stores respectfully requests this Court take judicial notice of Exhibits 1 through 5.

Dated: January 6, 2014

Respectfully submitted,



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Attorneys for Respondent Target Stores

## DECLARATION OF DONALD M. FALK

I, Donald M. Falk, declare as follows:


1. I am a member of the State Bar of California, and counsel for respondent Target Stores.
2. I am familiar with the facts represented in this Supplemental Request for Judicial Notice, and declare that they are true and correct and were obtained from reliable sources.
3. Exhibit 1 is a true and correct copy of a Notice of Entry of Judgment in *Cohen v. Hilton Hotels Corp.* (Super. Ct. Apr. 3, 2006) No. GIC 821664, a case discussed in the brief of *amici curiae* Bobbi Cohen et al. (“Cohen brief”). This document was obtained by the staff of Lexis Courtlink from the designated official, public sources.
4. Exhibit 2 is a true and correct copy of an article by William Ginsburg, *Prepare To Be Shocked: The Evolving Standard of Care in Treating Sudden Cardiac Arrest* (1998) 16 Am. J. of Emergency Med. 315. This article was obtained from the publisher’s website at <http://amjmed.com>.
5. Exhibit 3 is a true and correct copy of an article by R. Rodrigues et al., *What A Back Blow Can Do* (2010) 81 Resuscitation S56. The article was obtained by the staff of Wisconsin TechSearch from the National Library of Medicine.

6. Exhibit 4 is a true and correct copy of an article by A. Langhelle et al., *Airway Pressure With Chest Compressions Versus Heimlich Manoeuvre In Recently Dead Adults With Complete Airway Obstruction* (2000) 44 Resuscitation 105. The article was obtained by the staff of Wisconsin TechSearch from the National Library of Medicine.

7. Exhibit 5 is a true and correct copy of an article by Steven H. Abman et al., *Emergency Treatment of Foreign-Body Obstruction of the Upper Airway in Children* (1984) 2 J. of Emergency Med. 7. The article was obtained by the staff of Wisconsin TechSearch from the libraries of the University of Minnesota.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed on January 3, 2014, at San Francisco, California.



---

By: Donald M. Falk

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6 Attorney: DOUGLAS D. GUY, ESQ. (SBN 117844)

7 Attorneys for Defendant HILTON HOTELS CORPORATION

8 SUPERIOR COURT OF CALIFORNIA, COUNTY OF SAN DIEGO

9  
10 BOBBI COHEN, an individual, ) CASE NO. GIC 821664  
11 Plaintiff, )  
12 v. ) NOTICE OF ENTRY OF JUDGMENT  
13 HILTON HOTELS CORPORATION, a )  
14 Delaware corporation dba HILTON )  
15 LA JOLLA TORREY PINES, ) Judge Jay M. Bloom  
16 Defendant. ) Department 70  
17 ) Action Filed: November 26, 2003  
18 )

19 TO ALL PARTIES AND THEIR ATTORNEYS OF RECORD:

20 PLEASE TAKE NOTICE that on April 3, 2006, judgment was entered  
21 in favor of defendant HILTON HOTELS CORPORATION, a Delaware  
22 corporation dba HILTON LA JOLLA TORREY PINES and against plaintiff  
23 BOBBI COHEN. A conformed copy of the Judgment on Special Verdict is  
24 attached as Exhibit A.

25 Dated: April 7, 2006

GATES, O'DOHERTY, GONTER & GUY, LLP

26 By: 

27 DOUGLAS D. GUY  
28 Attorneys for Defendant  
HILTON HOTELS CORPORATION







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**F I L E D**  
Clerk of the Superior Court

APR 03 2006

By: L. ROCKWELL, Deputy

SUPERIOR COURT OF CALIFORNIA, COUNTY OF SAN DIEGO

BOBBI COHEN, an individual,	)	CASE NO. GIC 821664
	)	
Plaintiff,	)	JUDGMENT ON SPECIAL VERDICT
	)	
v.	)	
	)	
HILTON HOTELS CORPORATION, a	)	Judge Jay M. Bloom
Delaware corporation, dba	)	Department 70
HILTON LA JOLLA TORREY PINES,	)	
	)	Action Filed: November 26, 2003
Defendants.	)	

This action came on regularly for trial by jury on February 21, 2006 through March 15, 2006, before the Honorable Jay M. Bloom, Judge presiding. Plaintiff BOBBI COHEN appeared by and through Charles S. Roseman and Richard D. Prager of Charles S. Roseman & Associates. Defendant HILTON HOTELS CORPORATION dba HILTON LA JOLLA TORREY PINES appeared by and through Douglas D. Guy and David E. Wilkinson of Gates, O'Doherty, Gonter & Guy, LLP.

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1 A jury of twelve persons was regularly empaneled and sworn to  
2 try the action. Witnesses on the part of plaintiff and defendant  
3 were sworn and examined.

4 After hearing the evidence, the arguments of counsel, and  
5 instructions of the Court, the jury retired to consider their  
6 verdict, and subsequently returned to the courtroom, and being called  
7 to answer to their names, duly rendered their verdict in writing in  
8 words and figures, to-wit:

9 "Title of court and cause: We answer the questions submitted to  
10 us as follows:

11 1. Was defendant, HILTON HOTELS CORPORATION, negligent  
12 with regard to the death of Stuart A. Cohen?

13 \_\_\_\_\_ "Yes"       X  "No"

14 If your answer to question 1 is yes, then answer question 2. If  
15 you answered no, stop here, answer no further questions, and have the  
16 presiding juror sign and date this form.

17 Signed:  /s/ Eric Hedstrom   
18 Presiding Juror

19 Dated:  March 15, 2006  "

21 It appearing that by reason of said special verdict defendant  
22 HILTON HOTELS CORPORATION dba HILTON LA JOLLA TORREY PINES is  
23 entitled to judgment.

24 ///  
25 ///  
26 ///  
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1 Now, therefore, it is ORDERED, ADJUDGED, and DECREED that  
2 defendant HILTON HOTELS CORPORATION <sup>a Delaware Corporation</sup> dba HILTON LA JOLLA TORREY PINES  
3 is entitled to judgment against plaintiff BOBBI COHEN. Entitlement  
4 to costs shall be determined by statute and shall be submitted by way  
5 of memorandum of costs pursuant to statute.

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DATED: APR 03 2006

JAY M. BLOOM

HONORABLE JAY M. BLOOM  
JUDGE OF THE SUPERIOR COURT

APPROVED AS TO FORM:

CHARLES S. ROSEMAN  
Attorney for Plaintiffs

RICHARD D. PRAGER  
Attorney for Plaintiffs



## Prepare To Be Shocked: The Evolving Standard of Care in Treating Sudden Cardiac Arrest

WILLIAM GINSBURG, Esq

Standards of care are devised by juries in courts of law. They "evolve," in part, according to public expectations as those expectations are honed by the profession in its literature, its forums, and as reported in the popular press and media. Sudden cardiac arrest is a major killer in the United States. A significant number of deaths from sudden cardiac arrest can be prevented by using automatic external defibrillators in the out-of-hospital setting. These devices have become cost effective, reliable, and readily available and the standard of care requiring their use in the out-of-hospital setting has arrived. (*Am J Emerg Med* 1998;16:315-319. Copyright © 1998 by W.B. Saunders Company)

It is recognized practice within the hospital setting that early defibrillation is the accepted "standard of care" in responding to sudden cardiac arrest (SCA).<sup>1,2</sup> The necessary resources—defibrillators, trained personnel, and support teams—have long been available in this setting. If a hospital-based emergency physician failed to defibrillate a patient in ventricular fibrillation, this would likely be deemed unreasonable conduct below the legal standard of care, given the ready availability of defibrillators in the hospital setting, and could potentially result in legal liability for the physician and/or the hospital.

The logical medicolegal question that flows from this analysis is, should the same standard of care with regard to treatment of SCA that exists within the hospital environment, ie, early defibrillation, also apply to emergency response personnel and other first-responders outside the hospital setting? Now that many of the barriers previously inhibiting the widespread deployment of defibrillators outside the hospital have been overcome, a balancing of the costs and benefits of early defibrillation may well herald the extension of the standard of care beyond the hospital setting, into those environments where defibrillator technology has the greatest chance to be usefully applied.

Emergency response organizations, and the emergency physicians and medical directors who have the ability to influence out-of-hospital emergency care delivery systems,

have a responsibility to recognize this evolving standard of care and have a duty to ensure that emergency response teams are adequately equipped and trained in the use of defibrillators. By facilitating the widespread deployment of defibrillators in the out-of-hospital setting, emergency response organizations, including emergency physicians and medical directors, take an important and logical step toward achieving their ultimate objective—saving lives.

### BACK TO FUNDAMENTALS—TIME IS OF THE ESSENCE IN RESPONDING TO SCA

It is well known among emergency physicians and those who specialize in medical negligence cases that SCA is a leading cause of death in the United States, claiming approximately 350,000 lives each year.<sup>3,4</sup> SCA results from an electrical malfunction of the heart that causes an abnormal heart rhythm or arrhythmia, the most common of which is ventricular fibrillation.

The only proven therapy for treating ventricular fibrillation is defibrillation—an electrical shock to the heart that restores the organ's normal, coordinated rhythm and allows pumping action to resume. Cardiopulmonary resuscitation (CPR) may be useful as an interim measure to buy the victim more time; however, CPR by itself cannot reverse the symptoms of sudden cardiac arrest. Only defibrillation can perform this function.

Despite the proven efficacy of a treatment for SCA caused by ventricular fibrillation, approximately 95% of all victims who suffer from SCA each year will die.<sup>5</sup> This stems from the simple fact that approximately 90% of all sudden cardiac arrests occur outside the hospital setting, and, as such, most of the victims never receive the only proven treatment that may save their lives.<sup>6</sup> Studies have established that when defibrillation therapy is administered within the first few minutes of SCA, a patient's likelihood of survival may be as high as 80% to 90%.<sup>7-10</sup> With each minute of elapsed time, however, this survival rate diminishes by approximately 10%.<sup>10</sup>

Cities initiating early defibrillation programs have reported favorable results. For example, in Seattle, WA, where defibrillators are widely available to first responders and timely defibrillation is emphasized, the survival rate is 30%, well above the national average of 5%.<sup>10</sup>

These facts and statistics point to an important conclusion: improved treatment of SCA depends on the participation of emergency response personnel—the paramedics,

From Ginsburg, Stephan, Oringher, and Richman, Los Angeles, CA.

Manuscript received March 13, 1997, returned April 2, 1997; revision received April 17, 1997, accepted April 29, 1997.

Address reprint requests to Mr Ginsburg, Ginsburg, Stephan, Oringher & Richman, 10100 Santa Monica Blvd, 8th Floor, Los Angeles, CA 90067-4012.

**Key Words:** Sudden cardiac arrest, defibrillation, automatic external defibrillator, standard of care.

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emergency medical technicians (EMTs), police officers, fire department personnel, and others who first reach an SCA victim. These people represent the only caretakers with a window of opportunity to address the victim's symptoms within those precious first few minutes. Because time to defibrillation is the key variable, the burden of saving lives necessarily shifts to those emergency response personnel on the front lines. All available tools must, therefore, be in the arsenals of first responders so that maximum therapy can be delivered as quickly as possible, diminishing the number of lives lost to SCA.

### EVOLVING DEFIBRILLATOR TECHNOLOGY AND THE EXPANDED ROLE OF EMERGENCY RESPONSE PERSONNEL

Historically, several obstacles have inhibited wide deployment and availability of defibrillators to emergency response personnel and other individuals capable of acting in a first-response capacity in the out-of-hospital setting. The original, standard manual defibrillators were bulky, expensive, difficult to maintain, and required that the operator be trained to interpret electrocardiogram (ECG) strips and make a "shock" or "no shock" decision.

In the 1980s, automatic external defibrillators (AEDs) were developed. These devices contained microcomputers that could accurately interpret and identify the cardiac arrhythmia as ventricular fibrillation. As a result, it was no longer necessary for the AED operator to have expertise in interpreting ECG waveforms, thus broadening the class of potential operators. Nevertheless, persistent barriers such as intensive maintenance, weight, and cost prevented the wide deployment of AEDs in the out-of-hospital setting.

Currently, breakthroughs in AED technology are paving the way for wide-ranging deployment of AEDs in many settings and contexts where their use was previously impractical. New AEDs require less energy to administer an equivalent "shock," and are lighter, smaller in size, more durable, and less expensive than the former AEDs. Improvements in battery-system technology and the incorporation of self-test and status indicator features also make these new devices more reliable than their predecessors, and, according to the manufacturers' claims, they have substantially lower maintenance requirements.

AEDs are available from several manufacturers on a competitive basis, and the efficacy of the technology, as well as its cost effectiveness, have been proven.

Thus, because it is now cost- and risk-effective to maintain AEDs in most environments where first-aid and first-response measures are typically administered, the potential for criticism that such devices are not available when needed in the field has proportionately increased. In response to such criticism (and the lawsuits that may follow), the leaders of emergency response organizations have a duty to advocate for the inclusion of AEDs in the arsenal of medical equipment available to first-responders.

### EVOLVING PUBLIC EXPECTATIONS

The public perception of the "standard of care" may be evolving, in part, because advances in defibrillators have dovetailed with improvements in the nation's emergency response infrastructure as a whole. Communities around the

country have invested significant dollars to upgrade their 911 systems, have trained more citizens to administer CPR, and have vastly improved EMT capabilities by better equipping vehicles and enlarging the number of trained personnel.<sup>11</sup> In 1994, for example, the United States Department of Transportation incorporated defibrillation into their *EMT—Basic National Standard Training Curriculum*, thus requiring that all EMTs be trained to operate an AED. Emergency response personnel have thus been given a greater range of medical duties to perform, and the public's expectation of their abilities has grown to the point where they are often looked upon as physicians, or at least an extension of the medical facility.

Furthermore, many Americans are now more sophisticated about issues concerning their own health care. An explosion of new technologies, direct marketing to consumers by manufacturers, health care reform efforts that are forcing consumers to take responsibility for their own health care, the Internet, and a boom in health-oriented television shows have contributed to the education of the American public about a wide range of health issues.

This new public awareness and added consumer sophistication brings with it heightened scrutiny over the quality of health care delivered and an increasing desire to hold physicians, nurses, paramedics, EMTs, and other health care providers accountable for their actions. All physicians, and especially the emergency physicians, medical directors, and emergency response organizations who interface directly with the community, must be attuned to this fact. Today's tort-based legal system is geared toward juries comprised of individuals whose expectations are molded and affected by media and education in ways heretofore unthinkable. Information known only to the readers of technical journals and bulletins in the past, is now part and parcel of "real life television," the *Wall Street Journal*, *USA Today*, *Ladies Home Journal*, *Men's Health* and countless other publications inundating the market today. For example, the recent decision by American Airlines to outfit its entire fleet with AEDs—a news event that received coverage ranging from *USA Today* to the *Tonight Show with Jay Leno*—further elevates public expectation that when SCA occurs outside the hospital environment, AEDs should be on hand to save lives. In essence, AEDs, like many other therapies and diagnostic tools, are not a secret anymore.

### THE DISCONNECT: IMPROVEMENTS IN TECHNOLOGY AND INCREASED PUBLIC CONSCIOUSNESS HAVE NOT YET PRODUCED THE DESIRED RESULTS

Despite the advances in AED technology and the expanded role of emergency response personnel, little headway has been made in reducing the number of deaths attributable to SCA in the US. More often than not, first-response vehicles responding to an SCA call will arrive on the scene unequipped with a defibrillator. It is estimated that fewer than 25% of basic life support ambulances and only 10% to 15% of fire department vehicles that have emergency "first-response" duties are currently equipped with AEDs.<sup>12</sup>

These numbers appear inexcusably low, given the fact that the cost-per-life saved from SCA is far less than for many



other common diseases. According to one study, the cost-per-life saved from SCA by paramedics or emergency medical systems staffed with EMTs who are certified to provide external defibrillation is estimated at \$2,100 to \$2,300.<sup>13</sup> This figure contrasts with an expenditure of \$35,000 to \$45,000 for renal dialysis per year of useful life, \$50,000 per year of life saved for primary prevention of coronary artery disease by cholesterol reduction treatment with lovastatin (except in very high-risk patients), and \$15,000 to \$30,000 per year of life saved for screening and generic treatment of high blood pressure.

Given the relatively low cost and demonstrable benefits of maintaining these life-saving devices, the absence of AEDs in the out-of-hospital setting is an affront to the standard of care. The lack of AEDs in first-response/rescue situations and the concomitant lack of improved response to sudden cardiac arrest appear to stem more from a lag in knowledge about the availability of the new, improved devices and institutional inertia, rather than from any "real" technological or cost obstacles. The perennial excuse of "budget cuts," "lack of funding," and "inability to integrate the concept into the training program" are overshadowed by the "risk-benefit" analysis presented in the light of preventable deaths.

It would be unthinkable for an emergency physician not to provide early defibrillation to a patient who suffers a sudden cardiac arrest in the emergency department. Why should the standard be different in the out-of-hospital setting where defibrillator technology is readily available and EMTs are required to be trained to provide early defibrillation?

#### THE FRAMEWORK FOR ESTABLISHING LEGAL LIABILITY

As alluded to earlier, liability in the medicolegal context typically arises where the so-called "standard of care" in a particular area has been violated by doctors, nurses, emergency response personnel, or other health care providers. The term "standard of care" embraces an ever-shifting medicolegal concept, not well suited to objective definition.

In practice, the standard of care is a fact-specific inquiry, determined on an ad hoc basis by the trier of fact (be it judge or jury) in a particular case. A judge decides whether there is enough evidence presented by a plaintiff for a jury to consider. Once the judge determines that this evidentiary threshold has been met, the jury becomes the trier of fact. The trier of fact, then, considers all relevant medical evidence, including expert testimony from medical personnel, the existence of clinical practice guidelines that denote accepted or preferred practices in a particular area of medicine, and the attorney's powers of persuasion.

Trial evidence on the standard of care is presented through expert witness testimony. While the substance of this testimony/evidence is central to the jury's determination, because the ultimate issue is resolved by a "nonmedical" trier of fact, there will always be a certain degree of public perception and expectation factored into the equation—intangible factors that emanate from personal experience or images the individual has internalized from the world around him or her (eg, from television and the media). At some level, then, all medical evidence gets filtered through the lens of an individual's common sense and reason when

determining what type of behavior is appropriate under the applicable circumstances.

#### JURY VERDICTS CAN DRIVE THE EVOLVING STANDARD OF CARE

The current assumptions that are espoused to justify the creation and expansion of "standards of care" in the legal setting include the need for a mechanism outside of the medical and paramedical field to press the standard forward by identifying the availability of reasonable diagnostic and treatment techniques to medical providers who might otherwise be resistant to adopt them for cost or other motives.

Legislative mandate is one such external force. The common law jury system is another. As juries award money to plaintiffs for a physician's or health care facility's failure to perform in a specified manner, the medical community reacts by acknowledging an evolution of the "standard of care." If the medical community fails to respond, it will simply fall prey to further jury verdicts.

The fact that EMTs, paramedics, fire personnel, police personnel, and other city, county, and state employees, as individuals, are usually immune from civil suit for discretionary tasks undertaken in the course of performing their public duties does not weaken this proposition. When an emergency response unit in the field is suspected of negligence for its failure to be equipped with a defibrillator when responding to an SCA, the lawsuit that may well follow will be filed against the community, or the hospital, or other emergency response organization responsible for setting up and administering the response program for the benefit of the general public.

Sovereign immunity is a concept in the law designed to protect the tax-based public servants, as individuals, who are acting on behalf of the public and whose negligence would result in damages that are paid out of general public funds. Many community or industrial-based emergency response organizations and most emergency physicians, medical directors, corporations, and hospitals do not enjoy such immunity. Thus, they face exposure to legal liability and are the obvious target of plaintiff's lawyers seeking redress for what they consider to be damages caused by medical negligence.

#### THE STANDARD OF CARE IS EXPANSIVE

In a world where the standard of care can be shifting and uncertain, one thing remains very certain: as technology advances in a particular field, and as expectations evolve, so too does the standard of care. The application of the standard naturally expands to cover other settings and other medical personnel who are charged with the responsibility to remain abreast of the technological improvements. This does not mean that the mere existence of technology automatically mandates its use as essential to the standard of care. It does mean, however, that in circumstances where a device has proven effective in one setting, and advances in the technology allow the device to be deployed in ways that had heretofore been prohibitively expensive, unreliable, or impractical, a situation is created where the use of the device far outweighs the risks and costs, and hence, the standard of care evolves.

Examples abound. Capnometry, which was previously available only to anesthesiologists in the operating room, has evolved to the point where esophageal intubation can be virtually eliminated as a risk in the prehospital setting through the use of capnometric devices. The use of telemetry as simple and yet as complicated as facsimile machines has enabled immediate X-ray interpretation and ECG readings in the field. Similarly, telephone hook-ups now enable obstetrics practitioners to read and interpret live fetal monitor tracings for patients in labor, outside the hospital environment.

Such an evolution appears to be taking root with the recent breakthroughs in AED technology. Defibrillator technology, and the therapeutic concept behind the technology, is already well accepted as the standard of care in treating SCA in the hospital setting. The technology has also begun to infiltrate the out-of-hospital setting, where it has proven to be an invaluable tool in the hands of EMTs, police, and firefighters (if available). By reducing the costs and risks associated with AEDs and making the devices available to first-responders outside the hospital setting, the standard of care effectively expands to cover these potential users. The emergency response organizations responsible for equipping and staffing out-of-hospital vehicles have a responsibility to recognize this evolving standard and must play an active role in ensuring that these life-saving devices are made available in all appropriate out-of-hospital settings.

Emergency physicians and medical directors have an important and influential role to play here. While not all of these physicians have direct control over the out-of-hospital delivery system, such physicians—as opinion-leaders on emergency care in their communities—have a responsibility to speak up and advocate for the inclusion of life-saving devices such as AEDs when the out-of-hospital delivery system is obviously deficient.

#### **EVIDENCE OF THE EVOLVING STANDARD OF CARE: THE EVOLVING STANDARD OF CARE IS HERALDED BY THE LITERATURE, BY OFFICIAL RECOGNITION, AND BY PATIENT/JURY EXPECTATIONS**

There is a growing body of evidence to signal the evolving standard of care in treating SCA in the out-of-hospital environment. First, the literature is sufficient to put the profession "on notice" of an evolving standard care in the use of AEDs. Importantly, the existence of a standard of care may well be perceived on a "should have known" basis as well as a "knowledge in fact" basis, and the standard can evolve subtly without widespread fanfare or use. Moreover, the "legal" standard of care may actually be higher than current general practice in the community, where warranted by reasonable prudence and clear cost-benefit analysis.<sup>14</sup>

Second, there has been strong official recognition of the evolving standard of care by the American Heart Association (AHA). The AHA has acknowledged the value of AEDs in treating sudden cardiac arrest and the important role that first responders must play in reducing the response time to victims in ventricular fibrillation, arguing that up to 100,000 lives could be saved each year with earlier defibrillation.

The AHA's position is that "all personnel whose jobs require that they perform basic CPR [should] be trained to

operate and permitted to use defibrillators, particularly automated external defibrillators (AEDs)."<sup>1</sup>

Thus, the AHA apparently considers early defibrillation to be the standard of care in the community in first-response situations. "Failure of emergency personnel to have a defibrillator available during a cardiac arrest is difficult to defend."<sup>1</sup>

The AHA believes that AEDs should be widely deployed. This involves both increasing the number of AEDs in existing first-response vehicles, as well as expanding the group of first-responders who can successfully operate the technology. This position is further endorsed by the International Association of Fire Chiefs, which has called for all fire suppression vehicles in the US to be equipped with AEDs and for all fire personnel to be trained in their operation.<sup>15</sup>

Third, the expectations of citizens, who increasingly perceive emergency response personnel in the out-of-hospital setting to be an extension of the hospital environment, add additional weight to the arguments for an evolving standard of care in treating SCA. As noted above, such public expectations are formed by not only the peer-reviewed medical literature, but by the images set forth in the media and through life experiences.

If a victim in ventricular fibrillation is reached by emergency response personnel within the first few minutes, and the emergency responders are not equipped with an AED, the victim will probably die before reaching the hospital. Given the small incremental cost of maintaining an AED, family members would reasonably question why the first responders were not equipped with such a device. In view of the benefits of such devices, considered against the relatively minimal costs/risks, the lack of an AED would appear unreasonable under the circumstances and could result in the emergency services provider being deemed the *proximate cause* or what is sometimes referred to as a *substantial factor* in the patient's death. The concept of proximate cause is a legal one that means that the negligence of a tortfeasor is substantially related or connected with/to the damages suffered. In the case of SCA, the damage suffered is most often death.

#### **LEGISLATION AND INSURANCE MANDATES NOT ONLY FAIL TO HERALD THE COMING OF A STANDARD, BUT ARE OFTEN BEHIND THE BANDWAGON**

It would be imprudent for those who have the ability to implement AED technology on the "front lines" to wait until legislatures and/or insurance underwriters mandate early defibrillation as the standard of care in emergency response situations. Legislative bodies and insurers often act in response to medical malpractice lawsuits, not the other way around.

By the time the proverbial "horse is out of the barn" in terms of verdicts against emergency facilities and emergency response organizations, and the standard of care has risen to a sufficient level of concern to be mandated by legislation or insurance mandate, the cost of noncompliance is a fait accompli. The goal should be to remain ahead of the curve and recognize the emergence of a standard of care as it is evolving, thus avoiding the cost and precedential effect of multiple jury verdicts, which can lead to erosion of public

confidence and further enhance the tendency toward findings adverse to the emergency medical profession.

Delay in adopting AED technology in first-response situations puts plaintiffs' lawyers at a significant advantage, allowing counsel to argue that but for the absence of a reasonable and cost-effective treatment—the AED—the deceased might still be alive. Such arguments have great appeal when they are easily bolstered by experts, backed with convincing literature and statistics.

## CONCLUSION

The common denominator uniting all stakeholders responsible for treating SCA in this country is the fundamental desire to save lives. Moreover, as recognized by the medical, legal, and lay communities, the key ingredient to improving the survival rate from SCA is faster response time to defibrillation. As the technological and cost barriers previously inhibiting widespread deployment of AEDs in the field erode, the imperative to save lives, coupled with a balanced evaluation of the costs and benefits of AED deployment, heralds an extension of the standard of care requiring the use of AEDs in the out-of-hospital setting. The most logical and direct extension of this standard of care rests with emergency response organizations and the emergency physicians and medical directors who can influence the content of emergency response programs. These physicians should recognize and embrace their responsibilities in facilitating the widespread deployment of AEDs in the out-of-hospital setting, where these life-saving devices represent the best means of preventing thousands of unnecessary deaths attributable to SCA each year.

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AP086

**Fastrach laryngeal mask airway management in out-of-hospital critical care patients**

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**Purpose of the study:** We want to describe the epidemiologic profile of Fastrach Laryngeal Mask (FLM) intubations in out-of-hospital critical care patients attended by the Emergency System (ES) staff.

**Materials and methods:** Observational descriptive and retrospective study. The period goes from January 2002 to December 2007. 73 patients attended by de ES staff that required a FLM to airway management. Data were collected analyzing computerized clinical histories. Parameters: age, gender, medical or traumatic etiology, first cardiac rhythm, survival until hospital admission and the percentage of usage of this technique in the total amount of patients that required airway management.

**Results:** 4114 patients that required airway management, 73 of them with FLM (1.8%), 11.1% female and 84.9% male. Average  $50.7 \pm 20.5$  years old. Within the previous mentioned amount it was not possible endotracheal intubation using FLM in 4 of them (5.5%; 3 male and 1 female). In 48% (35) the cause of airway management was medical whereas in the other 52% (38) it was traumatic. In patients with medical etiology, 25 (71.4%), we found cardiac arrest first rhythm, and 10 (26.3%) among those with traumatic etiology. Survival (alive at hospital arrival) was 18 (51.5%) among patients with medical etiology and 24 (63.2) among those with traumatic etiology.

**Conclusions:** FLM is an easy technique which allows a fast airway management both in patients with extrinsic and intrinsic conditions has a difficult airway management.

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AP087

**What a back blow can do**Rodrigues R.<sup>1</sup>, Tranquada R.<sup>1</sup>, Menezes S.<sup>1</sup>, Rodrigues N.<sup>2</sup><sup>1</sup> Department of Anaesthetics, Hospital Central do Funchal, Funchal, Portugal<sup>2</sup> Medical Student, Faculdade de Ciências Médicas de Lisboa, Lisboa, Portugal

**Introduction:** The incidence of Foreign-Body Airway Obstruction (FBAO) events in hospitals is underestimated. Many sudden deaths resulting from FBAO are mistakenly ascribed to cardiac disease and other causes.<sup>1,2</sup> When FBAO appears in post-operative before the patient has begun oral intake, the diagnosis is difficult. A case of a symptomatic aspiration of a significant foreign body is presented here.

**Case report:** A 62-year-old male was due for repair of a large hernia on the linea alba under regional anesthesia and sedation. A history of instable angina, treated with amlodipine and aspirin, was mentioned during the pre-operative anesthetic consultation. Four hours after surgery, in the ward, the patient initiated sudden respiratory distress, chest pain, wheezy breathing, cyanosis and exhibited the universal choking signal. The patient was encouraged to cough while the emergency team was activated. The coughing was ineffective, so he was positioned on his left side and up to five back blows were applied between the shoulder blades. The blows were ineffective, and given the recent abdominal surgery, it was decided to apply five chest thrusts and repeat the back blows. After the second back blow the patient expelled his teeth appliance and resumed normal breathing.

**Discussion:** Removal of teeth appliances prior to anesthesia or sedation is essential.<sup>3</sup> In this case the suspicion, diagnosis and early beginning of maneuvers was extremely important. The education of professionals was crucial. The decision to apply chest thrusts instead of abdominal thrusts in the post-operative of abdominal surgery was the right decision.<sup>4</sup>

**Conclusion:** The recognition of FBAO was key to the successful outcome of this case.

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AP088

**Prehospital boussignac continuous positive airway pressure: One year experience**

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**Introduction:** Continuous positive airway pressure (CPAP) treatment for acute cardiogenic pulmonary edema (ACPE) has important benefits in gas exchange with reduction of endotracheal intubation (ETI) and related morbidity/mortality. The Boussignac CPAP (BCPAP) system is a small disposable lightweight plastic cylinder that is directly connected to a face mask. It has been shown to be effective and feasible in prehospital care.

**Methods:** A prospective study of one year was conducted in order to examine the clinical incomes of prehospital BCPAP. 48 patients with ACEP assisted by our emergency medical team were analysed on demographic and clinical features, tolerance and response to BCPAP, as well as for the need for ETI.

**Results:** The mean age was  $73.9 \pm 1.6$  years with 54% male patients. Hypertensive ACPE was diagnosed in 52% of the cases. Prehospital BCPAP and conventional medical treatment resulted in a significant improvement in systolic blood pressure (average decrease of  $25 \pm 5$  mmHg), respiratory rate (average decrease of  $5 \pm 1$  breaths/minute) and oxygen saturation (average increase of  $10 \pm 1\%$ ). Only two patients (4.2%) required prehospital invasive ventilation and other two needed subsequently ETI and ventilation upon arrival in the emergency department. BCPAP was mostly initiated at patient's residence and no technical difficulties were reported. The device was well tolerated in 93.8% of the patients. 94.3% of the medical staff clearly stated that an evident clinical positive outcome was achieved using BCPAP.

**Conclusions:** ACPE patients show significant improvement in oxygenation, subjective dyspnea, respiratory and heart rates with BCPAP system, producing a rapid physiological and symptomatic improvement. To sum up, the use of Boussignac continuous positive airway pressure in prehospital care for patients with severe ACPE, in association with a conventional medical treatment, allows a prompt clinical enhancement along with a decrease of endotracheal intubations.

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AP089

**Comparison of different methods ( $p_a\text{CO}_2$ ,  $p_{et}\text{CO}_2$ ,  $p_{tc}\text{CO}_2$ ) to determine carbon dioxide partial pressure ( $p\text{CO}_2$ ) in mechanically ventilated patients from an intensive care unit**

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Keywords: Capnometry; Capnography; Arterial blood gas analysis; Point-of-care testing

**Background:** Measurement of carbon dioxide partial pressure ( $p\text{CO}_2$ ) in mechanically ventilated patients has become standard in intensive care units (ICUs) for critically ill patients. Therefore, hyper- or hypoventilation with all their clinical consequences shall be avoided. Different methods are available to determine  $p\text{CO}_2$ , including arterial blood gas analysis ( $p_a\text{CO}_2$ ),<sup>1</sup> end-tidal ( $p_{et}\text{CO}_2$ ),<sup>2</sup> and transcutaneous ( $p_{tc}\text{CO}_2$ )<sup>3,4</sup> measurements.

The aim of this study was to compare the accuracy and reliability of different methods to determine  $p\text{CO}_2$  in mechanically ventilated patients from an ICU.

**Methods:** After informed consent was gained from the legal guardians,  $p\text{CO}_2$  was determined in  $n = 32$  patients requiring mechanical ventilation. Measurements were gathered every 30 min within a 2 h period by: (1) arterial blood gas analysis with Radiometer ABL 625 (ABL; Radiometer, Copenhagen, Denmark; gold standard) and (2) Immediate Response Mobile Analyzer (IRMA; Keller Medical, Bad Soden, Germany), by (3) end-tidal  $p_{et}\text{CO}_2$  (main stream gas flow) by a Propaq 106 EL monitor (Protocol Systems, Beaverton, OR, USA) and by (4) transcutaneous  $p_{tc}\text{CO}_2$  determination by a Tina TCM4 (Radiometer, Copenhagen, Denmark). Bland-Altman method was used for statistical analysis<sup>5</sup>;  $p < 0.05$  was considered statistically significant.

**Results:** Statistical analysis revealed excellent correlation between IRMA and ABL ( $r = 0.88$ ) as well as between  $p_{tc}\text{CO}_2$  and ABL ( $r = 0.79$ ), whereas correlation between  $p_{et}\text{CO}_2$  and ABL was weaker ( $r = 0.64$ ). Analysis by Bland-Altman revealed a bias and precision of  $2.0 \pm 3.7$  for the IRMA,  $2.2 \pm 5.7$  for transcutaneous and  $-5.5 \pm 5.6$  for end-tidal measurement.

**Conclusions:**  $p_a\text{CO}_2$  by IRMA and  $p_{tc}\text{CO}_2$  provided the best accuracy when compared to the reference measurement. In patients who need tight control of  $p\text{CO}_2$ , transcutaneous monitoring may be a better supplement to arterial blood gas analysis than capnometry/capnography.

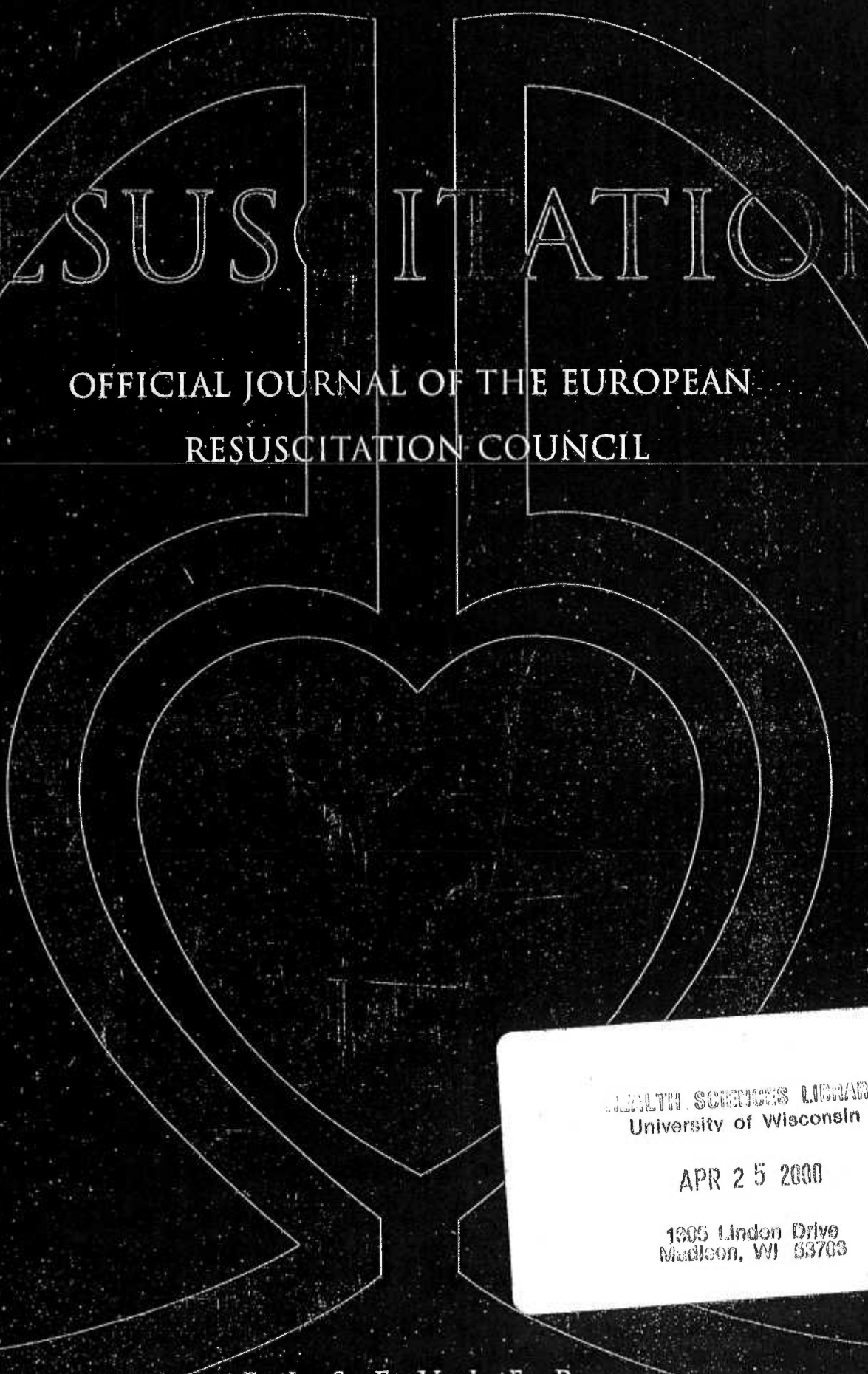
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# Airway pressure with chest compressions versus Heimlich manoeuvre in recently dead adults with complete airway obstruction

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## Abstract

In a previous case report a standard chest compression successfully removed a foreign body from the airway after the Heimlich manoeuvre had failed. Based on this case, standard chest compressions and Heimlich manoeuvres were performed by emergency physicians on 12 unselected cadavers with a simulated complete airway obstruction in a randomised crossover design. The mean peak airway pressure was significantly lower with abdominal thrusts compared to chest compressions,  $26.4 \pm 19.8$  cmH<sub>2</sub>O versus  $40.8 \pm 16.4$  cmH<sub>2</sub>O, respectively ( $P = 0.005$ , 95% confidence interval for the mean difference 5.3–23.4 cmH<sub>2</sub>O). Standard chest compressions therefore have the potential of being more effective than the Heimlich manoeuvre for the management of complete airway obstruction by a foreign body in an unconscious patient. Removal of the Heimlich manoeuvre from the resuscitation algorithm for unconscious patients with suspected airway obstruction will also simplify training. © 2000 Elsevier Science Ireland Ltd. All rights reserved.

**Keywords:** Airway obstruction; Basic Life Support (BLS); Cardiopulmonary resuscitation (CPR); Chest compression; Education; Guidelines

## 1. Introduction

Foreign body airway obstruction is an uncommon but preventable cause of cardiac arrest, with an incidence of 0.65–0.9/100,000 [1,2] as a cause of death. In choking victims who stop breathing the European Resuscitation Council (ERC) recommends up to five sharp slaps between the shoulder blades, followed by abdominal thrusts (the Heimlich manoeuvre) if this fails. If the victim becomes unconscious, this is to be followed by 'the sequence of life support' [3]. The American Heart Association (AHA) recommends the Heimlich manoeuvre with alternating finger sweeps as the only technique [4], arguing that back blows may not be

as effective as Heimlich manoeuvre in adults [5,6]. The AHA also claims that this will simplify training [4].

Based on a single case report Skulberg [7] suggested that standard chest compressions could be a better technique. If this is true, two additional goals might be achieved. It would simplify what needs to be learned for CPR and reduce the time without circulation from chest compressions in patients with cardiac arrest. We have therefore conducted a study of the airway pressure generated by chest compressions compared to abdominal thrusts in recently dead patients. Human cadavers were selected instead of animals, as the shape of the chest is different between animals and humans which makes extrapolation of data from one to the other unreliable.

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## 2. Materials and methods

The study was approved by the Regional Committee for Medical Research Ethics and performed in the Emergency Medical Service System of Oslo. Cadavers are not covered by the Helsinki declaration, and the ethics committee did not require informed consent from relatives. Twelve unselected recently dead adults of either sex were studied immediately after unsuccessful resuscitation from prehospital cardiac arrest. While still intubated and with the cuff inflated to create an airtight seal, the tracheal tube (ID 8.0 mm) was connected to a handheld pneumotachograph (VentCheck™, model 101, Novamatrix Medical Systems, CT, USA) for airway pressure measurements. The proximal end of the sensor was plugged to stimulate complete airway obstruction.

The peak pressures achieved with five standard chest compressions were compared with peak pressures achieved with five abdominal thrusts (Heimlich manoeuvre) in a randomised, crossover design. Before starting each procedure it was ensured that the lungs were in the resting expiratory position. Four male emergency physicians weighing 80–90 kg performed the procedures. All were advanced life support instructors with many years of practical CPR experience. Both procedures were performed according to the European Resus-

citation Council guidelines [3]. The abdominal thrusts were given kneeling astride the supine cadaver. Two paramedics controlled the performance of the procedures and recorded the results. The physicians received no feedback and were blinded from the results. Patient sex, age, particulars about their size/shape and complications during CPR such as rib fractures or lung aspiration were recorded.

The mean pressures generated by the five chest compressions were compared to the mean pressures generated by the five abdominal thrusts using Jandel SigmaStat© statistical software (Erkrath, Germany). Each cadaver served as its own control. After assessing the distribution of the data distribution, a paired *t*-test was used. Data are presented as means  $\pm$  SD.

## 3. Results

Ten recently dead men and two women with a mean age of  $68 \pm 15$  years and mean body weight of  $80 \pm 15$  kg were studied. Rib fractures were noted in three patients and pulmonary aspiration in one during the preceding resuscitation. One patient was very thin and the physician noted that he felt very little resistance in the epigastric region during abdominal thrusts before he felt the vertebral column. One corpse was extremely obese with a potbelly.

The mean peak airway pressure was significantly lower during abdominal thrusts compared to chest compressions,  $26.4 \pm 19.8$  cmH<sub>2</sub>O versus  $40.8 \pm 16.4$  cmH<sub>2</sub>O ( $P = 0.005$ , 95% confidence interval for the mean difference 5.3–23.4 cmH<sub>2</sub>O) (Fig. 1). In all but one cadaver, the extremely obese subject, the mean airway pressure was higher with chest compressions compared to abdominal thrusts. In two cadavers, the very thin subject, and an 80 kg woman with pulmonary aspiration, there was no detectable airway pressure change at all with abdominal thrusts (patients 1 and 2, Fig. 1)

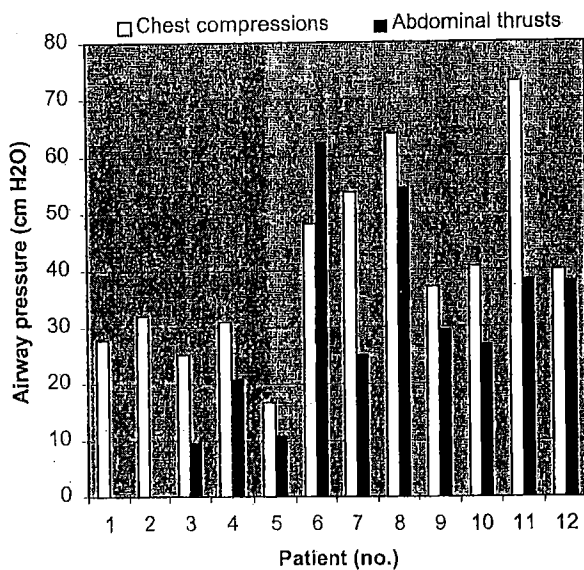


Fig. 1. Airway pressures with chest compressions and abdominal thrusts on twelve recently dead adults with complete airway obstruction. The airway pressure is significantly lower with abdominal thrusts than chest compressions ( $P = 0.005$ ).

## 4. Discussion

In this study we achieved higher airway pressures with standard CPR chest compressions than with abdominal thrusts in recently dead subjects with complete airway obstruction.

Since the introduction of abdominal thrusts by Heimlich in 1974 [6] there has been debate and controversy regarding which manual rescue technique is most efficient in choking victims. Most studies have compared abdominal thrusts, various chest thrusts and back blows [5,8–10]. For unconscious patients the suggested technique has been the Heimlich manoeuvre with rescuer sitting astride the patient. In the unconscious, markedly obese victim the AHA advocates chest thrusts (the hand position being identical to that for chest compressions) as an option. This is in contrast to our findings, where the noticeably corpulent subject was the only one where abdominal thrusts generated a higher airway pressure. In 1992 Skulberg [7] suggested that chest compressions might be more effective than the Heimlich manoeuvre in the unconscious subject. This was based on a case where the Heimlich manoeuvre failed to dislodge a foreign-body in an unconscious patient. As the patient also was pulseless, CPR was then started, and the airway was cleared with the first chest compression. The present study confirms Skulberg's hypothesis. We are aware of only one study of standard CPR chest compressions for foreign body removal. Gordon et al. [8] compared chest compressions with the Heimlich manoeuvre in six adult, anaesthetised volunteers and found pressures in the same range for the two methods (23 versus 17 cmH<sub>2</sub>O, respectively). Their findings have, to our knowledge, never been published in a peer-reviewed journal and there is no specific description of the way they performed the chest compression other than 'standard external compression'. It is not known if chest compressions were done according to the current recommended guidelines. It would not be ethical to do 4–5 cm compression of the sternum in healthy volunteers because of the significant risk of causing damage such as rib fractures, and the pressures achieved by Gordon et al. were lower with both techniques than in the present study.

In 1978, Ruben et al. [10] compared the Heimlich manoeuvre with sternal thrusts on six cadavers and found higher pressure with the latter, median 18 (range 0–62) versus 30 (range 16–40) cmH<sub>2</sub>O, respectively.

It has been speculated that the removal of a foreign body is dependent both on the pressure required to dislodge it and the ability to maintain pressure and potential air flow over time [8,11].

Thus, while a precordial thump might give a high peak pressure, it is sustained for only a very brief period with low flow rates [8]. The pressure is applied for a longer time with chest compressions. In the study by Gordon et al. [8] the airflows both with a partial airway obstruction and an open airway were similar for the Heimlich manoeuvre and chest compressions.

Substituting chest compressions for the Heimlich manoeuvre in unconscious patients has potential advantages in addition to creating a higher airway pressure. It will remove one step in managing an unconscious patient with cardiac arrest. The patient will be treated identically whether or not there is a foreign body airway obstruction. This should reduce confusion and improve training and practical performance. There is much evidence in the literature that the learning and retention of CPR skills is not very efficient [12–14]. There are many psychomotor skills to achieve, and there has been a drive towards simplifying CPR in the hope that this will reduce rescuer confusion and improve performance [15]. If removal of a foreign body can be achieved by chest compressions, this will also reduce the time without circulation in the patient with cardiac arrest.

In conclusion, the present findings indicate that standard chest compressions are more effective than the Heimlich manoeuvre for treating complete airway obstruction by a foreign body.

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# Clinical Communications Pediatrics

## EMERGENCY TREATMENT OF FOREIGN-BODY OBSTRUCTION OF THE UPPER AIRWAY IN CHILDREN

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**Abstract**—Recently, the Committee of Accident and Poison Prevention of the American Academy of Pediatrics presented its recommendations regarding the emergency management of the choking child. Renewed interest was stimulated in the controversy regarding whether back blows, abdominal thrusts, or chest thrusts should be used in the initial treatment of foreign-body obstruction of the upper airway. Two cases exemplifying problems in patient management are presented as a basis of focusing on the current controversy. Review of the clinical and experimental data suggests that back blows, followed by either chest or abdominal thrusts, are a reasonable approach to emergency airway obstruction, but that this recommendation is based on limited evidence.

**Keywords**—foreign body; airway obstruction; choking

### Introduction

Foreign-body aspiration resulting in acute upper airway obstruction is a major medical problem, causing an estimated 3,000 deaths per year.<sup>1</sup> In pediatrics it remains one of the leading causes of accidental death in children less than 6 years of age,

and morbidity from severe hypoxemia and cerebral edema may result in significant long-term neurologic sequelae. Despite the critical importance of acute, rapid, and successful intervention, controversy exists regarding the appropriate emergency management of acute large airway obstruction following foreign-body aspiration. This controversy was recently revived following publication of the recommendation of the Committee on Accident and Poison Prevention of the American Academy of Pediatrics (AAP).<sup>2</sup> Numerous articles and letters followed, further highlighting this debate.<sup>3-8</sup> Aspects of two cases are reported here to illustrate the problem and to provide a basis for discussing the controversy and current recommendation regarding the treatment of the choking child.

### Case Report 1

RM is a 9-month-old girl who was given an apple slice by her 3-year-old sister. Following ingestion, she abruptly developed respiratory distress, followed by choking, cyanosis, and rigidity. Her mother quickly grabbed her, draped the child over her arm,

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and attempted three unsuccessful back blows in succession. The child's aunt then performed an abdominal thrust that also failed to relieve the obstruction. Finally, the child's grandfather held her upside down, and delivered a forceful blow with the heel of his hand between her shoulder blades. The piece of apple was expelled from her mouth. Color and respiratory effort quickly returned. Her subsequent examination in the emergency room was completely normal; she has not developed any respiratory sequelae in the month following the episode.

### Case Report 2

JK, a 21-month-old boy, was running around the dinner table at a restaurant during a family reunion. He suddenly stopped, choked, and became cyanotic, despite vigorous respiratory efforts. His 17-year-old brother attempted an abdominal thrust without success. An uncle, however, quickly grabbed the child and gave him three back blows in rapid succession. With the third attempt, food was expelled, leading to resolution of his choking, cyanotic episode.

### Discussion

Although both children survived without sequelae, failure to administer the appropriate maneuver could have been disastrous. The controversy over whether abdominal thrusts (AT, the "Heimlich maneuver"), back blows (BB), or chest thrusts (CT) should be used to treat children with foreign-body obstruction of the upper airway remains unresolved. The need for rapid intervention to avoid the consequences of asphyxia, as well as the need for a clear, uniform message to the public, makes this controversy critical. Because most episodes occur away from hospital emergency rooms, successful treatment depends on the knowledge and ability of nonmedical personnel. Recently, a subcommittee of the

AAP, with support from the American Thoracic Society, published its recommendations favoring BB followed by CT in preference to AT.<sup>2</sup> Similar recommendations were made earlier by the American Heart Association and the National Academy of Science.<sup>9,10</sup> Others have concluded, however, that "back blows are death blows" and insist that AT is the treatment of choice.<sup>3,8</sup>

### Clinical Choice

Clinical data supporting the choice of one technique over another are limited. Because most episodes occur in the prehospital setting, are witnessed and managed by non-medical personnel, and are reported on a voluntary basis, attempts at collecting and interpreting clinical data have been difficult.<sup>11</sup> Isolated reports lack verification, documentation, and detail; they are inherently anecdotal and are heavily biased.

Redding reviewed a series of 225 cases of food choking treated with a variety of techniques that were reported to the American Heart Association's Emergency Cardiac Care Committee.<sup>11</sup> Of these, 116 used only one method, 29 used several, and 75 used multiple techniques but thought only one successful. As the initial procedure, BBs were successful in 50% of the reported cases; with ATs and CTs, the success rates were 78% and 64%, respectively. Each technique was also successful in some cases where the other was unsuccessful. AT succeeded in 38 cases in which BB failed; BB in 14 cases in which AT failed.

From the data it appears that a combination of methods may be necessary to dislodge a foreign body. It is not clear if the so-called "failure" of one technique could have aided the success of the second. Because of the inherent problems with the data, Redding chose not to perform statistical analysis and concluded that there was insufficient evidence to condemn or strongly recommend one maneuver over another. Instead, he suggested that these techniques



"should not be taught out of the context of other CPR measures." From a pragmatic standpoint, however, it is necessary to support and teach a uniform policy to the public that is not ambiguous. Unfortunately, there are no controlled prospective studies. Furthermore, it seems hard to envision such a study because most episodes occur in the prehospital setting. Also, ethical considerations would be prohibitive.

### *Experimental Studies*

Interpreting experimental data is problematic because of differences in experimental design (human v animal v artificial models; sedated v nonsedated) and difficulty in simulating the true clinical situation.

Table 1 summarizes the major experimental studies to date. Heimlich's initial study was performed on four anesthetized dogs intubated with a cuffed endotracheal (ET) tube that was obstructed with a rubber stopper.<sup>12</sup> Although rib cage compression was unsuccessful, abdominal thrusts dislodged the ET tube from the trachea with each attempt.

Guildner and co-workers studied anesthetized human volunteers to compare ATs and CTs.<sup>13</sup> Higher peak expiratory flows and volumes were obtained with CTs than with ATs. With total occlusion of the airway, CTs generated greater airway pressure. BBs were markedly ineffective in comparison with the manual thrusts. However, the authors still concluded that BBs should be used first, followed by CTs.

Gordon and his colleagues measured airway flow, volume, and pressure following the administration of BB, CT, and AT to human volunteers and compared these measurements with those generated with normal coughing.<sup>14</sup> In six conscious subjects, normal coughing produced mean pressures of 72 and 115 mm Hg at resting lung volume and total lung capacity, respectively. With anesthesia, BBs generated higher pressures than did CTs or ATs (35 v 19 v 15 mm Hg). In addition, the pressure

generated by BBs developed more rapidly than that of CTs or ATs. CTs and ATs, however, expelled a greater volume of air over a longer time period. They also reported results of animal studies in which meat was placed above and below the epiglottis. When obstruction occurred below the epiglottis, no technique was successful. They believed that the rapid rise and height of airway pressure induced by BBs would be sufficient to dislodge impacted foreign bodies. Because of the small volume of expelled air, however, BBs might not move the foreign body completely out of the airway. Although CTs or ATs might not dislodge a tight obstruction, these methods may be best for moving a previously "loosened" foreign body. Overall, the combination of BB and CT or AT was recommended.

Ruben and MacNaughton measured airway pressures induced by BB, CT, and AT in cadavers and anesthetized human volunteers.<sup>15</sup> As in Gordon's study, BBs generated more rapid rates of rise in pressure than did CTs or ATs; CTs, more than ATs. Measurements were then repeated after a silicone rubber cast of the larynx was attached to the ET tube. None of the procedures was successful in dislodging a foreign body from the model larynx. They concluded that none of the maneuvers could expel a tightly impacted foreign body; but with partial obstruction, BB might be the best method in light of its high peak pressure. They also emphasized the beneficial role of gravity.

In contrast, Day and co-workers recently presented experimental evidence that suggested BBs may be dangerous, and that the AT was the most effective artificial cough technique.<sup>6</sup> Using body plethysmography, chest strain gauges and accelerometers attached to the subject's neck, they demonstrated that delivery of BBs caused forward movement of the neck and straightening of the spine. BBs accelerated the neck of seated subjects upward, thereby forcing the foreign body downward at three times the pull of gravity, potentially causing impaction or worsening of an only partially

Table 1. Summary of Experimental Data

Study	Subjects	Experimental Findings	Results	Recommendations
Heimlich <sup>12</sup>	Dogs	Four animals anesthetized, intubated; ET tube obstructed; CT and AT performed.	AT but not CT successful in relieving obstruction.	AT best technique.
Guildner <sup>13</sup> et al	Humans	Anesthetized volunteers; measured flow, volumes, and pressures with CT, AT, and BB.	BB ineffective; CT developed greater airway pressure, volume, and flow than AT.	CT best procedure; BB should be performed, then CT.
Gordon et al <sup>14</sup>	Dogs, baboons, humans	Animal studies; meat placed above and below epiglottis; BB, CT, and AT compared. Human studies: conscious and anesthetized; pressure, flow, and volume measured.	BB best with meat above epiglottis; none successful if below epiglottis; normal cough with highest pressures; BB created highest, most rapid rise in pressure; CT and AT expelled greater volumes than AT.	High and rapid rise in pressure from BB best in dislodging impacted foreign object; combination of BB plus CT or AT better than single maneuver.
Ruben and MacNaughton <sup>15</sup>	Cadavers, humans	Silicone rubber casts of larynx attached to ET tubes of humans and cadavers; occluded, then BB, CT, and AT performed.	BB > CT > AT in generating airway pressure; tightly impacted foreign body not removed by any technique.	BB best.
Day et al <sup>8</sup>	Humans, model of infant airway	Body plethysmography, accelerometers, and strain gauges used; ball bearing placed in model of infant airway.	AT generated greater pressures than BB (15-27 v 7-13 mm Hg); BB caused straightening of spine, forward neck movement; BB with infant model caused downward movement of ball bearing.	AT best; BB may be dangerous.

ET, endotracheal; AT, abdominal thrust; CT, chest thrust; BB, back blow.

obstructed airway. They invoked Newton's Third Law, that "to every action there is always opposed an equal reaction."

To explain this finding, they studied volunteers with curved tubes containing ball bearings placed in their mouth and measured the distance the ball bearings traveled after BB or AT. AT moved ball bearings further than BB. Also, AT generated greater pressure than BB (15-27 mm Hg v 7-13 mm Hg).

This study drew much attention and criticism. First, it was pointed out that their use of the accelerometer was inappropriate. Greensher and Mofenson noted that the accelerometer should be attached to the foreign body, not the neck.<sup>16</sup> Second, were a foreign body to favor downward motion, this force would be counterbalanced by the rise of intrathoracic pressure induced by the BB.<sup>6</sup> Third, a foreign body would not accelerate downward in an airway if it were

not "structurally connected to elements of the neck itself," that is, a foreign body would be expected to maintain its position in the larynx during neck movement. Furthermore, although Day noted that AT generated greater overall pressure as measured by the movement of ball bearings within a tube, other authors have recommended BB because of the *acute*, instantaneous rise in pressure obtained, which is not seen with AT or CT.<sup>14,15</sup>

Based on the experimental data, the following conclusions can be reasonably drawn. First, the normal cough is much better than the artificial cough, and one should allow the subject with a partially obstructed airway to cough without interference. Second, BB produced higher and more rapid acute pressure spikes in comparison with the manual thrusts. However, BBs expell less volume of air and have a less sustained pressure than CT or AT. Furthermore, the combination of BB to dislodge an impacted foreign body, followed by CT or AT to expell it from the airway, may be optimal. Finally, gravity may aid expulsion.

### Complications

Selection of the best method must also consider complications. Ruptured stomach and lacerated spleen, retinal detachment, aortic thrombosis and pneumoperitoneum have been reported following AT.<sup>17</sup> However, the frequency of such injuries, relative risks of AT in comparison with CT and BB, and whether or not the infant or small child would be at relatively greater risk than adults are unknown. The fear of wedging a foreign body more deeply in the airway is a major concern with BB but the risk remains unproven. Possible complications of CT include pneumothorax, myocardial contusion, and abdominal trauma based on experience with cardiac compression with cardiopulmonary resuscitation (CPR). A recent review of infants fol-

lowing CPR has shown rib fractures secondary to chest compressions rare.<sup>18</sup> Whether or not this comparison is justified is controversial.<sup>3,6</sup>

### Recommendations

In conclusion, we make the following recommendations, which are in agreement with the AAP: First, one should assess airway patency; if partial obstruction is present, the subject's own cough reflex should be allowed to extrude the foreign body. If after a brief observation period the airway remains obstructed, or if the patient is unconscious, *then* one must intervene. Four back blows delivered with the heel of the rescuer's hand by striking the midthorax should be tried. If the patient is an infant, the head should be placed down, prone over the rescuer's arm. A larger child should be draped over the lap. If not successful, manual thrusts, preferably chest thrusts, should be performed, again four times. These should be performed as is done in external cardiac massage for CPR, with the child in a supine position. Next, the airway can be opened by jaw thrust for examination for the foreign body. A "blind sweep" should never be performed; the finger probe must only be performed if direct visualization is possible to avoid impacting a foreign body. If seen, one may remove digitally by performing a sweeping motion with the index finger. If no foreign body is seen and patient remains apneic, mouth-to-mouth resuscitation becomes necessary. If there is still no response, the back blows and thrusts should be repeated quickly. Emergency intubation, tracheostomy, or cricothyroidotomy may be performed, depending on the setting and rescuer's skills. Visualization by direct laryngoscopy and foreign-body removal with Magill forceps or Kelly clamps may be successful.

Because most episodes occur in the pre-hospital setting, the medical community's

major responsibility lies in instructing the public with clear and simple guidelines. Although controversy exists regarding the optimal emergency treatment of children with upper airway obstruction following foreign body aspiration, we believe that the AAP

recommendations are supported by the available data.

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I, Kristine Neale, declare as follows:

I am a resident of the State of California and over the age of eighteen years, and not a party to the within action; my business address is: Two Palo Alto Square, Suite 300, 3000 El Camino Real, Palo Alto, California 94306-2112. On January 6, 2014, I served the foregoing document(s) described as:

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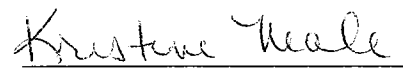
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Kristine Neale