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Post-Cardiac Arrest Therapeutic Hypothermia in New Jersey Hospitals: Analysis of Adoption and Implementation

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Background: While national guidelines recommend the use of therapeutic hypothermia (TH) for the treatment of out-of-hospital cardiac arrest (OHCA), adoption of the technique has been slow. In addition, little is known about how TH is applied in practice. This study sought to characterize the adoption and implementation of TH by acute care hospitals in the state of New Jersey.
Methods: A survey of all 73 acute care hospitals in New Jersey was conducted to solicit information about TH adoption, application, and methods. Additional information was gained through a review of 18 written TH protocols (covering 21 hospitals).
Results: After growing slowly from 2004 to 2008, TH use among New Jersey hospitals accelerated between 2009 and 2011. By 2011, 68.4% of New Jersey hospitals had a TH program in place, with an additional 13.6% indicating plans to begin one. Most hospitals indicated low volumes of OHCA patients (e.g., $\leq$10 per month). There was no relationship between OHCA volume and development of a TH program. The per hospital volume of OHCA patients receiving TH is even lower given the extensive patient exclusion criteria used by many facilities. TH hospitals vary widely in their TH exclusion criteria and cooling equipment and methods.
Discussion: The vast majority of New Jersey hospitals are now organized to implement national TH guidelines for initial survivors of OHCA. However, limited volumes of OHCA cases per hospital and lack of uniformity on how the guidelines are implemented raise new questions about the effectiveness of current practice in postarrest care. More detailed analysis of TH volumes versus outcomes and comparative studies of TH techniques are required to optimize postarrest care.

Introduction

Out-of-hospital cardiac arrest (OHCA) is a major public health challenge afflicting 295,000 U.S. residents annually (WRITING MEMBERS GROUP *et al.*, 2010). The incidence and survival from OHCA varies substantially across communities (Nichol *et al.*, 2008). Survival also varies by hospital with the majority of that variation unexplained by patient characteristics (Herlitz *et al.*, 2006; Liu *et al.*, 2008; Carr *et al.*, 2009b). Moreover, those who survive an OHCA often experience severe neurological impairment.

Therapeutic hypothermia (TH) is a fairly new and innovative procedure designed to improve neurologically intact survival from OHCA. The procedure involves reducing the body's core temperature for an extended period of time (e.g., 12–24 hours) during postarrest treatment. Two randomized clinical trials (RCTs) (Bernard *et al.*, 2002; HACA Study Group, 2002) and other observational studies (Hachimi-Idrissi *et al.*, 2001; Zeiner *et al.*, 2001; Langhelle *et al.*, 2003; Holzer *et al.*, 2005; Nielsen *et al.*, 2009) have demonstrated the efficacy of TH for improving neurologically intact survival after OHCA.

National guidelines have called for the use of TH on initial survivors of OHCA (International Liaison Committee on Resuscitation, 2005; Peberdy *et al.*, 2010). A variety of barriers, however, have limited the widespread adoption of TH. Some providers remain skeptical about the procedure's effectiveness, while others believe it is too complex to implement successfully (Merchant *et al.*, 2006; Brooks and Morrison, 2008). Other barriers include lack of knowledge, experience, personnel, resources, and infrastructure (Nichol *et al.*, 2010).

Current descriptions of TH programs have been limited to individual centers or physicians, with little information regarding the regional adoption and implementation of TH (Seif and Henderson, 2011). This study characterizes the

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adoption and implementation of TH by general acute care hospitals in New Jersey.

Methods

Design

We conducted a cross-sectional study of TH adoption by hospitals in New Jersey. The study was approved by the Institutional Review Board of the lead author's university.

Setting

New Jersey is a densely populated state of 8.8 million residents (U.S. Census Bureau, 2011). There are 73 acute care hospitals operating in New Jersey, all of which are required by state law to maintain a full-service emergency department (ED) 24 hours per day. The state's prehospital emergency medical services (EMS) include a mix of career and volunteer basic life support (BLS) ambulance companies. In most communities, private or municipal BLS units are supplemented by 21 county-based advanced life support (ALS) units staffed by career paramedics.

Telephone survey

We developed a brief (approximately 5–10 minutes) telephone survey related to hospital adoption and implementation of TH. We administered the survey to the ED nurse manager (or designated individual) at all 73 acute care hospitals in New Jersey. After pretesting with two out-of-state hospitals, the survey was fielded from June through August 2011. We also created a shorter survey for hospitals that were unwilling to participate in the full interview.

All hospitals initially received an information packet by mail. Each packet included a letter requesting participation, a copy of the survey questionnaire, IRB information, and study endorsement letters from the New Jersey Hospital Association and the New Jersey State Nurses Association.

The survey instrument for the full interview (see Appendix 1) contained questions regarding the volume of OHCA patients, adoption of TH, number of years the TH program has been in place among adopters, and methods of TH implementation. In hospitals without a TH program, the respondent was asked whether the hospital had any plans to develop one in the near future. In hospitals without a TH program or plans to develop one, the respondent was asked for the reasons why they are not adopting the procedure.

Hospitals that were unwilling to complete the full survey were asked to provide brief answers to two questions: (1) does your hospital provide TH to OHCA patients; (2) if so, since when, and if not, do you have plans to do so in the near future?

Written TH protocols

All TH hospitals completing the full interview were asked to provide a copy of their written TH protocols. The study team systematically reviewed the received protocols to identify additional TH program information, including the duration and timing of patient cooling and the measurement and response to patient shivering during the procedure.

Analysis

We used descriptive statistics (i.e., frequencies, percentages) to characterize TH adoption and implementation. Using TH program start dates, we determined the number of New Jersey hospitals adopting TH over time. We also identified the characteristics of TH program configuration, equipment, practices, and protocols.

To determine whether TH adoption is related to hospital characteristics, we used information from the 2011 New Jersey B-2 Hospital Utilization Report, which is maintained for regulatory purposes by the New Jersey Department of Health and Senior Services. Hospital characteristics of interest included patient volumes, lengths of stay, bed counts, and occupancy rates. We used membership in the Council of Teaching Hospitals (COTH) as an indicator of hospital teaching status. We used chi-square tests for percentages and one-way analysis of variance tests for continuous variables.

Findings

Fifty-four hospitals completed the full interview, and the remaining 19 answered the two brief questions. Hospitals completing only the brief interview were more likely to be non-teaching institutions but otherwise had characteristics similar to those completing the full survey. Among the 54 full interviews, 38 were conducted with the ED nurse manager. The remaining interviewees included a variety of professional titles such as assistant ED director, clinical nurse specialist, critical care nurse specialist, and clinical educator. Professional title was not recorded for six individuals who provided a full interview, and no titles were recorded during the brief interviews.

After growing slowly between 2004 and 2008, TH use by New Jersey hospitals accelerated in 2009 (Fig. 1). By 2011, 50 (68.4%) of the state's hospitals provided the procedure with

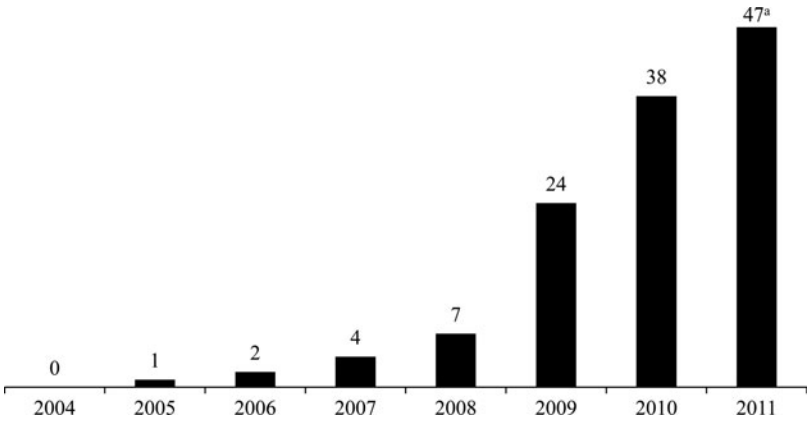

FIG. 1. Growth in number of New Jersey hospitals providing therapeutic hypothermia (TH). Source: New Jersey Out-Of-Hospital Cardiac Arrest Study Telephone Questionnaire. [a]Three additional hospitals provided TH in 2011 but could not report how long the TH program had been in place. Therefore, the total number of TH programs in 2011 is 50.

Table 1. Hospitals Providing or Planning to Provide Therapeutic Hypothermia (TH)

	Currently providing TH	*Plan to provide TH in the near future*	*Not providing TH and no plans*	*Total*
All hospitals	50 (68.4%)	10 (13.7%)	13 (17.8%)	73 (100%)
Hospitals completing full interview	39 (72.2%)	7 (12.9%)	8 (14.8%)	54 (100%)
Hospitals completing brief interview	11 (57.8%)	3 (15.7%)	5 (26.3%)	19 (100%)

Source: New Jersey Out-Of-Hospital Cardiac Arrest Study Telephone Questionnaire.

an additional 10 (13.7%) reporting plans to develop a TH program (Table 1).

Most hospitals reported treating a limited number of OHCA patients annually, with 70% caring for 120 or fewer OHCA patients annually (i.e., 10 per month) and 20% caring for 60 or fewer OHCA patients annually (i.e., 5 per month). Variation in OHCA volume was not associated with adoption or plans to adopt TH. While there were slight differences in TH adoption by number of maintained beds and ED visits, TH adoption was unrelated to teaching status, patient volume, and occupancy rates (Table 2).

Among hospitals with TH programs, there was substantial variation in their patient selection criteria, cooling methods, and practices (Table 3). While TH was most commonly applied for VT cardiac arrest, its use was less common for other rhythms. Only 51.3% of TH hospitals surveyed provided TH to OHCA patients for all four initial ECG rhythms.

The application of TH patient exclusion criteria varied significantly across TH centers (Table 3). The largest variation involved age-related exclusions, with some facilities ($n=21$, 53.8%) excluding pediatric patients and others excluding patients above an age threshold ($n=10$, 25.6%). Even then, the age threshold may not be followed strictly, as one respondent noted that they would make an exception for a "good 75 year old," referring to a patient whose overall medical history would allow TH to be used despite being above the age cutoff for that facility. In addition, 17.9% of TH hospitals applied all eight of the exclusions queried by the survey. Two-thirds of TH hospitals indicated other exclusion criteria including DNR status, terminal illness, preexisting coma, major trauma, and drug overdose/poisoning.

Eighteen of 39 hospitals with TH programs provided copies of their written protocols. Because some hospitals within the same system share the same protocol, the collected protocols apply to 21 hospitals. Among these hospitals, there was wide variation in the timing and duration of TH implementation (Table 4). Additional differences pertained to quantification and response to patient shivering. Across all of the protocol domains, details specified by some hospitals were not addressed by others.

Among the 13 hospitals that do not provide TH and have no plans to do so, eight completed a full interview. Two of them stated that their OHCA volume was insufficient to justify the procedure; two stated that TH is too resource intensive; and one indicated that hospital decision makers had doubts about the procedure's effectiveness. Four of the eight respondents could not give a specific reason why TH is not planned or currently performed. (One respondent gave two reasons.)

Discussion

In this study, we observed that, after a period of slow proliferation, adoption of TH by New Jersey hospitals accelerated

Table 2. Characteristics of Hospitals by Provision of Therapeutic Hypothermia (TH)

	Currently providing TH	*Plan to provide TH in the near future*	*Not providing TH and no plans*	p-*value*
Annual OHCA volume[a,b]				
≤12	0.0%	12.5%	0.0%	0.32
13–36	15.8%	12.5%	14.3%	
37–60	5.3%	12.5%	14.3%	
61–120	50.0%	62.5%	42.9%	
≥121	28.9%	0.0%	28.6%	
Teaching hospital	10.2%	0.0%	15.4%	0.47
Maintained beds[c]	291.7	203.3	234.2	0.10
Occupancy rate (%)[c]	70.5	67.9	73.7	0.54
Inpatient admissions[c]	4,083.4	2,547.3	3,401.6	0.15
Inpatient length of stay (days)[c]	4.8	5.0	4.7	0.72
ICU/CCU maintained beds[c,d]	26.5	14.7	27.6	0.13
ICU/CCU occupancy rate (%)[c,d]	78.3	72.1	76.1	0.67
ICU/CCU admissions[c]	235.1	152.6	191.1	0.36
ICU/CCU length of stay (days)[c]	4.7	4.0	6.1	0.51
ED visits[c]	13,506.7	9,008.8	12,207.8	0.10

Source: New Jersey Out-Of-Hospital Cardiac Arrest Study Telephone Questionnaire.
[a]Out-of-hospital cardiac arrest.
[b]Reported values are column percentages.
[c]Mean values.
[d]Intensive care unit/critical care unit.

Table 3. Characteristics of Therapeutic Hypothermia (TH) Protocols[a]

	Percentage
Inclusion criteria—initial ECG rhythms	
VT	91.9%
VF	89.2%
PEA	71.1%
Asystole	65.8%
Exclusion criteria	
Awake with normal mental status	81.6%
Age	71.8%
Awake patient	71.1%
Bleeding	68.4%
Recent surgery	55.6%
Infection/sepsis	50.0%
Hypotension	44.7%
Pregnancy	41.7%
Others	62.2%
Cooling methods	
Specialized systems	80.0%
I/V fluids	74.4%
Cold packs	59.0%
Blankets	51.3%
Endovascular catheter	28.9%
Others	2.6%
Cooling initiated in prehospital setting	35.9%

Source: New Jersey Out-Of-Hospital Cardiac Arrest Study Telephone Questionnaire.
[a]Based on 39 hospitals that have a TH program and completed the full interview.

Table 4. Details from Written Therapeutic Hypothermia (TH) Protocols

	Number (%) of responses[a]
Duration of TH	
24 hours	13 (72.2%)
12–24 hours	1 (5.6%)
Other[b]	1 (5.6%)
Not mentioned	3 (16.7%)
Defined start of TH duration	
Initiation of cooling	6 (33.3%)
Once target temperature is reached	2 (11.1%)
Not mentioned	9 (50.0%)
From ROSC	1 (5.6%)
Defined time for reaching target temperature	
4 hours	4 (22.2%)
6 hours	1 (5.6%)
6–8 hours	3 (16.7%)
Varies by patient characteristics[c]	2 (11.1%)
Not mentioned	8 (44.4%)
Defined rewarming time	
<6 hours	1 (5.6%)
6–12 hours	4 (22.2%)
>12 but <24 hours	2 (11.1%)
24 hours	6 (33.3%)
Other[d]	1 (5.6%)
Not mentioned	4 (22.2%)
Quantification of shivering	
Bedside Assessment Shivering Scale	2 (11.1%)
Twitch response per Ramsay scale	1 (5.6%)
ScVO2 level, "facial tenseness," ECG for noise and palpable skin vibrations	1 (5.6%)
Not mentioned	14 (77.8%)
Response to patient shivering[e]	
Medications	16 (88.9%)
Medications and blankets	3 (16.7%)
Not mentioned	2 (11.1%)

[a]Based on 18 written TH protocols.
[b]In one protocol, cooling time is variable depending upon patient response.
[c]Target times are different for elderly and obese patients.
[d]Until temperature of 36.5°C is reached.
[e]Protocols may list more than one response.

rapidly in 2009. As of August 2011, 82% of the state's hospitals have adopted or plan to adopt the procedure. Among those that provide TH, we observed significant variation in patient selection, cooling methods, and clinical protocols and practices.

Consensus guidelines on the recommended use of TH in postarrest care first appeared in 2005 (International Liaison Committee on Resuscitation, 2005) and were strongly reiterated by the American Heart Association in 2010 (Peberdy *et al*., 2010), which is one year after the acceleration of TH adoption in New Jersey began. Although the diffusion of effective medical technology can take many years, once a critical mass of early adopting hospitals is formed, remaining hospitals may feel pressure to avoid being left behind, leading to an acceleration in adoption. The use of TH typically does not have direct implications for hospital reimbursement. However, TH capability may enhance a hospital's overall reputation as a provider of high technology services, which can enhance reimbursement and market share more broadly and pre-empt the formation of competing specialty facilities (Devers *et al*., 2003). Moreover, if evidence of TH's clinical effectiveness is strengthened and broadened, Medicare and other payers may reconsider reimbursement for the procedure (Nichol *et al*., 2010). If so, hospitals without TH capabilities run the risk of foregoing a new revenue source.

Anecdotal reports suggest that the growing use of cooling techniques in the prehospital setting has added to the momentum for hospitals to adopt TH. Although we were not able to document the use of prehospital cooling over time, our analysis is the first (to our knowledge) to document systematically the prevalence of TH centers that coordinate patient cooling efforts with EMS.

Still, almost one-fifth of New Jersey's hospitals has not adopted the procedure and has no plans to do so in the near future. Non-adoption of TH appears to be driven by organizational cultural or idiosyncratic factors that are unrelated to easily measured hospital characteristics such as teaching status, occupancy, or patient volume. Although some survey respondents (primarily ED nurse managers) cited insufficient OHCA volume, resource intensity, or doubts about the procedure's effectiveness, others could not articulate a clear reason why their hospital was not providing TH. Although some hospitals view TH as a source of economic benefit, others may take the opposite view, particularly those with a large proportion of uninsured and Medicaid patients where the use of TH is likely to increase costs more than it increases revenue. Overall, the lack of TH use in these facilities raises questions about how and why some providers adopt new and recommended technologies while others do not.

Most survey respondents, regardless of TH adoption at their facility, reported fairly low OHCA volumes in their ED. Interestingly, many of the hospitals that plan to adopt TH in the near future currently see no more than a few TH patients per month. Given the complexity of TH implementation, this finding raises concern that many hospitals may not have a sufficient volume of patients to become proficient in the procedure. This issue is compounded by the fact that exclusion criteria for TH can be very stringent for some of these hospitals, limiting within-hospital TH volume even further.

The low volumes of OHCA patients seen by many New Jersey hospitals highlights the need to better understand whether there is a volume–outcome relationship for TH similar to that which has been demonstrated for other medical interventions, particularly those involving cardiac procedures (Canto *et al*., 2000; Nathens *et al*., 2001; Birkmeyer *et al*., 2003; Carr *et al*., 2009a). One recent study in particular finds that survival from OHCA is greatly reduced in hospitals that treat fewer than 40 cases per year (Callaway *et al*., 2010). Our analysis shows that more than 17% of New Jersey hospitals overall do not meet this 40-case threshold. Thus it might be beneficial to regionalize OHCA care, as the American Heart Association has recently advocated (Nichol *et al*., 2010).

Our finding of wide variation in TH implementation has important implications for patient care. First, differences in cooling methods and coordination with local EMS systems can lead to different rates of patient survival, neurological function, and resource use. Some of this variation is to be expected as equipment manufacturers innovate and improve TH technologies and hospitals using different combinations of equipment learn from experience. Nevertheless, rigorous evaluation is clearly needed to determine whether variation in TH practice is causing harm to certain groups of OHCA patients.

Second, the widely varying criteria for patient selection may create institutionalized treatment disparities where patients with the same presenting conditions can receive very different care based solely on the exclusion criteria of the admitting hospital. More broadly, variations in patient selection criteria raise the larger question of how hospitals develop their protocols—that is, independently or based on standards set by early adopters.

Our analysis is subject to some limitations. First, our findings are most directly relevant for New Jersey and other densely populated urban–suburban areas. In larger rural areas, the issues surrounding the adoption and implementation of TH may be quite different. Also, most of the data in our analysis come from the recollections of survey respondents. While these respondents (primarily ED nurse managers) are expected to be thoroughly knowledgeable, some answers, particularly those related to volume of OHCA patients seen may be imprecise. Nevertheless, exact counts of OHCA patient volumes would probably not change the qualitative nature of our findings. In addition, we were able to collect written TH protocols from only a subset of TH centers in New Jersey who offered them voluntarily. Thus we cannot be certain that these protocols are representative of TH practice statewide. The main finding from our protocol analysis, however, is the large variability in the details of TH implementation. It is not likely that this variability would be much less among TH centers that did not provide written protocols for our study.

The vast majority of New Jersey hospitals are now organized to implement national guidelines regarding the use of TH for initial survivors of OHCA. But limited volumes of OHCA cases per hospital and lack of uniformity on how the guidelines are implemented raise new questions about the effectiveness of current practice in postarrest care. More detailed analysis of TH volumes versus outcomes and comparative studies of TH techniques are required to optimize postarrest care.

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Disclosure Statement

No competing financial interests exist.

References

Bernard SA, Gray TW, Buist MD, Jones BM, Silvester W, Gutteridge G, Smith K. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. N Engl J Med 2002;346:557–563.

Birkmeyer JD, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. N Engl J Med 2003;349:2117–2127.

Brooks SC, Morrison LJ. Implementation of therapeutic hypothermia guidelines for post-cardiac arrest syndrome at a glacial pace: seeking guidance from the knowledge translation literature. Resuscitation 2008;77:286–292.

Callaway CW, Schmicker R, Kampmeyer M, Powell J, Rea TD, Daya MR, Aufderheide TP, Davis DP, Rittenberger JC, Idris AH, Nichol G; Resuscitation Outcomes Consortium (ROC) Investigators. Receiving hospital characteristics associated with survival after out-of-hospital cardiac arrest. Resuscitation 2010;81:524–529.

Canto JG, Every NR, Magid DJ, Rogers WJ, Malmgren JA, Frederick PD, French WJ, Tiefenbrunn AJ, Misra VK, Kiefe CI, Barron HV. The volume of primary angioplasty procedures and survival after acute myocardial infarction. National Registry of Myocardial Infarction 2 Investigators. N Engl J Med 2000;342:1573–1580.

Carr BG, Goyal M, Band RA, Gaieski DF, Abella BS, Merchant RM, Branas CC, Becker LB, Neumar RW. A national analysis of the relationship between hospital factors and post-cardiac arrest mortality. Intensive Care Med 2009a;35:505–511.

Carr BG, Kahn JM, Merchant RM, Kramer AA, Neumar RW. Inter-hospital variability in post-cardiac arrest mortality. Resuscitation 2009b;80:30–34.

Devers KJ, Brewster LR, Casalino LP. Changes in hospital competitive strategy: a new medical arms race? Health Serv Res 2003;38:447–469.

Hachimi-Idrissi S, Corne L, Ebinger G, Michotte Y, Huyghens L. Mild hypothermia induced by a helmet device: a clinical feasibility study. Resuscitation 2001;51:275–281.

Herlitz J, Engdahl J, Svensson L, Angquist KA, Silfverstolpe J, Holmberg S. Major differences in 1-month survival between

hospitals in Sweden among initial survivors of out-of-hospital cardiac arrest. Resuscitation 2006;70:404–409.

Holzer M, Bernard SA, Hachimi-Idrissi S, Roine RO, Sterz F, Müllner M; Collaborative Group on Induced Hypothermia for Neuroprotection After Cardiac Arrest. Hypothermia for neuroprotection after cardiac arrest: systematic review and individual patient data meta-analysis. Crit Care Med 2005;33: 414–418.

Hypothermia after Cardiac Arrest Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. N Engl J Med 2002;346:549–556.

International Liaison Committee on Resuscitation. 2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Part 5: Acute coronary syndromes. Resuscitation 2005;67:249–269.

Langhelle A, Tyvold SS, Lexow K, Hapnes SA, Sunde K, Steen PA. In-hospital factors associated with improved outcome after out-of-hospital cardiac arrest. A comparison between four regions in Norway. Resuscitation 2003;56:247–263.

Liu JM, Yang Q, Pirrallo RG, Klein JP, Aufderheide TP. Hospital variability of out-of-hospital cardiac arrest survival. Prehosp Emerg Care 2008;12:339–346.

Merchant RM, Soar J, Skrifvars MB, Silfvast T, Edelson DP, Ahmad F, Huang KN, Khan M, Vanden Hoek TL, Becker LB, Abella BS. Therapeutic hypothermia utilization among physicians after resuscitation from cardiac arrest. Crit Care Med 2006;34:1935–1940.

Nathens AB, Jurkovich GJ, Maier RV, Grossman DC, MacKenzie EJ, Moore M, Rivara FP. Relationship between trauma center volume and outcomes. JAMA 2001;285:1164–1171.

Nichol G, Aufderheide TP, Eigel B, Neumar RW, Lurie KG, Bufalino VJ, Callaway CW, Menon V, Bass RR, Abella BS, Sayre M, Dougherty CM, Racht EM, Kleinman ME, O'Connor RE, Reilly JP, Ossmann EW, Peterson E; American Heart Association Emergency Cardiovascular Care Committee; Council on Arteriosclerosis, Thrombosis, and Vascular Biology; Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation; Council on Cardiovascular Nursing; Council on Clinical Cardiology; Advocacy Committee; Council on Quality of Care and Outcomes Research. Regional systems of care for out-of-hospital cardiac arrest: a policy statement from the American Heart Association. Circulation 2010;121:709–729.

Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, Davis D, Idris A, Stiell I; Resuscitation Outcomes Consortium Investigators. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA 2008;300:1423–1431.

Nielsen N, Hovdenes J, Nilsson F, Rubertsson S, Stammet P, Sunde K, Valsson F, Wanscher M, Friberg H; Hypothermia Network. Outcome, timing and adverse events in therapeutic hypothermia after out-of-hospital cardiac arrest. Acta Anaesthesiol Scand 2009;53:926–934.

Peberdy MA, Callaway CW, Neumar RW, Geocadin RG, Zimmerman JL, Donnino M, Gabrielli A, Silvers SM, Zaritsky AL, Merchant R, Vanden Hoek TL, Kronick SL. Part 9: post-cardiac arrest care: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010;122:S768–S786.

Seif D, Henderson SO. Use of therapeutic hypothermia in post-cardiac arrest patients by emergency departments. Therapeutic Hypothermia and Temperature Management 2011;1:23–27.

U.S. Census Bureau 2011. New Jersey QuickFacts. Available at http://quickfacts.census.gov/qfd/states/34000.html. Accessed January 15, 2012.

WRITING MEMBERS GROUP, Lloyd-Jones D, Adams RJ, Brown TM, Carnethon M, Dai S, De Simone G, Ferguson TB, Ford E, Furie K, Gillespie C, Go A, Greenlund K, Haase N, Hailpern S, Ho PM, Howard V, Kissela B, Kittner S, Lackland D, Lisabeth L, Marelli A, McDermott MM, Meigs J, Mozaffarian D, Mussolino M, Nichol G, Roger VL, Rosamond W, Sacco R, Sorlie P, Roger VL, Thom T, Wasserthiel-Smoller S, Wong ND, Wylie-Rosett J; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2010 update: a report from the American Heart Association. Circulation 2010;121:e46–e215.

Zeiner A, Holzer M, Sterz F, Schörkhuber W, Eisenburger P, Havel C, Kliegel A, Laggner AN. Hyperthermia after cardiac arrest is associated with an unfavorable neurologic outcome. Arch Intern Med 2001;161:2007–2012.

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(*Appendix follows* →)

Appendix

The Center for State Health Policy
Rutgers University
(Identifying information has been redacted)
New Jersey Out-of-Hospital Cardiac Arrest Study
Telephone Questionnaire

Before you ask any questions, you need to complete the Informed Consent form with the respondent .
Respondent Name _____
Respondent Phone Number _____
Respondent Hospital Affiliation _____
Survey outcome:
Survey rescheduled to: _____
Survey partially completed, finish on: _____
Survey completed (enter date): _____
Respondent refused to participate…5
[Explain_____]
Respondent unable to participate…6
[Explain_____]

INTERVIEWER-ONLY ITEMS
Interviewer:

- Name _____ [name/initials]
- Date _____

Data Entry:

- Name _____
- Date _____

Preamble/Consent

Greeting: Hello, my name is _____. I am calling from Rutgers University. We are conducting a study of post-resuscitation care for initial survivors of out-of-hospital cardiac arrest (OHCA). For this, we are interviewing ER senior nurse managers from all the hospitals in New Jersy. May I speak with [name/the ER senior nurse manager]?

[Respondent unavailable]: When would be a good time to reach him/her? [Record day/date/time, thank, and end interview]

[Respondent comes to phone]: Hello, my name is [interviewer name]. I am calling from Rutgers University. We are conducting a study of post-resuscitation care for initial survivors of out-of-hospital cardiac arrest (OHCA). For this, we are interviewing ER senior nurse managers from all hospitals in New Jersey. **[Continue with text below]**

[This is the respondent] The interview will take approximately 10–15 minutes. **Your participation in this study is completely voluntary and confidential and there will be no penalty for not participating. If you participate, you may still choose not to answer any specific questions or withdraw from the study at any time.**

The interview will be audio-recorded in order to verify the accuracy of the transcriptions. **You do not have to agree to be recorded in order to participate in the study**. The names of all the nurse mangers and the hospitals will be kept confidential by Rutgers. Our report will include only aggregated information and no individual survey respondents or hospital names will be associated with specific responses. We will provide you with findings from our study once they become available. The information we collect will be used for further research, teaching, and presentation at scholarly conferences in the area of emergency medical care.

If you have any questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers University. Rutgers University, the State University of New Jersey, Institutional Review Board for the Protection of Human Subjects, Office of Research and Sponsored Programs, 3 Rutgers Plaza, New Brunswick, NJ 08901-8559. Tel: 732-932-0150 ext. 2104, Email: humansubjects@orsp.rutgers.edu. If you have any questions or concerns after the interview, please call the Principal Investigator for this study, Derek DeLia, at 848-932-4671.

May I proceed?

[If Yes] Interviewer signs consent below.
[If No] When would be a good time to call you back? _____

RESPONDENT/PROXY GAVE VERBAL CONSENT TO PROCEED WITH THE INTERVIEW:
_____ [Date:_____]
[Interviewer's signature]

_____
[Interviewer's printed name]
May I audio-record this interview?
Yes/No [circle the appropriate response]
[If Yes] Interviewer signs consent below.
[If No] Proceed with interview but do not record it.

RESPONDENT/PROXY GAVE VERBAL CONSENT TO PROCEED WITH AUDIO-RECORDING:
_____[Date:_____]
[Interviewer's signature]

_____
[Interviewer's printed name]

[Begin Survey]

1. In a typical month, approximately how many out-of hospital cardiac arrest (OHCA) patients do you treat in the ED? [Ask for annual count if small or unknown monthly]
   # of patients: _____
   Monthly: _____ Annually: _____
   Don't know/refused: _____
   Additional comments: _____

2. Does your hospital currently provide therapeutic hypothermia (TH) to any OHCA patients?
   Yes _____ No _____ [go to q2b] Don't know/refused _____ [go to q2b]
   Additional comments: _____

   2a. [If Yes] When did you begin implementation of your TH program? [Probe year and month if possible. Year/quarter is acceptable. Year only is the last option.]
   Month: _____ Quarter: _____ Year: _____
   Don't know/refused _____
   Additional comments: _____

[Go to Q3]

   2b. [If No to q2] Did you previously have a TH program?
   Yes _____ No _____ Don't know/refused _____
   Additional comments: _____

[Go to Q8]

3. For which of the following initial ECG rhythms would you provide TH after return of spontaneous circulation? [Record all that apply]
   a. [Would you provide TH after return of spontaneous circulation] for ventricular fibrillation (VF)?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____
   b. [Would you provide TH after return of spontaneous circulation] for ventricular tachycardia (VT)?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____
   c. [Would you provide TH after return of spontaneous circulation] for pulseless electrical activity (PEA)?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____
   d. [Would you provide TH after return of spontaneous circulation] for asystole?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____

4. Do you exclude OHCA patients from TH based on any of the following? [Record all that apply]
   a. [Do you exclude OHCA patients from TH based on] pregnancy?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____
   b. [Do you exclude OHCA patients from TH based on] awake patient?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____
   c. [Do you exclude OHCA patients from TH based on] awake with normal mental status?
      Yes _____ No _____ Don't know/refused _____
      Additional comments: _____

d. [Do you exclude OHCA patients from TH based on] age?
[If Yes] What are the exclusions? _____
No _____ Don't know/refused _____
Additional comments: _____
e. [Do you exclude OHCA patients from TH based on] bleeding?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
f. [Do you exclude OHCA patients from TH based on] patient had recent surgery?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
g. [Do you exclude OHCA patients from TH based on] hypotension (systolic pressure <90)?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
h. [Do you exclude OHCA patients from TH based on] infection or sepsis?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
i. [Do you exclude OHCA patients from TH based on] any other reason?
[If Yes] What are the exclusions? _____
No _____ Don't know/refused _____
Additional comments: _____

5. Which of the following methods do you use to provide TH? [Record all that apply]
a. [Do you use] cold IV fluids [to provide TH]?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

a1. [If yes] Where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other [specify]: _____
b. [Do you use] cold packs [to provide TH]?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

b1. [If Yes] Where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other [specify]: _____
c. [Do you use] water-circulating blanket (e.g., standard operating room blanket) [to provide TH]?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

c1. [If Yes] Where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other [specify]: _____
d. [Do you use] specialized external cooling system (e.g., Arctic Sun, Sub-Zero Kool Kit) [to provide TH]?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

d1. [If Yes] Where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other [specify]: _____
e. [Do you use] endovascular catheter system (e.g., Alsius catheter) [to provide TH]?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

e1. [If Yes] Where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other, specify: _____
f. [Do you use] any other method [to provide TH]?
f1. [If Yes] What methods do you use? _____
No _____ Don't know/refused _____
Additional comments: _____
f1. For each method used, where is cooling usually initiated? [Check all that apply]
ED: _____ ICU/CCU: _____ Other, specify: _____

6. For how long do you typically provide TH?
12 hours _____ 24 hours _____ Other, specify: _____

6a. Does it vary by patient or circumstances?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

6a1. [If Yes] For what patients or circumstances? _____
No _____ Don't know/refused _____

7. Do any EMS agencies initiate TH in the prehospital setting for your OHCA patients?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
[Go to Q9]

8. Do you have plans to begin using TH?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

8a. [If Yes] When? _____
Additional comments: _____
8a1. Are there any specific barriers that you face to develop your TH program?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

8a2. [If Yes] What are the barriers? [Check all that apply]
a. _____ Never considered
b. _____ Doubts about its effectiveness/lack of adequate evidence
c. _____ Lack of knowledge to develop a program
d. _____ Too complex
e. _____ Low volume
f. _____ Lack of resources. [**Probe**: Equipment, institutional support/interest]
g. _____ Other [specify]: _____
h. _____ Don't know/refused

8b. [If No to q8) Why not? [Check all that apply]
i. _____ Never considered
j. _____ Doubts about its effectiveness/lack of adequate evidence
k. _____ Lack of knowledge to develop a program
l. _____ Too complex
m. _____ Low volume
n. _____ Lack of resources. [**Probe**: Equipment, institutional support/interest]
o. _____ Other [specify]: _____
p. _____ Don't know/refused

9. Does your hospital have 24/7 intensivist coverage in units that care for OHCA patients?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
9a. [If No] Do you have any intensivist coverage in units that care for OHCA patients?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

10. Does your hospital operate an emergency medicine residency program?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
10a. [If Yes] In what fields? _____
10b. Approximately how many residents will rotate through this year?
Number of residents: _____
Don't know/refused _____
Additional comments: _____

11. Does your hospital operate a critical care fellowship program?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____
11a. [If Yes] In what fields? _____
11b. Approximately how many fellows will rotate through this year?
Number of fellows: _____
Don't know/refused _____
Additional comments: _____

12. Does your hospital have a written protocol for the provision of TH?
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

12a. [If Yes] Can you make a copy available for our study? We will not share the protocol with anyone outside of the study team or identify your facility in any publically available materials.
Yes _____ No _____ Don't know/refused _____
Additional comments: _____

12b. [If Yes] Please send the protocol by e-mail, mail, or fax to:
NJ Out-of-Hospital Cardiac Arrest Study
Email: magrawal@ifh.rutgers.edu
Fax: 732-932-0069
Mailing address: 112 Paterson Street, 5th Floor
New Brunswick, NJ 08901

13. Is there anything else you think we should know about therapeutic hypothermia or post-resuscitation care for cardiac arrest patients?

_____
_____
_____

No other comments: _____

Thank you for your participation.
We will provide you with findings from our study once they become available.

Where/to whom do we send these findings?
Name: _____
E-mail: _____
Address 1: _____
Address 2: _____
City: _____
State: _____
Zip: _____
Not interested in receiving them: _____
Additional comments: _____

15. Thanks again. Goodbye. [Hang up]

16. Interviewer: Do you need to go back and edit any answers?
[If Yes] Proceed backwards in survey to questions you need to revise.
[If No] _____ **[End Survey]**