ORIGINAL RESEARCH

Preparing for Burn Disasters: Predictors of Improved Perceptions of Competency after Mass Burn Care Training

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CE = continuing education
EMT = emergency medical technician

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Abstract

Introduction: Prehospital and community hospital healthcare providers in the United States must be prepared to respond to burn disasters. Continuing education is the most frequently utilized method of updating knowledge, skills, and competence among healthcare professionals. Since preparedness training must meet multiple educational demands, it is vital to understand how participants' work and educational experience and the program's content and delivery methods impact knowledge acquisition, and how learning influences confidence and competence to perform new skills.

Purpose: The purpose of this exploratory, convenience sample study was to identify healthcare provider characteristics and continuing education training content areas that were predictive of self-reported improvement in competence after attending a mass-casualty burn disaster continuing education program.

Methods: Logistic regression analysis of data from a post-training evaluation from nine, one-day continuing education conferences on mass burn care was used to identify factors associated with improved self-reported competency to respond to mass burn casualties.

Results: The following factors were associated most closely with increased self-reported competency: (1) prehospital work setting (odds ratio (OR) = 3.06, confidence interval (CI) = 0.83–11.30, $p = 0.09$); (2) 11 or more years of practice (OR = 0.31, CI = 0.09–1.08, $p = 0.07$); and (3) practice in an urban setting (OR = 0.01, CI = 0.18–0.82, $p < 0.01$). Confidence items included: (1) ability to implement appropriate airway management modalities (OR = 2.31, CI = 1.03–5.17, $p < 0.04$); (2) manage patients with electrical injuries (OR = 4.86, CI = 1.84–12.85, $p < 0.001$); (3) identify non-survivable injuries (OR = 2.24, CI = 0.93–5.43, $p = 0.07$); and (4) recognize special problems associated with burns in young children or older adults (OR = 2.14, CI = 0.87–5.23, $p = 0.10$). The final model explained 89.9% of the variability in self-reported competence.

Conclusions: Interventions used to train healthcare providers for burn disasters must cover a broad range of topics. However, learning needs may vary by practice setting, work experience, and previous exposure to disaster events. This evaluation research provides three-fold information for continuing education research: (1) to identify content areas that should be emphasized in future burn care training; (2) to be used as a model for CE evaluation in other domains; and (3) to provide support that many factors must be considered when designing a CE program. Results may be useful to others who are planning CE training programs.

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Introduction

Burns exact a tremendous toll on human life, bringing suffering, disability, and financial loss.[1] According to the American Burn Association, more than one million burn injuries occur each year in the United States, and 4,500 people die as a result of these injuries.[2] The need for the healthcare workforce to respond to large-scale, multiple-casualty events has become increasingly evi-

dent because up to 30% of the injured in any mass-casualty incident will require burn care treatment.[3,4] In addition, the quality of care within the initial hours after a burn injury occurs has a major influence on long-term patient outcomes; however, most initial burn care is provided outside of the burn center setting. Therefore, prehospital and community hospital healthcare providers in the US must be prepared to care for patients with burns.

Because continuing education is the most frequently utilized method of updating knowledge and skills among healthcare professionals, continuing education is the most likely route for enhancing preparedness efforts.[5,6] Continuing education is an important tool for building competence and providing professional growth. Since preparedness training must meet multiple educational and training demands, it is vital to understand how a program's content and delivery impact participants' knowledge acquisition, and how learning influences confidence and competence to perform new skills.

Bandura's Self-Efficacy Theory has been used widely to measure health education outcomes, and as a result, self-efficacy has been explored as a predictor of behavior performance.[7,8] According to Bandura's Social Learning Theory, confidence is directly related to self-efficacy, which in turn, may impact behavior.[9] One of the goals of the training program was to increase participants' confidence in their abilities, thereby improving their competence to perform critical assessments correctly and make appropriate care-related decisions when managing the care of multiple burn patients. In addition, the adult education literature promotes the concept that information should be applicable to the learner's work or to responsibilities important to the learner.[10] The life experiences of adults, the desire for self-directed learning, and the motivation to learn must be considered in framing adult education activities. Adult learners most frequently are motivated by the pragmatic desire to use or apply knowledge or skills.[11]

Noe states that training design must evolve from a systematic approach beginning with needs assessment and ending with evaluation.[12] One method used to appraise the quality of a CE offering is to measure its educational impact based upon the students' learning.[13] Evaluation research leads not only to a superior understanding of the fiscal return on education programs, but also permits the development of a CE curriculum to optimize participant learning.[14,15] Evaluative research can improve the design of courses for both beginning levels of learning and for the retention of skills among more experienced providers.[13]

Preparedness training must meet multiple educational demands, and most programs are designed to meet the needs of a variety of participants. Therefore, program planners should be asking themselves, "Does one size fit all?". Continuing education planners should consider investigating whether training content achieves similar educational outcomes among participants with different employment experience and educational preparation. For example, should the continuing education program content be similar or different for rural versus urban participants, or should instructional techniques vary for more experienced attendees as opposed to those with less experience? In addition, are certain portions of the program's content more or less salient to continuing education program attendees? Answers to these questions would help program planners to modify the program delivery to optimize learning outcomes.

Program Description

Burn care practitioners designed the program curriculum based upon key national protocols and procedures.[16–22] In November 2004, a brief needs assessment survey was e-mailed to 131 hospital administrators across the state of Kansas. The survey requested information about the hospitals' ability to respond to an event that would result in a large number of burn patients. Survey results were used to design the CE curriculum. The curriculum consisted of several tracks including: (1) a historical perspective of burn and fire disasters, disaster management, prehospital, initial hospital assessment and triage, and priorities of care; (2) inhalation injury and airway management; (3) fluid resuscitation; (4) special considerations for the very young and very old; (5) electrical and chemical injuries; (6) nuclear incidents; (7) caring for patients with non-survivable injuries; (8) wound care within the first 24 hours; (9) outpatient and home care; and (10) burn center care. All sections were designed to be applicable to the care of patients with burns in a single casualty incident, and to contrast the differences when caring for multiple patients.

Project Purpose

The "Preparing for Burn Disasters" continuing education program evaluation showed changes in knowledge; the percentage of correct responses pre- versus post-test increased between 30% and 65% on two-thirds of the knowledge items. In addition, significant increases in participants' overall self-ratings of ability and confidence in burn management were observed in every content area described within the program description. The majority of participants (64%) felt competent or highly competent to manage a mass burn casualty event after the training program.[23] The purpose of this secondary evaluation was to determine which factors were most influential and predictive for improving self-reported perception of competency achieved from this training.

Methods

The data for this analysis were derived from an evaluation of a burn care continuing education program.[23] The questionnaire for the program collected data on participants' demographic characteristics, including age, gender, profession (including advanced registered nurse practitioner, registered nurse (RN), licensed practical nurse (LPN), paramedic, emergency medical technician (EMT), physician, or physician assistant), type of work performed (including emergency medical services/prehospital care, flight transport team, emergency department, acute care provider, administration/management, or burn center nurse), years of practice in their current type of work, and motivation for attending a continuing education program.

The original evaluation also included 27 items that were used to assess changes in burn treatment knowledge, seven items used to measure skills for burn assessment, one item used to measure motivation to attend, and eight items to

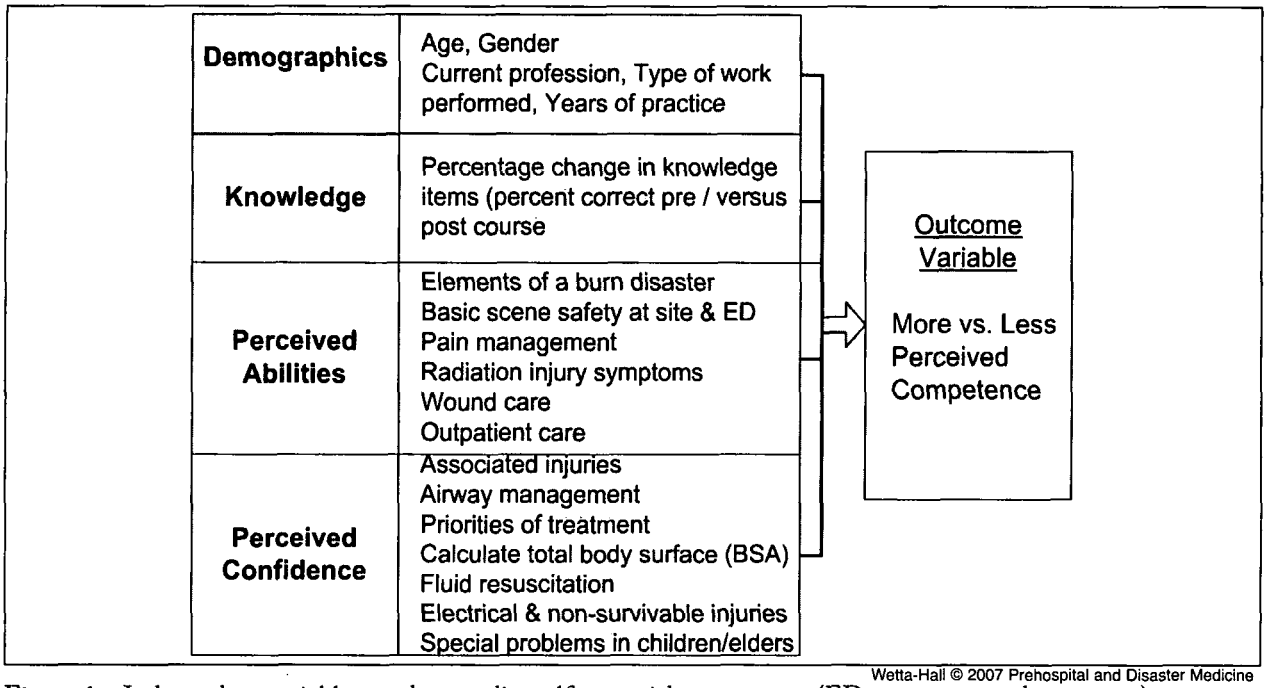

Figure 1—Independent variables used to predict self-reported competence (ED = emergency department)

	Original Sample (n = 383) %	Retained for Logistic Regression (n = 291) %
Gender		
Male	28.9	29.2
Female	71.1	70.8
Age Group (years)		
< 30	17.5	18.9
30–39	24.9	26.8
40–49	30.2	28.5
50	27.5	25.8
Location		
Urban	50.4	49.1
Rural	49.6	50.9
Profession		
Advanced Practitioner (MD/DO, PA, ARNP)	5.4	5.0
RN/LPN	58.8	55.9
Paramedic/EMT	35.7	39.1
Type of Work		
Prehospital care	38.9	39.2
Emergency Department	26.6	25.4
Acute Care/Burn Center	24.6	25.8
Management	10.0	9.6
Practice (years)		
≤10	53.6	56.7
11–25	35.0	33.0
>25	11.3	10.3

Table 1—Demographic characteristics (ARNP = advanced registered nurse practitioner; DO = doctor of osteopathy; EMT = emergency medical technician; LPN = licensed practical nurse; MD = medical doctor; PA = physician's assistant)

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Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	*p*-value
Type of work (prehospital)	3.06	(0.83–11.30)	0.09
Years of practice (≥11 years)	0.31	(0.09–1.08)	0.07
Training site (urban)	0.01	(0.18–0.82)	0.01
Confidence in content areas			
Airway management	2.31	(1.03–5.17)	0.04
Electrical injuries treatment	4.86	(1.84–12.85)	<0.001
Identify non-survivable injuries	2.24	(0.93–5.43)	0.07
Special problems (children/seniors)	2.14	(0.87–5.23)	0.10

Table 2—Significant predictors of improved self-reported competence; Alpha = 0.10. *Notes:* Ability items were not included in the regression analysis due to high co-linearity with confidence items. Gender, age, motivation to attend the CE offering and additional confidence items including identifying treatment priorities, calculating total body surface area, and fluid resuscitation, while not statistically significant, did improve the explanatory power of the model.

measure perceived confidence to perform critical assessments correctly. Finally, participants rated their overall sense of competence in managing a patient with burn injury using a four-point Likert-type scale. Reliability coefficients for this instrument were high.[24] For this analysis, competence was collapsed into a dichotomous variable: more versus less competent.

The present analysis examines the determinants of perceived competency (more versus less) among participants of the burn care training. Due to missing data in one or more fields of the survey results, 103 observations were dropped from the analysis. Screening for colinearity among variables was performed via a Pearson correlation coefficient matrix. Due to high correlations between ability and confidence items, ability ratings were eliminated from the model.

Analyses were conducted using SPSS 11.5 (SPSS Inc., Chicago, IL) for Windows (Microsoft Inc., Redmond, WA). Multivariate logistic regression (forward stepwise) was performed following the procedure recommended by Greenberg and Kleinbaum.[25] A total of 20 independent variables were used to predict self-reported competence among program participants, and included demographic characteristics, percent change in knowledge items, perceived abilities, confidence, and motivation to attend the program (Figure 1). All independent variables were entered into the multivariate logistic regression in a sequential manner. Statistical significance was confirmed using a chance of Type-I error at 10% (alpha) during modeling to identify all potential factors that could influence participant competence. Human subjects protection was secured through the University of Kansas School of Medicine-Wichita Institutional Review Board.

Results

A total of 280 participant surveys were used in the evaluation. Demographic information is summarized in Table 1. The majority of participants were female (70.8%), age 40 years or older (54.3%), and worked in the healthcare industry for 10 years or less (56.7%). More than half were employed as nurses (55.9%), while other professions listed were paramedic/EMT (39.1%), advanced practitioner (advanced registered nurse practitioner (ARNP), physician, physician assistant) (5.0%). Overall, 38% of participants worked in a prehospital or EMS setting, while the others were employed in hospital emergency department (26.6%), acute care (20.6%), management (10.0%), burn center (4.0%), or on a flight transport team (1.1%). The distribution of urban (49.1%) and rural (50.9%) participants was equal.

Results from multivariate logistic regression analyses (Table 2) showed that attendees with more perceived competence were from a prehospital work setting (odds ratio (OR) 3.06, confidence interval (CI) (0.83–11.30) $p = 0.09$, had 11 or more years of practice (OR = 0.31, CI = 0.09–1.08), $p = 0.07$, were more likely to practice in an urban setting (OR = 0.01, CI = 0.18–0.82), $p = 0.01$, and felt confident in the following areas: ability to implement appropriate airway management modalities (OR = 2.31, CI = 1.03-5.17), $p = 0.04$ manage patients with electrical injuries (OR = 4.86, CI = 1.84–12.85), $p < 0.001$, identify non-survivable injuries (OR = 2.24, CI = 0.93–5.43), $p = 0.07$, and recognize special problems associated with burns in young children or older adults (OR = 2.14, CI = 0.87–5.23), $p = 0.10$. Gender, age, motivation to attend the CE offering and additional confidence items including identifying treatment priorities, calculating total body surface area, and fluid resuscitation, while not significant, did improve the explanatory power of the model. Percentage change in knowledge was not retained in the final model. The final model explained 89.9% of the variability in self-reported perceptions of improved competence in burn disaster care.

Discussion

Many continuing education programs incorporate the widely used technique of a pre-/post-test to assess educational outcomes and program effectiveness.[26] However, this study is the first known study to use program evaluation data to identify predictors associated with improved competence related to the content provided in a continuing education program.

By utilizing regression analysis of program evaluation, curriculum developers can use their findings as an ongoing "needs assessment" and thus, make changes in current curriculum and develop future continuing education to "better fit" training attendees.[12] Careful examination of the model predictors can indicate where and why changes are most likely to be needed. For example, this analysis indicates that the effectiveness of overall curriculum was associated most with the less-experienced, prehospital service providers such as emergency medical technicians or paramedics from rural areas.

Participants with <10 years of practice may require additional experiential training to enhance their feelings of competency in responding to burn disasters. Participants with ≥11 years of practice were less likely to report improved competence. This may be explained by a high level of existing mastery among participants of burn disaster response concepts.

Participants who practiced in an urban setting had lower odds of reporting improved perceptions of competency, which suggests that working in an urban setting where multiple casualty incidents occur more frequently maintains currency of skills, and therefore, enhances perceptions of competency. This finding suggests that rural communities should pursue more community-based disaster drills to improve and maintain the skills of their healthcare providers.

For continuous curriculum improvement, content always should be reviewed for what is pertinent to the attendees. By understanding what areas of content contribute significantly to improved perceived competency, curriculum developers can focus emphasis on those topics. There were several areas of the didactic content (measured by confidence) in this evaluation, that were significantly associated with improved competence including: (1) airway management; (2) electrical injuries; (3) non-survivable injuries; and (4) special problems associated with children and seniors.

Airway management is a complex activity, but even is more complex for a burn victim. A burn patient initially may not require intubation, but as soft tissues of the respiratory system begin to undergo changes associated with the injury, immediate airway management becomes increasingly critical.

Severe electrical injuries are not common; they account for only 4.3% of all burn center admissions.[27] The external, visible burns can be managed in the same manner as all thermal burns; however, the problems for care providers unfamiliar with electrical burns may result from dangerous conditions at the point of rescue and the extensive internal and associated injuries that may not be outwardly apparent.

When a single patient is injured, the available resources may be sufficient to provide adequate medical care in a timely manner. Conversely, during a multiple-casualty incident, the care provider is faced immediately with the difficult decision of who will and will not receive care.[16] The "Preparing for Burn Disasters" curriculum specifically addressed the learning needs of the prehospital and initial hospital providers to identify those patients with burns who should be categorized into the expectant category when there are not sufficient available resources to care for all of the victims. Methods for managing these patients, their pain and anxiety, and providing compassionate care, were discussed at length during the continuing education program. Because care providers perform this activity infrequently, this content may have been influential particularly in enhancing the participants' self-reported competence.

Children and older adults present special considerations because treatment parameters for these populations differ substantially from other adult patients. Treatment issues for children, such as intravenous fluid resuscitation, difficult venous access, proportionately larger body surface area (BSA), higher weight-based calculations for resuscitation volume, higher recommended urine output, or modest hepatic glycogen reserves are different than those for adults.[28–29] For example, the elderly are more likely to be placed in the expectant category resulting in an emotionally taxing situation for care providers.[4] Special considerations for these patient groups received special emphasis during the continuing education program.

For identifying priorities of treatment, calculating total body surface area and the types and volume of fluid resuscitation were nearly even and, therefore, not statistically significant. However, these factors did strengthen the model. These findings suggest that participants may have had sufficient experience and confidence in these treatment modalities.

In a review of the literature of disaster preparedness continuing education program evaluations, two studies describe similar evaluation methods measuring and documenting changes in attitudes and knowledge as a result of participating in a continuing education program.[30,31] However, only one published study could be identified that used logistic regression analyses and independent variables of knowledge, attitudes, and confidence to identify predictors of healthcare practices. In a study of nurses' knowledge, attitudes, and experiences regarding advance directives, higher self-perceived confidence and experience with advance directives were significant predictors of participating in advance directive discussions with patients.[32]

Limitations

Self-selection bias is a potential limitation of this study in two ways. Findings were based upon a self-selected convenience sample of healthcare professionals who were sufficiently motivated to attend the continuing education offering. A second form of selection bias was that participants who completed the program and all pre/post assessments may have reported different attitudes and intentions, and therefore, may have generated different results. This limitation underscores the importance of providing incentives and/or encouragement to fully complete pre/post surveys. The results of this study may be exclusive to those healthcare providers who

attended and may not be generalizable to other geographic areas. Due to funding and logistical limitations, a randomized, controlled trial was not possible, and most studies evaluating CE programs do not include randomization.

Conclusions

Given the variety of specialists that are needed for preparation and response, developing experts to respond to disaster events requires considerable training effort.[33] Moreover, interventions to train healthcare providers for burn disasters must cover a broad range of topics, yet, learning needs may vary by practice setting, work experience, and previous exposure to disaster events. This extended evaluation research provides three-fold information for continuing education research: (1) to identify content areas that should be emphasized in future burn care training; (2) to be used as a model for continuing education evaluation in other domains; and (3) to support that the consideration of many factors when designing a continuing education program is important. The findings also underline the importance of experiential and educational factors in program planning. In the future, continuing education programs may need to be crafted differently for rural versus urban participants, or for those with more versus less years of experience. Findings suggest that "one size does not fit all," and continuing education programs may need to be tailored to meet the unique learning needs of each audience.

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