Recommended Modifications and Applications of the Hospital Emergency Incident Command System for Hospital Emergency Management

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Abbreviations:
CBRN = chemical, biological, radiological, nuclear
EMS = emergency medical services
HEICS = Hospital Emergency Incident Command System
PPE = personal protective equipment
SARS = Severe Acute Respiratory Syndrome
SECC = system emergency coordination center
START = Simple Triage and Rapid Treatment Triage System

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Abstract

The Hospital Emergency Incident Command System (HEICS), now in its third edition, has emerged as a popular incident command system model for hospital emergency response in the United States and other countries. Since the inception of the HEICS in 1991, several events have transformed the requirements of hospital emergency management, including the 1995 Tokyo Subway sarin attack, the 2001 US anthrax letter attacks, and the 2003 Severe Acute Respiratory Syndrome (SARS) outbreaks in eastern Asia and Toronto, Canada.

Several modifications of the HEICS are suggested to match the needs of hospital emergency management today, including: (1) an Incident Consultant in the Administrative Section of the HEICS to provide expert advice directly to the Incident Commander in chemical, biological, radiological, nuclear (CBRN) emergencies as needed, as well as consultation on mental health needs; (2) new unit leaders in the Operations Section to coordinate the management of contaminated or infectious patients in CBRN emergencies; (3) new unit leaders in the Operations Section to coordinate mental health support for patients, guests, healthcare workers, volunteers, and dependents in terrorism-related emergencies or events that produce significant mental health needs; (4) a new Decedent/Expectant Unit Leader in the Operations Section to coordinate the management of both types of patients together; and (5) a new Information Technology Unit Leader in the Logistics Section to coordinate the management of information technology and systems.

New uses of the HEICS in hospital emergency management also are recommended, including: (1) the adoption of the HEICS as the conceptual framework for organizing all phases of hospital emergency management, including mitigation, preparedness, response, and recovery; and (2) the application of the HEICS not only to healthcare facilities, but also to healthcare systems.

Finally, three levels of healthcare worker competencies in the HEICS are suggested: (1) basic understanding of the HEICS for all hospital healthcare workers; (2) advanced understanding and proficiency in the HEICS for hospital healthcare workers likely to assume leadership roles in hospital emergency response; and (3) special proficiency in constituting the HEICS *ad hoc* from existing healthcare workers in resource-deficient settings. The HEICS should be viewed as a work in progress that will mature as additional challenges arise and as hospitals gain further experience with its use.

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Characteristic	Advantages
Modular organization based on functions required in emergency response	Logical management structure Applicability to variety of healthcare organizations*
Fixed organizational hierarchy	Predictable chain of command
Communication occurs up and down the chains of command	Clear reporting channels
Each position supervises ≤7 other positions	Realistic span of control
Job action sheets define responsibilities of each position	Defined responsibilities Accountability of position function
Job action sheets prioritize actions of each position	Prioritized response
Job action sheets show prioritized actions as checklists	Improved documentation Improved cost recovery
Responsibilities, actions in emergencies parallel routine duties	Minimal disruption of existing hospital departments
Standardized terminology	Improved internal and external communication Facilitation of external assistance
Flexible activation of individual sections or branches of organization	Customized emergency response (minimal to full) to different types and magnitudes of emergencies Cost-effective emergency response
One individual may assume ≥1 position	Emergency response possible with minimum number of responders

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Table 1—Characteristics and advantages of the HEICS[1,2,22] (*urgent care centers, community health centers, extended care facilities, public health facilities)

Introduction

Over the past decade, the Hospital Emergency Incident Command System (HEICS) has emerged as a popular incident command system model for hospital emergency response in the United States (US) and other countries. Modeled after the FIRESCOPE management system for wildfires, the HEICS was developed by the Orange County, California Emergency Medical Services (EMS) in 1991 and tested at six hospitals in Orange County in 1992.[1,2] Revised in 1996 and 1998, the HEICS is now in its third edition.[1]

Since the HEICS was introduced in the early 1990s, several events that were unanticipated by previous iterations of the HEICS have transformed the requirements of hospital emergency management. First, the specter of chemical, biological, radioactive, and nuclear (CBRN) events due to acts of terrorism became real for many hospitals, producing new challenges for hospital emergency response.[3–5] Seminal terrorism-related CBRN events in recent years include the 1995 Tokyo Subway sarin attack and the 2001 US anthrax letter attacks.[6–9]

Type of hospital emergency	Representative discipline of Incident Consultant
Chemical emergency	Toxicologist, occupational health physician, emergency physician, HazMat specialist
Biological emergency	Infectious disease specialist, hospital epidemiologist, infection control officer
Radiological or nuclear emergency	Radiological safety officer, nuclear medicine physician, radiological therapy physician
Trauma/burn emergency	Trauma surgeon, burn surgeon, emergency physician
Emergencies with significant mental health needs	Psychiatrist, psychologist
Emergencies with significant numbers of pediatric patients	Pediatric emergency physician, pediatric intensive care specialist
Emergency with special emergency management considerations	Emergency physician
Emergency with significant facility legal exposure*	Attorney

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Table 2—Representative disciplines of Incident Consultants in emergencies (*Liability, regulatory, and statutory compliance; HazMat = hazardous materials)

Secondly, the potential for new, emerging, or re-emerging infectious diseases to generate worldwide pandemics was realized, as Severe Acute Respiratory Syndrome (SARS) outbreaks spread through East Asia and then to Toronto in 2003.[10–16] Accordingly, infectious diseases with secondary transmission have become a hospital emergency management issue worldwide.[17]

Third, the mental health support of patients, guests, and healthcare workers in emergencies has become an increasingly important consideration for hospital emergency response.[18,19] For example, the Tokyo Subway sarin attack drove an estimated 4,500 worried patients to hospitals and an uncounted number of so-called "white powder" events sent anxious patients to hospitals worldwide during the 2001 US anthrax letter attacks.[8] Outbreaks of SARS also generated substantial mental health needs. For example, the entire hospital staff at one Toronto hospital required psychosocial support during the 2003 SARS outbreak.[13]

Fourth, electronic information-sharing has become commonplace in most hospitals in the developed world. With the advent of inexpensive personal computers, electronic information-sharing devices, the Internet, and hospital intranets, hospital emergency response has become increasingly dependent on information technology and information systems.

At the same time, hospitals in the US and abroad have begun to use the HEICS and learn from its applications. For example, Arnold *et al* reported the implementation of the HEICS in acute care hospitals in Turkey after the Marmara and Duzce Earthquakes in 2000.[20] Zane and Prestipino reviewed the phased implementation of the HEICS at a six-

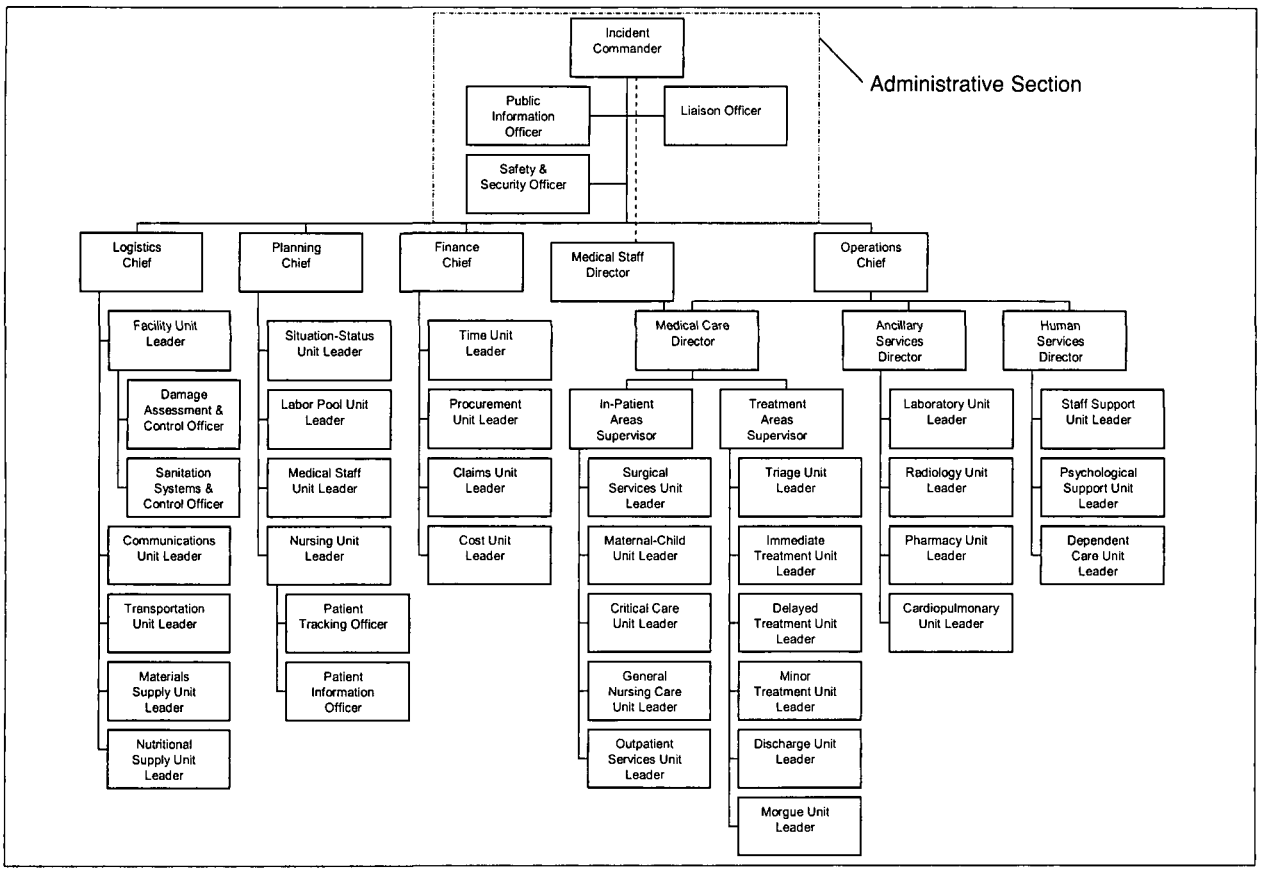

Figure 1—Hospital Emergency Incident Command System (HEICS) 3rd edition organizational chart[1]

hospital healthcare system in Massachusetts beginning in 2002.[2] Wang and Chang reported the implementation of the HEICS at hospitals in Taipei in 2003.[21] Tsai *et al* reported the application of the HEICS at a government hospital in Tainan, Taiwan, during the SARS outbreak in 2003.[15,16] Lessons learned from these and similar experiences also have begun to transform hospital emergency management.

The purpose of this article is to outline the modifications of the HEICS, which are required to match the needs of hospital emergency management today, including the introduction of several new leadership positions. New applications of the HEICS are suggested, including: (1) the adoption of the HEICS as the conceptual framework for organizing all phases of hospital emergency management; and (2) the application of the HEICS to healthcare systems. Lastly, three levels of healthcare worker competencies in the HEICS are described. These recommendations are based on the real-world experience of the authors with both the implementation of the HEICS in acute care hospitals, and the application of the HEICS to hospital emergency management in actual emergencies in Taiwan, ROC, Turkey, and the US.

HEICS

The HEICS is an organizational model for command and control in hospital emergency management, which is based on five major functional areas of hospital emergency response: (1) administrative; (2) logistics; (3) planning; (4) finance; and (5) operations, all under the overall leadership of an Incident Commander. These sections, in turn, are subdivided into 49 leadership positions, each of which has a job action sheet that lists the prioritized actions that each leader is expected to perform during hospital emergency response. The third edition of the HEICS is available online from the State of California Emergency Medical Services Authority. The characteristics and advantages of the HEICS are summarized in Table 1.[1,2,22] Figure 1 is the organizational chart from the third edition of the HEICS.[1]

New leadership position for expert advice

The first recommendation is that the HEICS should add an Incident Consultant position in the Administrative Section to provide expert clinical and technical advice to the Incident Commander as needed in CBRN events and other emergencies. The major rationale for the Incident Consultant includes: (1) the Incident Commander often requires immediate clinical and/or technical expertise in emergencies; and (2) existing members of the Administrative Section usually are unable to provide this expertise, since they rarely are content experts in CBRN emergencies, disaster medicine, or even emergency management (e.g., the Incident Commander typically is a hospital administrator in the US). The Incident Consultant should be viewed as:

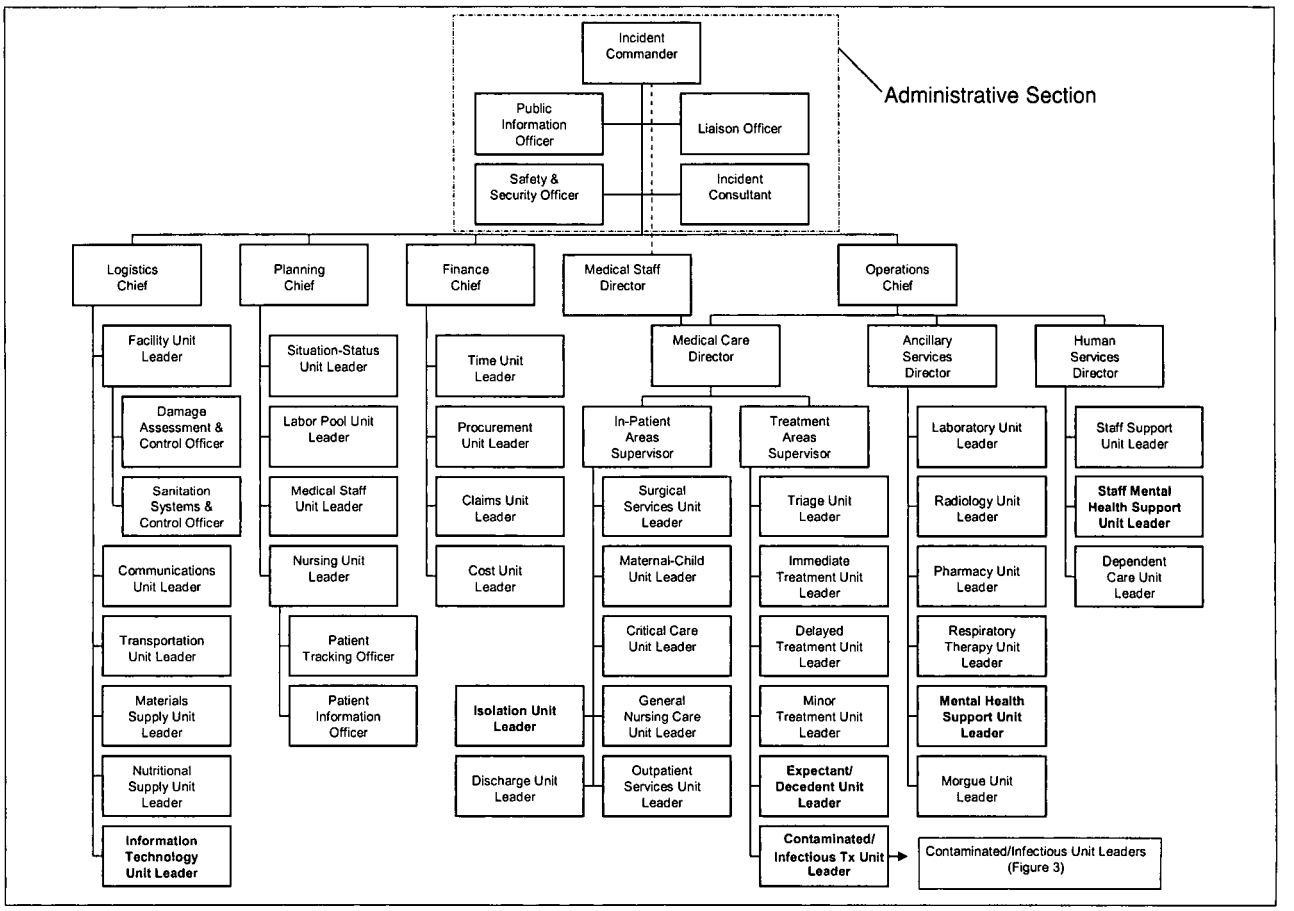

Figure 2—Recommended modifications of Hospital Emergency Incident Command System (HEICS) organizational chart (Tx = treatment) (Recommended modifications (bold))

(1) an optional position, which is activated by the Incident Commander as needed (or by pre-determined criteria); and (2) a flexible position, which is filled by the type of expert according to the type of event. Potential types of Incident Consultants are listed in Table 2. The administrative location of the Incident Consultant in the Administrative Section not only provides a direct pipeline to the Incident Commander, it also provides the Incident Consultant with the overall perspective of the hospital emergency response, enabling expert advice that is customized to the current situation. Incident Consultants not only should have vertical knowledge in their area of expertise, including relevant basic, clinical, and disaster science, but also core competency in hospital emergency management. Incident Consultants directly report to the Incident Commander.

New leadership positions for contaminated/infectious patients

The HEICS also requires several new leadership positions in the Operations Section to coordinate the management of contaminated or infectious patients in CBRN emergencies (Figure 2). Events involving CBRN pose a number of unique functional challenges for hospitals, including: (1) the potential for a large number of contaminated/infectious patients to arrive at hospitals unannounced and outside of EMS; (2) the potential for contaminated/infectious patients to pose a hazard to healthcare workers or the facility; (3) the need to identify potentially contaminated or infectious patients as the first priority of hospital triage; (4) the need to perform immediate life-saving interventions on contaminated or infectious patients with immediately life-threatening medical problems; (5) the need to assess potentially infectious patients for the presence of infection; (6) the need to decontaminate contaminated patients, healthcare workers, facilities, and equipment; (7) the need to protect the safety of healthcare workers, other patients, guests, and facilities at all times through the use of protective distancing and barriers, isolation precautions, personal protective equipment (PPE), and decontamination; and (8) the need to provide health services to patients within environments that are potentially hazardous to healthcare workers, patients, and guests (hot and warm zones).[3,4,23]

Contaminated/infectious treatment unit leader

The HEICS requires a Contaminated/Infectious Treatment Unit Leader to coordinate the overall management of contaminated/infectious patients who arrive at hospitals in CBRN emergencies (Figures 2 and 3). Key supervisory responsibilities include: (1) the triage of potentially contaminated/infectious patients; (2) the resuscitation of contaminated/infectious patients; (3) the assessment of infectious

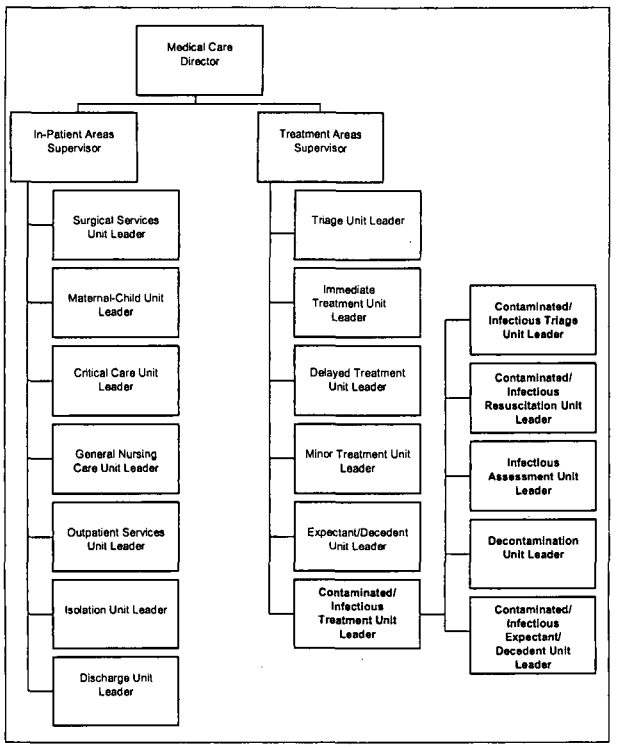

Figure 3—Recommended new HEICS positions in the treatment areas in CBRN emergencies with potentially contaminated or infectious patients (HEICS = Hospital Emergency Incident Command System; CBRN = chemical, biological, radiological, nuclear)

patients; (4) the decontamination of contaminated patients; (5) the management of contaminated/infectious decedent/expectant patients; and (6) the use of protective measures, which vary with the type of event, in order to ensure the safety of healthcare workers, other patients, guests, and the hospital.

Which of these roles will be required varies with the type of CBRN emergency that produces contaminated/infectious patients (Table 3). In small-scale CBRN emergencies, the Contaminated/Infectious Treatment Unit Leader is responsible for directly supervising all interventions that are needed for the initial management of contaminated/infectious patients. In large-scale CBRN emergencies that produce contaminated/infectious casualties, additional HEICS leaders will be required as listed in Table 3 and described below. The Contaminated/Infectious Treatment Unit Leader reports to the Treatment Areas Supervisor.

Contaminated/Infectious triage unit leader

The HEICS requires a Contaminated/Infectious Triage Unit Leader to coordinate the initial triage of potentially contaminated/infectious patients in large-scale CBRN emergencies (Figure 2). The Contaminated/Infectious Triage Unit Leader also supervises the use of protective measures during triage, including protective distancing and barriers, isolation precautions, and PPE.

The rationale for this position is that the triage of potentially contaminated or infectious patients in CBRN emergencies is fundamentally different than triage in other emergencies, because of the need to prevent secondary contamination or secondary transmission of infectious agents.[3,4,24] As a result, the hospital triage of potentially contaminated/infectious patients in CBRN emergencies should be carried out in two prioritized steps. First, patients should be triaged according to whether or not they potentially are contaminated or infectious. Second, potentially contaminated or infectious patients should be triaged according to the severity of their condition using the Simple Triage and Rapid Treatment Triage System (START) or a similar system and distributed to the appropriate in-patient unit (Figure 4).[25,26] Potential criteria for identifying contaminated or infectious patients in CBRN emergencies are listed in Table 4. For example, in the 2003 SARS outbreaks in Taiwan and Toronto, potentially infectious patients were identified at triage through the detection of fever or the presence of cough or diarrhea.[14,15] In a radiological or nuclear emergency, the identification of patients with radioactive contamination likely will be facilitated with the assistance of the hospital radiological safety officer or in-house radiological expert when available. The Contaminated/Infectious Triage Unit Leader reports to the Contaminated/Infectious Treatment Unit Leader.

Contaminated/Infectious Resuscitation Unit Leader

The HEICS requires a Contaminated/Infectious Resuscitation Unit Leader to coordinate the immediate resuscitation of potentially contaminated/infectious patients with immediately life-threatening conditions in large-scale CBRN emergencies (Figure 2). The Contaminated/Infectious Resuscitation Unit Leader also supervises the use of protective measures during resuscitation, such as protective distancing and barriers, exposure-time limits, isolation precautions, and PPE.

The rationale for this position is that some contaminated/infectious patients will arrive at hospitals with life-threatening problems and require immediate life-saving interventions, such as airway management, oxygen therapy, ventilation, needle thoracostomy (in the case of concomitant trauma), fluid resuscitation, or the provision of time-dependent antidotes, such as atropine and pralidoxime, before they undergo further assessment or decontamination. The goal of resuscitation in the Contaminated/Infectious Resuscitation Unit is to temporarily stabilize potentially contaminated or infectious, critically injured or ill patients prior to decontamination or assessment for the presence of infection as described below. The Contaminated/Infectious Resuscitation Unit Leader reports to the Contaminated/Infectious Treatment Unit Leader.

Infectious Assessment Unit Leader

The HEICS requires an Infectious Assessment Unit Leader to coordinate the medical assessment of potentially infectious patients in large-scale biological emergencies due to agents with secondary transmission (e.g., smallpox, SARS, viral hemorrhagic fever, pneumonic plague). The

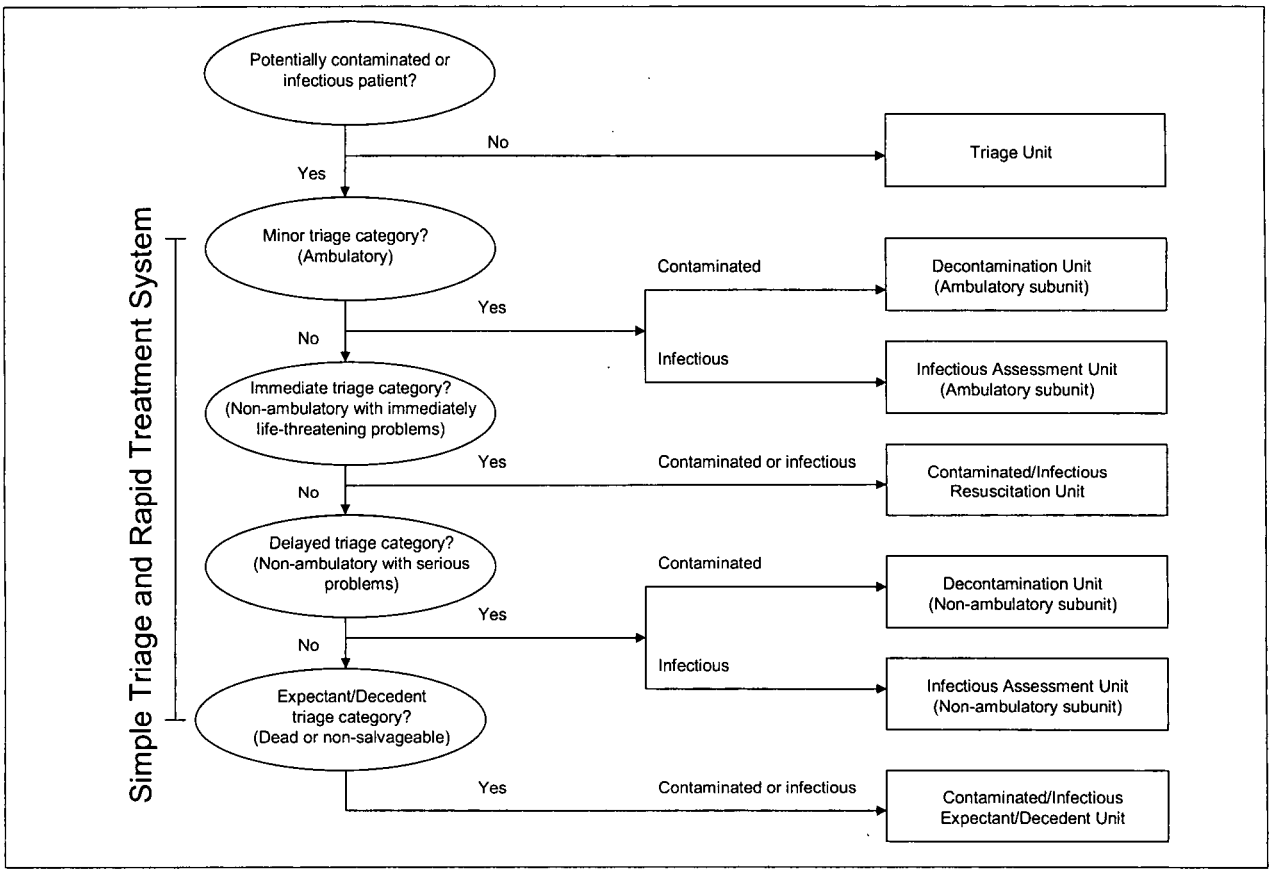

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Figure 4—Hospital triage in CBRN emergencies with potentially contaminated or infectious patients[26] (CBRN = chemical, biological, radiological, nuclear)

Infectious Assessment Unit Leader also is charged with preventing secondary spread during this assessment through the supervised use of infection control measures, such as protective distancing and barriers, isolation precautions, cohorting (patients and healthcare workers), and PPE.

The rationale for this position is that some patients require further medical assessment to determine whether they are infectious, because their complex clinical status cannot be determined at triage. The goal of medical assessment in the Infectious Assessment Unit is to identify infectious patients who pose a potential risk to others. For example, in the 2003 SARS outbreaks in Taiwan and Toronto, SARS assessment units were established outside emergency departments to assess patients identified at triage as potentially infectious. Medical assessment included portable chest radiography and sputum assay for the SARS virus.[13,14] Patients found to have suspected or probable SARS then were sent directly to the SARS isolation unit inside of the hospital. Patients for whom SARS was ruled out were sent to the "cold" emergency department or discharged to home. The Infectious Assessment Unit Leader also reports to the Contaminated/Infectious Treatment Unit Leader.

Decontamination Unit Leader

The HEICS requires a Decontamination Unit Leader to coordinate the decontamination of contaminated patients in large-scale CBRN emergencies (Figure 2).[27] The Decontamination Unit Leader also selects the type of decontamination (e.g., wet or dry) and supervises the use of protective measures during decontamination, including protective distancing and barriers, exposure time limits, and PPE.

The major rationale for this position is that many contaminated patients will arrive at the hospital during various CBRN emergencies and require decontamination before they safely can be allowed into the hospital.[3,4,7,9,23] While it is preferable for patients to be decontaminated in the field, this may not occur always.[28,29] Healthcare workers, equipment, and vehicles also may require decontamination. The goal of decontamination is to rapidly decontaminate potentially contaminated patients in a prioritized manner. The first priority group for decontamination is comprised of non-ambulatory patients with life-threatening injuries, who already have been stabilized temporarily in the Contaminated/Infectious Resuscitation Unit. The second priority group consists of non-ambulatory patients with serious injuries, and the third priority group is comprised

HEICS leader	Chemical emergency with contaminated patients (e.g., sarin vapor release)	Biological emergency with contaminated patients (e.g., anthrax powder release)	Biological emergency with infectious patients (e.g., SARS outbreak)	Radiological/Nuclear with contaminated patients (e.g., radioactive material release)
Contaminated/Infectious Treatment Unit Leader	X	X	X	X[a]
Contaminated/Infectious Triage Unit Leader	X	X	X	X[a]
Contaminated/Infectious Resuscitation Unit Leader	X	[b]	X	[b]
Infectious Assessment Unit Leader			X	
Decontamination Unit Leader	X	X		X[a]
Contaminated/Infectious Expectant/Decedent Unit Leader	X	[a]	X	[b]
Isolation Unit Leader[c]			X	

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Table 3—Hospital Emergency Incident Command System (HEICS) leaders required in large-scale chemical, biological, radiological, nuclear (CBRN) emergencies for the initial management of contaminated or infectious casualties according to the type of event (X = required; [a]Assistance by hospital radiological safety officer or other in-house radiological expert is recommended when available; [b]Unlikely to be required unless an additional mechanism of serious injury occurs, such as explosion; [c]Isolation Unit Leader is included in In-Patient Areas of the HEICS)

Type of emergency	Type of patient	Identification criteria
Chemical	Contaminated	History of significant exposure and lack of prehospital decontamination or Presence of visible or odorous contaminant[a] or Presence of key signs or symptoms[b]
Biological	Contaminated	History of significant exposure and lack of prehospital decontamination or Presence of visible contaminant[a]
	Infectious	Presence of key signs or symptoms[b]
Radiological/Nuclear	Contaminated	History of significant exposure and lack of prehospital decontamination[c] or Detection of radioactivity by Geiger Counter or other radiological survey instrument

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Table 4—Potential criteria for identifying potentially contaminated or infectious patients at triage in chemical, biological, radiological, nuclear (CBRN) emergencies ([a]Currently available chemical and biological detector devices too slow for rapid triage decision-making; [b]Varies with type of agent; [c]Only used if radiological detection device is unavailable)

of ambulatory patients. In large-scale emergencies, it may be necessary to subdivide the Decontamination Unit into ambulatory and non-ambulatory subunits (Figure 4). This Unit Leader also reports to the Contaminated/Infectious Treatment Unit Leader.

Contaminated/Infectious Expectant/Decedent Unit Leader

The HEICS requires a Contaminated/Infectious Expectant/Decedent Unit Leader, who during large-scale CBRN emergencies, coordinates the management of contaminated/infectious patients who are dead-on-arrival, die in the Treatment Areas, or are deemed unsalvageable and expected to die. The major rationale for this position includes: (1) the management of expectant and decedent patients has overlapping clinical, ethical, psychosocial, cultural, and legal considerations; and (2) the management of expectant and decedent patients who are potentially contaminated or infectious, mandates safety considerations, which warrant a distinct unit leader (e.g., patients in this unit continue to require protective distancing and barriers, isolation precautions, and PPE). Furthermore, contaminated decedents also will require decontamination in the Decontamination Unit after all live patients and healthcare workers are decontaminated. This Unit Leader reports to the Contaminated/Infectious Treatment Unit Leader.

Isolation Unit Leader

The HEICS requires an Isolation Unit Leader in In-Patient Areas of the Operations Section to coordinate the medical management of hospitalized infectious patients in

biological emergencies with the potential for secondary transmission (e.g., smallpox, SARS, viral hemorrhagic fever, pneumonic plague). An Isolation Unit permits potentially limited resources (e.g., trained personnel, PPE, environmental controls, prophylaxis) to be focused in a predesignated area with restricted access, serving as an additional barrier between patients with a highly transmissible infectious disease and the rest of the facility.[30] The Isolation Unit Leader also supervises the use of infection control measures in this unit, including protective distancing and barriers, isolation precautions, cohorting (patients and healthcare workers), and PPE.

In large-scale, infectious disease emergencies, it may be necessary to subdivide the Isolation Unit into medical and critical care subunits for the care of stable and unstable inpatients respectively.[13,15] During the 2003 SARS outbreak in Taiwan, some hospitals found it necessary to add an additional subunit for the quarantine of potentially infectious healthcare workers.[15] The In-Patient Isolation Unit Leader reports to the In-Patient Areas Supervisor.

New leadership positions for mental health support

The HEICS also requires new leadership positions in the Operations Section to coordinate mental health support in emergencies that produce significant mental health needs (Figure 2). Many types of emergencies may generate substantial mental health needs, including terrorism-related events, outbreaks of infectious diseases with the potential for secondary transmission, and radiological emergencies.[5,18,19] While most people usually do not panic during disasters or develop long-term psychiatric disorders as a result, they nevertheless experience mental health needs, which previous iterations of the HEICS may have underappreciated.[18,19] Mental health support is a horizontal function in hospital emergency response that involves at least four separate populations with unique mental health needs, including patients, guests (e.g., family members, loved ones, and caretakers), healthcare workers (including volunteers), and healthcare workers' dependents. Mental health support also involves a spectrum of clinical and supportive services, ranging from acute psychiatric care to spiritual support.

Mental Health Support Unit Leader

The HEICS requires a Mental Health Support Unit Leader to coordinate mental health support for patients and guests (i.e., family members, loved ones, and caretakers) in emergencies (Figure 2). The rationale for this position includes: (1) the need to coordinate mental health support for patients with guests, since guests usually accompany patients; (2) mental health support for patients including medical (i.e., psychiatric services provided by physicians or mid-level practitioners) and non-medical supportive services (e.g., assistance with emergency housing or family reunification); and (3) mental health support for patients and guests, which may be required hospital-wide (i.e., Treatment Areas and In-Patient Areas). The Laboratory Unit Leader, Radiology Unit Leader, and Mental Health Unit Leader may be viewed as comprising a natural, functioning bloc, since all coordinate physician and non-physician services that may take place in multiple settings throughout the hospital. The Mental Health Support Unit Leader reports to the Ancillary Services Director.

Staff Mental Health Support Unit Leader

The HEICS requires a Staff Mental Health Support Unit Leader to coordinate mental health support for hospital healthcare workers, volunteers, and healthcare workers' dependents (Figure 2). The rationale for this position includes: (1) the need to coordinate mental health support for healthcare workers with dependents, since a lack of coordination may result in decreased availability of healthcare workers, while they attend to the needs of their dependents; and (2) mental health support for healthcare workers and dependents includes logistical support (e.g., nutrition, clothing, beds). In particular, the Staff Support Unit Leader, Dependent Care Unit Leader, and the Staff Mental Health Support Unit Leader comprise a natural, functioning bloc, since all coordinate services for healthcare workers and their dependents. In addition, all three units are likely to draw healthcare workers from pre-existing "employee assistance program" staff in hospitals. The Staff Mental Health Support Unit Leader reports to the Human Services Director. This position replaces the Psychological Support Unit Leader in the third edition of the HEICS.

New leadership position for expectant/decedent care

The HEICS requires a new Expectant/Decedent Unit Leader in the Operations Section to coordinate the management of patients who are dead-on-arrival, die in the Treatment Areas, or are deemed unsalvageable and expected to die in emergencies (Figure 2). The major rationale for this position is that: (1) in many types of emergencies, hospitals are faced with both types of patients (although expectant patients are relatively rare); and (2) the management of expectant and decedent patients has overlapping clinical, ethical, psychosocial, cultural, and legal considerations. In particular, the Immediate Treatment Unit Leader, Delayed Treatment Unit Leader, Minor Treatment Unit Leader, and Expectant-Decedent Unit Leader comprise a natural, functioning bloc, since each coordinates the management of non-contaminated, non-infectious patients in one of the four triage categories of the START system.[26] The Expectant/Decedent Unit Leader reports to the Treatment Areas Supervisor. To accommodate this new unit leader, the Morgue Unit Leader should be moved to the In-Patient Areas as described below.

New leadership position for information technology management

The HEICS also requires a new Information Technology Unit Leader in the Logistics Section to coordinate the management of information technology and information systems, including hardware and software, in emergencies (Figure 2). The major rationale for this position is that hospitals increasingly have become dependent on information technology and information systems in emergencies to support: (1) the provision of static information to hospital emergency responders (e.g., clinical protocols, contact

information, maps); (2) the collection, processing, and dissemination of dynamic information (e.g., situation status reports, hospital capacity assessments, and hospital needs assessments); and (3) internal and external communication via e-mail.[31,32] The Information Technology Unit Leader reports to the Logistics Chief.

New locations for leadership positions

Updating the HEICS also will require the relocation of some unit leaders. First, the Morgue Unit Leader should be moved from the Treatment Areas to the Ancillary Services Area (Figure 2). The rationale for this includes: (1) the Morgue Unit is a cross-cutting unit that receives patients from throughout the hospital in emergencies (like other ancillary services); (2) the Morgue Unit provides both medical and non-medical services (like other ancillary services); (3) the burden of mortality on the Morgue Unit is far greater from in-patient areas than from the emergency department in most emergencies; and (4) supervisory oversight of the Morgue Unit by the Treatment Areas Supervisor is problematic, since most hospital morgues are located at sites remote from emergency departments.

In addition, the Discharge Unit Leader should be moved from the Treatment Areas to the In-Patient Areas (Figure 2). The rationale for this includes: (1) in most emergencies, the need to discharge or evacuate patients is far greater from the In-Patient Areas than the Treatment Areas (i.e., the number of patients who need to be rapidly discharged or evacuated from inside the hospital exceeds the number of patients who need to be discharged or evacuated from the emergency department in many emergencies); (2) in some emergencies, the need to discharge hospitalized patients may outlast the need to discharge emergency department patients (e.g., the discharge of in-hospital patients may continue for weeks in infectious disease emergencies); (3) the process of discharging or evacuating patients from the In-Patient Areas is more complicated, since the patients usually have more complex medical problems and are more likely to require special transportation resources; and (4) supervisory oversight of the Discharge Unit by the Treatment Areas Supervisor also is challenging, since discharge units often are located in hospital cafeterias or public spaces located apart from the emergency department.

New titles for leadership positions

The Cardiopulmonary Unit Leader should be renamed the Respiratory Therapy Unit Leader (Figure 2). The rationale for this title change includes: (1) the need for airway and respiratory interventions vastly overshadows the need for cardiac interventions in emergencies; and (2) most hospitals in the US have respiratory therapy departments, not cardiopulmonary departments. It should be noted that, in many countries, this unit is irrelevant altogether, since the concept of respiratory therapy does not exist (i.e., physicians and nurses provide all respiratory care).

New Applications of the HEICS

In working with the HEICS over the past several years, new applications of the HEICS were found. First, the HEICS is useful, not only as the command-control system during hospital emergency responses, but also as the organizing structure for hospital emergency management throughout the entire emergency management cycle, including the mitigation, preparedness, response, and recovery phases. For example, the three acute care hospitals in the Yale-New Haven Health System in Connecticut have adopted the HEICS as the conceptual framework for mitigating, preparing for, responding to, and recovering from emergencies. In particular, these hospitals have organized all of the elements of hospital surge capacity—facilities, supplies, equipment, pharmaceuticals, healthcare workers (leaders and non-leaders), healthcare worker competencies, information resources, and the policies and procedures that link these elements together—in terms of the HEICS. Accordingly, assessments are performed, needed facilities are identified, equipment and supplies are prepared, healthcare worker assignments are made, required competencies are built, information resources are readied, and policies and procedures are established in a HEICS-consistent manner.

In addition, the HEICS may be applied, not only to healthcare facilities, but also to healthcare systems. Accordingly, the Yale-New Haven Health System has developed a system-level, unified command system based on the HEICS for its system-level management team, including job action sheets for each leadership position. At the helm of this system-level, unified command system is a unified command executive, with the ultimate authority to direct emergency responses in events that transcend a single system hospital within the system. This system-level, unified command system is critical because it enables the overall coordination of emergency response among hospitals and the mobilization of resources among hospitals. Because the system-level unified command system oversees hospital emergency response over a 60-mile range (i.e., from Greenwich to Guilford, Connecticut), a System Emergency Coordination Center (SECC) was established. The SECC is equipped with an emergency communications system that links all system facilities via redundant modalities, including satellite telephones. Since many acute care hospitals today belong to larger multi-hospital, healthcare systems, especially in metropolitan areas of the US, this approach may be applicable elsewhere.

New Competencies in HEICS

At least three levels of competencies in the HEICS should be established for healthcare workers in acute care hospitals. First, all hospital healthcare workers should acquire a basic understanding of the HEICS in order to optimize hospital emergency response. In the Yale-New Haven Health System, instruction in the HEICS is provided to all healthcare system employees via a mandatory annual course, entitled "Emergency Management 102". Emergency Management 102 is a self-paced, 25-minute, interactive computer tutorial that teaches the major principles of hospital emergency management and the HEICS. As of January 2005, 10,820 hospital healthcare workers in the Yale-New Haven Health System have completed Emergency Management 102. Emergency Management 102 currently is

being provided to healthcare workers in 19 other acute care hospitals in Connecticut.

Secondly, healthcare workers likely to assume HEICS leadership positions in hospital emergencies require an advanced understanding of the HEICS and demonstrated proficiency in job action performance. In the Yale-New Haven Health System, these competencies are developed through participation in periodic tabletop disaster drills that involve all the HEICS leadership positions. In Turkey, advanced training in the HEICS has been provided by the Emergency Medicine Association of Turkey through regular courses that teach the principles of the HEICS to hospital healthcare workers through didactic lectures followed by table-top disaster drills that provide hands-on training in implementing the HEICS. Presently, >1,850 Turkish healthcare workers have been trained at 65 hospitals in this manner.

Third, physicians and nurses, likely to respond to emergencies in resource-deficient settings (e.g., small hospitals, rural hospitals, overnight shifts in large hospitals), require special competency in the HEICS, which will enable them to generate and assume multiple leadership roles during the earliest period after an event. For example, the only emergency physician on-duty at a 25-bed hospital in rural eastern Turkey (and one of the authors) used the HEICS to organize a small group of six family physicians and 16 nurses spontaneously to respond to the unexpected arrival of 56 victims from a mass-casualty motor vehicle collision on a state highway 12 km away. This hospital had only a five-bed emergency department, no operating room, and no hospital emergency response plan. At the onset of the event, the emergency physician, who assumed the role of the Incident Commander, rapidly appointed a Liaison Officer, Public Information Officer, Safety and Security Officer, Operations Chief, Logistics Chief, Treatment Areas Supervisor, and Triage Officer out of a limited number of personnel. The HEICS assisted this group in managing 30 patients with serious injuries (and transferring them to nearby trauma centers), 26 patients who were dead-on-arrival, the convergence of the local populace and the media on the hospital, and a barrage of telephone calls from worried family members, local government officials, and the media—all during the course of three hours. Accordingly, it seems that the ability to constitute the HEICS from scratch on an ad hoc basis is a critical competency in resource-deficient settings. Presently, the triage module in the American Medical Association's Advanced Disaster Life Support Course most closely approximates this type of training for civilian physicians and nurses.[33]

Conclusion

Several new challenges have emerged for hospital emergency management in recent years. Accordingly, several new leadership positions in the HEICS, new applications of the HEICS, and at least three levels of HEICS competencies for hospital healthcare workers are recommended. The HEICS should be viewed as a work in progress that will continue to mature as additional challenges arise and as hospitals gain further experience with its use.

References

1. Emergency Medical Services Authority. HEICS: The Hospital Emergency Incident Command System. Emergency Medical Services Authority Web site. Available at www.emsa.ca.gov/dms2/heics_main.asp. Accessed 20 December 2004.
2. Zane RD, Prestipino AL: Implementing the Hospital Emergency Incident Command System: An integrated system's experience. *Prehosp Disast Med* 2004;19:311–317.
3. Debacker M: Hospital preparedness for incidents with chemical agents. *International Journal of Disaster Medicine* 2003;1:42–50.
4. Macintyre AG, Christopher GW, Eitzen E, *et al*: Weapons of mass destruction events with contaminated casualties. Effective planning for health care facilities. *JAMA* 2000;283:242–249.
5. O'Neill K: The Nuclear Terrorist Threat. Washington, DC: Institute for Science and International Security; 1997. Available at www.isis-online.org/publications/terrorism/threat.pdf. Accessed 04 February 2005.
6. Jernigan DB, Raghunathan PL, Bell BP, *et al*: Investigation of bioterrorism-related anthrax, United States, 2001: Epidemiologic findings. *Emerg Infect Dis* 2002;8:1019–1028.
7. Okumura T, Nakasu N, Ishimatsu S, *et al*: Report on 640 victims of the Tokyo Subway Sarin Attack. *Ann Emerg Med* 1996;28:129–135.
8. Okumura T, Suzuki K, Fukuda A, *et al*: The Tokyo subway sarin attack: Disaster management, Part 1: Community emergency response. *Acad Emerg Med* 1998;5:613-617.
9. Okumura T, Suzuki K, Fukuda A, *et al*: The Tokyo subway sarin attack: Disaster management, Part 1: Hospital response. *Acad Emerg Med* 1998;5: 618–624.
10. Chen Y-C, Huang L-M, Chan C-C, *et al*: SARS in hospital emergency room. *Emerg Infect Dis* 2004;10:782–788.
11. Lim S, Clooson T, Howard G, Gardam M: Collateral damage: The unforeseen effects of emergency outbreak policies. *Lancet Infect Dis* 2004;4: 697–703.
12. Lateef F: SARS changes the ED paradigm. *Am J Emerg Med* 2004;22: 483–487.
13. Loufty MR, Wallington M, Rutledge T, *et al*: Hospital preparedness and SARS. *Emerg Infect Dis* 2004;10:771–776.
14. McDonald LC, Simor AE, Su I-J, *et al*: SARS in healthcare faciliteis, Toronto and Taiwan. *Emerg Infect Dis* 2004;10:777–781.
15. Tsai M-C, Arnold JL, Chuang C-C, *et al*: Impact of an outbreak of severe acute respiratory syndrome on a hospital in Taiwan, ROC. *Emerg Med J* 2004;21:311–316.
16. Tsai M-C, Arnold JL, Chuang C-C, *et al*: Implementation of the Hospital Emergency Incident Command System during an outbreak of severe acute respiratory syndrome (SARS) at a hospital in Taiwan, ROC. *J Emerg Med* 2005;28(2):185–196.
17. Arnold JL: Disaster medicine in the 21st Century: Future hazards, vulnerabilities, and risks. *Prehosp Disast Med* 2002;17:3–11.
18. DiGiovanni C: The spectrum of human reactions to terrorist attacks with weapons of mass destruction: Early management considerations. *Prehosp Disast Med* 2003;18:253–257.
19. Holmes A: System issues for psychiatrists responding to disasters. *Psych Clin N Am* 2004;27:541–548.
20. Arnold J, O'Brien D, Walsh D, *et al*: The perceived usefulness of the Hospital Emergency Incident Command System and an assessment tool for hospital disaster response capabilities and needs in hospital disaster planning in Turkey (abstract). *Prehosp Disast Med* 2001;16(2):s12.
21. Wang T-L, Chang H: Appraisal of disaster response plan of hospitals in Taipei judged by Hospital Emergency Incident Command System (HEICS). *Ann Disast Med* (Taiwan, ROC) 2003;1(2):104–111.
22. Keim M: Key topics for emergency health education in the Pacific. *Pac Health Dialog* 2003;(9)1:104–108.
23. Nozaki H, Hori S, Shinozawa Y, *et al*: Secondary exposure of medical staff to sarin vapor in the emergency room. *Intensive Care Med* 1995;21: 1032–1035.

24. Burkle FM: Mass casualty management of a large-scale bioterrorist event: An epidemiological approach that shapes triage decisions. *Emerg Med Clin N Am* 2002;20:409–436.
25. Kennedy K, Aghababian RV, Gans L, Lewis CP: Triage: Techniques and applications in decision-making. *Ann Emerg Med* 1996;28:136–144.
26. Super G. *START: A training module.* Newport Beach, CA: Hoag Memorial Hospital Presbyterian, 1984.
27. Schultz CH, Mothershead JL, Field M: Bioterrorism preparedness: I: The emergency department and hospital. *Emerg Clin N Am* 2002;20:437–455.
28. Dainiak N, Waselenko JK, Armitage JO, *et al*: The hematologist and radiation casualties. *Hematology* 2003 2003:473–496.
29. Waselenko JK, MacVittie TJ, Blakely WF, *et al*: Medical management of the acute radiation syndrome: Recommendations of the Strategic National Stockpile Radiation Working Group. *Ann Intern Med* 2004;140:1037–1051.
30. Srinivasan A, McDonald LC, Jernigan D, *et al*: Foundations for the Severe Acute Respiratory Syndrome Preparedness and Response Plan for Healthcare Facilities. *Infect Control Hosp Epidemiol* 2004;25:1020–1025.
31. Arnold JL, Levine BN, Manmatha A, *et al*: Information-sharing in out-of-hospital disaster response: The future role of information technology. *Prehosp Disast Med* 2004;19:3:201–207.
32. Chan TC, Killeen J, Griswold W, Lenert L: Information technology and emergency medical care during disasters. *Acad Emerg Med* 2004;11: 1229–1236.
33. American Medical Association: *Advanced Disaster Life Support Provider Manual.* Version 2.0. Chicago, IL: American Medical Association, 2004.