

hyperbaric oxygen chambers and its adequacy for toxic gas-generating disasters were investigated and analyzed based on medical institutions equipped with hyperbaric oxygen chambers.

**Method:** It is assumed that all hospitals with hyperbaric oxygen chambers should be included theoretically if a large number of patients require hyperbaric oxygen treatment in the event of a toxic gas disaster. First, we received data from the manufacturer that provided the hyperbaric oxygen chambers, interviewed the persons in charge, and then contacted the relevant hospitals to check the placement in the second step. Afterwards, the deployment of hyperbaric oxygen chambers and population-based deployment status, the simultaneous capacity of hyperbaric oxygen treatment, and the ability to perform hyperbaric oxygen treatment in response to toxic gas disasters based on region were analyzed.

**Results:** The annual number of hyperbaric oxygen chambers showed the first increase period in 2015 and the second increase period after 2019. Even when analyzed based on population-based, simultaneous capacity, and treatment performance, the distribution of hyperbaric oxygen therapy chambers was uneven especially in special areas.

**Conclusion:** In preparation for future disasters, a regional arrangement plan for hyperbaric oxygen chambers should be established and implemented. The national monitoring system and the long-distance transport system should be established until proper distribution.

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### Early Clinician Exposure to the Physiologic Damage of Firearms: A Feasibility Study

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**Introduction:** In comparison to many nations in the developed world, the United States has more cases of civilian ballistic injuries. Both low and high velocity firearm injuries are frequently encountered in American urban trauma centers, and physicians become familiar with these traumatic injury patterns. Physicians from other nations may rarely encounter such injuries. With an increase in international conflict, there is an increased need for clinicians to participate in international medical aid which may include patients with ballistic injuries. Clinicians with limited familiarity of such injuries may result in under-triage and delayed recognition of injury severity, resulting in increased morbidity and mortality of patients. This study aims to show that a course on ballistic injuries will improve clinician recognition of injury patterns and comfort levels managing these patients.

**Method:** Clinicians participated in a course which was designed to introduce ballistic injury patterns. The course was reviewed and supported by emergency medicine physicians who work in a large level I trauma center in the Southeastern United States and serve in clinical roles with EMS and community law enforcement. Course content included demonstrations of firearm injuries by discharging weapons into gels and models

designed to replicate human body tissue. Participants were surveyed prior to and after completing the course regarding their comfort with firearms and firearm related injuries.

**Results:** Participants reported increased comfort level with the management of ballistic injuries. The course requires a full day of expert physician time, approximately US\$600 in supplies if performing live demonstrations, and the cost of designated space for safe firearm discharge and use.

**Conclusion:** This course or a similar course with pre-fired demonstration rounds proved to be feasible and beneficial for those who will likely encounter firearm injuries in their clinical environment. There are both quantifiable and perceived benefits for physicians.

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### Developing Contents of Practical Training for Decontamination of Radiation-contaminated Patients Using VR Training Simulator

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**Introduction:** The KIRAMS establishes radiological emergency institutions and provides training for emergency medical agents. However, because of the uniqueness of radioactive accidents, the current training program has a limitation in the realistic description. Therefore, training programs based on virtual augmented reality technology that can describe radiological emergencies are required. In this study, the contents of practical training for decontamination of radiation-contaminated patients as a part of radiation disaster prevention personnel training using VR simulator are developed.

**Method:** Environments and devices required for treating patients with complex radiation damage are made visible using VR simulator to enable practical training of techniques and practices that will be required in actual radiation emergencies or training. The VR decontamination training content uses three Point tracking techniques to calculate the location of the head-mounted display device and the hand to visualize the movements. Additionally, Universal Render Pipeline technology was used to develop realistic visualizations of situations.

**Results:** In this study, VR decontamination treatment practice content was developed, which allows a single trainee to go through the entire treatment process of treating radiation-contaminated patients. The radiation-exposed patient's treatment process is composed of nine subprocesses, including wearing personal protective equipment, obtaining samples from openings, taking measurements, cleaning contaminated injuries, and so on. A checklist user interface was used to enable trainees to check their progress. The trainee can practice patient treatment with a controller while using VR decontamination treatment content. Additional functions such as narration, sound effects, animation, and so on were added to high educational effects.

**Conclusion:** In this study, VR decontamination treatment content was developed using VR training simulator to practice

the treatment of radiation-contaminated patients. The results of this study will contribute to fostering the workforce response to radiation through efficient education using a VR training simulator, as well as promoting the use of radiation safety regulations.

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### Combined Trauma and CBRN Exposure

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**Introduction:** Whether it is COVID in New York, chemicals in Syria, or a radiological exposure from a dirty bomb or nuclear detonation, trauma is increasingly mixed with CBRN. Decontamination, isolation, and newer treatments all impact the patient as well as the physician. Military physicians regularly plan for these patients, but the civilian world has not. Civilian CBRN training has been spotty, at best. Our recent experience with COVID and the current threats of nuclear attack, emphasize the need to integrate CBRN exposure into our trauma treatment plans, both to help our patients and to protect the caregivers.

**Method:** Literature review and US Department of Health and Human Services Guidelines.

**Results:** A template for patient flow and treatment priorities is presented along with just-in-time references. Triage guidelines for trauma patients with Acute Radiation Syndrome (ARS) are also provided.

**Conclusion:** Civilian preparation for managing the CBRN contaminated trauma patient starts with a mental model of treatment priorities and self-protection strategies. Just-in-time treatment references can provide additional support and confidence.

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### The Training Effects of Mass Casualty Triage in Radiological Events for 119 Emergency Medical Team

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**Introduction:** Korea Institute Radiological Medical Sciences operates an emergency medical response system in case of a radiological accident or disaster. A radiation accident or disaster can affect large-scale patients and destroy medical infrastructure. However, there is currently a lack of specialized education for treating large-scale patients or high-dose exposure patients. This study aimed to evaluate the efficiency of radiological mass casualty triage education programs and present a new training method to improve the ability of 119 emergency medical teams in the event of a radiological accident or disaster.

**Method:** The results of mass casualty triage for radiological events were analyzed using the audience response system and questionnaire for paramedics who participated in the radiation

accident response training program. For 25 paramedics, a pre-post evaluation was conducted on two items: understanding the mass triage and understanding the radiological mass triage. The data were analyzed using the SPSS WIN 23.0 program.

**Results:** Thirty simulated patient scenarios were developed with the addition of clinical symptoms of radiation exposure based on the four trauma classifications: immediate, urgent, delayed, and death. The triage results of 30 cases conducted by 119 emergency medical teams were evaluated, and the trainees were asked to respond to the level of improvement in their knowledge of triage through pre- and post-training questionnaires. As a result of the pre- and post-education questionnaire, the degree of understanding of the mass triage was 3.8 before education and 4.4 after education, showing a significant difference ( $p=.003/\text{MAX}=5$ ). The pre- and post-education questionnaire results of radiological mass triage showed a difference between 2.3 before education and 4.1 after education ( $p=.000/\text{MAX}=5$ ).

**Conclusion:** For effective radiation medical response, 119 emergency medical teams are required to have a repetitive mass triage education program for radiological events. It is especially important to provide a radiological triage system for field application.

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### Children's Welfare Concern in a Full-scale Disaster Pediatric Drill

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**Introduction:** Children are almost systematically involved in mass casualty events, especially in the context of terrorist attacks. Unfortunately, the emergency medical responder preparedness is quite often low when it comes to pediatrics, on both technical and emotional sides. Preliminary training is indispensable, and full-scale simulations are arguably the best solution to tackle the needs of the first responders. The purpose of the study was to describe a simulation-based pediatric training with pediatric psychological support set up for the drill.

**Method:** A full-scale exercise involving children between five and fifteen years old was conducted in the Toulouse municipal stadium during the preparation of the 2016 UEFA (European Football Championship) in France. As children welfare was the primary concern, a psychological support team was present at each stage of the drill and assessed any mental harm that could have happened. Children were asked about their feelings at the end of the exercise with a 5-point Likert rating scale and their parents had to report any perceived changes in the following week.

**Results:** Out of 16 children participating in the drill, four were in an immediate situation (P1), four were in an emergent situation (P2), and eight were in an urgent situation (P3). One hundred percent of them rated their experience as very good and expressed no stress to their parents in the week that followed,