Results: The final logistic regression models included peak CK and macroscopic abnormal urine finding for RE; peak CK, macroscopic abnormal urine finding, tachycardia, and delay of rescue response for HD; and peak CK and presence of body injury for death. The patients whose peak CK was >100,000, always had HD or death. Although the outcomes of patients with severe crush syndrome (peak CK >75,000) were not severe (RE) if they had received massive volume resuscitation (>160m1/kg/day), the Mantel-Haenszel test showed no significant relationship between the amount fluid administered and outcome ($p = 0.63$).

Conclusions: We found several risk factors for each outcome following crush syndrome that are pathophysiologically reasonable. The peak CK was a strong prognostic factor for all three outcomes. Because only 3% of patients received massive fluid resuscitation, the beneficial effects of fluid resuscitation did not show statistical significance. However, it may be useful for crush syndrome except for extremely severe patients (peak CPK >100,000).

Keywords: crush syndrome; death; earthquake; fluid resuscitation; hemodialysis; risk factors; volume

G-63

Cost-Effectiveness Analysis of Volume Resuscitation Therapy for Crush Syndrome Patients following a Large Earthquake

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Introduction: Several articles have reported the effectiveness of fluid resuscitation therapy following crush injury, but the number of patients in these studies is small. In our previous report on the Hanshin-Awaji Earthquake, fluid resuscitation therapy did not show a statistically significant effect because few patients received massive fluid resuscitation. In this study, we performed meta-analysis to integrate all clinical studies of traumatic crush syndrome, and conducted a cost-effectiveness analysis of fluid resuscitation therapy to prevent fatal and/or severe complication of crush syndrome.

Methods: A simple decision-tree model was used to compare massive fluid resuscitation (>160ml/kg/day) strategy (MF) and less fluid infusion therapy (LF) over a short time period. Outcomes were defined in terms of expected utility (EU). Transition probabilities were obtained from our previous report and the published literature, and integrated with meta-analysis. Utilities were elicited from expert panels, and reported as quality-adjusted expected survival (QAES). Cost data were estimated based on the current insurance system in Japan. Tornado diagram analysis was performed on all probability and utility values to clarify the influence of each factor, and further one-way sensitivity analysis was done in order to explore the threshold of each variable. Monte-Carlo probabilistic sensitivity analysis was undertaken to simulate the uncertain clinical situation.

Results: Expected Utility analysis demonstrated a QAES of 0.759 with MF, and a QAES of 0.665 with LF. A tornado diagram analysis showed that salvage rate at three hours after earthquake, and the complication rate of renal failure and mortality in the MF group have the greatest influence on the decision. Monte-Carlo sensitivity analysis of 10,000 samples revealed that the MF strategy had greater QAES in 98.2% of cases. Cost-effectiveness analysis indificated that about $17,000/QAES for the MF strategy versus $40,000/QAES for the LF strategy. Cost of in-patient care and quality of life for uncomplicated patients and renal failure morbidity for MF patients are significant factors in cost-effectiveness analysis.

Conclusions: MF strategy is a cheaper and more effective therapy for crush syndrome patients, compared to LF. Effort should be directed to improve patients' outcomes according to the factors reported that influence the treatment decisions in the current study. Further study of medical preparedness for MF is needed to provide international guidelines for medical response planning for crush syndrome patients.

Keywords: cost-effectiveness; crush syndrome; fluid resuscitation; Great Hanshin-Awaji Earthquake; renal failure; treatment

G-64

Estimation and Reduction of Casualties in Buildings During Earthquakes

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The aim of this study is to examine the use of Loss Estimation Techniques (LETs).

Most of the well-known applied LETs are aimed at understanding the probable human fatalities and property damage. Medical parameters of disasters such as the number of wounded people and the classification by the types of injuries seldom are considered by the modern LETs. At the same time, these parameters are very important for the development of preventive medical preparedness for a forthcoming disaster.

A sad experience in the last earthquakes was classification of different types of buildings from a point of view of the inhabitants' vulnerability. Moreover, even non-destructive earthquakes have caused human victims

who can be grouped into two categories. Some low-frequency oscillations of structures give rise to panic among inhabitants who rush to the staircases of multistoried buildings. The combination of a panic and gathering in the staircases that are the weakest structural element in building leads to casualties in non-damaged buildings. Some high-frequency oscillations produce heart attacks in persons who seem to be healthy.

The above aspects of medical casualties and corresponding LETs are discussed in this paper.

Keywords: causes of injury; damage; earthquakes; loss estimation techniques; panic; structural strength

G-65:
Simulation for Estimating Timing for Influenza Vaccination for Disaster Refugees

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Introduction: Prevention of infectious diseases by vaccination has been one of the major merits of medicine. In particular, influenza vaccination is recommended with expected benefits for high-risk groups such as the elderly, children, and adults who have serious health problems. Deaths and serious complications are largely preventable by timely vaccination under specific conditions such as the aftermath of a disaster. However, there, are few scientific studies that suggest the most appropriate timing for vaccination, which corresponds to actual surveillance data. This is true especially for the critical decisions, e.g., whether or when refugees following a disaster should have the vaccines has not been investigated using quantitative methods.

Methods: We conducted a decision analysis based on the decision-tree model as to whether the influenza vaccination should be performed or not in terms of maximizing life expectancy given the risk caused by the vaccination.

Results: We theoretically formulated the decision level at which the benefit of the vaccination overcomes the risk. Furthermore, we applied the results of this decision analysis to investigate the appropriate timing for vaccination in term of cost-effectiveness. The mathematical obtained formula will be helpful for decision-makers who wonder when the influenza vaccination should be conducted under the disaster circumstances in which the surveillance data suggest the influenza epidemic is highly likely to become a serious problem.

Conclusions: The computer simulations based on the records from the Great Hanshin-Awaji Earthquake, in Kobe, Japan in 1995, validated the formula to determine the optimal onset time for population-based vaccination activities.

Keywords: disasters; Great Hanshin-Awaji Earthquake; influenza; public health; refugees; surveillance; vaccination, timing of

G-66
Snow-Slide Accident with 41 Cases of Sudden Death

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This article deals with a snow-slide that occurred on the Ton Gu La Mountains at an altitude of 5,400 meters above the sea

Cause: The snow-capped tops of the mountains above the snowline are frozen all year. But, the temperature below the snowline is only 10–15° C. Therefore, the internal part of snow gradually dissolves and the snow loses its support. Eventually, snow slides occur.

Case Report: 41 persons were killed in a snow slide. They all were young men <25 years old and were submerged by a thick layer of snow. They died suddenly from traumatic asphyxia. The clinical signs of the dead showed that all of the dead persons were submerged under a few meters of snow and died of crush syndrome. The vocal cords closed immediately, and the air in the lungs and trachea could not be expired, and the intrathoracic pressure became elevated. The organs in the mediastinum were displaced. Most of the venous blood was forced toward veins of head, neck, and the upper part of chest that do not contain valves. Clinically, there were subcutanous ecchymoses, conjunctival hemorrhage, and fractures.

Prophylaxis: Any one wishing to pass through this area is advised to avoid passing through the mountains prone to develop snow slides. If it is necessary for persons to go this area, they should pass on the northern slope of the mountains. Some guides and natives of Xi Zang usually mark the safety line before mass corps can pass through the area.

Keywords: asphyxia; valanches; mountains; safety; snow-slides; traumatic asphyxia

General Session XV
Cardiopulmonary Resuscitation
Tuesday, 11 May, 8:30–9:45 hours
Chair: ***Judith M. Fisher, Kenji Oguri***

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Out-of-Hospital Cardiac Arrests in the Northern Part of Osaka Prefecture: Utstein Style Reporting in Japan

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Objective: To describe the epidemiological features of