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### 146.
### The Sarin Disaster in Tokyo—A Preliminary Kamedo Observer Report

*P Kulling,[1] H Henmi,[2] M Minami,[3] N Takasu[4]*
[1]KAMEDO, Department of Emergency and Disaster Planning, National Board of Health and Welfare and Swedish Poisons Information Centre, Stockholm, Sweden
[2]Department of Emergency and Critical Care Medicine, Nippon Medical School, Tokyo, Japan
[3]Department of Hygiene and Public Health, Nippon Medical School, Tokyo, Japan
[4]Department of Emergency Medicine, St. Luke's International Hospital, Tokyo, Japan

During the morning of 20 March 1995, there was a release of a toxic gas in the subway in central Tokyo. Three subway lines were affected, and there were poisoned victims at 15 stations.

Early symptoms included eye irritation, malaise, breathing difficulties, and muscular weakness followed by unconsciousness, bradycardia, and in very severe cases cardiorespiratory arrest. Pronounced miosis (pinpoint pupils) was present in all victims who had significant exposure.

The clinical picture indicated organophosphate poisoning which quite soon was verified by analysis of the toxic agent which proved to be the nerve gas Sarin. Blood analyses in many victims showed very low cholinesterase activity. The Sarin metabolites isopropanol and acetone also were detected in many patients

Treatment with atropine and in many cases also pralidoxime proved to be effective. In severe cases, atropine was administered in doses of up to 10 mg per hour for 24 hours when given without the oxime, and 2 mg per hour when given combined with pralidoxime. In less severe cases, much lower doses of atropine (and pralidoxime) were administered. In mild cases only a single atropine dose was necessary.

In all, approximately 5,000–6,000 persons were exposed to the toxic gas. Ten victims died (nine at the accident site and one after arrival at the hospital). In total, 550 victims were transported by ambulance to hospitals in Tokyo, but many victims were transported by bus, private cars, or came on foot. For example, at St. Luke's International Hospital, 730 patients were evaluated, but only 64 were transported to the facility by ambulance, 40–50 patients arrived by bus arranged by the fire brigade, and the rest by private cars or on foot. A total of 110 patients were admitted, six of these to the ICU. The rest of the patients were discharged after examination. Most admitted patients were able to leave the hospital within two days of the event, except for the severe cases. Some patients who presented severe symptoms seem to have recovered completely, but a few cases suffer from hypoxic brain damage.

### 150.
### Emergency Report: A Case Study of 640 Victims of theTokyo Subway Sarin Attack

*Tetsu Okumura, MD,[1] Nobukatu Takasu, MD,[1] Shou Miyanoki, MD,[1] Akihiro Mituhashi, MD,[1] Shinichi Ishimetsu, MD,[1] Shigeaki Hinohara, MD,[2] Per Kulling, MD[3]*
[1]Emergency Department, St. Luke's International Hospital Tokyo, Japan
[2]Director of St. Luke's International Hospital Tokyo, Japan
[3]Department of Emergency and Disaster Planning, National Board of Health and Welfare and Swedish Poisons Information Center, Stockholm, Sweden

On the morning of 20 March 1995, the Tokyo Subway System was filled with a noxious substance later identified as a diluted form of a nerve gas called Sarin. Five subway cars were affected during the morning rush hour. Twelve victims were killed and thousands more sickened.

St. Luke's International Hospital is located near the affected subway station, Tsukiji Station. Therefore, the hospital received the greatest number of patients within the Tokyo area, a total of 640 patients; 111 patients were admitted to this hospital. Three patients were in cardiopulmonary arrest upon arrival; one was nonresponsive to resuscitation efforts, and two were resuscitated successfully. Of the two resuscitated patients, one had undergone severe hypoxic brain damage and died on hospital day 23, the other fully recovered.

Respiratory arrest secondary to nerve gas exposure is the most critical complication. Most of the patients complained of headache, dyspnea, nausea, eye-pain, blurred vision, dark vision, etc. Upon physical examination, miosis was the most prominent finding. Treatment consisted of administration of atropine and pralidoxime within three hours of initial chemical exposure. Within 2–4 days 95% of patients recovered and were subsequently discharged.

### 098.
### Industrial Accidents: Some Consideration on Existing Regulations

*L. Altias, G.A. Zapponi*
Istituto Superiore di Sanita, Rome, Italia

This study focused on some main characteristics of catastrophic accidents involving hazardous chemicals. For instance, some statistics concerning major accidents involving the spill of chlorine and ammonia that took place in the period of 1919–1978 (Health and Safety Commission 1979) indicate that releases from 2–90 tons. and from 19–600 tons. for these two chemicals occurred. However, in the events reported as causing the higher number of deaths, release of the chemicals ranged from 20–30 and 19–90 tons, and for both of these chemicals, the highest amounts released did not cause deaths.

Also, in the case of flammable gases or vapours, there was no clear correlation between the amount of chemical involved and the number of fatalities.

Moreover, well-known mathematical models used for accident risk assessment appear to indicate that the radii of the areas potentially involved by "fireballs" or by "unconfined vapor explosive clouds." In general, hazardous clouds released into the air generally are described by a mathematical function whose first derivative decreases for increasing amounts of the material released. Lastly, a simple non-parametric, statistical analysis of the OECD data (1988) concerning more than 360 major accidents involving hazardous chemicals and materials recorded in member countries in the period 1971–1987, appear to indicate that the mortality rate attributable to accidents in ship transport (about 1% of the reported accidents and 10% of the reported fatalities) is higher than the one attributable to the categories (which do not appear significantly different) represented by road transport (about 10% of accidents and 20%, of fatalities), processing-use-production (about 30% of accidents and 1/3 of fatalities), and trans-shipment and pipeline transport (about 10% and 8% of accidents and 10% and 8% of fatalities, respectively). Storage and rail transport of hazardous chemicals (about of 18% of accidents in both cases and 8% and 5% of deaths respectively, seem to be characterized by a mortality rate which is lower that the previous ones.

Some tentative conclusions may be drawn from these data. First, the simple reference to a quantity threshold of hazardous chemicals cannot provide an exhaustive criterion for the identification of major risk plants; and evidently, the consideration of the possible human exposure patterns always is necessary. Second, well-known mathematical models and simple criteria indicate that in many cases, the radii of the areas possibly involved by clouds of hazardous chemicals may decrease slightly even if the quantity of hazardous substances involved decreases substantially. Lastly, many data indicate that the transport of hazardous chemicals may represent an important source of risk, at least similar to the one attributable to industrial activity involving the same chemicals.

## 147. Medical Management of Environmental Emergencies: Whose Job Is It?

*Dr. Peter J. Baxter*
University of Cambridge Clinical School, Addenbrooke's Hospital, Cambridge, England.

Technological emergencies affecting public health include acute urban air-pollution episodes, major fires, releases of chemicals from industrial plant or during transportation, and nuclear accidents. The main, but not necessarily exclusive route of human exposure to the injurious agents involved is airborne, and so the issues surrounding the public-health risks of exposure and the medical management of those exposed or injured in these different types of incidents of the possible acute and chronic physical and mental health effects; provision of advice to the emergency services on the health risks to emergency workers and the public; supplying information to the affected community and their medical attendants; and, in particular, advising on evacuation measures when the incident permits timely evacuation to take place. At present, training in emergency or public-health medicine does not equip physicians to undertake this role, but the need for expertise in the medical management of such technological incidents, and in environmental medicine in general (including developments in the UK on who should be doing it), will be shown by describing the lessons learned at a major plastics fire in Thetford, England. A simple model for predicting exposure, and hence the evacuation criteria on which to base decisions on evacuation of nearby communities in future fires of this type, also will be given.

## 033. Chemical Disarmament in Iraq: Notes on the Medical Support

*C. Bellanger, L. Schollaert, C. Carton, D. Lison, J. Willems*
Royal School of Military Medical Services, Ghent, Belgium

One of the conditions for a cease fire between Iraq and the coalition forces was the elimination of Iraq's weapons of mass destruction. For the chemical weapons, this meant a three stage process: Phase I—inspection and survey; Phase II—the disposal of weapons, facilities, and other related items through destruction, removal or rendering harmless; and Phase III—long-term monitoring to ensure ongoing verification.

The medical support of the small team of experts required a combination of general environmental and industrial medicine, toxicology, and emergency medicine. Due to the experimental character of the task, a lot of problems were identified only on the field. Lonely and a long way from home, the medical officer had to deal with those problems by staying calm, being supported by his knowledge of chemical warfare, clinical experience, and, not at least, by a good "home team" with access to the world's medical literature. To avoid dramatic situations, most of the time was spend on preventive actions and safe standard operational procedures.

## 079. Transportation of Dangerous Substances: Consequences of an Accident

*L. Bracco, V. Rocchi*
Ispesl/Dipia: Istituto Superiore per la Prevenzione, e la Sicurezza del Lavoro, Environmental Impact Department, Roma, Italia

A simulated accident due to a fireball of liquid propane gas that developed from a 30-ton road tanker is described, and the stricken area is described.

Simulation models have been employed in order to assess the effects of the fireball. The models have been taken as a basis for determining the distances, for fixed values of thresh-