Health Risks of Chemical Irritants and Materials Used in Mass Gatherings

Collaborating Centre for Oxford University and CUHK
for Disaster and Medical Humanitarian Response
CCOUC 災害與人道救援研究所

This informational guide provides up-to-date information on the health risks associated with exposure to chemical irritants (tear gas and pepper spray) commonly used in crowd control and hand-held laser devices.

For more information:
Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), The Chinese University of Hong Kong
Address: 3/F, School of Public Health, Prince of Wales Hospital, Shatin, N.T., Hong Kong
Email: ccouc@cuhk.edu.hk
Website: www.ccouc.org

Tear Gas (CS Gas)

(common component: 2-chlorobenzalmalononitrile)

Potential Health Impact of CS Gas [1-5]

Skin	Immediate symptoms Burning sensation and skin irritation Prolonged health impact *For a few days:* redness, swelling, itchiness, pain, burning sensation, burns, rash, allergic contact dermatitis or eczema *For a week or more:* rash, blistering, loss of skin pigmentation
Respiratory system	Immediate symptoms Coughing, chest tightness, runny nose, difficulty in breathing, respiratory irritation, sore throat, burning of the throat Prolonged health impact *For a week or more:* coughing, sputum, worsening asthma (asthma patient) *For months:* decreasing lung capacity (smokers)
Eyes	Immediate symptoms Tearing, irritation, stinging, blurred vision, conjunctivitis Prolonged health impact *For a few days or more:* reduced vision, red and painful eyes (keratitis)
Gastro-intestinal system	Excessive salivation, nausea, vomiting, diarrhea, abdominal pain, loss of appetite
Others	Psychological impacts (e.g. post-traumatic stress disorder)

Additional health threats

- People with pre-existing respiratory conditions such as asthma are particularly at risk.
- Being hit by tear gas cartridge can cause severe bruising, eye injury, blindness or skull fracture. Serious injuries from tear gas shells have been reported in India (patients recruited from January 2008 to December 2009), resulting in nerve injuries and amputation.[5,6,7]

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Pepper Spray

(main component: oleoresin capsicum (OC))

Potential Health Impact of a OC Agent [8,9,10]

Skin	Immediate symptoms Acute burning pain, tingling (pin or needle sensation), redness, swelling, itchiness Prolonged health impact Persistent dermatitis with severe redness or blister formation after prolonged exposure
Respiratory system	Immediate symptoms Oral: inflammation of the mucous membranes, coughing, choking, inability to speak (due to vocal cord involuntary contraction or paralysis) Nasal: irritation, burning pain, sneezing, nasal discharge Respiratory: severe coughing, mucus secretion, shortness of breath, wheeze and chest tightness
Eyes	Immediate symptoms Redness, swelling, severe burning pain, tingling, excessive tears, involuntary or reflex closing of eyelids, persistent pain, swelling around the eye Prolonged health impact Dry eyes, possible permanent defects if sprayed directly to the eyes
Systematic toxicity	Disorientation, fear, loss of body motor control (diminished hand-eye coordination), rapid breathing, excess fluid in lungs (pulmonary edema), headache, increased heart rate and blood pressure

Systematic Review on Health Impact of Tear Gas and Pepper Spray

A study published in BMC Public Health included 31 studies on the health impact of tear gas and pepper spray from 11 countries between January 1990 to March 2015.[10] Among a total of 5,910 persons with recorded exposure to chemical irritants, 5,131 (87%) suffered injuries. Among the recorded injuries, 98.7% fully recovered but 1.3% suffered permanent injury and there were two recorded deaths.

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Health Management

Tear Gas and Pepper Spray

Immediate First Aid[11,12]

- There are no antidotes for tear gas and pepper spray.
- Remove patient away from the source of exposure and seek fresh air.
- As particulate or vapour clouds are carried downwind, move to an upwind position if possible or get as far away as possible from the source of the fumes.
- Put patient at rest in a semi-upright position.
- Wash face and skin with water or isotonic saline. Do not rub eyes. Do not use oil or vinegar to wash eyes.
- Clothing may be contaminated and may need to be removed.
- Remove contact lens and accessories (jewelleries, watches, rings, hearing aids).
- In most cases symptoms are temporary and will recover by themselves without treatment.

Environmental Risks

- Tear gas residue and solid particles might remain in the surrounding area. There was a reported case in Scotland of inadvertent secondary exposure from contact with contaminated furniture by CS agent.[13] Another study suggested tear gas could cause environmental health effects to bystanders.[14]
- The use of chemical irritants in enclosed spaces without safe exit or escape routes increases exposure to the agent and exacerbates ensuing injuries.[10]

SPECIAL NOTES

- Patients with severe injuries, breathing difficulties and eye injury should seek medical assistance immediately as further treatment would be required.
- Although the effects of tear gas and pepper spray are mainly temporary, a minority of people may have prolonged symptoms. If in doubt, seek medical assistance as soon as possible.

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Laser Hazards

Possible Health Risks of Hand-held Laser Devices[15,16,17]

Eyes	Immediate symptoms Bright flash, after-images, dazzling effect, heat in the eyes, irritation, distraction and temporary loss of vision Prolonged health impact Retinal lesions (pigment changes, yellow foveal lesions, macular holes and haemorrhage) causing impaired visual acuity

Classification of Laser Products

According to the International Electrotechnical Commission (IEC) standard, laser products are classified from Class I to IV. Products are listed from the least hazardous Class I (laser printers) and Class II (bar code scanners) to the most hazardous Class IV (industrial lasers and medical lasers for eye surgery). Laser pointers are generally categorised as Class IIIa, limiting the output power to less than 5 milliwatts (mW).[18,19]

The US Food and Drug Administration considers the risk of injury very small when Class IIIa pointers are used.[16,19] The World Health Organization is more cautious and states that laser pointers higher than Class II are considered too powerful for general use.[15]

Systematic Review on Health Impact of Laser Pointers

A review published in Deutsches Ärzteblatt International identified 48 publications describing a total 111 patients with acute and / or permanent damage due to laser pointers up to January 2017.[17] With regard to the laser pointers injuries reported, 51% were caused by blue, 28% by green, and 21% by red laser pointers. The radiation output power of the measured laser pointers (n=33) ranged from less than 5 mW (n=11) to over 1000 mW (n=3). The fundoscopy findings in these patients included yellowish lesions in the area of the fovea (n=37), hemorrhage (n=16), pigment changes (hypo- and hyperpigmentation) (n=59), as well as macular hole formation (n=26).

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Health Management

Hand-held Laser Devices

Seek Medical Assistance

- Medical attention should be sought if after-images (image that continues to appear in the eyes after a period of exposure to the original image) persist for hours.
- Any change in reading vision should lead to medical assessment of any potential laser eye injury.

SPECIAL NOTES

- The extent and severity of any eye injury will depend upon several factors including the laser power entering the eye and the duration of the exposure. While the risk of permanent eye injury from a laser pointer may be small, a person receiving transient eye exposure may experience symptoms as listed. Overpowered laser pointers (Class IIIb) can cause immediate eye damage and temporary blindness when viewed directly.[15,16]
- There is no evidence showing an association of laser pointer lights and seizures. However, strong photic stimuli may induce seizures and is associated with epilepsy.[20,21]

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INFORMATION FACT SHEET WORKING GROUP

- Prof Emily Ying Yang CHAN, Professor and Head, Division of Global Health and Humanitarian Medicine, Director, CCOUC, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Dr Pui Hong CHUNG, Public Health Medicine Specialist and Professional Clinical Consultant, Division of Global Health and Humanitarian Medicine, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Prof Colin A GRAHAM, Professor and Director of Emergency Medicine, Accident and Emergency Medicine Academic Unit, Faculty of Medicine, CUHK.
- Prof Kevin HUNG, Assistant Professor, Accident and Emergency Academic Unit, Faculty of Medicine, CUHK.
- Prof Jean KIM, Associate Professor and Head, Division of Epidemiology. JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Prof Eric Kam Pui LEE, Assistant Professor, Division of Family Medicine and Primary Care, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Mr Siu Kai LO, Research Assistant, CCOUC, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Prof Regina Wing Shan SIT, Associate Professor of Practice in Family Medicine and Family Medicine Specialist, Division of Family Medicine and Primary Care, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Mr Chi Shing WONG, Publications Manager, CCOUC, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Prof Samuel Yeung Shan WONG, Professor and Head, Division of Family Medicine and Primary Care, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.
- Dr May Pui Shan YEUNG, Public Health Medicine Specialist and Professional Clinical Consultant, Division of Global Health and Humanitarian Medicine, JC School of Public Health and Primary Care, Faculty of Medicine, CUHK.