Tear Gas

Version 1.0 · Current · October 2026 · Codebook variable: `I_TearGas`

Definition

Tear gas is an area-dispersal chemical irritant deployed through canisters, grenades, launched munitions, pyrotechnic devices, foggers, or similar systems to affect an environment, crowd, or enclosed space rather than a single targeted person.

This category includes:

- CS (2-chlorobenzalmalononitrile);
- CN (chloroacetophenone);
- CR (dibenzoxazepine) where used;
- thrown or launched tear-gas canisters;
- gas grenades;
- micro-pulverized chemical agents;
- pyrotechnically dispersed chemical irritants; and
- comparable environmental-denial or area-saturation systems.

This category excludes personal-issue handheld OC or chemical spray, classified as Handheld Chemical Spray, and point-target chemical projectiles such as PepperBall or FN 303-type irritant rounds, classified as Extended-Range Chemical Weapons.

This definition corresponds with the research dataset, where `I_TearGas` is coded when law enforcement deploys CS/CN canisters, gas grenades, or micro-pulverized area agents designed for environmental denial rather than individual target striking.

How It Is Designed to Work

Tear gas is designed to make an environment temporarily difficult or intolerable to remain in. Unlike handheld chemical spray, which is directed primarily at a specific person, tear gas works through environmental contamination. The intended effects include:

- intense eye irritation;
- involuntary tearing;
- blepharospasm or difficulty keeping the eyes open;
- burning of exposed skin;
- nasal and throat irritation;

- coughing;
- chest discomfort;
- subjective difficulty breathing;
- disorientation;
- anxiety or panic; and
- a strong behavioural incentive to leave the contaminated area.

The principal operational objective is generally not neuromuscular incapacitation but rather altering movement or behaviour by making continued exposure aversive.

CS

CS is the most commonly discussed modern tear-gas agent in the literature. It is generally dispersed as fine particulate matter or aerosolized material and primarily affects ocular tissues, respiratory mucosa, skin, and sensory nerve pathways. Rothenberg and colleagues (Rothenberg et al., 2016) describe CS as activating sensory pathways associated with pain and irritation, including TRPA1-mediated nociceptive signalling.

CN

CN is an older lacrimating agent. Medical reviews generally describe it as having a less favourable toxicity profile than CS, particularly for ocular and dermal injury (Schep et al., 2015).

Environmental delivery is the defining feature

Tear gas differs fundamentally from individualized force because dose is difficult to control. Actual exposure depends on agent concentration, number of canisters or grenades, ventilation, wind, room volume, distance, exposure duration, the person's ability to leave, re-entry into contaminated areas, and cumulative deployment. As a result, the officer or commander typically controls the amount released but not the exact dose received by each person.

Tear Gas Is Not a Single Homogeneous Exposure

"Tear gas" is a practical category rather than a single chemical or delivery method. Important variables include CS versus CN versus CR, aerosol versus smoke or pyrotechnic dispersion, indoor versus outdoor deployment, single versus repeated canister use, direct projectile impact versus ambient exposure, concentration, duration, ventilation, temperature, and whether exposed persons have a viable escape route. These differences make it difficult to assign a single injury probability to "tear gas." The evidence is strongest for identifying risk-enhancing conditions, not for producing one universal exposure-risk number.

Evidence of Effectiveness

Overall assessment

The evidence is low-to-moderate in strength for operational effectiveness, moderate-to-strong for acute irritant effects, and moderate for injury and health-risk characterization. The literature clearly establishes that tear gas produces acute sensory effects capable of making an environment difficult to tolerate, but what is much less well established is whether tear-gas deployment safely disperses crowds, reduces violence, prevents injury, improves public order, prevents use of more injurious force, or merely relocates a crowd while exposing both involved and uninvolved people. This distinction is central: physiologic effect is well established; public-safety effectiveness is not.

Immediate sensory effectiveness

Schep, Slaughter, and McBride [(Schep et al., 2015)] reviewed CN, CS, and OC toxicology and found that riot-control agents reliably produce lacrimation and respiratory irritation. Typical effects occur rapidly, commonly within tens of seconds, and include eye closure, tearing, photophobia, coughing, throat irritation, chest tightness, and difficulty remaining in the contaminated area. At the mechanistic level, tear gas is therefore clearly capable of producing the aversive effects for which it is designed.

Crowd dispersal versus crowd safety

A major weakness in the literature is that dispersal itself is often treated as evidence of effectiveness, even though dispersal does not necessarily answer whether the intervention reduced violence, lowered injury, improved compliance, prevented escalation, or created safer conditions overall. The systematic review by Haar and colleagues [(Haar et al., 2017)] concluded that chemical irritants may have a limited role in crowd control but also identified substantial potential for misuse and indiscriminate injury. This evidence supports a cautious distinction between, first, the ability to make people leave an area – which is biologically plausible and well established – and, second, net effectiveness as a public-safety intervention, which remains poorly studied.

Containment paradox

Tear gas is intended to cause people to move away from exposure. That mechanism becomes problematic when law enforcement simultaneously blocks exits, contains the crowd, funnels people through a narrow route, deploys agents from multiple directions, or uses gas in an enclosed structure. In those conditions, the intervention can create a conflict between the command to disperse and the physical ability to escape the agent. This issue appears repeatedly in both health literature and legal analysis.

What is missing

The peer-reviewed literature does not provide strong generalizable estimates for the percentage of crowds successfully dispersed, time to dispersal, probability of renewed disorder after displacement, effect on arrests, effect on assaults against police, effect on civilian injury, probability of preventing baton, projectile, or firearm

force, effectiveness compared with communication and negotiated dispersal, effectiveness compared with targeted arrests, net public-safety benefit, or whether large-scale chemical deployment reduces or increases overall disorder. For a scientific evidence library, tear gas should therefore not be described as "effective" solely because it reliably causes pain and movement.

Injury and Safety Evidence

Systematic review evidence

Haar and colleagues (Haar et al., 2017) conducted a systematic review of injuries and deaths associated with chemical irritants. The review included 31 studies from 11 countries and identified 5,131 people who suffered injuries after chemical-irritant exposure. Across 9,261 documented injuries, 74.3% were minor, 17% were moderate, and 8.7% were severe and required professional medical management. The review documented two deaths, permanent disability, severe ocular injury, respiratory injury, neurologic injury, dermal injury, and projectile-related trauma. The authors identified several factors associated with more severe outcomes: prolonged exposure, high concentrations, repeated deployment, enclosed spaces, environmental conditions, and direct projectile impact.

These data should not be interpreted as injury probabilities for all exposed persons. The review was largely composed of people who sought medical care or otherwise entered published datasets. Its strength is in demonstrating what kinds of harm occur and what conditions increase severity.

CS-specific systematic review

Dimitroglou and colleagues (Dimitroglou et al., 2015) systematically reviewed evidence on CS exposure. They identified 35 eligible studies, including 25 case reports or case series, seven descriptive studies, and three analytical studies. Reported effects included dermal injury, respiratory symptoms, ocular symptoms, life-threatening reactions, and longer-term health effects. The review found that serious outcomes were particularly associated with confined or enclosed-space exposure, which is one of the strongest recurring findings across the tear-gas literature.

Enclosed-space risk

Tear gas deployed outdoors into an open area with multiple escape routes is not equivalent to tear gas deployed inside a home, inside a jail cell, inside a vehicle, in a stairwell, inside a transit station, or in another poorly ventilated environment. Haar et al. (Haar et al., 2017) documented a death from respiratory arrest after CS aerosol was deployed inside a home. Dimitroglou et al. (Dimitroglou et al., 2015) likewise identified enclosed exposure as a major risk factor for severe and prolonged effects. The mechanism is straightforward: concentration rises, exposure lasts longer, contaminated particles remain suspended or deposited, people may be unable to leave, and repeated canisters can create cumulative dose. This makes confined-space deployment qualitatively different from open-air crowd dispersal.

Respiratory Effects

Respiratory irritation is an expected effect, not an accidental side effect. Schep et al. (Schep et al., 2015) describe nose and throat burning, cough, chest tightness, dyspnea, and breathing difficulty. Most healthy exposed persons recover after removal to fresh air. However, risk may increase with asthma, chronic respiratory disease, high concentration, prolonged exposure, repeated exposure, physical exertion, panic, restraint, or inability to leave the contaminated environment.

Vulnerable populations

The evidence is not strong enough to calculate precise subgroup-specific risk, but particular concern is reasonable for children, older adults, people with asthma, people with chronic pulmonary disease, pregnant persons, medically frail persons, and people unable to self-evacuate. The ethical and policy significance of this uncertainty increases because tear gas is area-based and poorly individualized.

Ocular Effects

Expected ocular effects include burning, tearing, blepharospasm, conjunctival irritation, photophobia, and temporary difficulty seeing. More serious ocular injury can occur, particularly when exposure involves high concentration, prolonged contact, delayed decontamination, or direct impact from a launched munition or canister. Projectile injury must be analytically separated from chemical toxicity: a canister that strikes a person's head or eye introduces a kinetic mechanism in addition to the agent itself.

Dermal Effects

Skin exposure commonly produces burning, erythema, itching, and irritation. More severe effects can include blistering, dermatitis, burns, and prolonged skin injury. CN appears to have a less favourable dermal toxicity profile than CS in medical reviews (Schep et al., 2015). Pyrotechnic delivery systems can also introduce thermal injury independent of chemical toxicity.

Longer-Term and Delayed Effects

The historical assumption that tear-gas effects are always brief and self-limited is not fully supported by the literature. Dimitroglou et al. (Dimitroglou et al., 2015) identified reports of prolonged and delayed health effects. Karagama and colleagues (Karagama et al., 2003) examined short- and longer-term effects after CS exposure and documented symptoms persisting beyond the immediate incident in some exposed persons. Rothenberg et al. (Rothenberg et al., 2016) argued that epidemiologic evidence and mechanistic understanding justify greater caution about repeated or high-dose exposure than traditional "temporary irritation" descriptions suggest. Brown and colleagues (Brown et al., 2021) similarly concluded that important knowledge gaps remain regarding toxicity, dose, and long-term effects.

The strongest conclusion is not that long-term harm is common but that the scientific evidence is insufficient to state confidently that all tear-gas exposure is transient and without lasting consequence.

Contemporary Protest Exposure

Torgrimson-Ojerio and colleagues (Torgrimson-Ojerio et al., 2021) surveyed adults who reported tear-gas exposure during the 2020 Portland protests. Respondents reported a range of respiratory, ocular, dermal, gastrointestinal, and menstrual/reproductive symptoms, as well as healthcare utilization following exposure. The study is valuable because it captures contemporary repeated community exposure outside formal medical case series. However, it has important limitations including self-reported exposure, self-selected respondents, no unexposed randomized comparison group, uncertain individual dose, and potential concurrent exposure to other crowd-control agents. It should therefore be interpreted as evidence of reported health burden, not a precise causal incidence estimate.

Area Effects and Indiscriminate Exposure

A defining safety issue is that tear gas is inherently difficult to confine to one person. Haar et al. (Haar et al., 2017) emphasize that aerosolized chemical irritants can affect intended targets, peaceful demonstrators, bystanders, nearby residences, journalists, medics, and police themselves. This distinguishes tear gas ethically and operationally from individualized force. When deployed into a mixed crowd, law enforcement cannot reliably determine the dose received by the person committing violence, a peaceful person beside them, a child, a journalist, a medic, or a resident exposed downwind. The intervention therefore has a collective exposure profile.

Projectile and Canister Injury

Tear-gas deployment can create a second force mechanism when canisters or grenades are launched. Haar et al. (Haar et al., 2017) documented substantial projectile trauma associated with chemical-irritant munitions: across the broader chemical-irritant review, 231 projectile injuries were identified, of which 63 were severe. Direct impact can cause head injury, ocular injury, fracture, penetrating trauma, and traumatic brain injury. A launched tear-gas canister should therefore not be evaluated solely by the toxicology of CS or CN.

Fire and Thermal Risk

Pyrotechnic tear-gas systems may generate substantial heat. Potential secondary hazards include burns, ignition of combustible materials, structure fire, vegetation fire, and smoke inhalation. The risk profile therefore depends partly on the delivery system, not merely on the chemical agent. This is especially relevant in residences, wooded areas, encampments, structures with flammable contents, and scenes where people may be physically unable to evacuate quickly.

Decontamination and Aftercare

The first priority after significant tear-gas exposure is generally removal from the contaminated environment. Schep et al. [Schep et al., 2015] emphasize fresh air, removal of contaminated clothing where appropriate, ocular irrigation, skin decontamination, symptom-directed supportive care, and medical assessment where symptoms are severe or persistent. There is no universal antidote. Medical evaluation becomes particularly important for persistent breathing difficulty, severe ocular pain, visual loss, burns, altered consciousness, chest pain, or symptoms that fail to improve after removal from exposure.

When Its Use May Be Appropriate

The empirical literature does not establish a universal threshold for tear-gas deployment. A defensible use generally requires a substantial public-safety objective that cannot reasonably be achieved through less indiscriminate means. Potentially appropriate circumstances may include serious riotous violence, a dangerous crowd that cannot safely be approached for individualized enforcement, a barricaded person where chemical agent may permit resolution without firearm entry, situations where officers reasonably need to create distance between violent groups, or circumstances where environmental chemical deployment may prevent use of more injurious force.

The strongest justification is where the threat is serious, the objective is clear, warnings are feasible, escape routes are available, vulnerable third parties can be minimized, agent quantity can be controlled, and the alternative is reasonably expected to produce greater harm.

When Its Use May Be Inappropriate

Peaceful or non-threatening crowds

Area chemical force is difficult to justify against a crowd that is peaceful, non-threatening, compliant, or engaged only in minor disorder. The presence of a small number of unlawful actors does not automatically create a strong justification for exposing everyone nearby.

No viable escape route

Using an agent designed to make people flee while preventing them from leaving creates a foreseeable risk of excessive exposure and panic. Deployment is especially problematic where exits are blocked, the crowd is trapped, people are compressed against barriers, officers fire from multiple directions, or escape routes are unclear.

Enclosed spaces

The health evidence strongly supports heightened caution in confined areas. Repeated CS deployment inside a poorly ventilated structure can create concentrations substantially greater than those expected during open-air use.

Hospitals, schools, care facilities, and similar environments

Area chemical agents are difficult to individualize around populations who may be medically fragile, unable to evacuate, dependent on respiratory equipment, or include children. The risk-benefit threshold should therefore be substantially higher.

Fire-sensitive environments

Pyrotechnic delivery may be inappropriate where ignition risk cannot reasonably be controlled.

Punitive or retaliatory use

Tear gas should not be deployed to punish a crowd, because people insult police, solely to accelerate compliance where no meaningful safety concern exists, or after the public-safety objective has already been achieved.

Repeated saturation

Each additional canister increases cumulative environmental concentration. Repeated deployment should therefore require reassessment rather than being treated as one continuous force decision.

Relevance to Edged-Weapon Encounters

Tear gas has a narrower role in edged-weapon response than most individual force options because it is designed to alter an environment, not to immediately stop one person's weapon movement. Its potential value arises primarily in contained, barricaded, or otherwise time-rich incidents.

Potential role

Area chemical deployment may help officers influence a barricaded armed person to leave a location, make continued occupation of a confined area difficult, create movement that permits arrest or negotiation, reduce the need for officers to make a high-risk physical entry, or contribute to resolution without immediate firearm confrontation. The mechanism is therefore more closely related to environmental pressure and movement than immediate incapacitation.

Conditions favouring deployment

Use is more plausible where the edged-weapon subject is contained, officers have time, the location can be managed without exposing uninvolved people, escape or surrender routes are available, the chemical concentration can be reasonably controlled, and officers are prepared to manage the subject if they emerge still armed.

Failure consequences

Tear gas does not mechanically prevent stabbing or other weapon use. An exposed person may remain armed, emerge suddenly, become disoriented, move unpredictably, attempt escape through an unintended route, or continue aggressive behaviour despite substantial irritation. Deployment may therefore change the location or timing of the threat without eliminating it.

Risk trade-off

For the subject, tear gas may avoid a direct kinetic or firearm intervention but can produce respiratory, ocular, dermal, projectile, and secondary environmental injury, especially with high-dose or enclosed-space exposure (Haar et al., 2017; Dimitroglou et al., 2015). For police and third parties, the principal risk is loss of control over dose, movement, visibility, direction of exit, and who becomes exposed. Tear gas is therefore most defensible in edged-weapon incidents as a planned containment or barricade tool, not as a rapid response to an immediately advancing attacker.

U.S. Legal Considerations

Fourth Amendment framework

Where tear-gas deployment constitutes a seizure of identifiable persons, the force is generally analyzed under *Graham v. Connor*. Relevant considerations include the severity of the underlying conduct, whether individuals pose an immediate threat, resistance or flight, warnings, availability of escape routes, ability to target only persons creating the threat, quantity and duration of chemical exposure, and whether force continued after the need for it ended. Crowd-control cases can also involve First Amendment rights, due process, municipal liability, protest restrictions, and injunctions governing police tactics.

Individualized threat matters

Federal excessive-force law generally resists the proposition that force against one person is justified solely because nearby people are acting unlawfully. The constitutional analysis remains tied to the conduct of the person subjected to force and the governmental interest in using force against that person. This principle is particularly important for area chemical agents because they are difficult to individualize.

Warning and opportunity to disperse

Where circumstances permit, courts often treat warning as an important part of the reasonableness analysis for substantial crowd-control force. A meaningful dispersal warning should ordinarily provide understandable notice, a reasonable opportunity to comply, and an actual route by which compliance is possible. A warning that cannot be heard, cannot be understood, or cannot be obeyed because exits are blocked provides substantially less support for force.

Headwaters and chemical-force principles

Although *Headwaters Forest Defense v. County of Humboldt*, 276 F.3d 1125 (9th Cir. 2002) concerned pepper spray rather than tear gas, it established an important Ninth Circuit principle concerning chemical force. The court held that chemical irritant use against nonviolent protesters who posed no safety threat could constitute excessive force. The case demonstrates that chemical agents are not constitutionally trivial merely because their expected effects are temporary.

Crowd-control qualified immunity

Qualified-immunity doctrine in protest cases remains highly fact-specific and continues to vary by circuit. Courts consider whether the plaintiff was personally threatening, whether dispersal orders were given, whether compliance was possible, whether officers targeted the plaintiff or deployed indiscriminately, the type and quantity of force, the state of clearly established law at the time, and whether the crowd presented an immediate public-safety threat. There is accordingly no scientifically or legally defensible rule that tear gas is lawful whenever a crowd has been declared unlawful; the constitutional question remains dependent on the actual circumstances.

Ethical and Moral Considerations

Tear gas raises different ethical issues from individualized less-lethal force because the mechanism is inherently collective.

Indiscriminate burden

The central ethical problem is that the agent does not reliably distinguish between a person committing violence, a peaceful demonstrator, a journalist, a medic, a bystander, a child, or a nearby resident. That makes proportionality difficult.

Effectiveness versus coercion

The fact that tear gas causes people to leave does not necessarily prove that its use was ethically justified. Pain can be behaviourally effective while still being disproportionate. A sound assessment therefore asks whether area chemical force achieved a public-safety objective that could not reasonably have been achieved with less indiscriminate harm.

Escape as part of the mechanism

Because the intervention works by motivating people to escape exposure, providing a viable escape route is part of the ethical design of its use. Using tear gas on people who cannot leave converts temporary environmental denial into involuntary sustained exposure.

Vulnerability

Area agents expose people without individualized assessment of vulnerability. This is especially important for asthma, respiratory disease, disability, age, pregnancy, mobility limitations, and other conditions officers may neither know nor be able to observe.

Collective punishment

Using tear gas against an entire crowd because some members have acted unlawfully risks turning a public-safety tool into collective punishment. The larger and more heterogeneous the crowd, the more important this concern becomes.

Evidence uncertainty

Because high-quality evidence on net crowd-safety effectiveness is weak, claims that tear gas is necessary to "restore order" should not automatically be treated as scientific conclusions.

Evidence Limitations

- Effectiveness is poorly measured. Most studies examine symptoms and injuries rather than whether deployment improved public safety.
- "Dispersal" is an incomplete outcome. Movement away from an area does not necessarily equal reduced violence or reduced harm.
- Exposure dose is rarely known. Environmental concentration varies continuously with wind, ventilation, quantity, and duration.
- Multiple agents are often used together. Protesters may be exposed to CS, OC, kinetic projectiles, noise devices, smoke, and physical force in the same event.
- Medical samples are selected. People who seek care are not representative of everyone exposed.
- Many studies rely on self-report.
- Delivery systems differ. Aerosol, pyrotechnic canister, grenade, and launched munition create different risk profiles.
- Enclosed-space exposure is disproportionately represented in serious cases but cannot be translated into a universal risk estimate.
- Long-term health effects remain insufficiently studied.
- There is little rigorous comparative research evaluating tear gas against alternative crowd-management strategies.
- Vulnerable populations are poorly represented in controlled research.
- Projectile trauma must be separated from chemical toxicity when evaluating launched canisters.

Bottom Line

Effectiveness

The evidence strongly supports tear gas as an effective irritant: CS, CN, and related agents reliably cause tearing, eye closure, respiratory irritation, pain, and a strong incentive to leave the contaminated environment. The evidence is much weaker on whether deployment produces a net improvement in crowd safety, reduces violence, or outperforms less indiscriminate alternatives.

Injury

Most reported effects are temporary and involve the eyes, skin, and respiratory tract, but clinically significant injury is well documented.

Serious injury/death

Severe respiratory exposure, enclosed-space deployment, direct projectile trauma, burns, and high cumulative dose can produce major injury or death. Such outcomes are uncommon but clearly possible.

Comparative safety

Tear gas may avoid some close-contact or kinetic force, but it exposes larger numbers of people and cannot reliably individualize dose. Comparative safety is not easily quantified.

Environmental limitation

Enclosed spaces, repeated deployment, high concentrations, and inability to escape materially increase risk.

Tactical limitation

Crowd dispersal should not be treated as equivalent to public-safety effectiveness. The evidence base is much stronger on physiologic effects than on whether tear gas improves overall event outcomes.

Risk-benefit assessment

The strongest justification for tear gas is a serious public-safety problem involving dangerous behaviour that cannot reasonably be managed through more targeted means, where warnings, escape routes, dose control, and aftercare are feasible. Its weakest justification is against peaceful or non-threatening crowds, in confined spaces without compelling necessity, where people cannot escape, or as punishment or indiscriminate coercion.

Core Peer-Reviewed Evidence

1. Haar, R. J., Iacopino, V., Ranadive, N., Weiser, S. D., & Dandu, M. (2017)
Health impacts of chemical irritants used for crowd control: a systematic review of the injuries and deaths caused by tear gas and pepper spray.

BMC Public Health, 17, 831.
DOI: 10.1186/s12889-017-4814-6

Priority: Essential / strongest broad health synthesis.

Contribution: Systematic review of 31 studies from 11 countries.

Key finding: 5,131 injured people were identified; of 9,261 documented injuries, 8.7% were severe.

Serious outcomes: Two deaths and permanent disabilities were documented.

Risk factors: Enclosed spaces, prolonged exposure, higher concentrations, environmental conditions, and projectile trauma.

Key value: Establishes that chemical irritants can produce substantial morbidity despite generally transient intended effects.

Limitation: Injury-selected populations prevent calculation of a deployment-level injury probability.

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2. Dimitroglou, Y., Rachiotis, G., Hadjichristodoulou, C., et al. (2015)
Exposure to the Riot Control Agent CS and Potential Health Effects: A Systematic Review of the Evidence.
International Journal of Environmental Research and Public Health, 12(2), 1397–1411.
DOI: 10.3390/ijerph120201397

Priority: Essential CS-specific systematic review.

Contribution: Reviewed 35 studies of CS exposure.

Key finding: Ocular, respiratory, and dermal effects were common, while life-threatening and longer-term effects were documented.

Critical risk factor: Severe outcomes were particularly associated with confined or enclosed environments.

Limitation: Evidence base consisted heavily of case reports and descriptive studies.

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3. Rothenberg, C., Achanta, S., Svendsen, E. R., & Jordt, S.-E. (2016)
Tear gas: an epidemiological and mechanistic reassessment.
Annals of the New York Academy of Sciences, 1378(1), 96–107.
DOI: 10.1111/nyas.13141

Priority: Essential mechanism and epidemiology review.

Contribution: Reassesses tear-gas safety using both epidemiologic and mechanistic evidence.

Key value: Connects CS/CN irritant effects to sensory nociceptive pathways and questions assumptions that exposure is uniformly short-lived and medically trivial.

Limitation: Review literature rather than a deployment-effectiveness study.

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4. Schep, L. J., Slaughter, R. J., & McBride, D. I. (2015)
Riot control agents: the tear gases CN, CS and OC–a medical review.
Journal of the Royal Army Medical Corps, 161(2), 94–99.
DOI: 10.1136/jramc-2013-000165

Priority: High clinical/toxicology review.

Contribution: Reviews mechanism, clinical effects, toxicity, and treatment for CN, CS, and OC.

Key finding: Serious systemic effects are uncommon under ordinary exposure conditions, but high concentrations can cause severe complications and death.

Operational value: Provides clinically useful timing, decontamination, and treatment information.

Limitation: Not designed to measure police operational effectiveness.

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5. Brown, J. S., et al. (2021)
Reevaluating tear gas toxicity and safety.
Inhalation Toxicology.
DOI: 10.1080/08958378.2021.1963887

Priority: High contemporary safety review.

Contribution: Reassesses toxicologic assumptions concerning modern tear-gas exposure.

Key value: Highlights major uncertainties in dose, repeated exposure, vulnerable populations, and longer-term health outcomes.

Limitation: Toxicology-focused rather than policing-effectiveness research.

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6. Torgrimson-Ojerio, B. N., et al. (2021)
Health issues and healthcare utilization among adults who reported exposure to tear gas during 2020 Portland (OR) protests: a cross-sectional survey.
BMC Public Health, 21, 803.
DOI: 10.1186/s12889-021-10859-w

Priority: High contemporary population-health evidence.

Contribution: Examined reported health effects among people exposed during repeated 2020 protest deployments.

Key finding: Respondents reported respiratory, ocular, dermal, gastrointestinal, and other symptoms, with some seeking healthcare.

Key value: Captures repeated community exposure outside narrow emergency-department samples.

Limitation: Self-selected, self-reported cross-sectional survey cannot establish precise causal incidence.

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7. Karagama, Y. G., Newton, J. R., & Newbegin, C. J. R. (2003)
Short-Term and Long-Term Physical Effects of Exposure to CS Spray.
Journal of the Royal Society of Medicine, 96(4), 172–174.
DOI: 10.1177/014107680309600404

Priority: Supporting real-world health evidence.

Contribution: Examined immediate and longer-term symptoms following CS exposure.

Key value: Supports the conclusion that symptoms are not invariably limited to the immediate exposure period.

Limitation: Exposure circumstances and sample size limit broad risk estimation.

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8. Chused, T. M., et al. (1971)
Medical Care During the November 1969 Antiwar Demonstrations in Washington, DC.
Archives of Internal Medicine.
DOI: 10.1001/archinte.1971.00310130071007

Priority: Foundational crowd-medicine evidence.

Contribution: Historical medical documentation from large-scale protest and crowd-control operations.

Key value: Provides early empirical evidence of health burdens associated with mass chemical-agent deployment.

Limitation: Historical policing practices and delivery systems differ from contemporary use.

Evidence Rating

Physiologic effectiveness: ★★★★★

Tear gas reliably produces acute ocular, respiratory, and sensory irritation.

Crowd-control effectiveness: ★★☆☆☆ to ★★★☆☆

Dispersal is plausible and commonly observed, but rigorous evidence of net public-safety benefit is limited.

General injury evidence: ★★★★☆

Multiple systematic reviews and observational studies document a broad range of health effects.

Serious-injury probability: ★★★☆☆

Severe injury is clearly possible, but deployment-level probabilities are difficult to establish.

Mortality evidence: ★★★☆☆

Deaths are documented, particularly with high-dose/enclosed exposure and projectile trauma, but routine exposure mortality is not well quantified.

Long-term health evidence: ★★☆☆☆ to ★★★☆☆

Persistent effects are reported, but high-quality longitudinal evidence remains limited.

Comparative evidence: ★★☆☆☆

Little rigorous evidence compares tear gas with alternative crowd-management strategies.

Overall confidence: Moderate for health effects; low-to-moderate for operational effectiveness.

Research-library conclusion

Tear gas is well established as an effective irritant but much less well established as an effective public-safety intervention. CS, CN, and related agents reliably cause tearing, eye closure, respiratory irritation, pain, and a strong incentive to leave the contaminated environment. Most exposures produce transient effects, but systematic reviews document severe injuries, permanent disability, and rare deaths, with risk increasing in enclosed spaces, during prolonged or repeated exposure, at high concentrations, and when launched canisters cause direct trauma. The principal evidence gap is operational rather than toxicologic: relatively little high-quality research demonstrates that tear-gas deployment reduces violence, prevents injury, or produces better overall crowd outcomes than more targeted alternatives. Its strongest justification is therefore a serious and otherwise difficult-to-control public-safety threat where people can receive warning, leave the affected area, and avoid prolonged exposure. Its weakest justification is indiscriminate use against peaceful or mixed crowds, deployment where escape is impossible, repeated saturation of confined environments, or use primarily to punish or accelerate compliance rather than address a substantial safety threat.

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HOW TO CITE

Edged-Weapon Response Lab. (2026). *Tear Gas*. In *EWRL Evidence Library* (Version 1.0). https://droptheknife.org/evidence-base/I_TearGas (https://droptheknife.org/evidence-base/I_TearGas)