



Final Report HFM-073

Appendix G: Glossary of Terms Important to the Human Effects of Non-Lethal Technologies

G. There are an enormous number of terms relating to human effects from different perspectives, e.g., medical, biological, physiological, psychological, sociological, psychiatric, legal, pathological, and so forth. This Glossary attempts to define some of the terms that are most relevant to the human effects of non-lethal weapons so that NATO HFM and RTO will have a common reference. There is a special focus on terms that are used in minutes of the meetings of HFM-073 and in the body of the HFM-073 Final Report. Criteria for including words are:

- Terms unique to the human effects of NLTs
- Common terms that are used in an unusual way in the context of NLT human effects
- Common terms that are used with their usual meaning, but are very important to the human effects of NLTs

3-Rib Chest Structure: A mechanical model used to measure chest compression and thoracic response (chest wall velocity) from ballistic impacts.

Accreditation: The official certification that a model or simulation or process is acceptable for use for a specific purpose. Also see Validation and Verification.

Acceptability: The complex determination of whether the contemplated use of a non-lethal technology is (1) worth the cost in manpower, material, and time involved; (2) is consistent with the law of war; and (3) is militarily and politically supportable.

Acute Effects: An immediate physiological, behavioural, or psychological effect occurring as a result of the stimulus from an NLT. Examples of acute desired effects include pain from a kinetic impact, distraction from a flash-bang, and irritation of the eyes and lungs from Oleoresin Capsicum.

After-Action Review (AAR): A professional discussion of an event that enable soldiers to discover for themselves what happened, why it happened, and how to sustain strengths and improve on weaknesses. It is a tool that leaders, trainers, and units use to get maximum benefit from every mission or task. It could be used to assess the operational performance of NLT.

Asphyxia: Decreased oxygenation of the blood, often due to the inability to breathe due to airway obstruction or irritation.

Asphyxia, Positional: Asphyxia caused by restricting a human in a position in which breathing is inhibited.

Basis Responses: A set of abilities defined by SAS-035 as the smallest set of descriptors that form the basis from which all the desired target responses necessary to accomplish anti-personnel and anti-materiel assigned mission tasks can be generated. These Basis Responses describe the Required Responses and Measures of Response in a simple and common manner such that they can be mathematically compared in order to compute the Measures of Effectiveness. They are a means of reducing complex information to a minimum ordered set of actions to allow the Measures of System Effectiveness to be mathematically calculated. The following seven Basis Responses were listed:

- Physical Function
- Mobility
- Communication
- Sense and Interpret
- Group Cohesion
- Identification

Battle Stress: A temporary disorder of psychological function and performance experienced by some individuals during combat. Battle Stress cases are considered as Battle Casualties, but the majority of these casualties do not become patients and most can be handled outside of the medical support system.

Behavioral Effect: An effect on the behavior or performance of a person.

Blunt Trauma: Change of body structure caused by imparted kinetic energy.

Bystander: A person located near the target of a NLW who is not an adversary and is not the intended target of the NLW. Similar to the term “non-combatant.” The safety of bystanders will be an important issue for the use of NLTs.

Chronic and Long-Term Effects: Effects of a NLT that could affect health over a long period of time, even years. The potential effects most often cited are the induction or promotion of cancer, the reduction of fertility and/or the increase of birth defects, and facilitation of a variety of physiological disorders and diseases. Concern applies both to the user, who may experience repeated low-level exposure and to the targets, who may experience multiple acute high-level exposures. Such effects may take many years to appear.

Commotio Cerebri: Shock to the brain causing unconsciousness. This condition is especially relevant to kinetic NLT.

Commotio Cordis: A ventricular fibrillation induced by impacts to the front chest, particularly near the front left ventricle, during repolarization.

Communication: Capability of exchanging information with other persons via verbal or non-verbal means. The goal of some NLTs is to disrupt this capability.

Compliance: The act of submitting to the will, control, or orders of another person.

Confuse: To disrupt thinking with clarity or acting with intelligence and understanding.

Concussion: An injury to the brain produced by a violent blow and followed by temporary or prolonged loss of function and consciousness.

Constraints to NLTs: Limiting factors that influence development, testing, training, and deployment of NLTs. For example, certain conventions, laws, & treaties restrict the use of chemicals in combat; standards that set limits on human exposure to electromagnetic fields, lasers, or acoustics may limit testing and training on some NLTs. The claim or perception that some NLT effects are tantamount to torture could limit their use.

Control Force: Police or military personnel attempting to restore civil order. Also see “crowd control” and “riot control.”

Contusion: An injury to an organ or tissue that is caused without breaking the skin, e.g., a bruise.

Countermeasure: A means via actions or equipment by targets to defeat the goals of a NLT.

Crowd Control: The goal to effect the gathering, unified action, or dispersal of a crowd in a desired manner.

Cultural Background: Characterization of human groups by such factors as ethnicity, religious beliefs, and education. It is believed that cultural background will affect human response to some NLT, especially those relating to psychological effects.

Dazzle: Temporary loss of vision or temporary reduction in visual acuity. Also see “Glare.”

Damage Assessment: The evaluation of the effect of NLTs on targets.

Deception: Measures designed to mislead the enemy by manipulation, distortion, or falsification of information in order to influence his course of action.

Delayed Effect: Physiological (e.g., health), behavioural, or psychological effect of a NLT that appears some time after the original stimulus, e.g. a delayed toxic effect.

Denial Measure: An action to hinder or deny the enemy the use of space, personnel, or facilities. Threats, barriers, and the induction of pain are examples of denial measures.

Desired Effects: The objective for using the NLT, e.g., distraction, incapacitation, repel. Also see “undesired effects.”

Deter: To prevent or discourage from acting by imposing fear or doubt regarding the consequences of the action or by creating a physical obstacle.

Disable: To deprive targets of capability and effectiveness, often by impairing their physical abilities.

Disorient: To impair targets sense of spatial or temporal relationship with their surroundings or goals.

Disperse: To decrease the density of a group of people, e.g., breaking up a crowd.

Distract: To cause to turn away from the original focus of attention or interest.

Dose-Response: The relationship between the intensity of a stimulus (dose) and its effects. For any specified effect, a dose-response curve can be created. The separation between the dose-response curves for desired and undesired effects of a non-lethal technology defines its margin of safety and its operating envelope.

Duration of Effect: The time course of recovery from an effect produced by NLT. The duration of the effect of a NLT is important in assessing its effectiveness and in planning its use. It is also important for planning the interrogation of a captured target and in assessing medical management of an injured target. Also see “Time of Effect”

Effect: Change produced by an action or stimulus.

Effectiveness: A measure of the success of a NLT in meeting its objectives. From an operational perspective, it is a measure of the ability of a specific NLW when employed in a given scenario to allow achievement of mission objectives by an employing force.

Energy Coupling: The efficiency of transfer of energy from one medium to another. For the human effects of NLT, the issue is usually how well energy couples with the human body. For example, infrasound delivered in air couples poorly with the human body, whereas infrasound delivered in water couples well with the human body. Energy that strikes a human that is not coupled well, is usually either reflected by the body or passes through the body.

Environmental Effects: Effects of NLTs on fauna or flora. The goal to preventing undesirable environmental effects is codified in the definition of non-lethal weapons. The issue of environmental effects is especially important for chemically based NLT, the residue of which could remain for a considerable time.

Exposure Standards: Health and Safety standards developed to protect the general public and operators from exposure to potentially harmful physical or chemical stimuli. These standards are generally very conservative, employing a large safety factor. They do not apply to the use of such stimuli in NLTs against a target and are generally relaxed during warfare. However, they apply during the development and testing of NLTs and in training and exercise scenarios. In military operations, they usually apply to weapon’s operators and other personnel. In NATO, such standards are codified as Standardization Agreements (STANAGS), e.g., STANAG 2345 for exposure to radio frequency radiation.

Extrapolation: Using specific, limited observations and data (e.g., from an animal, physical, or computer model, from a small subset of the human population, or using sub-optimal levels of an NLT) to predict the effects of NLTs on humans in an operational situation. Also called generalization.

Flash-Blindness: The temporary loss of vision following exposure to a bright light.

Glare: Loss of visual performance (veiling glare) or annoyance or discomfort (discomfort glare) produced by light greater in intensity than that to which the eyes are adapted. Diminished vision can also be produced from light reflecting or scattering from surfaces, such as windshields, water surfaces, or VDTs (reflection glare).

Group Cohesion: The level of organization, cooperation, and density of a group or crowd of individuals.

Head Injury Criterion (HIC): A measure developed by the U. S. National Highway Traffic Safety Administration to indicate the probability and severity of skull fracture.

Human Effects: Effects on a human being, including psychological, physiological, and physical effects. Knowledge about human effects can be obtained by observation, experimentation, and modelling. Data can be collected from animal models and directly from humans in both laboratory and field conditions. Knowledge about the human effects of non-lethal weapons is essential to assure operational utility, technological feasibility, and policy acceptability.

Immobilize: To stop, restrict, or hinder movement.

Imparted Energy: The total energy transferred from a kinetic device to the human body. Also see “energy coupling.”

Incapacitate: To deprive the target of strength or ability, temporarily inducing a state where no effective action can be performed.

Indecisiveness: Reduced ability to plan or make a decision and act effectively.

Injury Criteria: The critical levels of various damaging effects, such as blast pressure and thermal radiation, required to achieve specified levels of damage. Also see “dose-response.”

Interim Total Body Model (ITBM): A compilation of various thoracic, abdominal, and head injury models, most often based on a biomechanical lumped parameter representation of anatomical behavior. The ITBM is being used to model the effects of blunt impact NLT.

Lobdell's Model: A lumped parameter biomechanical model of how the thorax will respond to high mass, low velocity impacts. Developed to support injury assessment for the automotive industry, now used to model the effects of blunt impact NLT.

Margin of Safety: A term borrowed from pharmacology that indicates the separation between an effective dose and a toxic dose of a drug for a specified population of users. For non-lethal technologies, the margin of safety defines the operating environment between operational effectiveness of a NLT and the occurrence of undesirable effects. The margin of safety is often expressed as a ratio of the threshold value for damage divided by the threshold for effectiveness. It can be readily visualized by plotting dose response curves for desired and undesired effects on the same graph. The margin of safety can be highly affected by the variability of the relevant population of targets. A technology with a large margin of safety is preferred.

Measures of Effectiveness (MOE): Defined by NATO RTO SAS-035 as a quantitative or qualitative measure that indicates the degree to which a military objective can be achieved by using one or more systems (lethal/non-lethal) in an operational context, e.g., probability of damage, etc.

Measures of Operational Effectiveness (MoOEs): Defined by NATO RTO SAS-035 as a quantitative or qualitative measure of the impact of the use of NLTs to the overall success of an operation.

Measures of Performance (MOP): Defined by NATO RTO SAS-035 as a measure of the intrinsic quality of the system under consideration (taking into account environmental conditions). Examples are speed, payload, range, time on station, frequency, or other distinctly quantifiable performance features.

Measures of Response (MOR): Defined by SAS-035 as a measure of how a target reacts (desired/undesired) to a system that is applied (i.e., taking into account countermeasures).

Measures of System Effectiveness (MoSEs): Defined by SAS-035 as an overall measure of the effectiveness of a system employing NLTs. It is a combination of the Measures of Response, the Target Response Characteristics, and the Required Responses.

Medical Response: Agents and procedures to treat the acute and delayed effects of NLTs to facilitate the reversal of acute effects and the prevention of delayed effects, based on medical need. Particularly for novel NLT, preparation for medical treatment will help reduce casualties and undesired effects. Medical responders should be prepared to treat operators, targets, and bystanders who may intentionally or accidentally be exposed to NLT.

Mobility: The capability of individuals or groups of people to move from one location to another, characterized by speed and direction.

Model: A physical or mathematical representation of the real world, simplified by ignoring certain details. Models allow complex systems and situations to be understood and their outcomes predicted within the scope of the model, but may give incorrect descriptions and predictions for situations outside the realm of their intended use. Also see “extrapolation” and “dose-response.”

Motivate: To provide with an incentive; to move to action; impel.

Motivation: From the perspective of NLT’s, the strength of the targets’ desire to achieve their goal, or conversely, the strength of the targets’ ability to resist the application of an NLT. Although this is an easily understood term, there are few objective metrics for assessing motivation with respect to a given NLT. In many cases, motivation is directly proportional to the effective dose of an NLT.

Non-Lethal Effect (NLE): An effect that incapacitates or repels personnel, with a low probability of fatality or permanent injury, or disables equipment, with minimal undesired damage or impact on the environment.

Non-Lethal Technologies (NLTs): Technologies being considered or utilized for non-lethal weapons.

Non-Lethal Weapons (NLWs): Weapons that are explicitly designed to incapacitate and repel personnel, with a low probability of fatality and permanent injury, or to disable equipment, with minimal undesired damage or impact on the environment. (NATO NLWs Policy)

Operating Envelope: The range of applications (dose, level) of a NLT in which desired effects are maximized and undesired effects are minimized. Also see “dose response” and “margin of safety.”

Operator: With respect to NLWs, the person responsible for firing, launching, or otherwise delivering a NLT to a target. For many NLT, operators may experience repeated low-level exposure and run the risk of accidental high-level exposures. Also see “Safety Standards.”

Pain: An unpleasant sensation occurring in varying degrees of severity as a consequence of injury or exposure to intense stimuli likely to cause injury, disease, or emotional disorder. The most basic form of pain is assumed to help prevent injury. Humans usually seek to reduce or avoid pain. The induction of pain to compel adversary compliance is common to many existing and proposed NLW.

Pain Compliance: The use of pain to exert control over a target. Also see “compliance.”

Performance: The efficiency and quality of a purposeful action. One goal of NLTs is to disrupt the performance of targets. Means of assessing changes in performance caused by NLTs could be an important issue for the NATO RTO Human Factors and Medicine Panel.

Personal Protection: Protective clothing or other means used by an operator or user to prevent potentially hazardous exposure to an NLT. Also see “countermeasure.”

Physical Restraint: The control of the capacity or mobility of targeted individuals or groups by physical means (e.g., handcuffs).

Physiological Effect: An effect on the anatomy or functioning of the human body.

Pre-empt: To act to gain time and space in order to forestall the activities of an adversary in order to maintain freedom of action.

Probability of Damage: Defined by NATO RTO SAS-035 as the probability that damage will occur to a target expressed as a percentage or as a decimal.

Probability of Detection: Defined by NATO RTO SAS-035 as the probability that a person, object or phenomenon will be detected, expressed as a percentage or as a decimal.

Probability of Unintended Effects Given a Hit (P_{HL}): Defined by NATO RTO SAS-035 as conditional probability of injury or lethality given a hit. This probability is specified as a function of dose and may vary according to population and individual variables such as age, gender, sensitivity, clothing, and motivation level.

Probability of Intended Effect Given a Hit (P_{HE}): Defined by NATO RTO SAS-035 as the conditional probability of achieving the task objective. This probability is specified as a function of dose and may vary according to population and individual variables such as age, gender, sensitivity, clothing state, and motivation level.

Probability of Hit (P_H): Defined by NATO RTO SAS-035 as a term used by the modelling community to describe the probability that a target will be hit by a given release of a munition, expressed as a percentage or as a decimal.

Probability of Kill (PK): Defined by NATO RTO SAS-035 as a term used by the modelling community to describe the probability of stopping specific functions of a target if that target is hit.

Psychological Effect: An effect on the mind (e.g., thinking, attitude, motivation, etc.) of a person. It is often considered as an intermediate to a behavioural effect. Undesired psychological effects of non-lethal technologies on the target, bystanders, and operators could also be an issue and should be evaluated in any complete risk analysis.

Psychological Operations: Military operations designed to have an effect on the mind (e.g., thinking, motivation, attitude, etc.) of a person.

Reostatic Weapons: With respect to NLW, the ability of a single weapon or technology to produce a spectrum of desired effects merely by adjusting the level of exposure or some other parameter. For example, the same weapon might be adjusted to produce annoying effects at lower levels, incapacitation at higher levels, and lethality at even higher levels. Also called tunable or scalable weapons.

Repel: To ward off or keep away; drive back

Riot Control: The management of a large group of people engaged in unrestrained civil disobedience. Also see “Crowd Control.”

Risk Characterization: The formal process by which desired (i.e., intended) and undesired (i.e., unintended) effects of NLTs are identified, examined, and evaluated to determine the technology's effectiveness and safety.

Rules of Engagement (ROE): Directives issued by competent military authority that delineate the circumstances and limitations under which forces may initiate and/or continue combat engagement with other forces encountered. Standing ROE refer to those generally intended for all situations, but tailored ROEs for specific situations may augment those standing rules. Knowledge of the human effects of NLTs will be extremely important for specifying appropriate ROE for NLWs.

Secondary Injuries: Injuries that are not due to the primary intent or effect of the non-lethal weapons, but occur as an unanticipated or unavoidable sequelae. For example, an anti-electronic weapon could disrupt life-sustaining medical equipment leading to death. Any NLW that induces momentary loss of equilibrium could inadvertently lead to injuries from falling.

Sense of Anonymity: The feeling of being anonymous and therefore being unlikely to be held accountable. Individuals in a crowd or mob often have a sense of anonymity that releases them from their behavioural norms.

Simulation: An attempt to predict aspects of the behavior of some system by creating an approximate (mathematical) model of it. This can be done by physical modeling or by writing a special-purpose computer program. The use of simulations allows many iterations of proposed scenarios with different assumptions.

Spasm: An involuntary and unnatural contraction of one or more muscles or muscular fibers. Spasms are usually either clonic or tonic. In clonic spasms, the muscles or muscular fibers contract and relax alternately in very quick succession. In tonic spasm, the contraction is steady and uniform, and continues for a comparatively long time. Also see “tetanus.”

Spoof: Mislead, often through the use of faked or altered communications.

Startle: A reaction to a sudden noise, impact, or flash that causes an involuntary response such as stiffening of the body, flexion of the arms, a verbal response, or fall to the ground. Flash-Bang devices often produce a startle response.

Stun: Condition of complete inability to act purposely. When applied to an individual, it implies inability to attack or defend or even move.

Target: Person at whom a NLT is directed. Also see “bystander.”

Tetanus: A state of continuous muscular contraction, especially when induced artificially by rapidly repeated stimuli. Electrical stimulation can result in tetanus.

Threshold Effect: An effect for which a threshold dose must be exceeded before the effect is observed. Because of the variability of human response, thresholds are often expressed probabilistically as the dose that elicits the subject response in 50% of the population; this metric is called the Effective Dose 50 (ED50). Also known as the “minimal effective dose.”

Time to Effect: The time between exposure to a NLT and the desired effect. This time may be immediate (e.g., kinetic weapons), take a few seconds to occur (e.g., millimetre wave heating), or take many seconds (e.g., calmatives). Also see “Duration of Effect”

Trauma: Any injury, either physical or psychological.

Undesired Effects: Effects of a NLT that do not support the goals of its use. Lethality and permanent injury clearly are undesired effects of NLT. These are sometimes referred to as “side effects” or “unintended effects.”

User: The operator of an NLT. Acute and long-term safety of the user will be important to the policy acceptability of NLT.

Validation and Verification (V&V): A process whereby a device, procedure, simulation, model or other product is tested for meeting its design requirements and specifications. Validation assesses the relevance of the product to its stated purpose. Verification assesses the degree of accuracy and reliability of the product.

Vertigo: A feeling of dizziness or loss of equilibrium that may lead to falling down.

Viscous Criterion: An empirically derived injury criterion developed for the automobile industry for low velocity, high mass impacts to the chest. Equivalent to the maximum product of chest wall velocity and compression (VC_{max}).

Visual Obscuration: Temporary impairment of vision, e.g., with a bright light or certain lasers. May also be called “temporary blindness.”

Vulnerability: Susceptibility to an effect (e.g., incapacitation, injury). The variability of the vulnerability of different individuals in a target population is a major challenge for the evaluation and use of NLWs.

