

Annex: First DOMILL statement on the medical implications of the use of the M26

Advanced Taser (December 2002)

Background

- A1. The role of the DSAC²⁶ Sub-committee on the Medical Implications of Less-lethal Weapons (DOMILL) is to provide the Secretary of State for the Home Department and the Secretary of State for Northern Ireland with:
- c. Advice on the medical implications of generic classes of less-lethal (LL) weapon systems (which includes biophysical, pathological and clinical aspects);
 - d. Independent statements on the medical implications of use of specific LL systems, when used according to the formal guidance provided to users;
 - e. Advice on the risk of injury from identified LL systems striking specific areas of the body, in a format that would assist users in making tactical decisions, and developing guidance to users to minimise the risk of injury.
- A2. This advice is in support of the UK Government's requirements arising from:
- f. Recommendations 69 and 70 of the Patten report into policing in Northern Ireland²⁷: (i) a research programme to find an acceptable, effective and less potentially lethal alternative to the Baton Round, (ii) provision of a broader range of public-order equipment to the police;
 - g. The desire of the Association of Chief Police Officers (ACPO) to have a wider range of options in conflict management scenarios, including those most commonly associated with self-defence and restraint, and the police use of firearms.

In summer 2000, the Secretary of State for Northern Ireland set up a UK-wide inter-departmental Steering Group to co-ordinate a programme to address both requirements.

- A3. The report of the Steering Group on Phase 2 of the programme described the various classes of LL weapon systems being evaluated to address the requirements²⁸. The report categorises the technologies according to the requirement for research and evaluation. Within Category A (devices which may be subject to research and evaluation immediately) are electrical incapacitation devices, specifically Tasers.

Evaluation of Tasers

- A4. Tasers are hand-held devices that propel two barbs at an individual. The barbs are intended to attach to the skin or clothing on the torso and/or lower limbs. A sequence of very short duration high voltage current pulses passes through wires connecting the device to the barbs. The current flows into the body and results in a loss of muscular control and in pain. Some models also enable direct contact of the Taser hand-set to the surface of an individual; two closely spaced fixed electrodes pass the current pulses into the subject. This manner of application is usually classed as use in "stun" or "probe" mode; pain is the principal local physiological effect.
- A5. The Police Scientific Development Branch of the Home Office has undertaken an evaluation of a number of commercially available Taser devices²⁹. The evaluation

²⁶ Defence Scientific Advisory Council.

²⁷ Report of the Independent Commission on Policing in Northern Ireland; September 1999.

²⁸ Patten Report Recommendation 69 and 70 Relating to Public-Order Equipment – A research programme into alternative policing approaches towards the management of conflict. Second Report of the Steering Group; November 2001. www.nio.gov.uk/policing.htm.

²⁹ PSDB Evaluation of Taser Devices. Publication Number 9/02, September 2002.

addressed barb accuracy and dispersion, the measurement of electrical output and reliability, a review of manufacturers' claims and handling characteristics in a number of test scenarios. DOMILL also undertook a general review of the medical implications of the use of Tasers^{30,31}.

- A6. On the basis of the objective technical and medical evaluations, and the policy underpinning the development of a broader range of options for conflict management in the UK, ACPO has proposed that an operational trial of the M26 Advanced Taser should take place. DOMILL was invited to provide this current statement for Ministers on the medical implications of the use of the M26 Advanced Taser in an operational trial.

Guidance on use by police of the M26 Advanced Taser

- A7. The policy and practice defining the training for use, deployment and operational use of a weapon system is central to an assessment of the medical implications of that use. The ACPO Guidance³² states that an operational trial would be limited to firearms officers in selected police forces. The M26 Advanced Taser would provide firearms officers with additional means of dealing with threats of violence in which conventional firearms and other less-lethal tactical options may be deployed. Such options include batons, sprays of sensory incapacitant, and "empty hand" physical restraint.
- A8. Deployment and use of the Taser would conform to the principles of guidance already laid down in the ACPO Manual of Guidance on Police Use of Firearms. The trial would be subjected to critical and independent review.

Technical approach for the assessment of medical implications of use

- A9. The milestones placed upon DOMILL by the Steering Group dictated the nature of the technical approach: a wide-ranging review of literature and preliminary analytical studies on the biophysical interaction of Taser current pulses with the body. On behalf of DOMILL, the Defence Science and Technology Laboratory (Dstl) undertook a comprehensive review of information publicly available, and provided by manufacturers and police forces in North America. Over 800 references were acquired and reviewed. The review encompassed:
- a. basic neurophysiological science to consider the mechanism of the interaction with excitable tissues;
 - b. peer-reviewed scientific and medical papers specifically addressing laboratory and operational use of Tasers and stun weapons: electrical output, risks to personnel, analyses of medical issues observed in hospital facilities in individuals subjected to Tasers, and the circumstances surrounding the deaths of personnel subjected to Tasers in the course of their arrest;
 - c. evidence on the risks provided by manufacturers: scientific, medical, use on volunteers and records of operational use;
 - d. the basis of the application of electrical safety standards and criteria to Taser outputs;
 - e. newspaper reports of Taser use and complications arising from use;
 - f. surveys of effectiveness and injuries observed and recorded by law enforcement agencies in the United States and Canada;
 - g. peer-reviewed papers on the hazardous effects of electric fields on physiology.

³⁰ The Medical Implications of the Use of Electrical Incapacitation Devices (Tasers). Prepared for DOMILL by the Defence Science and Technology Laboratory. DSTL/CBS/BTP/DOC/594/1.0. April 2002.

³¹ An Update on the Review of the Medical Implications of the Use of Electrical Incapacitation Devices. Prepared for DOMILL by the Defence Science and Technology Laboratory. DSTL/CBS/BTP/PAT-ACPO/MAN/COM/3. 30 September 2002.

³² The M26 Taser. Operational Trials involving Firearms Officers in Selected Forces. Notes for Guidance on Police Use. ACPO. 4 September 2002.

The review by Dstl was conducted by cardiac and nerve electrophysiologists, physicists and engineers specialising in the interaction of electrical energy with the body, and trauma specialists.

- A10. Dstl also undertook computer-based modelling of the interaction of Taser pulses with the body. The primary purpose was to assess qualitatively the distribution of currents from Tasers in the body, and to determine semi-quantitatively the changes in current magnitude and distribution for different barb separations and Taser outputs.
- A11. DOMILL endorsed Dstl's approach and reviewed the substantial body of information compiled by Dstl. This statement is based on these data.

Classification of Taser outputs

- A12. Tasers have been classed by users as "low-power" (5-7 Watt) or "high-power" (14-26 Watt). Tasers have been in use for over 20 years, principally in the US. Over most of this period, only low-power Tasers were available, deployed and used. High-power Tasers have been available and in use on volunteers and operationally for about two years; the M26 Advanced Taser is classed as high-power. Assessments undertaken by the PSDB showed that the principal differences in measured output between low- and high-power Tasers were the pulse repetition rate and pulse duration; differences in peak current and voltage between devices were also noted. Dstl modelling studies showed that the magnetic field strength in the body (an index of current) was greater with the high-power Tasers.

The evidence of hazard and risk from the M26 Advanced Taser

- A13. The body of manufacturers' experimental evidence from biological models of the hazardous and intended effects of Taser on excitable tissues is not substantial, particularly with regard to the M26; the peer-reviewed evidence is even more limited. The epidemiological evidence to assess the hazards associated with use of the M26 Advanced Taser is not as robust as that for the low-power models. However, the manufacturer's database of over 1600 operational uses of the M26 and reports from law enforcement agencies in North America did offer some insight into the risks and nature of injuries.

Classification of injuries

- A14. Unintended adverse effects from the use of Tasers may be classed thus:
- Primary: immediate or delayed consequences of electrophysiological phenomena resulting directly from the current flow in the body; it is surmised from the known effects of electric fields and currents on the body (for example, lightning, electric fence controllers) that the organ of principal concern is the heart;
 - Secondary: physical trauma directly associated with Taser use, principally injuries from the barbs and falls; the head is the principal area at risk;
 - Coincidental: injuries received in the incident not directly related to Taser use e.g. baton use, self-inflicted wounds, gun-shot wounds.

It is notable that in two surveys from law-enforcement agencies in North America, more than half of the number of people confronted with the M26 Advanced Taser were impaired by alcohol, drugs or mental illness. Some drugs and metabolic consequences of muscular activity are believed to increase the susceptibility of the heart to potentially life-threatening disturbances of rhythm (arrhythmias).

Conclusions

- A15. On the basis of the evidence, the following conclusions are offered on the medical implications of the use of the M26 Advanced Taser in an operational trial that may be undertaken within the terms of the ACPO Guidance provided to DOMILL.
- A16. **Deaths:** Over the period of use of low-power Tasers, there have been a small number of deaths associated with a large number of operational uses. One paper discusses 16 deaths over a 4 year period in Los Angeles³³. Other factors such as pre-existing heart disease and drug use were implicated in these reported deaths. On the available evidence, DOMILL considers it extremely unlikely that a death from primary injuries has been caused by a low-power Taser.
- A17. With regard to the high-power M26 Advanced Taser, the risk of death from primary injury is low and in common with low-power Tasers, is certainly very much lower than that from conventional firearms. Deaths have been reported to be associated with (but not necessarily caused directly by) use of the M26. DOMILL is not aware of any deaths from primary injuries with this weapon, in both operational and volunteer use in North America.
- A18. The confidence of the opinion of a very low risk of death from future use of the M26 is not as high as that for the low-power devices. This uncertainty arises from the smaller numbers of historical operational uses, and the dearth of information on the potentially adverse electrophysiological effects of the higher current flow in the body, particularly in subjects who may have a predisposition to cardiac arrhythmias arising from drug use, pre-existing heart disease or genetic factors.
- A19. DOMILL is not aware of any deaths arising from the secondary consequences of Taser use.
- A20. **Life-threatening and serious injuries:** The risk of life-threatening injuries and of other serious injuries such as the loss of an eye, is considered to be very low. The intuitive high risk of serious head injury from an uncontrolled collapse is not manifested in practice; most subjects apparently collapse in a semi-controlled manner.
- A21. The probability of impact of a barb on the surface of the eye is considered to be low. The impact of barbs on the head has occurred operationally; non-operational evaluation trials on targets have also resulted in head impacts. On the basis of trial data, it is probable that by employing the ACPO Guidance, fewer than 1% of upper barb impacts will hit the head. In the worst case of frontal application, the eyes are a small proportion of the presented area of the head.
- A22. The PSDB has shown in trials that the Taser may cause combustion of flammable solvents on the subject's clothing. This may result in serious burns to the torso and head; the Guidance to Users must highlight and control the risk from flammable liquids such as petrol on the subject.
- A23. **Other effects:** Falls may result in abrasions, scratches, minor lacerations, swellings and areas of redness on the skin. Minor secondary trauma from the penetration of the skin by the barbs will occur; there is sufficient experience from North America to effect simple removal by UK medical professionals.
- A24. Some of the barb penetrations will exhibit small circular burns; areas of skin where current has entered the body from barbs retained in clothing may also exhibit burns. These burns are likely to resolve within a few days, without complications and the need for medical intervention.
- A25. DOMILL is not aware of any evidence that the Taser would induce an epileptic seizure.
- A26. The M26 Taser has a US laser classification that indicates that it is potentially hazardous for *intrabeam* viewing of its sighting laser. The classification according to British Standards and the potential to cause injury must be determined.

³³ Kornblum RH, Reedy SK (1991). Effects of the Taser in fatalities involving police confrontation. J Forensic Sci. Vol 36, 434-448. For a rebuttal of some of the conclusions of this paper, see Allen TB (1992). Discussion of "Effects of the Taser in fatalities involving police confrontation". Letter to Editor. J Forensic Sci. Vol 37, 956-958.

- A27. **Use on drug and cardiac-impaired individuals:** It is believed that drugs such as cocaine and pre-existing heart disease may lower the threshold for cardiac arrhythmias. Many of the 16 fatalities associated with use of the low-power Tasers in the Los Angeles survey had also taken PCP (phencyclidine) prior to the incident. PCP is also thought to be pro-arrhythmogenic but is infrequently encountered as a substance of abuse in the UK.
- A28. There is no experimental evidence that the aforementioned pro-arrhythmic factors increase the susceptibility of the heart to low- or high-power Tasers specifically, sufficient to cause an arrhythmic event. Nevertheless, there is sufficient indication from the forensic data and the known electrophysiological characteristics of the heart (and the effects of certain drugs on this) to express a view that excited, intoxicated individuals or those with pre-existing heart disease could be more prone to adverse effects from the M26 Taser, compared to unimpaired individuals. The ACPO Guidance to Users reflects this view.
- A29. **Overall:** From the available evidence on the use of the device, the risk of life-threatening or serious injuries from the M26 Advanced Taser appears to be very low.

Recommendations

- A30. Research should be undertaken to clarify the cardiac hazards associated with use of the Taser on individuals who could be considered to have a greater risk of adverse effects. The principal investigations should address:
- Accurate, quantitative estimates of the magnitude of the magnetic and electric field strengths from the M26 in potentially vulnerable parts of the body; this would require enhancement of the preliminary model developed by Dstl. These data will focus the investigations in (b) and (c) below;
 - Possible hypersusceptibility to Taser currents arising from drugs commonly abused in the UK, acidosis and pre-existing disease; *in vitro* tissue models are available that could be used to address these issues;
 - The vulnerability of pacemakers and other implanted devices; this issue requires a more thorough review. Experimental studies to assess electromagnetic incompatibility issues are currently not warranted and should await the outcome of the review;

DOMILL does not consider it *essential* from a medical perspective that these studies are completed before approval is considered for the M26 Advanced Taser trial under the terms of the ACPO Guidance.

- A31. The output of the sighting laser of the M26 Taser should be measured, classified according to British Standards and operated to reduce the risk from the ocular hazard.
- A32. Forensic Medical Examiners (FME) and appropriate clinical staff in the principal hospitals within the areas of the police forces participating in the trial should be briefed on the nature of the M26 Advanced Taser, clinical and operational experience from North America, and the presumed and known risk factors. Additionally, it is recommended that a paper be prepared addressing these issues and the wider policy underpinning use, for submission to an appropriate clinical journal.
- A33. At the end of any operational trial (or 6 months after commencement, whichever is earlier), the Home Office should provide DOMILL with a report outlining the circumstances of every use of the M26 Advanced Taser, the post-incident medical assessments undertaken by the FME, and the clinical consequences noted by the FME or clinical staff. DOMILL should be advised as soon as practical of any primary or secondary injury that could be classed as life-threatening, unexpected, or potentially leading to disability.
- A34. DOMILL should inspect the M26 Training Programme Manual to advise on the specific medical risk factors declared in the document.
- A35. DOMILL should be advised of any changes in:

- g. the specification or performance of the M26 Advanced Taser;
- h. the guidance to users, and training practices;
- i. the policy and practice of deployment, use and audit.

Chairman, DSAC Sub-committee on the Medical Implications of Less-lethal Weapons