DSAC Sub-committee on the Medical Implications of Less-lethal Weapons (DOMILL)

Second statement on the medical implications of the use of the M26 Advanced Taser (July 2004)

Background

27. The role of the DSAC\textsuperscript{21} 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:

\begin{itemize}
  \item d. Advice on the medical implications of generic classes of less-lethal weapon systems (which includes biophysical, pathological and clinical aspects);
  \item e. Independent statements on the medical implications of use of specific less-lethal systems, when used according to the formal guidance provided to users;
  \item f. Advice on the risk of injury from identified less-lethal 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.
\end{itemize}

28. On 30 Jan 03, the Home Secretary gave authority to proceed with an operational trial of the M26 Taser as a less-lethal option in incidents at which authority to use firearms had been granted. The M26 Taser would be used by police officers already trained in the use of firearms. The operational trial commenced on 21 Apr 03 for a duration of 12 months. Five police forces are taking part in the trial, employing a joint policy, operational guidance and training strategy developed by the Association of Chief Police Officers (ACPO). The police forces funded an independent evaluation of the trial, undertaken by PricewaterhouseCoopers.

29. Prior to the commencement of the trial, DOMILL provided an independent statement on the medical implications of the use of the M26 Taser within the ACPO Policy and the ACPO Operational Guidance\textsuperscript{22}. The statement was based primarily on an assessment of the medical risks undertaken on behalf of DOMILL by the Defence Science and Technology Laboratory (Dstl). The statement is an Annex to this document. DOMILL also produced medical advice notes for the subjects on whom the M26 had been used, hospital staff, and General Practitioners. The DOMILL statement concluded that: "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."

30. DOMILL recommended that research should be undertaken to clarify the cardiac hazards associated with use of the M26 Taser on individuals who could be considered to have a greater risk of adverse effects. The principal investigations should address the possible cardiac hypersusceptibility to M26 Taser currents arising from drugs commonly used illegally in the UK, acidosis and pre-existing disease, and a more thorough review of the vulnerability of pacemakers and other implanted devices. DOMILL did not consider it essential from a medical perspective that the studies be completed before approval was considered for the initial trial of the M26 Taser under the terms of the ACPO Policy and Guidance. DOMILL also requested that the output of the sighting laser of the M26 Taser should be measured and classified according to British Standards.

Extension of the operational trial of the M26 Taser

31. An interim report on the first five months of the operational trial has been produced by PricewaterhouseCoopers. The interim report concluded that use\textsuperscript{23} of the M26 Taser “helped

\textsuperscript{21} Defence Scientific Advisory Council.
\textsuperscript{23} “Use” by ACPO’s definition is the: (i) drawing of a device in circumstances where any person perceives the action as a use of force or a threat of use of force; (ii) discharging the barbs at a subject; (iii) application and discharge in “touch stun” mode.
secure a positive outcome to an incident, minimising the potential need for officers to deploy other, possibly more lethal technologies". ACPO has proposed that, subject to a review of the medical assessment and Ministerial support, the trial should be extended thus:

- With Chief Officer agreement, the trial should be extended to all forces for use by existing firearms officers, in situations where an authority for firearms would be granted in accordance with criteria presently laid down within the ACPO Manual of Guidance on the Police Use of Firearms;
- The five forces within the current trial should commence a further trial for 12 months where the deployment of the M26 Taser is extended for use by specialist units at incidents where there is presently no remit to authorise firearms, but where officers are facing violence or threats of violence of such severity that it is likely that they will need to use force to protect themselves or a member of the public.

32. ACPO and the Home Office have requested that DOMILL review the extant medical statement and offer a second statement on the medical implications of use, consequential to:
- Revised and reviewed ACPO policy, operational guidance and training;
- The outcome of the research to date addressing their recommendations in the extant statement;
- The data presented to them by ACPO on the outcome (to date) of the initial trial currently proceeding.

This statement is the outcome of that review.

Review of the research undertaken

33. **Effect of M26 Taser cardiac currents.** The research requested by DOMILL was undertaken by Biomedical Sciences department of Dstl. Dstl adopted a two-fold experimental approach to clarifying the risks of adverse cardiac effects arising from use of the M26 Taser:

a. **Effect of drugs of abuse on cardiac function.** This approach was predicated on empirical observations made in the United States that many of those involved in confrontations in which Taser was used were under the influence of drugs. The hypothesis tested was that the drugs *per se* could predispose an individual to an adverse cardiac event, irrespective of Taser use. Seven drugs of abuse were tested for their ability to modify the electrical properties of cardiac ventricular conduction tissue *in vitro*.

b. **Direct application of electrical pulses to isolated beating hearts.** The pulses represent the current predicted to flow in the heart during discharge of the M26 Taser. The assessment is designed to investigate the effect of the pulses on heart rhythm, the threshold for any effects observed and the effects of selected drugs of abuse upon this threshold. These studies necessitated the development of novel, complex computer models of the interaction of M26 Taser pulses with the human body, in order to predict the shape and magnitude of current flowing in the heart.

34. **Effect of drugs of abuse on cardiac function.** Seven recreational drugs, or their active metabolites, were examined in the sheep isolated cardiac Purkinje fibre preparation. MDMA (Ecstasy) and phencyclidine (PCP) produced effects on the action potential suggestive of an increased risk of development of *torsades de pointes* arrhythmia. Although cocaine, cocaethylene (a psychoactive metabolite formed when cocaine and alcohol are concurrently...

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25 The assay looked at the effect of drugs on the cardiac action potential (the electrical basis for cardiac conduction, contraction and relaxation) in sheep isolated Purkinje fibres. Prolongation of the action potential duration is thought to be a possible marker for a potentially lethal type of ventricular arrhythmia known as *torsades de pointes*.
abused) and (+)-methamphetamine did not induce action potential prolongation, a critical review of the scientific and clinical literature revealed that these drugs still have the potential to compromise cardiovascular function in a way that could precipitate a life-threatening cardiac event. The clinical literature suggested that morphine (the principal metabolite of heroin) and Δ9-tetrahydrocannabinol (the principal psychoactive component of cannabis) are likely to be relatively benign in terms of cardiovascular toxicity at doses likely to be employed by abusers.

35. The results from the study, together with evidence gleaned from the literature, suggest that some frequently abused drugs have the potential to contribute to any cardiac-related morbidity or mortality that may arise in the context of Taser use. Furthermore, it seems reasonable to assume that this conclusion could be generalised to other emotionally charged and possibly violent confrontations with law enforcement personnel.

36. The adverse cardiac effects produced by any individual drug are likely to be dependent on several risk factors, including dose consumed, co-use with other drugs (including pharmaceutical drugs and ethanol) and pre-existing heart disease. This complex interplay of multiple risk factors could conceivably contribute to any cardiac-related morbidity or mortality associated with Taser use against drug-intoxicated persons. Officers should be aware that the risk of any adverse response in the aftermath of Taser deployment may be higher in drug-impaired individuals and, accordingly, they should be vigilant of any unusual behaviour displayed by the apprehended person that may signal the need for early medical intervention.

37. DOMILL has reviewed the paragraph in its first statement that discussed pro-arrhythmic factors (paragraph 28) and concludes that it does not require modification on the basis of the current work. The current work provides experimental evidence to support the original statement.

38. **Direct application of electrical pulses to isolated beating hearts.** The complex mathematical modelling underpinning the second experimental approach has never been undertaken before and has challenged the limits of current knowledge. Early setbacks with the modelling have been overcome and the quantitative modelling of the M26 Taser current flow in the heart will be completed shortly. This will enable the studies on the isolated beating heart to commence.

39. **Vulnerability of pacemakers and other implantable electronic devices.** The implanted devices examined in the review included cardiac pacemakers, cardioverter defibrillators, cochlear implants and other implantable neurostimulatory devices, such as phrenic and vagal nerve stimulators. Published material on the construction of the devices was consulted to assess the likely consequences of Taser barb impact on the device. An assessment of available published information on the observed interaction of external electromagnetic fields with active implantable devices was also undertaken. The review also addressed the probability of a person wearing an active implantable device being present in a situation where a Taser may be deployed and used; this drew upon a comparison of the age profiles of the frequency of use of pacemaker and implantable cardioverter defibrillator wearers in the UK, and data on the age profile of persons arrested by the police.

40. It was concluded that the probability of direct impact and physical damage to implanted electronic devices was very low. The effects of M26 Taser electrical fields on the function of cardiac pacemakers are unlikely to be permanent. The limited number of studies that have been reported on devices similar to Tasers indicate that effects are likely to be limited to reversion to asynchronous pacing mode, and that these effects are temporary. The effects of Taser output on implantable cardioverter defibrillators are likely to be similar to those on cardiac pacemakers. The nature of the cardiac rhythm sampling process indicates that application of a Taser for a period of 5 seconds is unlikely to result in inappropriate therapy delivery. The effect of Taser outputs on other active implantable devices, such as cochlear implants and nerve stimulators, has not been reported. The interaction with nerve stimulators could produce deleterious effects but the risk of such interaction occurring is low, and it is unlikely that the effects will be long-term or life-threatening.
41. The age profile of cardiac pacemaker recipients is significantly different from the overall population and that of persons arrested in situations where a Taser may be deployed. The probability of an individual wearing a pacemaker being present in such a situation is therefore likely to be considerably lower than the overall incidence of pacemakers in the population.

42. It is concluded that there is no requirement to undertake experimental studies on the vulnerability of active implantable medical devices to the output of the M26 Taser.

**Ocular hazard of the laser sight**

43. The output of the sighting laser has been tested and is a Class 3R according to the British Standard BS EN 60825-1. Class 3R exceeds the internationally agreed maximum permissible exposure values, but due to the safety factors in these values, devices of this Class are unlikely to cause ocular injuries for accidental exposures. Intentional viewing or deliberate exposure of the eyes of a subject must be avoided.

**Overall conclusion**

44. The risk of life-threatening or serious injuries from the M26 Taser is very low.

**Recommendations**

45. DOMILL reaffirms its view that it does not consider it essential from a medical perspective that the experimental studies are completed before approval is considered for the extension of the M26 Taser trial under the terms of the ACPO Guidance. This DOMILL statement will be reviewed when the results of the study on the isolated beating heart are available.

46. The studies by Dstl on the effects of drugs on isolated Purkinje fibres should be published in the medical press.

47. Six months after the commencement of the extended operational trial, the Home Office should provide DOMILL with a report outlining the circumstances of every use of the M26 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.

48. DOMILL should be advised of any changes in:
   - d. the specification or performance of the M26 Taser;
   - e. the guidance to users, and training practices;
   - f. the policy and practice of deployment, use and audit.

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