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**Title** Military Standard Operating Procedures Translated Into Civilian Best Practice: Delivery of Cold Water Immersion to Treat Exertional Heat Stroke At Brighton Marathon 2023

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**Military Standard Operating Procedures Translated Into Civilian Best Practice:  
Delivery of Cold Water Immersion to Treat Exertional Heat Stroke At Brighton  
Marathon 2023**

Exertional Heat Stroke (EHS) poses a threat to United Kingdom (UK) Service Personnel and is a Research & Clinical Innovation (R&CI) priority in the Defence Medical Services (DMS). Initiated promptly, body cooling may rapidly and completely reverse brain dysfunction and mitigate risk of multiple organ failure (1,2). Cold water immersion (CWI) is the preferred cooling modality in EHS guidelines (1,3) and the optimal method applicable to UK Service Personnel.

Despite adoption of CWI at the Commando Training Centre Royal Marines (CTCRM) (2), its uptake in wider UK military and civilian race medicine remains limited. Potential barriers to implementation include lack of awareness; unfamiliarity with the methods and systems available; and potential safety concerns for immersed casualties. These have been overcome at CTCRM (2), with over 50 casualties treated.

In early 2023, a collaboration was established between Brighton Marathon Medical Team (BMMT), CTCRM Medical Team and R&CI, in order to enable CWI capability at the marathon that April. Priorities were to ensure personnel, technical and logistical requirements could be met, with the course and associated medical facilities constructed only 48 hours beforehand. The evening prior, running water was established and six portable water impermeable bags (Polar Life Pod®, Polar Products, Ohio) for delivering CWI, plus ice, were deployed at the two main medical tents.

Next morning, CWI simulation was incorporated into the BMMT pre-race moulage. Subsequently, incapacitated runners were triaged for CWI in both tents. One casualty presented at the finish line with confusion and rapidly deteriorated to Glasgow Coma Scale

10/15. Rectal temperature was 41.9 °C and CWI was initiated for EHS (Figure 1).

Restoration of consciousness was observed as he cooled below 41 °C (Figure 2); with ice added sparingly to support this process (total 5 kg, water temperature 5.0 - 8.7 °C) and encapsulation up to his midriff, the exposure remained tolerable. Body core temperature of <39 °C was targeted and achieved in 21 minutes, at which point he was removed from CWI, in keeping with the experience of CTCRM (whereby active cooling to 38.6 °C, as advocated in generic guidance (3), can result in sub-normal core temperature from 'overshoot' associated with ongoing heat loss). He was observed for four hours, guarding against rebound hyperthermia. Biochemical abnormalities noted at point-of-care had resolved upon discharge and he was signposted to supervised recovery.

This was the first delivery of CWI at the Brighton Marathon, despite its established status as one of the largest mass participation events in the UK. We also believe that this is the first reported domestic use of CWI with a portable water impermeable bag at an event of Brighton's standing. CWI was achieved with an impressive cooling rate 0.14 °C.min<sup>-1</sup> (acceptable range 0.08 - 0.15 °C.min<sup>-1</sup>) (3). The implementation of CTCRM standard operating procedures, tailored to the available conditions and resources, provides a model for wider CWI roll-out in the civilian space and in Defence. To maximise uptake and efficacy, promotion of effective planning, team management and risk mitigation is required, through training and ongoing education.

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Figure 1. Casualty treatment by CWI at the Brighton Marathon, using the standard operating procedures developed at CTCRM. Note that the pod has been configured to focus cooling around the lower limbs and midriff, with upper limbs exposed for access, and the head and neck - including ears and airway - free for communication. A wetted blanket provides additional cooling around the shoulders and adjacent torso. Images with permission of D J Stotty Images.

Figure 2 Core temperature response of a marathon runner incapacitated and treated by CWI at the finish-line medical treatment tent in Brighton. Level of consciousness assessed by Glasgow Coma Scale (GCS; blue circles) increased to normal as core temperature (T<sub>c</sub>; red squares) reduced <41 °C.