

LEADING ARTICLE

PERSONAL VIEW: MILITARY FORENSIC MEDICINE – FORENSIC MEDICINE IN A MILITARY SETTING

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ABSTRACT

This paper advocates for the establishment of a dedicated scientific forum for Military Forensic Medicine (MFM). Within Europe, the number of forensic medicine professionals possessing direct experience in military contexts remains limited. These (frequently hostile) environments often involve operational, legal, and logistical complexities that differ significantly from those encountered in civilian forensic practice. As a specialised and emerging field, MFM would benefit from a supranational platform aimed at advancing scientific discourse, fostering collaboration, and disseminating expertise across national boundaries. The proposed forum could facilitate structured networking between military and civilian forensic specialists, thereby enhancing preparedness and interoperability. Such an initiative could be supported under the auspices of established international bodies, such as the International Committee of Military Medicine (ICMM) or the North Atlantic Treaty Organisation (NATO) Committee of the Chiefs of Military Medical Services (COMEDS).

Keywords: *Cause of death; forensic ballistics; forensic medicine; forensic pathology; military medicine*

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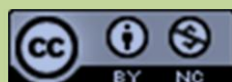
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*application of forensic medicine expertise (both clinical and pathological) within the military context"*¹. A potential question that arises is whether there is a need to establish yet another medical/forensic speciality given the already extensive range of existing specialities. The answer is no, MFM does not necessitate the creation of a new medical/forensic speciality per se. However, numerous reports from colleagues across various countries highlight that individuals lacking specific knowledge or training in military forensic medicine often face significant challenges when applying forensic principles to casework in military settings.

THE CONCEPT OF MILITARY FORENSIC MEDICINE

The conceptualisation of Military Forensic Medicine (MFM) has emerged through ongoing discussions among the authors, who recognised the need for a specialised scientific forum dedicated to this field. We define MFM as "the

The integration of forensic medicine within an environment that inherently involves the application of bodily harm or even lethal force may initially seem incongruous. Yet, the fundamental tenet of MFM is to derive valuable insights from the bodily injuries, whether physical or psychological, inflicted upon or sustained by

adversaries in the context of military operations. This knowledge serves a dual purpose: first, to better prepare and equip military personnel to operate effectively in hostile environments, and second, to advance the understanding of the evolving pathology of warfare and its profound impact on both survivors and their families.

In this paper, we will explore several key aspects of MFM, highlighting both the solutions and challenges faced by various countries, predominantly North Atlantic Treaty Organisation (NATO) members. One significant benefit of MFM is the establishment of standardised methodologies for documenting and describing injuries across different nations, thereby enabling uniform evaluation of findings related to both deceased soldiers and survivors. Furthermore, the expertise of military medical examiners plays a crucial role in determining the causes of death in military personnel, thus contributing to valuable lessons learnt that can inform improvements in equipment design and recommendations for safeguarding the health and well-being of soldiers.

SCOPE OF MFM

Most, if not all, of the domains encompassed by MFM are already established subdisciplines within the broader field of forensic medicine or forensic sciences. These include forensic pathology, radiology, odontology, toxicology, genetics, and anthropology. While there is considerable overlap between military and civilian forensic cases, military contexts often present unique challenges that civilian forensic practitioners may not be equipped to address.

For instance, although parachuting incidents also occur in civilian settings—possibly even more frequently in terms of volume—the nature of military parachuting introduces distinct complexities. Special equipment, mission context, and operational secrecy can significantly affect the forensic investigation. One illustrative case involved the death of a Special Forces operator during a parachute jump as part of a covert operation. In such cases, civilian forensic pathologists may lack the necessary familiarity with military procedures, equipment, and operational parameters, particularly when access

to classified information is restricted. In this instance, resolution was achieved through interdisciplinary collaboration among a military pathologist, a flight surgeon, and a military parachuting expert.

Another important dimension is clinical forensic medicine, particularly in cases involving allegations of sexual assault or physical violence. These cases frequently fall under the purview of military physicians and nurses who mostly lack specialised forensic training. The military environment—often characterised by geographic and social isolation in remote camps—can exacerbate this gap. Personnel primarily trained in life-saving interventions may not be adequately prepared to collect and document forensic evidence to the standards required by judicial processes². Consequently, there is a clear need for targeted forensic training for military healthcare providers operating in such contexts. Finally, we contend that experts in military forensic medicine can serve a critical function in truth-seeking efforts during and in the aftermath of armed conflicts³⁻⁵. Their expertise is particularly valuable in the forensic investigation of alleged violations involving the use or misuse of weapons and weapon systems, especially in cases where such actions may contravene the Geneva Conventions or established Rules of Engagement concerning both military personnel and civilian populations. The ongoing conflict in Ukraine has underscored the relevance of such investigations⁶.

Table 1 outlines several domains in which the involvement of professionals possessing both civilian forensic training and operational military experience would be advantageous. In the following sections, we will examine a selection of these areas in greater detail.

Table 1: Domains in which the involvement of professionals possessing both civilian forensic training and operational military experience would be advantageous

- Anthropology – fragmented body parts
- Clinical forensic medicine
- Chemical, Biological, Radiological, and Nuclear (CBRN)
- Crime scene investigation in the military setting
- Disaster Victim Identification (DVI)—particularly aviation pathology
- Ethics
- Forensic odontology—particularly DVI
- Handling of deaths in the military setting
- Hypothermia, hyperthermia
- International humanitarian law – weapons effects
- Investigation of alleged war atrocities - Katyn massacre
- Military medical handling in role1/role2 setting and (air)medevac (relevant for pathology and clinical forensic medicine)
- Military pathology for training military physicians
- North Atlantic Treaty Organization (NATO) medical standards and their medicolegal consequences
- Parachute accidents
- Toxicology – particularly abuse of illicit drugs
- Underwater medicine – drowning, diving and hyperbaric treatment
- Use and interpretation of military reports regarding trauma by the pathologist: Tactical Combat Casualty Care (TCCC) card, 9-liner
- Weapons screening
- Wound ballistics
- Wound ballistics, including lesions due to explosions, behind armour trauma, and blast trauma

CARE OF THE DEAD

It is an unfortunate but well-recognised reality that military personnel may die in combat or in circumstances resembling warfare. Accordingly, it is generally assumed that all nations maintain formal procedures for managing such fatalities. In most cases, the logical approach would be to adapt established civilian protocols to the military context wherever feasible. Responsibility

for formulating and implementing these procedures falls not only to medical professionals but also to relevant administrative authorities.

Comprehensive training is essential for all personnel involved in the post-mortem care process, including physicians, nurses, chaplains, and enlisted service members, who are tasked with preparing the deceased for repatriation and completing the necessary documentation. Clear assignment of responsibilities is critical; under no circumstances should bereaved families be confronted with military representatives who appear unprepared or uncertain in their duties, as this can exacerbate their distress.

Each nation may determine who is best suited to develop and oversee these procedures. However, in most NATO member states, the only military-affiliated professionals regularly involved in the care of the deceased are civilians, such as reserve pathologists⁷. These individuals, through their civilian roles, are routinely engaged in communicating with bereaved families and are thus well-versed in the sensitivities involved. Their existing protocols may serve as a valuable foundation for adaptation to military contexts.

WOUND BALLISTICS

Wound ballistics is a foundational speciality within military medicine, involving contributions from a diverse range of medical disciplines. In some countries, leading experts in wound ballistics have traditionally been surgeons, such as T. Kocher and M. Fackler, while in others, forensic pathologists or collaborating scientists have been at the forefront, including figures such as K. Sellier and B. Kneubuehl⁸. It is, however, imperative that military forensic pathologists possess more than just a rudimentary understanding of wound ballistics⁹⁻¹⁴. A key aspect of their role involves ensuring that military operations adhere to the Laws of War, notably the Geneva Conventions and similar international agreements^{15,16}.

More than a century ago, The Hague Declaration of 1899 introduced restrictions on weapon usage, and since then, it has been the responsibility of legal experts, surgeons, and forensic pathologists to assess the impact of new weaponry.

According to Article 46 of the Geneva Convention, all new weapons must undergo a "legality" investigation before being deployed in combat. This legal and medical scrutiny ensures compliance with international humanitarian standards. One of the authors has been directly involved in "weapon screening" processes, particularly when new types of small arms ammunition are proposed, to verify that such innovations do not contravene the principles set forth in The Hague Declaration or the Geneva Conventions. While technicians may possess in-depth knowledge of the weapons themselves, it is the forensic expert who focuses on understanding the resulting lesions and injuries caused by these weapons.

DVI – DENTAL AND ANTHROPOLOGY

Disaster Victim Identification (DVI) is not typically associated with MFM, yet certain aspects of DVI work share a close relationship with military forensic practices¹⁷. A primary example is the identification of aircrew members in the aftermath of aircraft accidents. The United Kingdom's Royal Air Force has long operated the Institute of Aviation Pathology and Tropical Medicine at RAF Halton, which specialised in such efforts¹⁸. Additionally, several years ago, NATO introduced Standardisation Agreement (STANAG 2464) and Allied Medical Publication (AMedP-3.1), which provide guidelines on forensic odontology, thereby significantly stimulating the involvement of military dentists in victim identification processes.

In the context of aircraft accidents, anthropological expertise is also frequently required, a speciality that is actively applied within the US Armed Forces Medical Examiner system. Military forensic pathologists have also contributed to civilian disaster response, as demonstrated in the aftermath of the Thai Tsunami, where experts from the French Gendarmerie Nationale and the Italian Carabinieri were deployed. Furthermore, the Dutch Rijksidentificatieteam is a military-led unit, and the Belgian DVI team traces its origins to the Belgian Gendarmerie/Rijkswacht.

The ongoing crisis in Ukraine has highlighted the potential for violations of international

humanitarian law, and in the early stages of the conflict, national DVI teams were called upon by Interpol and the Prosecutor of the International Criminal Court (ICC) to assist in identifying buried victims, underscoring the critical role of forensic experts in the identification process during conflict situations.

HYPERBARIC AND AVIATION PATHOLOGY

The human body can be exposed to both hypo- and hyperbaric environments, which can result in specific pathologies that are encountered in both civilian and military settings. Diving accidents, which can occur due to human or non-human errors in hyperbaric conditions, may lead to various injuries, including drowning and decompression sickness (commonly referred to as caisson's disease). Diving has long been a popular recreational activity for civilians, and professional divers have always been integral to civilian maritime operations, particularly within shipping and port authorities. However, it is within the naval forces of many nations that much of the scientific research on diving physiology and safety has been conducted. While respiratory physicians and anaesthesiologists have typically been the primary experts in this area, forensic pathologists also play a crucial role in multidisciplinary teams when accidents occur, particularly in investigating the causes of mishaps and preventing further incidents¹⁹.

Similarly, military flights involve aircraft that subject the human body to unique accelerations and pressures, distinct from those encountered in civilian aviation. These physiological phenomena must be thoroughly understood and integrated into forensic analysis²⁰ to accurately assess the factors that may have contributed to incidents such as the loss of aircraft control. The skills required to operate military aircraft differ significantly from those needed in civilian aviation, and thus, the forensic evaluation of fatal or material accidents in this context necessitates specialised knowledge. Furthermore, pathology related to peculiarities of military aviation (e.g., ejection seat injuries) may be encountered^{21,22}. In cases where criminal justice proceedings are initiated, the ability to make an informed determination regarding the cause of such accidents becomes imperative.

CLINICAL FORENSIC MEDICINE

Forensic medicine can be broadly categorised into clinical forensic medicine and forensic pathology. Forensic pathology primarily focuses on the examination of deceased individuals, while clinical forensic medicine is more encompassing, dealing with the examination of living victims and perpetrators of physical, psychological, and sexual violence. In civilian contexts, these cases are typically managed by various authorities, with forensic physicians or pathologists and forensic nurses being the primary professionals responsible, depending on the country. However, in some instances, civilian physicians such as general practitioners or gynaecologists may also conduct such examinations.

In military settings, particularly during operations in foreign countries, the responsibility for conducting these examinations typically falls to the unit's medical officer or medical authority. Unfortunately, these officers are often insufficiently trained for the specific demands of a forensic examination in cases of assault or violence. Given this, it is logical that military forensic pathologists, who possess both civilian expertise and an understanding of the unique constraints of the military environment, should assume a central role in training military medical personnel²³. This ensures that the necessary skills and knowledge are imparted to those responsible for conducting such critical examinations in the field.

TOXICOLOGY

This speciality is already actively engaged within the military in managing Chemical, Biological, Radiological, and Nuclear (CBRN) situations^{24,25}. However, when addressing cases involving the influence of alcohol or drugs (e.g., aviation mishaps), this area is most effectively managed by the forensic pathologist. Forensic pathologists, particularly those with experience in clinical forensic pathology or within the autopsy suite, possess the requisite expertise to handle such cases with precision.

It is essential that this work is carried out in close collaboration with toxicologists, whether military or civilian. The success of this interdisciplinary approach depends on the integration of forensic pathology and toxicology, ensuring comprehensive analysis and accurate conclusions in cases involving substance-related influences.

ORGANIZATION OF MFM

Only the major global powers, such as the United States and France, possess dedicated institutes or departments of forensic medicine. In contrast, countries with limited resources or those that do not consider permanent staffing of such departments to be cost-effective must seek alternative solutions. We identify two primary approaches to addressing this challenge.

The first approach is a *laissez-faire* model, where, in the event of a forensic issue, local forensic pathologists are contacted in the hope that they possess the necessary expertise to handle the case. Moreover, it is hoped that these pathologists can quickly acquire a sufficient understanding of the military environment to offer a statement that integrates both the professional forensic considerations and the military context. However, through discussions with colleagues from various NATO countries, we have become increasingly convinced that this reactive approach is not optimal or even acceptable.

The second approach, which has been implemented in Belgium and Denmark, involves employing forensic pathologists who work full-time in civilian forensic institutes or departments but also serve as reserve officers, having undergone comprehensive military training from the ground up. While these specialists are few, they ensure access to the requisite military expertise and context by establishing connections with colleagues who possess specialised knowledge that can be adapted for military applications. Additionally, they should focus on building an international network to facilitate the exchange of information and experiences.

To support this model, we propose the creation of an "International Society for Military Forensic Medicine". Such a scientific organisation, ideally

supported by the Surgeons General, would serve as a resource to offer assistance across NATO, as well as provide guidance to military entities on the establishment of MFM frameworks within their respective countries. Such an initiative could be supported under the auspices of established international bodies, such as the International Committee of Military Medicine (ICMM) or NATO's Committee of the Chiefs of Military Medical Services (COMEDS).

By leveraging the experience of full-time or reserve forensic pathologists, dentists, anthropologists, and nurses, this society would provide valuable insights into what has been successful and what pitfalls should be avoided. The aim is to ensure that lessons learnt from prior efforts are applied effectively while minimising the risk of repeating past mistakes.

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CONFLICTS OF INTEREST

The author declared no conflicts of interest.

DISCLOSURE

These views reflect the personal opinions of the authors and do not represent official policy. PJTK and WJ are members of the Editorial Board of the Sri Lanka Journal of Forensic Medicine, Science & Law. Therefore, they did not participate in any way in the publication/decision-making process of this submission, as per journal policy.

ETHICAL ISSUES

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AUTHOR CONTRIBUTIONS

PJTK: Design of the work; drafting the work; final approval of the version to be published; and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **GV:** Design of the work; drafting the work; final approval of the version to be published; and agreement to be accountable for all aspects of

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REFERENCES

1. Jacobs W, Knudsen P, Visseau G. Military Forensic Medicine: forensic and military medicine at a crossroad. *BMJ Military Health*. 2025 Jun 24:military-2025-003035. <https://doi.org/10.1136/military-2025-003035>.
2. Buyse K, Goorts K, Peeters D, Dhondt D, Portzsky G. Sexual harassment at work within Belgian Defense: a prospective study. *BMJ Military Health*. 2023;169(5):397-402. <http://dx.doi.org/10.1136/bmjilitary-2021-001855>.
3. Jacobs W, Campobasso C, Dewinne J. Organisational aspects of DVI work: Lessons from the exhumation, examination and human identification of war graves in the former Yugoslavia (Kosovo). *Annales de Medecine Militaire Belge*. 2000;14:193-8.
4. Jacobs W, Hermans W, Campobasso C, De Kinder J, Dewinne J. Ballistic trauma analysis of 212 victims recovered from 6 mass graves in the former Yugoslavia. *Annales de Medecine Militaire Belge*. 2001;15:11-4.
5. Sprogøe-Jakobsen S, Eriksson A, Hougen HP, Knudsen PJT, Leth P, Lynnerup N. Mobile autopsy teams in the investigation of war crimes in Kosovo 1999. *Journal of Forensic Sciences*. 2001;46:1392-6. <https://doi.org/10.1520/JFS15161J>.
6. Prentice A. French forensic experts in Bucha to help Ukraine investigate possible war crimes. *Reuters*. 2022 April 13. Available from: <https://www.reuters.com/world/europe/french-forensic-experts-bucha-help-ukraine-investigate-possible-war-crimes-2022-04-12/>.
7. Balkert LS, Thomsen AH, Knudsen PJT. Danish military fatalities in international operations 2002-2018, *BMJ Military Health*. 2024;170:465–9. <https://doi.org/10.1136/military-2022-002164>.

8. Kneubuehl BP, Coupland RM, Rothschild MA, Thali MJ. Wound ballistics: Basics and Applications. Berlin: Springer-Verlag; 2011.
9. Karger B, Meyer E, Knudsen PJT, Brinkmann B. DNA typing of cellular material on perforating bullets. *International Journal of Legal Medicine*. 1996;108:177-9. <https://doi.org/10.1007/BF01369787>.
10. Knudsen PJT. The effect of the THV bullet in animal tissue. *Zeitschrift für Rechtsmedizin*. 1988;101:219-27. <https://doi.org/10.1007/BF00200227>.
11. Knudsen PJT. Cytology in ballistics, An experimental investigation of tissue fragments on full metal jacketed bullets using routine cytologic techniques. *International Journal of Legal Medicine*. 1993;106:15-8. <https://doi.org/10.1007/BF01225018>.
12. Knudsen PJT, Svender J. Doppler radar velocity measurements for wound ballistics experiments. *International Journal of Legal Medicine*. 1994;107:1-6. <https://doi.org/10.1007/BF01247266>.
13. Knudsen PJT, Sørensen OH. The initial yaw of some commonly encountered military rifle bullets. *International Journal of Legal Medicine*. 1994;107:141-6. <https://doi.org/10.1007/BF01225601>.
14. Knudsen PJT, Sørensen OH. The destabilizing effect of body armour on military rifle bullets. *International Journal of Legal Medicine*. 1997;110:82-7. <https://doi.org/10.1007/s004140050036>.
15. Knudsen PJT, Theilade P. Terminal ballistics of the 7.62mm NATO bullet autopsy findings. *International Journal of Legal Medicine*. 1993;106:61-7. <https://doi.org/10.1007/BF01225042>.
16. Knudsen, PJT, Vignæs JS, Rasmussen R, Nissen PS. Terminal ballistics of 7.62mm NATO bullets: experiments in ordnance gelatin. *International Journal of Legal Medicine*. 1995;108:62-7. <https://doi.org/10.1007/BF01369906>.
17. Schuliar Y, Knudsen PT. Role of forensic pathologists in mass disasters. *Forensic Science, Medicine and Pathology*. 2012;8(2):164-73. <https://doi.org/10.1007/s12024-011-9300-3>.
18. Mason JK. Aviation Accident Pathology. London: Butterworth; 1962.
19. Casadesus J, Aguirre F, Carrera A, Boadas-Vaello B, Serrando M, Reina F. Diving-related fatalities: multidisciplinary experience-based investigation. *Forensic Science, Medicine and Pathology*. 2019;15:224-32. <https://doi.org/10.1007/s12024-019-00109-2>.
20. Perrier E, Carlioz R, Deroche J, Quiniou G, Burlaton JP. Physiologie cardiovasculaire aéronautique. *Encyclopédie Médico-Chirurgicale*. Elsevier; 2003.
21. Epstein D, Markovitz E, Nakdimon I, et al. Injuries associated with the use of ejection seats: a systematic review, meta-analysis and the experience of the Israeli Air Force, 1990-2019. *Injury*. 2020;51(7):1489-96. <https://doi.org/10.1016/j.injury.2020.04.048>.
22. Lewis ME. Survivability and injuries from use of rocket-assisted ejection seats: analysis of 232 cases. *Aviation, Space & Environmental Medicine*. 2006;77(9):936-43.
23. Kotsyubynska YZ. Current issues of forensic medicine in the conditions of military actions. *Art of Medicine*. 2022;23(3):129-33. <http://dx.doi.org/10.21802/artm.2022.3.23.129>.
24. Sardarian A, Givens M, Schwartz JF, Cole R, Rudinsky SL. Introduction to treating patients exposed to Chemical, Biological, Radiological, and Nuclear (CBRN) threats: A military medical case-based curriculum. *MedEdPORTAL*. 2024;13;20:11433. https://doi.org/10.15766/mep_2374-8265.11433.
25. Titus E, Lemmer G, Slagley J, Eninger R. A review of CBRN topics related to military and civilian patient exposure and decontamination. *American Journal of Disaster Medicine*. 2019;14(2):137-49. <https://doi.org/10.5055/ajdm.2019.0324>.