Unexploded Ordnance Management			
Original Release/Approval	6 Mar 2012	Note: This CPG requires an annual review.	
Reviewed: Feb 2012	Approved:	6 Mar 2012	
Supersedes:	**This is a new CPG and must be reviewed in its entirety.**		
☐ Minor Changes (or)	☐ Changes are substantial and require a thorough reading of this CPG (or)		
☐ Significant Changes			

1. **Goal.** The purpose of this CPG is to provide details on the procedures to safely remove unexploded ordnance impaled in a human body and minimize risks to providers and the surgical facility.

2. **Background.** Military ordnance may rarely become impaled in a warriors body in the course of normal military action. Thirty-six reported cases from WWII through Vietnam and the Somalia conflict were discussed in a 1999 review article published in Military Medicine (1). Three cases reported in Afghanistan since 2006 indicate that the risk of similar events has not diminished. Immediate yet proper decisions by medical leaders faced with the prospect of surgically removing unexploded ordnance can have great impact not only on the casualty but also on providers (and the facility itself) placing them in jeopardy to remove the ordnance. A discussion of steps to avoid accidental discharge of the impaled ordnance and steps to mitigate risks to providers and the surgical facility is warranted and appropriate planning should occur at each surgical facility.

3. **Ordnance Triggering Mechanisms.**

   Fundamental to this discussion is a basic understanding of triggering mechanisms for those ordnance types most likely to become impaled in the body: mortar, Rocket Propelled Grenade (RPG) and 40 mm projectiles. A basic, unclassified understanding how triggering occurs may allow the surgeon and surgical team to inadvertently avoid causing the ordnance to explode:

   a. Fuse: some sort of malfunction occurred causing the ordnance not to explode on impact into the patient and inadvertently bypassing the safety or the malfunction can cause the ordnance to explode. All retained ordnance should therefore be considered "armed" or activated to a degree that final triggering of the fuse would cause the ordnance to explode. Fusing and triggering mechanisms vary by the type and variety of ordnance and may even vary within the same type of ordnance depending on where the ordnance was manufactured.

   b. Mortar: becomes "armed" and capable of exploding based on the number of rotations or spins completed after leaving the launching tube. Upon impact, a nail like device located in the cone or nose of the device is pushed down into a fissile explosive that then detonates the actual explosive charge. Pressure on the nose of the mortar may trigger the device to explode.

   c. RPG: becomes "armed" based on acceleration, centrifugal and inertial ("setback") forces at the time of the launch which closes a contact fusing the warhead. It is triggered by a

variety of means including direct impact, a shear or glancing of the device or by a piezoelectric (crystal) mechanism that is either light, electrical or heat sensitive. These mechanisms mean that either reorienting the patient or shining direct sunlight as well as providing a direct electric current to the device can cause it to fully trigger and explode.

    d. 40mm Projectile (Mk 19): high explosive round that could become impaled; arming distance approximately 15-30 meters (50-110 ft).

4. Rotary Wing Transport.

If the patient requires rotary wing transportation while the ordnance remains in place, it is essential to properly ground the patient to the helicopter to avoid static electricity from causing the ordnance to trigger and explode. The aircrew must be consulted to ensure proper grounding of the patient to the aircraft. The patient should be extracted and positioned in the same position they were found, if possible, such the orientation of the ordnance is not changed and the trigger mechanism completed.

5. Command Decision Priorities.

Safe removal of unexploded ordnance requires significant coordination with local security, the base command element and Explosive Ordnance Disposal (EOD) personnel:

    a. Base Security & Command: the area where the patient is located should be secured or cordoned off to a distance determined to provide a safe standoff should the explosive detonate. All non-essential personnel, including medical providers, should move to that stand off point. The local commander should be informed that an UXO patient is under surgical care at the surgical facility or is due to arrive if prior notification is given.

    b. EOD: It is imperative that EOD staff be contacted and physically participate as part of normal coordination to establish stand-off perimeter guidance and landmarks as this should not be determined at the last minute in the event an impaled UXO victim. Furthermore, EOD can advise placement and even assist in construction of an UXO barricade where the removed UXO could be moved following surgery. The EOD unit contact information should be clearly posted in the surgical facilities administrative area and the phone number validated periodically.

    c. The EOD technician or other subject matter expert should be able to provide his opinion on the likelihood of detonation. This must be factored into a risk benefit analysis. As the common impaled ordnance types have a number of variants, the EOD specialist can provide advice on specific types of munitions. In some instances, the EOD technicians actually assisted in removal of the ordnance during surgery (1, 3.).

6. Ancillary Surgical Site.

    a. If possible, triage of the patient should be done outside the fixed or tented surgical facility and the patient should not be brought into the fixed or tented surgical facility. Ideally, this will be done nearby the main surgical facility but at a safe standoff distance.

    b. Safe removal of the UXO should be accomplished in an ancillary surgical site, depending on the risk of detonation. This is done to avoid bringing the ordnance into the main operating rooms. An ancillary surgical site should be established outside the main surgical facility where the surgical removal of the ordnance can be safely and

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expeditiously performed. This site should be well lighted and have the necessary anesthetic and surgical equipment available. The floor should be level and large enough to place the operating table or gurney and to position portable X-ray equipment. Once the UXO has been removed, the patient can quickly be moved to the fixed or tented surgical facility to complete the operation.

7. **Patient Triage.**

The basic principle that a patient with a impaled UXO could potentially endanger staff and the main surgical facility that might otherwise be able to save other more sick or urgent patients, demands that they be triaged to delayed and or expectant category should there be multiple casualties requiring surgical care. This is independent of nation of origin of the patient. Comfort care, when appropriate, can be provided with the patient moved to a safe distance from the fixed or tented surgical facility. A nurse or corpsmen/medic can be assigned to perform this function under the supervision of the EOD specialist as to how to approach the patient.

8. **X-Ray & Ultrasound.**

Plain radiographs are generally considered safe with respect to potential inadvertent triggering of the UXO. The patient should not be reoriented to obtain the films, again because any movement can inadvertently complete the triggering mechanism and cause an explosion. The effects of ultrasound or CT scan on unexploded ordnance are not well documented in the literature (3). However, it is prudent to avoid these imaging modalities unless they are absolutely necessary.

9. **Surgical Instruments & Adjuncts.**

Adjuncts such as electrical cautery should be avoided always because the trigger could be energized. Likewise, mechanical saws that emit an electrical field should be avoided in favor of non-powered manual saws. The same type of electrical field is emitted by such devices as blood warmers or pumps which should be avoided.

10. **Operating Personnel.**

Every person not deemed absolutely essential to achieve safe removal of the ordnance should be removed from the vicinity of the UXO. Specifically, all necessary equipment should be laid out in advance of the operation, thereby eliminating the need for an operating room technician. An assistant surgeon should also be used only if it is absolutely necessary and the safe removal of the ordnance could not be safely accomplished without that extra pair of hands.

Personnel typically volunteer to participate in these operations despite the significant danger. Final selection of the surgeon(s) to conduct the operation should be left up to the surgical unit commander and/or the lead surgeon. It is imperative that the unit commander and the lead surgeon make every effort to limit and eliminate the need for additional staff thereby minimizing the risk to the surgical team which needs to remain mission capable.

Personnel participating in the surgery should gown and glove over the battle personal protective equipment including ballistic glasses, helmet and body armor with ballistic plates.

11. Anesthetic Considerations.

In most cases, general anesthetic will be used for these operations. For stable patients where the ordnance is impaled in an extremity, a nerve block is an acceptable alternative. The anesthesia provider, once the anesthetic is induced, should provide an appropriate bolus dose of anesthetic agents and neuromuscular blockers then move away from the ancillary operating room so as not to be present when the ordnance is being removed, again to preserve the fighting force and maintain mission capability.

Use of supplemental oxygen during the operation to remove the ordnance should be limited so as to eliminate this additional combustible source.

12. Surgical Strategy & Priorities.

The guiding principle is to remove the ordnance by the most expedient means possible.

This may require "en bloc" resection of the tissue around the ordnance with amputation of the affected limb above the ordnance if this is deemed the quickest way to safely remove the ordnance. Simultaneous damage control operation for other injuries should be limited to life and or limb preservation surgery and any additional surgery should be delayed until after the ordnance has been removed.

An effort should be made to avoid banging or contacting the ordnance with hands or surgical instruments. Also, an attempt to stabilize the limb if the ordnance is impaled there should be made to avoid excessive vibration or movement which could complete the trigger.

13. Performance Improvement (PI) Monitoring.

   a. Intent (Expected Outcomes).

      1) EOD expertise is essential for aiding in the safe removal of the UXO

      2) It is essential to protect medical personnel and the surgical facility from damage that could render the MTF mission non-capable

   b. Performance/Adherence Measures.

      1) EOD was contacted early in the management of the case

      2) The procedure was carried out in an ancillary surgical site away from the MTF

   c. Data Source.

      1) Patient Record

      2) Joint Theater Trauma Registry (JTTR)

   d. System Reporting & Frequency. The above constitutes the minimum criteria for PI monitoring of this CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the Joint Theater Trauma System (JTTS) Director, JTTS Program Manager, and the Joint Trauma System (JTS) Performance Improvement Branch.

14. Responsibilities. It is the trauma team leader's responsibility to ensure familiarity,

appropriate compliance and PI monitoring at the local level with this CPG.

15. References.

1. Lein B, Holcomb J, Brill S, Hetz S, McCrorey T. Removal of Unexploded Ordnance from Patients: A 50-Year Military Experience and Current Recommendations. Military Medicine 1999; 163(3):163-165.

2. Verbal communication with various US Army, US Navy and US Marine Corps Explosive Ordnance Disposal Technicians 2011.

3. Ann Emerg Med. 1996 Aug;28(2):183-7. Safety of imaging exploding bullets with ultrasound. Schlager D, Johnson T, McFall R. Department of Emergency Medicine, Kaiser Permanente Medical Center, Santa Rosa, California, USA. STUDY OBJECTIVE: To evaluate the safety of using ultrasound to image exploding bullets that have not detonated. METHODS: We evaluated various types of exploding bullets using ultrasonography at various depths with various transducers and using standard radiography. RESULTS: None of the unexploded bullets subjected to ultrasonography or standard radiography exploded. CONCLUSION: Our results suggest that evaluation of exploding bullets with ultrasonography is safe. Personal communication, LTC John Oh MD.

Approved by CENTCOM JTTS Director, JTS Director and CENTCOM SG

APPENDIX A
ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGs

1. **Purpose.**

    The purpose of this Appendix is to ensure an understanding of DoD policy and practice regarding inclusion in CPGs of "off-label" uses of U.S. Food and Drug Administration (FDA)–approved products. This applies to off-label uses with patients who are armed forces members.

2. **Background.**

    Unapproved (i.e., "off-label") uses of FDA-approved products are extremely common in American medicine and are usually not subject to any special regulations. However, under Federal law, in some circumstances, unapproved uses of approved drugs are subject to FDA regulations governing "investigational new drugs." These circumstances include such uses as part of clinical trials, and in the military context, command required, unapproved uses. Some command requested unapproved uses may also be subject to special regulations.

3. **Additional Information Regarding Off-Label Uses in CPGs.**

    The inclusion in CPGs of off-label uses is not a clinical trial, nor is it a command request or requirement. Further, it does not imply that the Military Health System requires that use by DoD health care practitioners or considers it to be the "standard of care." Rather, the inclusion in CPGs of off-label uses is to inform the clinical judgment of the responsible health care practitioner by providing information regarding potential risks and benefits of treatment alternatives. The decision is for the clinical judgment of the responsible health care practitioner within the practitioner-patient relationship.

4. **Additional Procedures**.

    a. Balanced Discussion. Consistent with this purpose, CPG discussions of off-label uses specifically state that they are uses not approved by the FDA. Further, such discussions are balanced in the presentation of appropriate clinical study data, including any such data that suggest caution in the use of the product and specifically including any FDA-issued warnings.

    b. Quality Assurance Monitoring. With respect to such off-label uses, DoD procedure is to maintain a regular system of quality assurance monitoring of outcomes and known potential adverse events. For this reason, the importance of accurate clinical records is underscored.

    c. Information to Patients. Good clinical practice includes the provision of appropriate information to patients. Each CPG discussing an unusual off-label use will address the issue of information to patients. When practicable, consideration will be given to including in an appendix an appropriate information sheet for distribution to patients, whether before or after use of the product. Information to patients should address in plain language: a) that the use is not approved by the FDA; b) the reasons why a DoD health care practitioner would decide to use the product for this purpose; and c) the potential risks associated with such use.

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