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TECHNICAL GUIDE NO. 6

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Delousing Procedures for the Control of Louse-borne Disease During Contingency Operations

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Armed Forces Pest Management Board

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AFPMB TECHNICAL GUIDES

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Inquiries, comments or suggestions for improving TGs may be directed to the Chief, ISD, at (301) 295-7476, FAX (301) 295-7473.

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TECHNICAL GUIDE NO. 6

Delousing Procedures for the Control of Louse-borne Disease During Contingency Operations

1. Purpose

The purpose of this technical guide is to provide guidance on safe, effective and efficient procedures for controlling outbreaks of louse-borne disease, such as epidemic louse-borne typhus (*Rickettsia prowazekii*), epidemic relapsing fever (*Borrelia recurrentis*), and trench fever (*Bartonella quintana*), in enemy prisoners of war and other internment/resettlement camps under control of the Department of Defense (DoD). Louse-borne disease control in the absence of mass delousing with power equipment or the topical application of pesticide dusts must be accomplished through the joint efforts of a variety of DoD non-medical and medical assets to control both body lice and the pathogens they transmit.

2. References

See Appendix A for references.

3. Background

The DoD no longer possesses mass delousing capability using power delousers dispensing topically applied pesticides. However, body lice and louse-borne disease outbreaks occur sporadically worldwide in areas where U.S. Forces operate. Because louse-borne typhus is lifelong, humans are regarded as the primary reservoir for the bacteria (16). Social disruptions and population crowding due to natural disasters or political/military conflicts can result in the spread of body louse infestations among prisoners of war and displaced persons (i.e., refugees). With regard to military conflicts, Article 29 of the third Geneva Convention (1949) states that detaining powers shall take all sanitary measures necessary to prevent epidemics (1). U.S. military police units are charged with the responsibility to conduct internment and resettlement operations, and U.S. medical units are also involved in providing support in such situations. In addition to operating camps for enemy prisoners of war (EPWs), the U.S. military has responsibility for operating camps for civilians displaced by military actions or natural disasters. Military police typically operate such camps and they refer to such civilians as civilian internees (CIs), other detainees (ODs), or retained persons (RPs). Quartermaster units can provide field laundry and bath units to support such internment operations. Although military police, quartermaster, and medical units are responsible for dealing with refugees and other displaced persons and EPWs, they no longer have the capability to conduct mass delousing operations, and no clear guidance on louse control is currently available for their use. This document is intended to fill that guidance gap.

Louse infestations during WW I were common and concern about louse-borne disease was so great that, after the armistice in 1918, returning troops were deloused at ports of debarkation, where they were quarantined for 14 days. At the beginning of WW II, louse control procedures

had not progressed far beyond such techniques as dusting with NCI powder (96 percent naphthalene, 2 percent creosote, 2 percent iodoform) and smearing "vermijelli" (crude mineral oil, soft soap, and water, mixed 9:5:1) along the seams of clothing, a practice retained from WW I. In WW II, the delousing powder of choice was MYL, a mixture of substances with pyrethrins as the primary active ingredient, which was gradually replaced by DDT in 1943. The military's first multi-nozzle, gasoline engine-driven power delousing equipment was also developed and deployed at this time. (2)

Mass delousing machines were used during the Korean conflict. The failure of DDT to control body lice on prisoners of war and Korean refugees in early 1951 stemmed from louse resistance to this insecticide. Due in part to the development of resistance by body lice to DDT on a global scale, the DoD dropped DDT dust from the military supply system in 1965. It was replaced with lindane, which effectively controlled DDT-resistant lice and was included in the military supply system for that purpose. However, as early as the mid 1950s, reports of lindane resistance in body lice had begun to appear in various parts of the world (2). Nonetheless, lindane dust, which was a U.S. Environmental Protection Agency (EPA) registered product, was the U.S. Armed Forces standard delousing material until the 1990s.

In the early 1990s, the U.S. Army Medical Research and Materiel Command (USAMRMC) began looking for replacement delousing powders in an attempt to find safer and more effective alternatives to lindane dust. The DoD was advised by the Food and Drug Administration (FDA) on February 23, 1993 that any newly developed dusting powder or material intended to be applied directly on humans for the control of body lice would be considered a drug subject to regulation by the Federal Food, Drug and Cosmetic Act (3). The FDA regards new preparations offered for use as human pediculicides to be new drugs requiring an approved New Drug Application. The USAMRMC then asked commercial pesticide manufacturers to develop a product that could be licensed by the FDA for use in power delousing machines. No pesticide manufacturing company agreed to develop such an item, citing lack of a sufficient market in which to sell a product that would have to undergo an expensive developmental effort. On March 25, 1994, the AFPMB recommended that lindane powder be removed from the military supply system due to safety concerns over use of this product, which had been identified as a carcinogen. As no chemicals were either available or being developed for use in delousing machines, the AFPMB requested cancellation of the national stock number for power delousing equipment on May 29, 1997.

Although chemical dusts containing lindane, permethrin, and other chemicals are still used in other countries to control body lice, the DoD bases its treatment recommendations on products that can be used in the U.S. Even if a topical pesticide dust could be administered to infested personnel, the application of such chemicals to the skin of personnel who are very likely to have cuts, abrasions, or open lesions is ill advised. Currently, DoD relies on permethrin to treat uniforms to repel and control body lice on soldiers and prisoners of war. Permethrin-treated clothing has been shown to offer protection against body louse infestations, even after over 20 wash cycles (4). Testing of permethrin-treated uniforms with other biting insects (e.g., mosquitoes) has shown that the fabric continues to protect from bites through 50 wash cycles. DoD currently has three permethrin formulations registered with the EPA, including a process for

factory treatment of uniforms. However, no pesticides are registered with the U.S. Environmental Protection Agency for use in mass delousing. Therefore, the DoD cannot use pesticides in mass delousing to effectively treat louse-infested refugees or other displaced persons.

Although U.S. Forces possess the capability to protect themselves from disease through the use of permethrin-treated BDUs, louse infestations and louse-borne disease may be a threat in other populations for which the DoD must care (Appendix B). The DoD has responsibility for the health and welfare of prisoners of war and, on a short-term basis, may be responsible for displaced persons or refugee populations until non-governmental organizations can take over their care. Use of permethrin-treated BDUs or treatment of civilian clothing with permethrin may not be practical in these situations. Although international health organizations still propose mass delousing with pesticide powders to control epidemic louse-borne disease (Appendix C), the DoD no longer has that capability, so there is a need for an alternative treatment protocol. Additionally, although mass delousing of foreign nationals may be acceptable when conducted by a non-governmental organization, these intrusive procedures would likely not be tolerated when conducted by military personnel on peoples of other cultures.

Currently, the best alternative available to U.S. Forces for controlling louse-borne disease in populations such as prisoners of war and displaced persons involves therapeutic treatment of louse-borne disease in conjunction with control of lice through bathing infested personnel while cleaning their clothes using laundering regimens lethal to lice and their eggs. The International Committee of the Red Cross used this approach successfully in 1991 in Ethiopia subsequent to the civil war in that country (5). That control effort demonstrated that case treatment with antibiotics alone was insufficient to stop the spread of louse-borne relapsing fever. Only when delousing was also done was disease controlled. Camp staffs accomplished delousing by ensuring that prisoners of war bathed and by boiling their clothes for 30 minutes. Using these techniques, the number of soldiers deloused per day ranged from 490 to 1215 in a camp containing 18,628 soldiers awaiting repatriation. Though the laundering techniques used in Ethiopia were effective, they went well beyond the lethal time or temperature combinations needed to kill lice and their eggs. The Standard Operating Procedures for in-processing detainees in Afghanistan and Iraq between 2003 and 2011 included making detainees wear coveralls and providing routine medical care. This SOP was adequate to negate concerns about louse-borne disease. Similar SOPs would be adequate, unless the numbers of persons that had to be in-processed were large enough to overwhelm the system.

Another potentially effective tool to control body louse infestations associated with social disruptions is the use of oral ivermectin. Foucault et al. (17) demonstrated that ivermectin is effective in controlling body louse infestations. Ivermectin is currently used in the US to treat onchocerciasis, strongyloidiasis, ascariasis, trichuriasis, filariasis and enterobiasis, (http://www.pdr.net/drugpages/productlabeling.aspx?mpcode=52402845) and has been recommended as an off-label treatment for scabies and body lice. Ivermectin is used commonly in the developing world to treat these and other parasites. It is used in veterinary medicine to eliminate fleas and ticks. By administering 3 doses of 12mg each at 7-day intervals, Foucault et al. showed that the number of lice in a cohort of 33 homeless individuals fell dramatically from

1898 to just 15 in 14 days. Combined with current delousing techniques, therapeutic treatment with ivermectin could prove to be a useful and practical approach to control of louse-borne typhus outbreaks. It must be stressed that the use of oral medications would require a physician to make off-label prescriptions, which can only be done as part of direct care. The primary method of delousing recommended by this technical guide employs laundering. The remainder of this document provides guidance on laundering regimens which, when combined with bathing of lousy individuals, will result in delousing detainee populations.

4. Laundering and Temperatures Lethal to Lice

Buxton (6) conducted laboratory tests showing that louse eggs are killed after a 5 minute exposure to a temperature of 53.5^{o} C (128^{o} F) or a 10 minute exposure at 52^{o} C (126^{o} F). Busvine (7) proposed killing lice and eggs in clothing and blankets by immersing them in 60^{o} C (140^{o} F) water for 10 minutes, but gave no reason why he chose the higher temperature. Busvine also found that it would be necessary to expose infested clothes to *still* air at 70^{o} C (158^{o} F) for one hour to kill all lice and their eggs (= nits) due to the insulating properties of clothing materials, and suggested that improving air circulation would decrease the time markedly. Makara (8) showed that *circulating* air above 60^{o} C (140^{o} F) through clothing killed all stages of lice within 15 minutes. He also stated that temperatures of 60^{o} C will kill lice and nits in seconds and added that immersion in water hotter than 70^{o} C for one second is enough to kill lice and nits. Todd (9) conducted laboratory experiments that indicated that the lethal temperature for body louse adults and nits exposed to heated water for 15 minutes lies between 46 and 51.5^{o} C (115-125^{o} F).

These studies show that washing lousy clothes for at least 15 minutes at 54^{o} C (130^{o} F) or hotter is sufficient to kill all life stages on them. As washed clothes must be dried, drying clothing items in a tumble drier that circulates air through the clothes at 60^{o} C (140^{o} F) or hotter for about 15 minutes provides additional assurance that all lice and their nits will be killed. These temperatures are easily achieved in home as well as industrial laundering cycles intended for most fabrics. Increasing temperatures above those cited would further ensure that all life stages of lice are killed and allow for shorter exposures to hot air or water. For example, wash time could be decreased to 10 minutes at 60^{o} C (140^{o} F), or 5 minutes at 70^{o} C (158^{o} F). Drying time could be decreased to 10 minutes at 70^{o} C (158^{o} F), or 5 minutes at 77^{o} C (170^{o} F). All these time recommendations assume that efficient circulation of air/water occurs to ensure all parts of the infested cloth are exposed to the proper temperature for the appropriate time.

Woolen items present a challenge because not all of them can be laundered in water and those that can must be washed in water that usually should not exceed 32^{o} C (90^{o} F), which is below the lethal temperature for lice and their nits. However, many fabrics, including woolens, can be dry cleaned, and dry cleaning processes kill all louse life stages (6) (10).

Body lice are quite tolerant of cold temperatures. Busvine (7) reported that exposure of louse eggs to temperatures of -20^{o} C (-4^{o} F) for 5 hours was needed to kill them all. This fact makes use of cold temperatures to disinfest lousy clothing impractical.

A more recent study on lice mortality after immersion in water was conducted by Mumcuoglu et. al. (15) and showed that all lice died after immersion in 10 ml of tap water within 19 hours. In terms of removing body lice from infested clothing and bedding, this alternative to insecticides could be used if infested items are immersed for 24 hours or greater.

Current U.S. military (e.g., U.S. Army) field laundry systems can achieve maximum washing temperatures of about 71^{o} C (160^{o} F) and drying temperatures in excess of 71^{o} C (160^{o} F) (11). In addition, drying uniforms at an operating temperature of 60^{o} C (140^{o} F) for 15 minutes will kill lice and nits. The wash cycle intended to prevent shrinkage and fading of battle dress uniforms (BDUs) does not exceed water temperatures of 43^{o} C (110^{o} F). However, as BDUs can be treated with permethrin, this limitation should not pose a problem because infestations will not occur in treated items, and cleaning BDUs (even at cool temperatures) and then treating them with permethrin will kill all louse stages on the uniforms. The cleaning cycles intended for military woolen items achieve only marginally lethal temperatures (49^{o} C (120^{o} F)) and this only in the drying cycle, which can be quite short for such items. Thus, military field laundry systems have the washing cycles able to achieve temperatures sufficient to kill lice and nits on civilian clothing items excluding those made of wool.

5. Prevention and Control

a. Primary and Secondary Prevention of Louse-borne Disease

An effective control program for louse-borne disease should start with both primary and secondary preventive measures. Primary measures serve to reduce the chance that cases of louse-borne disease will occur, whereas secondary prevention focuses on treating the disease when it does occur. Medical personnel need to provide oversight and participate as required to ensure that an effective louse-borne disease prevention program is executed. Individual delousing can be accomplished with laundering and bathing procedures and should be augmented with permethrin treatment of clothing whenever possible. These procedures are based in part on a strategy that first proved successful in Naples in 1943, prior to the use of mass delousing operations (Appendix C), and consists of the following steps:

Primary Prevention

-Initial screening

-Case finding

-Isolation

-Contact delousing

Secondary Prevention

-Treatment of patients with louse-borne disease

(1) Initial screening. DoD regulations (12) on the operation of internment camps for EPWs and other retained persons direct that a medical officer examine each new internee upon arrival at a camp and monthly thereafter. Internees are not to be admitted into the general camp

population until their medical fitness is determined, in part through examinations to assess the state of health, nutrition, and cleanliness of each internee and to detect vermin infestation and communicable diseases. Part of the medical processing that is normally accomplished after arrival includes a physical inspection, during which time the presence of head and body lice can be determined (13). Personnel infested with body and head lice should be segregated from those who are not until delousing can be accomplished. Segregation should not separate family units. See "Delousing Procedures" below for details.

(2) Case finding. Determination of the presence of body lice during the screening phase should trigger close monitoring of the at-risk population by the medical staff to identify cases of louse-borne disease as soon as possible. Identification of cases of louse-borne disease must be based on case definitions established by the medical staff. Delousing of infested personnel should proceed as soon as possible, but, in the absence of louse-borne disease, the infestation should be viewed as a sanitation issue, not a medical emergency issue.

(3) Isolation. Military field manuals implementing the DoD regulations on the operation of internment/resettlement camps direct that all internees suspected of having communicable diseases must be isolated from the general population for examination by a medical officer (13). However, if louse-borne disease is confirmed, isolation of patients from other people is *only* required until the patients and anyone they may come in contact with are deloused. The diseases in question (louse-borne typhus, epidemic relapsing fever, trench fever) are not transmitted from person to person, but by lice only, so once a patient is deloused, there is no need to keep them isolated from other, uninfested people. Thus, if the logistical system is temporarily overloaded and camp inhabitants cannot all be deloused, then deloused patients must only be isolated from infested individuals to prevent their re-infestation and possible further transmission of a disease. Deloused and louse-infested personnel should not be allow to mix, irrespective of whether or not they have a louse-borne disease, because re-infestation of personnel would result in further loading of the logistical system. When isolation must be accomplished, family units should not be separated.

(4) Contact delousing. Immediate contacts of patients should be given priority for delousing and isolated following the same guidelines for isolation of patients discussed above. See "Delousing Procedures" below for details. If head lice are present, they should be treated following standard medical protocols for that pest. Medical personnel should observe contacts for the maximum incubation periods of the louse-borne disease they are suspected of having. These are 14 days for louse-borne typhus, 15 days for relapsing fever, and 30 days for trench fever (14).

(5) Treatment of patients with louse-borne disease. Patients identified using the case definition developed by the local surgeon should be deloused and then treated for the particular louse-borne disease present with an appropriate therapeutic regimen. Although pediculicide shampoos are available for treating head lice (which live on head hair), they have little effect against body lice (which live on the victim's clothing). If head lice are present, they should be treated following appropriate medical protocols for treatment of those pests. Body louse eggs or nits, which are deposited in the seams of clothing, are unaffected by shampooing the hair or

bathing the body, so delousing must include treatment of clothing. See "Delousing Procedures" below for details.

b. Delousing Procedures

Control of body louse infestations is the first step in preventing outbreaks of louse-borne disease. Body louse control should be accomplished by removing patients' clothing and laundering it and any bedding they may possess. As a protective measure, anyone handling louse-infested clothing or materials should, at a minimum, use the DoD Insect Repellent System (Appendix E) and wear surgical gloves. Laundry personnel should also wear protective gloves, surgical masks, and possibly rubber waterproof aprons when handling infested items (11). Infested clothing should not be stored on or near un-infested cloth materials or handled by unprotected personnel.

Once they are deloused, no extraordinary measures are needed to delouse patients' bodies other than a normal shower and shampoo because body lice live and lay eggs on the clothes, not the body. If head lice are present, standard protocols for their control should be enacted. Whenever possible, cleaned clothing should be impregnated with permethrin using methods currently available in the DoD supply system (Appendix D) to prevent re-infestation by lice.

Washing clothing in cycles that provide water at a minimum time and temperature of 15 minutes and 54^{o} C (130^{o} F) is adequate to kill all lice and nits on clothing materials. Ensure that washing machines are not overloaded so that agitation is sufficient to thoroughly wet all layers of the clothing materials in the load with hot water for the minimum time and that insulating bubbles are dispelled from the fabrics. If the efficiency of agitation or wetting of clothing by the machine is suspected of being sub-optimal, hotter temperature water and/or longer exposure times should be used to ensure louse and nit mortality. Woolen items often cannot be laundered in water, and those that can must be washed at temperatures that are not lethal to lice or their nits. However, woolens can often be dry cleaned, which kills all louse life stages.

If laundry facilities are not available or are overwhelmed with the volume of clothing to be deloused, manual methods may be used. For example, manually soaking clothing materials in field-expedient hot water baths will also result in delousing of the items immersed. However, care must be taken that water temperatures are maintained at 54^{o} C (130^{o} F) or higher for at least 15 minutes and that manual agitation is done to ensure that all cloth surfaces are rapidly saturated and that insulating air bubbles are dispelled from the fabric.

Drying clothing items in a tumble drier that circulates air through the clothes at 60^{o} C (140^{o} F) or hotter for 15 minutes will also kill all louse life stages and so provides additional assurance that all lice and their nits are killed. If mechanical driers are unavailable, washed clothes may be air dried provided that lethal times and temperatures were achieved in the washing cycle.

A field-expedient method of using air temperature to kill lice may be available in hot, sunny environments. This could involve such approaches as hanging infested clothes in a "hot house" structure, such as a metal shack, where internal temperatures reach or exceed 70^{o} C (158^{o} F) or

higher for at least one hour. Because there is essentially no air circulation in such structures, an extended time is needed to ensure lethal temperatures are achieved at the center of all clothing items.

The bottom line on field-expedient methods is that *so long as the minimum lethal time and temperature regimens are reached throughout all portions of the infested clothing* a wide variety of innovative methods could be used.

Dry cleaning processes also result in delousing of clothing materials. This process is particularly useful for delousing woolen items.

Unfed body lice can reportedly live for no more than 10 days off the human body. This length of time is due in part to environmental temperatures off the human body that may lead to death. However, lice at the center of a mass of clothing may, under the correct conditions, survive for nearly a month. Therefore, the method of setting clothing aside to wait until all lice and nits die is impractical. Further, as the sanitation standards of EPW and displaced persons camps must be maintained at high levels, this method of louse control is not an option.

6. Summary

Control of louse-borne disease depends on a coordinated effort among operational, logistical and medical organizations to identify body louse infestations in EPW and displaced persons populations under DoD control. DoD can no longer control body lice by dusting infested personnel with pesticides. Field laundry units or contractors can dry clean, or wash and dry clothing at times and temperatures lethal to lice and their eggs, which is the method of control to be used for delousing clothing items. Clinicians will determine louse-borne disease surveillance techniques, case definitions and therapeutic regimens for the treatment of patients.

Humanitarian operations involving tens of thousands of people will quickly overwhelm military assets, so early planning is necessary to get assistance from host nation and other non-governmental organizations to accomplish the mission. Contracting laundry and bath support from civilian sources will have to be an option included in the contingency plans for any such operations.

APPENDIX A - References

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12. U.S. Army Regulation (AR) 190-8/OPNAVINST 3461.6/AFJI 31-304/MCO 3461.1, *Enemy Prisoners of War, Retained Personnel, Civilian Internees and Other Detainees*, 1 November 1997.

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APPENDIX B - DoD Responsibility for EPWs, Displaced Persons, and Refugees

The DoD responsibility for caring for the health and welfare of enemy prisoners of war (EPWs), displaced persons and refugees is documented in a number of DoD and Service publications, some of which are annotated below.

Joint Pub 3-07, *Joint Doctrine for Military Operations Other Than War*, 16 June 1995.
Paragraph IV.2.l (Medical Ops) states that when planning for MOOTW, the potential to treat the host nation indigent population or allied military personnel must be considered. The respective capabilities of allied, civilian relief, or other supporting medical forces should be considered prior to finalizing the medical support concept.

Joint Pub 4-02, *Doctrine for Health Service Support in Joint Operations*, 30 July 2001.
Chapter II, paragraph 5.c, states that the Joint Force Surgeon (JFS) is responsible for recommending and monitoring preventive medicine and care provided to the civilian population and other beneficiaries. The JFS is also to keep the combatant commander appraised of the status of and assistance required by and provided to the civilian populace, enemy prisoners of war (EPWs), nongovernmental organizations (NGOs), and international organizations (IOs). The JFS also advises supporting civil affairs forces on humanitarian and civic assistance (HCA) activities within the theater.
Chapter II, paragraph 2.i., states that in consonance with provisions outlined in the Geneva Conventions, EPWs held by US forces are afforded the same level of Health Service Support as U.S. forces.
Appendix E, paragraph 1.f., states that medical obligations under international law will be particularly crucial to the management of non-force personnel such as EPWs, civilian refugees, detainees, and non-force combatants. HSS plans must detail the degree of care offered to these groups and how continuity of care is to be provided, when needed.

AR 190–8/OPNAVINST 3461.6/AFJI 31–304/MCO 3461.1, *Enemy Prisoners of War, Retained Personnel, Civilian Internees and Other Detainees*, 1 October 1997.
This publication is the DoD regulation guiding the operation of camps where a variety of non-DoD personnel might be detained.
Paragraph 6-6 relates to civilian internees and states that the medical officer is responsible for detecting vermin infestation and controlling communicable diseases.

APPENDIX C - Review of Methods of Controlling Body Louse Infestations

The following are some methods that have been used or are currently recommended for use in controlling epidemics of louse-borne disease by various health organizations.

U.S. Army, 1943: An effective protocol for controlling epidemic typhus was used as early as 1943 in combating the typhus outbreak in Naples, Italy (1). Its most important components included:

-case finding
-isolation
-removal of patients to hospitals
-contact delousing

Although mass delousing was credited with averting outbreaks of typhus in other populations in Europe in 1944-45, it is important to note that the four steps listed above, rather than mass delousing or vaccination, were deemed responsible for stopping the 1943 Naples epidemic (2).

World Health Organization, 1997 (3):

-Exposure of infested clothing to heat to kill lice and nits, or
-Individual or mass delousing of people using pesticide dusts
-Impregnation of clothing with a pesticide such as permethrin
-Observation of louse-infested persons exposed to typhus fever for 15 days after application of an insecticide with residual effect
-Surveillance of all immediate contacts for two weeks
-Thorough chemical delousing of clothing of fatal victims of louse-borne typhus
-Treatment of cases with antibiotics

[Note: This fact sheet states "The easiest control method of occasional infestations is to expose infested clothing to a minimum temperature of 70 degrees C for at least one hour." However, this statement does not clarify whether exposure is in air or water. Exposure to hot air requires far more time than hot water due to the insulating properties of clothes against air. Water penetrates clothing far faster and reduces the lethal exposure time to a fraction of that needed when using air alone.]

Pan American Health Organization, 1982 (4):

-The method of choice is that of mass delousing of the population with insecticide dust delivered by a compressed air duster. Use of shaker cans will also suffice.
-Clothing fumigants can be used if the fumigation is supervised by properly trained personnel.
-Mass laundering of clothing is effective only if a water temperature of 52 degrees C or more can be maintained. [Duration of exposure to temperature not stated]

American Public Health Association, 2008 (5):

-Prophylactic hand or power dusting of at-risk populations with pesticidal dusts, or impregnation of clothing with residual insecticide. NOTE: There are currently no pesticides registered with the Environmental Protection Agency that are labelled for use in mass-delousing. Therefore mass delousing cannot be done by U.S. personnel. Personal communication (LCDR Brian F. Prendergast) with preventive medicine personnel from NATO nations participating in the war in Afghanistan showed that none of those nations could legally use pesticides for mass delousing.
-Improvement of living conditions and provision of bathing and laundering facilities
-Quarantine of infested contacts for 15 days after application of residual insecticide
-Surveillance of contacts for 2 weeks
-Treatment of cases with antibiotics

Ethiopia, 1991: The Ethiopian civil war in the early 1990s resulted in a situation where mass delousing (not conducted by U.S. personnel) was deemed necessary and involved 48,628 prisoners of war (6). That International Committee of the Red Cross operation demonstrated that case treatment with antibiotics alone was insufficient to stop the spread of louse-borne relapsing fever. Only when delousing was also done was disease controlled. Delousing was accomplished by bathing prisoners of war and boiling their clothes for 30 minutes. Using these techniques, the number of soldiers deloused per day ranged from 490 to 1215. This study clearly showed that case treatment with antibiotics must be combined with delousing operations to stop the spread of louse-borne disease (7).

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APPENDIX D - Permethrin Impregnation Methods Available in the DoD Supply System

NOTE: Technical Guide (TG) 36, *Personal Protective Techniques Against Insects and Other Arthropods of Military Significance*, should be consulted for detailed information on the proper use of these products. TG 36 is available at the Contingency Operations page of the Armed Forces Pest Management Board's Web site: http://www.acq.osd.mil/eie/afpmb

NSN 6840-01-345-0237: INSECT REPELLENT, CLOTHING APPLICATION, IDA KIT, 40% permethrin, 12 kits/box; Click here to check the Contingency Pesticide List for current cost. Each kit treats one complete camouflage uniform (blouse and trousers). This technique involves placing each component of a complete BDU set in a re-sealable plastic bag containing the permethrin solution. After two hours, the clothing items are removed from the pouch and hung to dry. The process results in a permethrin treatment that lasts the life of the uniform. Per treatment cost is about $3.50 per uniform.

NSN 6840-01-334-2666: INSECT REPELLENT, CLOTHING APPLICATION, 151-ml bottle, 40% permethrin liquid, 12/btls/bx; Click here to check the Contingency Pesticide List for current cost. Each bottle provides sufficient permethrin to treat up to eight complete camouflage uniform (blouse and trousers). The resulting permethrin treatment lasts the life of the uniform and costs about $1.70 per uniform. However, this is logistically the most difficult and potentially environmentally contaminating process. Certified pesticide applicators must conduct the process, and excess pesticide running off the uniforms during treatment must be contained to prevent environmental contamination.

NSN 6840-01-278-1336: INSECT REPELLENT, CLOTHING APPLICATION, AEROSOL, 0.5% permethrin, 12/6 oz cans/box; Click here to check the Contingency Pesticide List for current cost. Each aerosol can of this product treats one complete camouflage uniform (blouse and trousers). The application lasts only about six weeks or six washings. Thus, although the per treatment cost of this item is the lowest of the available methods (about $3/treatment), it is the most costly in the long term because multiple treatments need to be performed to provide coverage for operations in excess of six weeks.

Factory-treated Uniforms: At the time of this writing, the Army is fielding the Fire Resistant Army Combat Uniform - Permethrin (FRACU-P) and the Multi Cam uniform to service members deploying in support of combat operations. Both of these uniforms are treated at the factory during production. The Army Combat Uniform (ACU) remains untreated at the time of this writing and cannot be effectively treated with permethrin. The Marine Corps Combat Utility Uniform (MCUU) is also treated at the factory. However, the Fire-retardant MCCU (sometimes referred to as Fire-retardant Outer Gear or FROGs) are not treated with permethrin. The Navy working Uniform (NWU) types I, (blue) II (desert) and III (woodland) are not treated at the factory and should be treated after-purchase.

APPENDIX E – Useful Links

Click here to open the USAPHC Fact Sheet on the DoD Insect Repellent System

Click here to open the USAPHC Fact Sheet on Louse-Borne Typhus (Jan 2010)

Click here to open the National Center for Medical Intelligence site (formerly AFMIC)

Click here to open the Centers for Disease Control and Prevention link on typhus