Special Operations Individual Medical Equipment Part 2 – The In-Use and Survival Medical Kits

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ABSTRACT

Special Operations Forces (SOF) Operators need a variety of individual medical items that can generally be broken down into three types of medical kits: a major trauma kit, to treat major traumatic wounds; an in-use medical kit, to prevent or treat anticipated common medical conditions during operations; and a survival medical kit, to treat minor injuries and ailments when in a survival/evasion situation.

Aim

The aim of this article, the second in a two-part series, is to provide insight on how to custom-build an individual in-use medical kit and survival medical kit for SOF.

Operational Requirements

An in-use medical kit allows SOF Operators to prevent or treat injuries and ailments likely to occur and require immediate attention, or to prevent potential mission-degrading medical conditions on a routine basis. A survival medical kit should allow a SOF Operator in a survival/evasion situation to treat a reasonable range of anticipated injuries and ailments in order to allow him the ability to evade back to friendly positions or await recovery. These kits should be small, durable and light.

Conditions For Use

The kit allows a SOF Operator to provide basic self-care without having to rely on the team medical pack or when no collective medical supplies are available, i.e. when a team is split to conduct a short-duration task without a medic.

Contents from a survival medical kit should only be used when in a survival/evasion situation, i.e. when an SOF Operator is definitively separated from his team, if evading with others, or when cut-off from any collective medical supplies, such as those carried in the team medic's medical pack.

Criteria For Selecting Kit Contents

The kits should meet the operational requirements listed above. A balance should be sought between light weight and compactness on the one hand, and comprehensiveness on the other. A sensible approach is to limit kit contents to items most likely to be needed and those of greatest importance.

During mission execution or when evading, SOF personnel may find themselves in remote areas, encountering environmental hazards similar to those faced by wilderness travelers.[1] Based on this assumption, identifying the most common medical problems encountered during wilderness travel will help to select kit contents, realizing that tactical considerations should be taken into consideration. Invaluable additional information may be available from classified sources, such as survival, evasion, resistance, and escape (SERE) products.

Various common medical problems have been reported during outdoor activities, including foot blisters, gastrointestinal disorders, cuts, abrasions, bites, stings, infections of the skin and upper respiratory tract, musculoskeletal injuries, and pain/aches.[2-12] Contents should reflect health threats specific to the theatre of operations, e.g. altitude and endemic diseases, as well as specific personal medical requirements, such as allergies. Temperature range and humidity are also important considerations, e.g. certain medical products do not remain stable in hot humid climates, although conclusive data is not readily available for most medications.[13]

Other factors dictating the kit's contents are the individual's level of medical proficiency and the availability of controlled medicines. As a survival medical kit is intended to be used by an isolated individual, this shouldn't contain any items that cannot be used on oneself.

Possible Contents

Taking into account the above criteria, possible contents are listed as follows:

Wound cleansing items

Wound cleansing materials have to be included in order to prevent wound infection. Several survival

manuals recommend potassium permanganate to be included as an antiseptic, due to its potential use for other applications as well,[13-16] but its effectiveness is seriously questioned.[17] Even for more commonly used antiseptics such as povidone iodine and chlorhexidine, there seems to be no consensus as to their advantage to clean a contaminated wound.[18,19] Apart from their questionable effectiveness, there is some concern over the safety of antiseptics on open wounds, as they may be toxic to cells essential to wound healing, although this may be dependent on the concentration.[20,21]

Whereas data on the effectiveness of antiseptics remains inconclusive at best, it seems to be much more accepted that wound irrigation is an effective and preferred method for wound cleansing.[22-24] When using water to irrigate a wound, potable water seems to be adequate, if not better, than normal saline.[25-32]

Pressure required for irrigation is an important consideration; forcefully injecting the irrigant solution with a syringe through an 18 to 20 gage plastic catheter (without the needle) held about ½"-1" from the wound, generates sufficient pressure.[33-36] Low pressures generated by piston syringes without a catheter or by bulb syringes, are not adequate.[37,38] Specially designed irrigation syringe tips are commercially available. (Figure 1) One model integrates a shield to protect against splashes. While it works well, this protection is not required for self-aid, in addition, the device is bulky and being made of polystyrene, it is relatively fragile.

Figure 1: *Irrigation syringe with dedicated and improvised 18g tips*

Although the optimal volume required is unknown,[39] at least 100-300ml may have to be used until visible contamination is removed.[40] These amounts of water fall within the limits of what can realistically be expected to be carried by dismounted individuals.

Wound irrigation is probably as effective as cleaning a wound with gauze swabs,[41] which along with tweezers, may still be required if embedded particles cannot be removed by irrigation.[42]

Wound dressings and tape

It is recommended that once a wound has been cleaned it should be covered with a dressing to prevent further contamination. Traditional wound dressing materials include non-adherent dressings (as an initial layer), gauze pads (to absorb wound exudate) (Figure 2), and bandages, as well as adhesive tape or retention

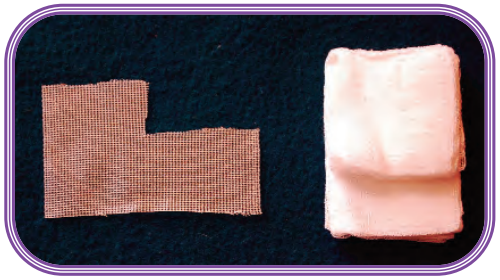


Figure 2: *Non-stick dressing (left) and gauze pads (right)*

sheets, to keep the dressings in place and further protect wounds. For small wounds, combined adhesive dressings/bandages are more convenient.

Protecting wounds from the environment with traditional dressings is not easy, and even when kept dry, they should be changed regularly. Moisture vapor permeable adhesive film dressings (consisting of a thin vapor-permeable polyurethane film sheet, coated with an adhesive) can be applied to superficial wounds with minimal exudate, and can also be used as a secondary dressing to keep other dressings in place.[43] (Figure 3) Hydrocolloid dressings (which are thicker and contain gel-forming agents that absorb liquid and keep the wound hydrated) are better able to cope with wound exudate production.[44] (Figure 4) Both types are impermeable to micro-organisms and liquids and can remain in place for several days. Some are individually sealed in a waterproof package, some also have integral gauze pads (providing an all-in-one composite dressing), and some provide enhanced adhesion for use in hot and humid environments. These dressings should be large enough to adhere to the skin up to about an inch from the wound edges.

Figure 3: *Adhesive film dressings*

Figure 4: *Hydrocolloid dressing*s

While some wilderness medicine handbooks mention a requirement for primary dressings to be sterile,[45,46] other manuals simply recommend clean dressings.[47,48] The benefits of more expensive sterile over non-sterile dressings are far from clear.[49,50]

Figure 5: *Blister dressings*

Although specifically designed primary and secondary dressings exist to preventively mask friction-prone skin areas and/or to cover them following development of blisters, the aforementioned moisture vapor permeable adhesive film and hydrocolloid dressings can be used to prevent and treat blisters as well. (Figure 5) When selected to be used on feet, many have to be covered with tape to keep them in place and/or to protect them from friction.

Tape can also be used on its own to prevent blisters. Sheets, such as self-adhesive, non-woven fabric dressing retention sheets, or tape rolls with a peel-off backing, are much more convenient than most rolls of tape where the tape sticks to itself, as the required amount and sizes can easily be cut and stored flat, thus usually taking significantly less space, while they can also easily be split over different kits or kit components. (Figure 6)

Figure 6: *Self-adhesive tape and dressing retention sheets with peel-off backing*

For the surface closure of cuts, wound closure strips are useful, and often preferred to anything else.[51,52] They take up less space than specially designed butterfly bandages, although both can be improvised using other types of adhesive tape.

Skin adhesive

In order to improve the adhesive power of tape, wound closure strips, and blister dressings, a skin adhesive may be required. Compound tincture of benzoin, or Friar's balsam, is widely used, but may not always be able to sufficiently augment adhesion in wet environments.[53] Preparations containing gum mastic reportedly provides better adhesive strength than those based on benzoin.[54,55] (Figure 7)

Skin cleaning fluid

An alcohol-based skin cleaning fluid is useful to clean the skin before applying adhesives so they will stick better. Some types are claimed to also toughen the skin, which is useful as a blister prevention measure,[56] but firm data confirming this characteristic is lacking.

Figure 7: *Gum mastic (left) and compound tincture of benzoin (right) skin adhesives*

Foot powder

Foot powder may help to prevent friction blister formation on feet. Many types are only of benefit for a short while and actually increase the occurrence of blister formation when used longer than one hour, while aluminum-containing antiperspirants may work better for long-duration use.[57] Foot powder is also useful when using tissue adhesives to reinforce blister dressings, where it can be sprinkled after applying the dressing, in order to neutralize any adhesive extending beyond the margins of the dressing, preventing socks from sticking to the skin or to the dressing[58].

Lubricants

Lubricants are useful to prevent or alleviate the painful effects of chafing by clothing or equipment against the skin, which depending on the individual, typically occurs on the inner thighs when sweating heavily or when clothing gets wet from rain. Care should be taken when selecting a product that is intended primarily to be applied to the feet, as just like some foot powders, they may increase the incidence of blisters during long-duration activities.[59] Bottles with a roll-on applicator are often bulky and heavy and may easily leak their greasy contents. A semi-solid lubricant such as petroleum jelly (petrolatum, soft paraffin) is more convenient and can also be used to protect the lips from the wind, or to soothe cracked skin. Vaseline gauze can be used for treatment of injuries and can also serve as a candle when needed.

Analgesics

Different types of painkillers should be carried. An antipyretic analgesic provides relief for minor pain, and also reduces fever. Acetaminophen (called paracetamol in Europe) is the usual drug of choice. Acetylsalicylic acid (aspirin) is to be avoided, as it acts as a blood thinner (impeding blood clot formation in case of bleeding) and is more easily affected by heat and humidity. Anti-inflammatory analgesics provide relief for mild to moderate pain, and are useful for musculoskeletal pain such as sprains and bone injuries. Traditional non-steroidal anti-inflammatory analgesics, such

as ibuprofen, also interfere with the blood's ability to clot and are better replaced by newer types such as meloxicam. For moderate to severe pain, a stronger analgesic may be added.

Antidiarrheals

As diarrhea is a very common outdoor problem, it is important to carry bowel motion inhibitors such as loperamide. While these only treat the symptoms of diarrhea and not the underlying cause, their usefulness lies in the fact that they limit the number of stools, an important consideration while on the move.

Antiemetics

Antiemetics are especially useful where there is a risk of dehydration, if vomiting interferes with fluid intake, or to prevent vomiting (as an anticipated side-effect) prior to taking other medication such as some antimalarials.[61]

Antitussives

Coughs are a common symptom associated with respiratory infections that are rarely life-threatening and usually self-limiting.[62] While symptomatic treatment may not be medically necessary, tactical considerations may require antitussives to be carried. Codeine phosphate is commonly used as an antitussive. It can also be used as an analgesic (alone or in combination with acetaminophen, providing stronger analgesia than either acetaminophen or codeine alone), [63] or to treat diarrhea.[64,65]

Antibiotics

Oral antibiotics to treat (bacterial) diarrhea are routinely recommended for travelers going to tropical/remote areas,[66, 67] and often antibiotics for skin infections and for respiratory infections are recommended as well.[68,69]

Once antibiotic treatment is started, it is important to take a full course, often continuing for at least a couple of days after the signs and symptoms of infection have disappeared. Depending on tablet/capsule size and the number of daily doses required, this means that antibiotics can take up considerable space, so ideally, a single broad-spectrum antibiotic should be selected. Quinolones such as ciprofloxacin or levofloxacin may be effective to treat all the aforementioned infections, but more than one antibiotic may be required in case of quinolone allergy.[70,71] An additional advantage of ciprofloxacin is its stability long after the manufacturer's expiration date, even under hot and humid conditions.[72]

Although included in recommended personal medical kit lists of several wilderness medicine handbooks,[73] topical eye antibiotics should not be generally included in individual medical kits, as using them for the wrong disorder might do more harm than good.[74] Correct self-diagnosis of eye disorders by non-medical personnel is difficult in the field, and even if the knowledge was present, several diagnostic items would still be required.[75]

Antihistamines

Antihistamines are useful for treating the symptoms of allergic reactions, especially after insect bites and stings. Although some survival manuals recommend antihistamine cream to be carried,[76] topical antihistamines can cause skin sensitization and may be less effective,[77] so it is better to select a long-lasting non-sedating oral antihistamine (e.g. cetirizine).

Antimalarials

Malaria is an infectious disease that occurs in those (sub)tropical areas in which *Anopheles* mosquitoes are present. Depending on the risk in the operational area (which may vary according to exact location, altitude, and season), antimalarials may have to be taken prophylactically, in addition to other measures, as no single preventive measure is 100% effective. The exact type depends on several factors, including the geographical area and individual tolerance, and will have to be tailored to each individual.[78] As acute severe *falciparum* malaria is a medical emergency,[79] antimalarials for emergency self-treatment should be carried as well. They may be different from the drugs to be taken prophylactically.

Oral rehydration salts (ORS)

ORS sachets contain a balanced mixture of dry salts and carbohydrates, used to treat dehydration and sodium and potassium depletion due to excessive perspiration or diarrhea. While glucose-based ORS help maintain hydration, ORS containing rice-based complex carbohydrates are a better choice, as they also decrease stool volume, shorten the duration of diarrhea, and more effectively promote water absorption.[80-83] (Figure 8)

Figure 8: *Glucose-based (left) & rice-based (right) oral rehydration salts*

Insect repellent

Besides being a nuisance, insects can transmit many diseases and their bites usually cause local swelling and itching, which in turn may lead to secondary skin infection due to scratching. The use of insect repellent is an essential part of personal protective measures to avoid insect bites,[84] although it does not protect against stinging insects, such as bees and wasps.[85] Repellents containing KBR 3023 or containing DEET (N,N-diethyl-3-methylbenzamide, previously called N,N-diethyl-m-toluamide) work well, but many products containing essential oils (e.g. citronella) as the active ingredient, are only effective for a short while at best.[86] Higher DEET concentrations provide longer-lasting protection, but the increase in duration is disproportional in concentrations above 50%. Extended-release DEET formulations can prolong the protection without increase in concentration.[87] As repellents are unable to protect skin more than 4cm away from the application site,[88] correct application implies covering all areas of exposed intact skin, while ensuring they don't come into contact with the mouth, the eyes, open wounds, irritated skin, and in the case of DEET, also plastic spectacles or watches. Repellents are affected by environmental effects such as exposure to heat and humidity, so a large enough supply should be carried so it can be reapplied regularly.

Water disinfection tablets

While cooking might be the best option to kill harmful micro-organisms in water, this is often not possible in an evasion scenario, so water disinfection tablets should be carried. If a water filtration system is carried, additional treatment with chemicals will almost always be required anyway, since most filters alone cannot reliably remove viruses. Large-capacity individual systems that provide adequate disinfection are usually too bulky to be routinely carried on the body, Disinfection tablets provide a useful alternative in an evasion scenario, for almost no space/weight penalty.

Chlorine or iodine tablets are a traditional choice, but although effective against bacteria, viruses, and most protozoa, including highly resistant giardia lamblia cysts,[8,9,90] they are not effective at practical doses and contact times against omnipresent and diarrhea-causing cryptosporidium oocysts.[91,92] In addition, when using chlorine or iodine tablets, prior filtration to remove suspended particles will usually be required due to these disinfectants' reaction with organic material, leaving a reduced concentration available for disinfecting the water being treated. Either a dedicated device (e.g. Millbank bag) or an improvised filter will then have to be used. Portable water filters with sufficiently small pore sizes can eliminate cryptosporidium cysts, but may rapidly become clogged, if used to filter debris.[93]

In spite of recommendations found in some survival manuals, potassium permanganate has no proven record of efficacy, while there are concerns over its toxicity.[94] Tablets containing silver ions as the only active ingredient are only effective against bacteria,[95] not against viruses and protozoa, and are merely intended to protect stored drinking water against (re)contamination. However, most waterborne pathogens, including cryptosporidium, can be inactivated by chloride dioxide,[96,97] which can now be generated easily from relatively small tablets, providing a convenient water disinfection option in the field. If intelligence indicates that chemical pollution is present, a system integrating a carbon filter may be required.

Dental cavity filling

A temporary dental cavity filling is useful to treat toothaches caused by lost fillings or damaged teeth.[98,99] The basic materials used for temporary fillings are zinc oxide and oil of cloves (eugenol), which will have to be mixed.[100] A very small tube containing a single material which hardens after contact with humidity (saliva) takes less space and is easier to use than a multi-component mixture.

Tweezers

Tweezers with a fine point are very useful in many environments to remove ticks or embedded objects (e.g. thorns, wood splinters) from the skin. (Figure 9)

Bite/sting suction device

In spite of manufacturers' claims and previous recommendations to use a mechanical venom suction

Figure 9: *Tweezers*

device immediately following snakebite,[101] there seems to be no scientific proof that sufficient venom is removed to make any difference.[102] While it also hasn't been proven that suction is harmful to humans,[103] there are some concerns that the concentration of venom under the suction cup may cause massive tissue necrosis.[104] The lack of evidence that it really works, means that carrying this relatively bulky device should be considered only if it is felt that it may be of psychological benefit, realizing that other treatment options, which may be fairly limited when isolated, should not be delayed by its use.

High-altitude medication

For high-altitude patrols, oral medications to deal with altitude-related illnesses should be carried by all patrol members.[105] Commonly used medications include acetazolamide (125mg tablets/capsules), nifedipine (20mg slow-release tablets/capsules), and dexamethasone (4mg tablets/capsules). While these are the medications of choice for prevention and/or treatment of acute mountain sickness, high-altitude pulmonary edema, and high-altitude cerebral edema, recommended combinations and dosages may vary, depending on local treatment protocols. Many protocols can be followed with the aforementioned doses, but sometimes taking multiple tablets or half tablets may be required in order to do so. For the treatment of high-altitude pulmonary edema, an additional single sublingual nifedipine 10mg dose (to be taken together with the first extended release dose of nifedipine) may be added, but, while recommended by some,[106,107] it is discouraged by others.[108]

Vitamins and minerals

Vitamin and mineral supplements are not normally required for healthy, fit, well-fed men, but supplements from selected micronutrients may be beneficial when a well-balanced diet is not available or during sustained operations in extreme environments, especially in cold weather, at high altitude, or when diving (Table 1).[109] Since it is hard to find single tablets or capsules containing only the exact amounts of recommended vitamins and/or minerals, supplements may include other vitamins and/or minerals as well, provided neither iron nor copper are included,[110] and tolerable upper intake levels (i.e. an estimate of the highest level of intake without appreciable risk of adverse health effects) are not exceeded.

Recommended Daily Vitamin and Mineral Needs

Prolonged physical stress in austere environments

Vit. C : minimum 200mg

Cold weather operations

Vit. B1 : 3mg
Vit. B2 : 2mg
Vit. C : 250mg
Vit. E : 400 IU
Zn : 15-20mg

High-altitude operations

Vit. C : 1000mg
Vit. E : 400 IU to be taken in divided doses in the morning and evening

Diving operations

two hours before extended dives :
Vit. C : 1000mg
Vit. E : 400 IU

Table 1: *Recommended vitamin and mineral needs*

Stimulants

Even if proper sleep management is always preferred to taking drugs, the use of alertness-enhancing drugs may be appropriate for the management of fatigue, when sleep loss is inevitable during sustained operations or in an evasion scenario.

Caffeine is a freely available substance which is effective in countering the detrimental performance effects of extended wakefulness.[111,112] In spite of fears that caffeine may not work well when large amounts are consumed on a regular basis, the regular intake of caffeine (e.g. from coffee) seems not to reduce the effect of caffeine on performance.[113,114] Caffeine can be found in a number of easy-to-carry products, including pills and gum.

Dextroamphetamine and modafinil are alertness-enhancing controlled medications that have been reported as effective.[115-117]

Cutting instrument

A cutting instrument will be required to cut dressings, bandages, and tape. Since a knife is normally carried as a universal utility tool in the field, and bandage scissors should be part of the individual major trauma kit, no additional cutting tools need to be carried as part of an in-use or survival medical kit. Surgical blades or razor blades are often included in the general packet of a survival kit, but while useful for some general survival tasks, are not specifically required for medical applications on oneself.

Needle

A sterile needle is useful to open blisters, so fluids can be squeezed out, while keeping most of the blister roof intact. This will minimize discomfort and may reduce the possibility of infection.[118]

Person-specific medical items

Personal prescription drugs, over-the-counter drugs, and any other medically related items may have to be added, as required by each individual. Examples include motion sickness medication, laxatives, and antacids, some of which are sometimes recommended for general, rather than for person-specific use, for specific environments or mission profiles.[119,120]

Operators who are known to be allergic to insect bites/stings should carry an anaphylaxis kit,[121] which could include an epinephrine auto-injector. (Figure 10)

Figure 10: *Epinephrine auto-injector*

Individuals wearing contact lenses should carry rewetting solution.[122]

Packaging

All items affected by water or moisture should be waterproofed. In a wet environment, it is highly recommended for moisture-sensitive items to be waterproofed separately, even if waterproof containers are used for the overall packing of kits.

Pills, tablets, capsules, and, depending on outer packing materials used, sharp items such as tweezers, can be carried inside small waterproof hard plastic tubes. High-density polyethylene (HDPE) tubes work well, but the right types or sizes are often difficult to find. (Figure 11) If required, cotton wool should be added to prevent rattling, not only to help maintain noise discipline, but also to avoid pulverization of pills or tablets. Often, medications packaged in this way take less space than when carried in their original blister packages.

Figure 11: *Small waterproof HDPE tubes with dollar cent for size comparison*

Repackaging fluids in small, durable, waterproof HDPE bottles with a screw cap, often provides a far more secure and compact option than using the original containers.[123] (Figure 12) Swab sticks are designed for single use only, yet are often bulky when packaged.

Figure 12: *Waterproof HDPE bottles*

A more sensible approach is to use either small single-use vials, or a small plastic bottle, combined with a few cotton-tip applicators. For fluids used to cleanse the intact skin, towelettes provide a compact option, but visual inspections of undamaged packages will not be possible, so regular replacement may be required to be sure they haven't dried out.

To store semi-solid lubricants, a small jar (with a capacity of about 20ml) takes less space than the containers they normally come in. (Figure 13)

Figure 13: *Small jars*

Figure 14: *Waterproof containers*

Foot powder can also be stored in a waterproof bottle, but care should be taken when using it, if no dispenser cap is available. Using a narrow-neck bottle (which will have to be filled with some type of funnel), will reduce the risk of spills.

Some products, such as tablets producing chloride dioxide, may have to be stored in their original vacuum package, in order not to be affected by air or moisture.

One of the most challenging tasks when building in-use and survival medical kits is to find lightweight and compact outer containers which protect the contents from water, pressure, and puncture, yet allow easy and repeated access, and are small enough to fit into clothing pockets or load-bearing gear pouches. (Figure 14)

While there are many different waterproof first aid kits on the market, few have a suitable container as required for a military in-use or survival medical kit, or kit component:

- Non-waterproof rigid boxes, both plastic and metal, can be waterproofed using tape, but this will preclude easy and repeated access. Tape can be re-used in theory, but can rapidly become useless due to contact with dirt, etc.
- Waterproof semi-rigid plastic (e.g. polypropylene) containers rarely remain waterproof when under physical pressure, and may crack when exposed to extreme temperatures.
- Box-shaped waterproof rigid plastic (e.g. polycarbonate) containers are usually made from very thick materials, so apart from being relatively heavy, they have a conical shape, due to which the usable (inner) volume is disproportionately small compared to the overall (outside) volume.

- Bottle-shaped containers don't offer easy access to bottom-packed items, while a reasonably sized diameter to allow easy access would most often require too large a bottle.
- Soft (flexible) waterproof containers often come in too large of sizes, and many do not offer the abrasion/puncture resistance required for military field use. However, some may be suitable to pack in an in-use or survival medical kit or part thereof, especially those made from thick rubber, provided they are protected from punctures.
- Box-shaped metal containers with an integral rubber rim within the lid, to protect against water, rarely have the correct size to fit a medical kit, although the smaller types can be used to carry those components that require waterproofing. Positive pressure is usually required to keep the lid sealed, which can be maintained by metal locking roller clasps. Some metal containers are advertised as water-resistant, but are not able to keep out water even for a short while when submerged, so prior testing is highly recommended, to avoid surprises when in the field.

Medical items may make up approximately 50% of a survival kit,[124] both in terms of quantity and total volume of items carried, if only dedicated survival items are taken into account (excluding dual-use items required for routine field use). Whether these medical items are packed as part of a larger survival kit or as a separate kit, is largely a matter of personal choice. The second option offers several advantages: It avoids having too bulky a survival kit, especially if a comprehensive range of medical items is included, it allows the general part of a survival kit to be permanently sealed, and depending on the load-carrying gear used, it may be easier to pack two small containers than one larger, although their combined volume will invariably be larger. As a general guide, a survival medical kit should normally be small enough to be stored inside an A5-size bag. (Figures 15, 16)

Mixing in-use or survival medical kit contents with items from an individual major trauma kit, on the other hand, is not recommended, as both are designed for totally different situations.

Figure 15 and 16: *Survival medical kits*

Packing will also be guided by how a kit is organized and where a kit or kit component is carried (see below).

Kit Breakdown And Carrying Locations

A survival medical kit should be carried on the body. The preferred location is probably inside a combat jacket's lower pocket, where it doesn't interfere with load-carrying gear or body armor, which is feasible in temperate and cold climates. (Figure 17) In freezing conditions, it may well be necessary to wear it in the inside pocket of a jacket if possible, using body heat to prevent contents from freezing. In hot conditions, it will probably be necessary to dedicate some precious packing space inside a belt, chest rig, or load-bearing vest pouch, as jungle and desert shirts usually have no suitable large pockets. (Figures 18, 19) An alternate location might be inside a so-called "go-bag" or "bug-out bag," or any similar bag, small rucksack, or pouch intended to carry essential equipment in an evasion scenario. (Figure 20)

Figure 17: *Lower smock pocket able to carry survival medical kit and part of in-use medical kit*

Figure 18: (Above) *Survival medical kit & part of in-use medical kit carried in chest rig pouch*
Figure 19: (Below) *Survival medical kit & part of in-use medical kit carried in assault vest pouch*

An in-use medical kit, less those items required also for survival use (see below), can be carried at whatever location is most suitable, and may be split

Figure 20: *Survival medical kit & part of in-use medical kit with examples of pouches and bags to carry them.*

into several components, depending on size and the context in which its items are expected to be used. (Figure 21) Rucksacks may be the most appropriate location (Figure 22), especially to carry those items that are too large to be carried inside uniform pockets or assault vest pouches, such as a complete foot care kit. A comprehensive foot care kit, although having utility in many survival situations as well, may be most useful; however, when carrying heavy loads (it might be best carried with that load, i.e. inside a rucksack), while a survival kit would typically contain less bulky yet essential foot care items anyway.

In order to avoid unnecessary duplication, some medical items required in a survival medical kit, but also required in other than survival situations, might be carried only as part of an in-use medical kit. (Figure 23) These include reusable instruments and consumable medical supplies that are periodically required in very

Figure 21: *In-use medical kit - part 1 (items not required for survival use)*

Figure 22: *Possible location to carry part of the in-use medical kit. Those items required also for survival use should be carried with the survival medical kit*

small quantities, such as malaria prophylaxis. Sufficient supplies should then be included to cover a reasonably long period beyond the planned mission duration, and these items may have to be packed separately from other in-use medical kit items and carried on the body, just

Figure 23: *In-use medical kit - part 2 (items also required for survival use)*

like a survival medical kit, and will become part of it in a survival situation. The principle, an in-use individual medical pack becoming a Soldier's survival medical pack, in case he is cut-off from his unit, has been documented in military handbooks for decades.[125-127] For consumable items that are bulky and repeated use is anticipated, regardless of the situation, a supply split between the in-use and the survival medical kit might be the preferred option.

As always, the tactical situation should be taken into consideration. If, for instance, the evasion plan for an operation in a mountainous environment calls for an immediate descent, it will most likely not be useful for cut-off individuals to have high-altitude medications on the body.

It should also be remembered that in a survival situation, medical supplies from an individual's major trauma kit may be used for other than their intended purpose. An example would be gauze, which could also be used to scrub or dress outdoor wounds, minimizing – or maybe even eliminating – the amount that needs to be included in a survival medical kit.

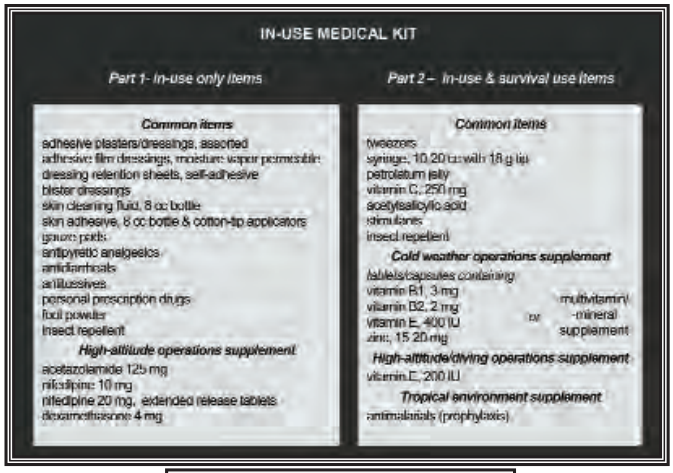
Marking And Documentation

Tubes should be marked with water-resistant labels stating the contents, expiration dates, and directions for use. One method to protect the labels from moisture is to place them inside the tubes, but their visibility will be reduced when using opaque tubes.

Waterproofed sheets containing an inventory, and possibly more detailed instructions on the use of selected components, will provide an overview of what's carried and will also facilitate more rapid kit preparation and periodic inspections.

For medical kits carried across borders during deployments, the requirement for appropriate documents for controlled drugs and for other prescription-only medicine may have to be considered,[128] especially when using commercial transportation systems.

This article was intended to give some insights as to why some items might be included as part of an in-use SOF survival medical kit. It should be remembered that kit contents should always be adapted to the mission, the environment, and the individual. Only a properly packed and configured kit, carried in a suitable location, will make it truly useful, provided adequate training has been conducted prior to mission execution.



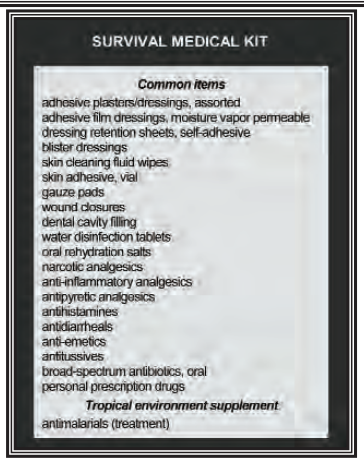


Table 2: *Sample survival medical kit and in-use medical kit contents*

References

1. Zafren K., Butler F.K. (1998). Wilderness medicine and military medicine, in: Tactical management of wilderness casualties in Special Operations, *Wild Environ Med*; 9:62-63.
2. Kogut K.T., Rodewald L.E. (1994). A field survey of the emergency preparedness of wilderness hikers, *J Wild Med*; 5:171-178.
3. Borland M.L., Rogers I.R. (1997). Injury and illness in a wilderness multisport endurance event, *Wild Environ Med*; 8,82-88.
4. Welch T. (1997). Data-based selection of medical supplies for wilderness travel, *Wild Environ Med*; 8:148-151.
5. Zell S.C. (1997). Environmental and recreational hazards associated with adventure travel, *J Travel Med*; 4:94-99.
6. Richards P. (2002). Chapter 24 Tropical forest expeditions, in: Anderson S, Warrell D (eds), Expedition Medicine, Second Edition, Royal Geographical Society (with the Institute of British Geographers), pp. 273-277.
7. Gardner T.B., Hill D.R. (2002). Illness and injury among long-distance hikers on the long trail, Vermont, *Wild Environ Med*; 13:131-134.
8. Boulware D., Forgey W.W., Martin W.J. (2003). Medical risks of wilderness hiking, *Am J Med*; 114(4):288-293.
9. Leadership School's Incident Profiles, 1999–2002, *Wild Environ Med*; 14,174-182.
10. McLaughlin K.A., Townes D.A., Wedmore I.S., et al. (2006). Pattern of injury and illness during expedition-length adventure races, *Wild Environ Med*; 17:158-161.
11. Boulware D.R. (2006). Travel medicine for the extreme traveler, *Dis Mon*; 52(8):309-325.
12. Goodyer L., Gibbs J. (2004). Medical supplies for travelers to developing countries, *J Travel Med*; 11:208–11.
13. Williams S.R., Nix D.A., Patel K.H. (2007). Appendix: Drug storage and stability, in: Auerbach PS (ed.), Wilderness Medicine, 5th edition, Mosby.
14. Wiseman J., (1986). The SAS survival handbook. London: Collins Harvill.
15. Davies B. (1996). The SAS escape, evasion and survival guide. London: Bloomsbury.
16. International Special Training Centre, Combat survival handbook, November 2001.
17. United States Environmental Protection Agency - Office of water, alternative disinfectants and oxidants guidance manual, April 1999, pp. 5-6.
18. The Remote, Austere, Wilderness and Third World Medicine Discussion Board Moderators, Survival and Austere Medicine: An Introduction, 2005, p. 29.
19. Burks R.I. (1998). Povidone-iodine solution in wound treatment, *Phys Ther*; 78(2):212-218.
20. Drosou A., Falabella A., Kirsner R.S. (2003). Antiseptics on wounds: An area of controversy, *Wounds*; 15(5):149-166.
21. Cross J., PA (2007). Pearls from the ER, August.
22. Anderson W. (2001). Wound care in the field, *JSOM*; 1(1):72-74.
23. The Merck Manual for Healthcare professionals. Retrieved 23 December 2009 from (http://www.merck.com/mmpe/sec 21/ch308/ch308a.html).
24. Felizardo G., Wound irrigation, North Carolina statewide program for infection control and epidemiology, University of North Carolina, March 2002. Retrieved 23 December 2009 (http://www.unc.edu/depts/spice/WoundIrrigation.doc).
25. Angerås M.H., Brandberg A., Falk A., et al. (1992). Comparison between sterile saline and tap water for the cleaning of acute traumatic soft tissue wounds. *Eur J Surg*; 158(6-7):347-50.
26. Svoboda S.J., Owens B.D., Gooden H.A., et al. (2008). Irrigation with potable water versus normal saline in a contaminated musculoskeletal wound model. *J Trauma*; 64(5):1357-1359.
27. American Heart Association, *Circulation*, November 2005, III-115-III-125.
28. Miller D.M., Brodell R.T., Herr R. (1996). Wilderness dermatology: Prevention, diagnosis, and treatment of skin disease related to the great outdoors, *Wild Environ Med*; 2:146-169.
29. Moscati R.M., Mayrose J., Reardon R.F., et al. (2007). A multicenter comparison of tap water versus sterile saline for wound irrigation, *Acad Emerg Med*; 14(5):404-9.
30. Bansal B.C., Wiebe R.A., Perkins S.D., et al. (2002). Tap water for irrigation of lacerations, *Am J Emerg Med*; 20(5):469-72.
31. Whaley S. (2004). Tap water or normal saline for cleansing traumatic wounds? *Br J Community Nurs*; 9(11):471-8.
32. Cross J., op. cit.

33. Allen R.C. Pararescue medication and procedure handbook, Second Edition, 28 February, 2001.
34. Felizardo G., op. cit.
35. The Merck Manual for Healthcare professionals. Retrieved 23 December 2009 from (http://www.merck.com/mmpe/sec21/ch308/ch308a.html).
36. Miller D.M. et al., op. cit.
37. Felizardo G., op. cit.
38. Cross J., op. cit.
39. Anglen J.O., MD. (2001). Wound irrigation in musculoskeletal injury, *J Am Acad Orthop Surg*; 9:219-226.
40. The Merck Manual for Healthcare professionals. Retrieved 23 December 2009 from (http://www.merck.com/mmpe/sec21/ch308/ch308a.html).
41. The Joanna Briggs Institute, Solutions, techniques and pressure for wound cleansing, Best Practice 2006, 10(2):1-4.
42. Donelan S. (2003). Teaching wound care and bandaging: An historical perspective, *Wild Environ Med*; 14, pp. 47-56.
43. Rosie P. (2001). Vapour-permeable film dressings in wound management, *J Comm Nurs*; 15(12):20-25.
44. Thomas S., Loveless P. (1997). A comparative study of the properties of twelve hydrocolloid dressings, *World Wide Wounds*, Retrieved 22 December 2009 from (http://www.worldwidewounds.com/1997/july/Thomas-Hydronet/hydronet.html).
45. Wilkerson J.A. (1992). Medicine for Mountaineering and Other Wilderness Activities, 4th edition, California, p. 87.
46. Isaac J., Goth P. (1991). The Outward Bound Wilderness First-Aid Handbook. New York: Lyons and Burford, p. 136.
47. The Remote, Austere, Wilderness and Third World Medicine Discussion Board Moderators, op. cit., p. 44.
48. Semer N.B. (2003). The HELP guide to basics of wound care, Global-HELP Organization, p. 9.
49. Worrall G.J. (1987). Repairing skin lacerations: Does sterile technique matter? *Can Fam Physician*; 33:1185-1187.
50. Wooten M.K., Hawkins K. (2005). WOCN position statement, clean versus sterile: Management of chronic wounds, *Wound Ostomy and Continence Nurses Society*, IL, January.
51. Forgey W. (1997). Wilderness Medicine: Beyond First Aid. Ics Books.
52. Weiss E.A. (2005). A comprehensive guide to wilderness and travel medicine, 3rd edition July, Oakland, CA: *Adventure medical kits*, p. 89.
53. Watt A. (2002). Chapter 29 Canoe, kayak, and raft expeditions, in : Anderson S, Warrell D (eds), *Expedition Medicine*, Second Edition, Royal Geographical Society (with the Institute of British Geographers), p.334.
54. Mikhail G.R,. Selak L., Salo S. (1986). Reinforcement of surgical adhesive strips, *J Dermatol Surg Oncol*; 12(9):904-5.
55. Lesesne C.B. (1992). The postoperative use of wound adhesives. Gum mastic versus benzoin, USP, *J Dermatol Surg Oncol*; 18(11):990.
56. Mulvaney M., Harrington A. (1994). Cutaneous Trauma and its Treatment, in: James WD (Ed), Office Of The Surgeon General Department of the Army, United States of America, Military Dermatology, *Textbook of Military Medicine*, p. 146.
57. Trayers F. (2006). Blisters in the backcountry, *Wilderness Medicine*; 23(3):10-11.
58. Tan S., Kok S., Lim J. (2008). Efficacy of a new blister prevention plaster under tropical conditions, *Wilderness Environ Med*; 19:77-81.
59. Trayers F., op. cit.
60. Rose S.R. (2001). International Travel Health Guide, 12th ed. Northampton, MA: *Travel Medicine;* p. 15.
61. Davis T.M., Phil D., Malaria Treatment, University Department of Medicine, Fremantle Hospital, Western Australia (online resource – last update : January 2004) Retrieved 3 December 2009 (http://www.rph.wa.gov.au/malaria/treatment.htm).
62. Dryden M. (2002). Chapter 18 Common Infections, in : Anderson S, Warrell D (eds), *Expedition Medicine,* Second Edition, Royal Geographical Society (with the Institute of British Geographers), p. 198
63. Illingworth R. (2002). Chapter 3 Expedition Medical Kits, in: Anderson S, Warrell D (eds), *Expedition Medicine*, Second Edition, Royal Geographical Society (with the Institute of British Geographers), p. 30.
64. Dryden M., op.cit, p. 195.
65. Sheppard T. (1988). Desert Expeditions, 3rd Edition. London: Expedition Advisory Centre, Royal Geographical Society, p. 63.
66. Whatley A.D., Barbeau D.N., Travel health kits, in: Centers for Disease Control and Prevention, Travelers' Health - Yellow Book. Retrieved 22 December 2009 (http://wwwn.cdc.gov/travel/yellowBookCh2-HealthKit.aspx).
67. Prince Leopold Institute of Tropical Medicine, How to travel and stay healthy, Useful information for good health before your departure, during your trip and after your return. Retrieved 12 June 2008 from (http://www.itg.be/ITG/Uploads/MedServ/egezond.pdf).
68. Retrieved 24 December 2009 from (http://www.mdtravelhealth.com/index.php?sub=4&illness=medical_kit).
69. Rose S.R., op. cit., p. 15.
70. Retrieved 24 December 2009 from (http://www.mdtravelhealth.com/index.php?sub=4&illness=medical_kit).
71. 75th Ranger Regiment, U.S. Army Special Operations Command, *Ranger Medic Handbook* 2007.
72. Lewin M.R., Jensen S.C., Platts-Mills T.F. (2007). Wilderness preparation, equipment, and medical supplies, in: Auerbach PS (ed.), *Wilderness Medicine*, 5th edition, Mosby, (Chapter 81).
73. Walden J. (2007). Jungle travel and survival, in: Auerbach PS (ed.), *Wilderness Medicine*, 5th edition, Mosby.
74. CAPT (U.S. Navy, Ret) Frank K. Butler Jr. MD, personal communication to the author, e-mail dated 31 January 2009.
75. Butler F.K. (2007). The eye in the wilderness, in: Auerbach PS (ed.), *Wilderness Medicine*, 5th edition, Mosby.
76. Davies B, op. cit.
77. Retrieved July 2008 (http://cks.library.nhs.uk/insect_bites_and_stings/management/detailed_answers/treatments_not_recommended#-258557).
78. Lamb L., Nicol E., New and emerging concepts in travel medicine, *R Army Med Corps* 153(1): 40-43.
79. Van den Enden E. (2007). Illustrated lecture notes on tropical medicine. Antwerp: Prince Leopold Institute of Tropical Medicine.

80. Molla A.M., Ahmed S.M., Greenough W.B. 3rd. (1985). Rice-based oral rehydration solution decreases the stool volume in acute diarrhea, *Bulletin of the World Health Organization*; 63(4):751-6.
81. Gore S.M., Fontaine O., Pierce N.F. (1992). Impact of rice based oral rehydration solution on stool output and duration of diarrhea: Meta-analysis of 13 clinical trials, *BMJ*; 304(6822):287-91.
82. Wall C.R., Bates M.S., Gleghorn G.J., Ward L. (1997). Studies of water and electrolyte movement from oral rehydration solutions (rice- and glucose-based) across a normal and secreting gut using a dual isotope tracer technique in a rat perfusion model, *Alim Pharmacol Ther*; 11(3):581-587.
83. Greenough W.B. (2004). The human, societal, and scientific legacy of cholera, *J Clin Invest*; 113(3):334–339.
84. U.S. Army Center for Health Promotion and Preventive Medicine, DoD Insect Repellent System, June 2007.
85. The Medical Letter, Inc., Insect repellents, in : *The Medical Letter On Drugs and Therapeutics* 2003;45.
86. Van den Enden E, op. cit.
87. Retrieved 24 December 2009 from (http://www.mdtravelhealth.com/index.php?sub=4&illness=insect_repellents).
88. Fradin M.S., Day J.F. (2002). Comparative efficacy of insect repellents against mosquito bites, *N Engl J Med*; 347(1):13-8.
89. Fraker L.D., Gentile D.A., Krivoy D., et al. (1992). Giardia cyst inactivation by iodine, *J Wild Med*; 3:351-357.
90. Jarroll E.L., Bingham A.K., Meyer E.A. (1981). Effect of chlorine on giardia lamblia cyst viability, *Appl and Environm Microb*; 41(2):483-487.
91. Gerba C.P., Johnson D.C., Hasan M.N. (1997). Efficacy of iodine water purification tablets against cryptosporidium oocysts and giardia cysts, *WEM*; 8:75-77.
92. Starke J.A., Bowman D.D., Labare M., et al. (2005). Do iodine water purification tablets provide an effective barrier against cryptosporidium parvum? *Mil Med*; 170(1):83-86.
93. Goodyer L. (2000). Food and water hygiene for the traveller, *Pharm J*; 264:134-139.
94. Information provided to the author by Nomad's Traveller's Store & Medical Centre, London, dated 27 May 1999.
95. Goodyer L.I. (2004). Travel medicine for health professionals. London: Pharmaceutical Press, p. 59.
96. Backer H.D. (2007). Field water disinfection, in: Auerbach PS (ed.), *Wilderness Medicine*, 5th edition, Mosby, p. 1394.
97. Pietroski N. (2008). Wild water everywhere, but is it safe to drink (or play in)? Better safe than on the run from waterborne illnesses in the wild, *Wilderness Medicine*; 25(3):8-11.
98. Platts-Mills T. (2007). What's in your kit? *Wilderness Medicine*; 24(2):5-6.
99. Antarctica New Zealand, First Aid Manual. Christchurch, New Zealand: Antarctica New Zealand, 2006, p. 66.
100. Dickson M. (2006). Where there is no dentist, Eleventh printing. Palo Alto, CA: Hesperian Foundation, pp. 145-6.
101. Otten E. (1998). Scenario 7: Snakebite, in: Tactical management of wilderness casualties in Special Operations, *Wilderness Environ Med*; 9(2):99-103.
102. Auerbach P.S., Norris R.L., Disorders caused by reptile bites and marine animal exposures, in : Braunwald E., Fauci A.S., Jameson J.L., et al. (eds.), *Harrission's Principles of Internal Medicine*, 16th edition, p. 2593.
103. Paul Auerbach MD, personal communication to the author, e-mail dated 21 July 2008.
104. Rose J.W., Treatment for snakebite in U.S. Naval units deployed ashore and the use of antivenin, Navy Operational Medical Lessons Learned Center, August 2004.
105. Zafren K., (1998). Scenario 9: Altitude sickness, in: Tactical management of wilderness casualties in Special Operations, *Wild Environ Med*; 9(2):108-111.
106. Goodyer L. (2001). Environmental Hazards, *Pharm J*; 266:577-80.
107. Tannheimer M., Höhenmedizin, presentation at the 2nd Tactical Combat Casualty Care Symposium, Special Operations Training Centre, Pfullendorf, May 2007, and personal communication by Dr. Markus Tannheimer, e-mails to the author dated 6 July 2007 and 18 July 2007.
108. Davis, P.R., Pattinson K.T., Mason N.P., et al. (2005). High altitude illness, *J R Army Med Corps*; 151:243-249.
109. Deuster P.A., Kemmer T., Tubbs L., et al., *The Warfighter Nutrition Guide*, Retrieved 16 July 2009 from (http://champ.usuhs.mil/warfighterguide.html).
110. Patricia A. Deuster, PhD, MPH, CNS, personal communication to the author, e-mail dated 15 July 2009
111. Wyatt J.K., Cajochen C., Ritz-De Cecco A. et al. (2004). Low-dose repeated caffeine administration for circadian-phase-dependent performance degradation during extended wakefulness, *Sleep*; 27(3):374-81.
112. Tharion W.J., Shukitt-Hale B., Lieberman H.R., (2003). Caffeine effects on marksmanship during high-stress military training with 72 hour sleep deprivation, *Aviat Space Environ Med*; 74(4):309-14.
113. McLellan T.M., Bell D.G., Lieberman H.R. et al. (2003). The impact of caffeine on cognitive and physical performance and marksmanship during sustained operations, *Can Mil J*; 4(4)Winter 2003-2004:47-54.
114. Smit H.J., Rogers P.J. (2000). Effects of low doses of caffeine on cognitive performance, mood and thirst in low and higher caffeine consumers, *Psychopharmacology*; 152:167-173.
115. Caldwell, J.A. (2005) Dextroamphetamine and modafinil are effective countermeasures for fatigue in the operational environment, in: Strategies to maintain combat readiness during extended deployments – A human systems approach (pp. 31-1 – 31-16). Meeting Proceedings, NATO Research and Technology Organization Human Factors and Medicine Panel Symposium, Prague, Czech Republic, 3-5 October 2005.
116. Young S.E., Pierluisi G. (2008). Operational performance and preventive medicine, in: Schwartz R.B., McManus J.G., Swienton R.E. (eds.), *Tactical Emergency Medicine*. Philadelphia: Lippincott Williams & Wilkins, pp.134-5.
117. Younggren B.N., Harrison B. (2008). Sustained and continuous operations, in: Schwartz R.B., McManus J.G. Jr, Swienton R.E. (eds.), *Tactical Emergency Medicine.* Philadelphia, pp. 138-9.

118. Knapik J.J., Reynolds K.L., Duplantis K.L., et al. (1995). Friction blisters. Pathophysiology, prevention and treatment, *Sports Med*; 20(3):136-47.
119. British Army, Jungle operations personal survival and safety guide, Issue 1.0, February 1999, Army Code 71666, p. 5.
120. Plaster J. 1993). The ultimate sniper : An advanced training manual for military and police snipers. Paladin Press, p. 32.
121. USSOCOM Tactical Medical Emergency Protocols for Advanced Tactical Practitioners, *JSOM* Spring 2009 Training Supplement, p. 11.
122. Butler F.K., op. cit.
123. Wilderness EMS Institute, Personal Wilderness Medical Kit, Version 2.0, August 5, 2001.
124. Headquarters, Department of the Army, Field Manual 3-05.70, Survival, May 2002, pp. 3-5.
125. Ministry of Defence, Land Operations – Volume V – Operational techniques under special conditions, Part 2 – Jungle, B – Jungle skills and drills, 1974.
126. Ministry of Defence, Infantry Tactical Doctrine Volume 1, The Infantry Company Group Pamphlet No. 5, Infantry Company Group Jungle Tactics, December 1999, Army Code No. 71614, pp. 1-16.
127. [Canadian Forces] Defence Staff, B-OG-302-004/FP-001, Specific Operations, Volume 4, Part One, Jungle Operations, 1979.
128. Goodyer L., (2001). Medical Kits for Travellers, *Pharm J*; 267:154-158.

Dirk Geers has been serving in a number of SOF positions and has been heavily involved in the development of medical kits for SOF.