AN OVERVIEW OF MASS DISINFESTATION PROCEDURES AS A MEANS TO PREVENT EPIDEMIC TYPHUS

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Abstract—In many parts of the world louse-borne disease, particularly epidemic typhus, is a risk to refugees and displaced persons as well as those involved in humanitarian relief programmes. This paper discusses the methods of mass disinfestation employed in past programmes, the infrastructure that enabled them to succeed and and the reasons why mass disinfestation using dusts is unlikely to work in the future. proposals and improvements appropriate to current situations are outlined.

INTRODUCTION

Natural and man-made catastrophes result in a loss of governmental and social infrastructure leading to a breakdown of hygiene and sanitation and in doing so enhancing the risk of disease transmission among an increasingly susceptible population. Under these conditions arthropod-borne diseases such as typhus, malaria, dengue fever, plague and gastro-intestinal infections may rise to epidemic proportions.

It is considered increasingly likely that British Servicemen will become more frequently involved in UN peace-keeping operations. Should this be the case there is real need to re-assess the techniques of mass disinfestation which were introduced over fifty years and have not since been implemented as a means to control outbreaks of epidemic typhus.

LICE AND TYPHUS

The significance of epidemic typhus should never be under-estimated. Lousiness and typhus are associated with war, famine and crowded unsanitary conditions among a malnourished population. (Ackerknecht, 1965; Cloudsley-Thompson, 1977).

The causative organism *Rickettsia prowazekii.* was named after two workers, one American, Ricketts, and an Austrian, Prowazek, who contracted and subsequently died from the disease they were both studying.

Typhus is a febrile illness of sudden onset with a sometimes transient rash and an incubation period of generally between eight to twelve days, (Cloudsley-Thompson, 1977). In Europe, where the disease occurs in the winter months, mortality may reach 80%. There is still difficulty in differentiation between typhus and typhoid, hence the similar nomenclature. Indeed, in many European countries the two diseases share the same name, typhus being termed *typhus exantimaticus* and typhoid *typhus abdominalis*. Typhus is treatable with doses of chloramphenicol or doxycycline. No licenced vaccines are available for use and neither vaccines nor antibiotics would prevent the spread of the disease. (Scholdt, 1989).

It is considered that the effective management of an epidemic in a war zone would, even now, be beyond the resources of any medical aid. The focus for intervention must therefore be on prevention. (Chetwyn, 1992).

The rickettsia are passed in the faeces and body of the louse and not by the bite. The body louse *Pediculus humanus humanus* is the recognised vector of the disease but the role of the head louse, *Pediculus humanus* var *capitis* has, as yet, not been satisfactorily determined. Lice become infective six days after ingesting the innoculum and unusually die at 8–12 days, (Service, 1986) suggesting that the association between the causative organism and the louse is comparatively recent. The faeces, which are dry and friable, may remain infective for up to 66 days. (Manson, 1972).

Taking examples from recent history and leaving aside the effects of typhus in the past, it can be seen that the Balkans in particular have had a long association with the disease. The history and

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progress of the Serbian epidemic of 1914 is graphically described by RP Strong in his work on typhus fever At the beginning of the First World War, 200,000 deaths in Serbia were recorded in a six-week period from an overall population then of 3 million. The Austrian army did not invade for fear of contracting the disease and the progress of the war was subsequently delayed for six months. At the peak of the epidemic 2500 new cases per day were being recorded in military hospitals alone and it was calculated that three times this number were admitted to hospital among the civilian population, a total of 10,000 new cases per day. In European Russia during the revolution between 1917 and 1923 the typhus epidemic claimed over 3,000,000 lives from 35,000,000 cases (Strong, 1920).

Individuals who have contracted typhus in the past and recovered, may be subject to Brill-Zinsser disease, a recrudescent form of typhus independent of louse infestation. This was first recognised by Zinsser among Jewish immigrants from the Balkans in 1912 in New York. However, should lice become infected after feeding on an infective person the epidemic form then re-emerges. In former Yugoslavia where Brill-Zinsser disease is endemic there were, according to US sources of information, a conservative estimate of 803 cases recorded between 1965 and 1974. At the present time head and body louse infestations are ubiquitous among displaced persons throughout former Yugoslavia (Chetwyn, 1993).

DUSTING TECHNIQUES

The currently advocated delousing techniques originated as a result of a major typhus epidemic in Naples in the winter of 1943. The success of this programme was later attributed to a newly developed insecticide, DDT. However, there is some suggestion that this might not have been the case and that the disease was already in decline by February 1944 when quantities of DDT were transported to the area from the USA. In all 1040 deaths were recorded. At its height the mortality rate reached 80% (Cloudsley-Thompson, 1977). Typhus broke out in the concentration camps, notably Belsen, in Germany and other parts of central Europe at the conclusion of the Second World War. This led to a suspension of repatriation of displaced persons for several months. Indeed, those attempting to return to their homes were not permitted to cross the Rhine in a westerly direction without being able to produce a certificate indicating they had been deloused. Those travelling east had no such movement restrictions.

So great was the fear of the spread of the disease throughout Europe at that time that in Britain, as well as other western European countries, typhus squads were formed to prevent the import of the disease.

The techniques employed in Naples and the camps would not have been possible had they not taken advantage of the military infrastructure and available logistic resources as well as large numbers of manpower. In Naples teams of Servicemen formed sections of the population together into the first of two enclosed areas, ("dirty" and "clean"). As the population passed between a series of "choke-points" separating the two areas they were dusted manually using "puffer" type dusters filled with DDT : A procedure that became known as the "15 puff method" which effectively introduced insecticide beneath the clothing via the shirt sleeves, collar and trouser waist and legs (Handbook of Army Health, 1978). Treated persons were then passed through to the "clean" area. Records were kept to ensure that this process was repeated after 10–14 days. In the concentration and labour camps this technique was again used, but at this point a mechanical method was introduced consisting of petrol-driven compressors feeding six or eight "pistol-grip" sprayers via a central distribution valve.

In both situations the procedure was effective because:

a. an existing infrastructure was present
b. access was not restriced
c. manpower was plentiful
d. logistics and finance were assured
e. the target population was enclosed in a controlled area
f. compliance with the regime was not in question

The requirement to carry out mass delousing procedures as a means to prevent or control epidemic typhus has not been addressed since the Second World War with the exception of the current situation in former Yugoslavia. Over the same period of time the existing literature has copied *verbatim* the chapters on louse control with no thought as to their application in more modern times. In the intervening period there have been considerable social and technological developments which now argue against the use of dusting techniques as the sole method of disinfestation. Dusting does of course have a place in the prevention of typhus, but should now be considered as only one of a number of measures for the control of lice.

In more open situations where the affected population is dispersed and mobile, the manpower, time and logistic requirements argue against dusting, especially when access is severely restricted, affecting the frequency, and therefore efficacy, of treatment. Common sense dictates that this method should not be recommended for those with dermatological problems such as scabies or those with exposed wounds, as direct absorption of insecticides could interfere with later treatment of the wounds, or could in themselves cause problems.

At best the procedure is undignified. As the operator's exposure to the insecticide is considerably greater than those being treated this requires the use of protective clothing and breathing apparatus, especially in enclosed spaces, this can be frightening to the population, particularly children. These factors combine to ensure poor compliance.

The simple "puffer" type dusters can be effective for use on small groups or for distribution in self-help schemes but the demands on manpower limit their use with large populations.

The compressor system has seldom worked well. In addition to the general problems associated with dusts the demand for compressed air at each outlet overburdens the reservoir resulting in a loss of operating pressure. A second problem is that water, and sometimes oil, enters the system as a consequence of air compression thus acting to clog the dust and stop the flow. The recently developed "Millbank Duster" is a CO_2 -powered applicator that offers some advantages. It is portable and will ensure a dry, powered stream of dust with precision. It is a method currently used in former Yugoslavia.

IMPREGNATION TECHNIQUES

A method that needs to be considered as an alternative to dusting is the impregnation of clothing. The process is simple, cheap, safe and will afford protection for at least six weeks, surmounting the problems of repeated treatments in areas difficult to access regularly.

The process of clothing impregnation as a method of disinfesting lousy clothing has been evaluated by Scholdt *et al.* against both laboratory and natural strains of *P. humanus humanus.* The technique was found to be highly effective even after 20 post-treatment washings and is recommended for use in areas endemic for louse-borne disease (Scholdt *et al.*, 1989).

Pyrethroid insecticides can be diluted in water to give an optimal target dose on clothing, (200mg/m^2:permethrin or 10mg/m^2:l-cyhalothrin). The clothing to be treated is dipped in the solution for two minutes then removed and allowed to dry. In static locations this process can be accomplished in large tubs or baths, the quantities proportional to the volume of clothing to be treated. An alternative is the use of mobile laundry units where the insecticidal treatment is introduced at the final rinse. Laundries could be linked to shower stalls or soup-kitchens when there is time to heat the water. In this way the delousing process is relatively low-profile the emphasis being placed on the ready availability of hot water and clean clothing. In emergency situations where time is of the essence only the treatment of the clothing in cold water need take place. In extremes, tumble drying at 60^{0}C for 15 minutes has been said to destroy lice and their eggs (Lloyd, 1919; Service, 1986) although the degree of control achieved would be for a much shorter period.

While it is accepted that the laundering process can be carried out in a variety of situations at static locations, either externally organised or as part of a self-help initiative, there is much to be said for mobile units which can administer to a wider area. These units would differ from mobile field laundries in that the equipment, washers, driers, calorifiers, pumps and generators would be integral to the vehicle and not demounted before operation.

Using this technique the costs of equipment would be offset against manpower costs expended in conventional dusting. It is accepted that quantities of water are needed, which in some situations would be a scarce commodity. Were this to be the case, an adaptation of this technique would be the distribution of pre-treated clothing, usually underwear to replace infested clothing. This could be carried out prior to dispatch by donor countries at the manufacturing point.

INSECTICIDES AND REGISTRATION

Insecticides are registered for specific uses which are stated on the label, itself a legal document. The label may vary slightly for individual end-users. For example, a demand for an insecticide originating in the UK will, unless required for export to another country with different requirements of use, be marked with the appropriate UK label. The label cannot be altered on the understanding that a non-specified use would only be carried out in a third-party country. This poses a problem as insecticides cannot be stockpiled for use in emergencies. To re-register a product for further uses is the responsibility of the manufacturing company, who then finance the additional investigations. The return on investment to re-register a dust for disinfestation purposes is not financially viable.

While there is a reasonable argument that in emergency situations the rules should be waived for humanitarian reasons, it should be remembered that humanitarian efforts have a very high media profile and if it were found that that an obsolete or non-registered formulation was being used, the negative media coverage would obscure the objectives and, above all, waste time.

DDT is no longer used for disinfestation purposes and was superseded by malathion, an organophosphate insecticide in the 1960s. The use of DDT has largely been banned and malathion is now a European Community red-listed item, (Environmental Protection Act 1990) and therefore effectively scheduled for obsolescence. Ironically, both DDT and malathion still have WHO approval for use but are certainly not the least hazardous or most effective insecticide of choice. Modern pyrethroid insecticides have a very low mammalian toxicity >2000 mg/kg, and active ingredients such as permethrin or l-cyhalothrin are considerably less hazardous and equally effective but are not registered for louse control in the UK , USA and most European countries where stockpiles could most logically be held for use in emergencies.

The paradox of product registration needs to be seriously addressed by WHO to grant short-term product registration licences in emergency situations.

SELF HELP KITS

As a temporary measure in isolated areas, self-help kits for the treatment of scabies, head lice as well as body lice need to be considered. The content of the kits should be designed to fulfil the requirements of a community for a set number of days or weeks according to the time it would take to either re-supply the kits or initiate larger and more permanent procedures. The kits should include adequate instructions in English and the language of the community at risk and be issued as supplements to a basic personal hygiene pack allowing individuals to keep themselves clean.

It is considered that as a yardstick the contents of each kit would be sufficient for five persons for two weeks and include:

a. Head louse lotion (permethrin or malathion based).
b. 150ml Scabicide, (preferably not benzyl benzoate).
c. 300g, 0.5% permethrin powder
d. 100ml, 10% Peripel (for clothing treatment).
e. 1 small hand-held powder applicator.
f. Full, comprehensive but simply explained instructions and diagrams.
g. 2 pair household rubber gloves.

SCABIES AND HEAD LICE

While a lesser risk to health, both head lice and scabies are highly contagious in conditions of poor hygiene. The stigma of infestation in a modern society results in avoidance of the problem

rather than its solution. In these cases education at an appropriate level is the key issue to put the problem into the correct perspective.

The treatment programmes already described will, to a large extent, control both of these infestations. However, as already stated, dusting techniques may aggravate scabies conditions and are therefore not considered appropriate.

CONCLUSION

It is more than fifty years since the last large-scale disinfestation programmes were conducted as a means to control outbreaks of epidemic typhus. In the interim period technological advances have been balanced by reductions in manpower. Recently, there has been a perception that pesticides, and other potentially beneficial compounds, are undesirable. The fact that the number of lives saved overwhelms any negative effects is seldom as ardently stated in the popular media. However, for any form of vector control to be effective and fully accepted, these perceptions and sensitivities need to be taken into consideration. Hence the substitution of DDT in favour of pyrethroid formulations. Both will kill lice but the latter option is more acceptable, and indeed less hazardous. Similarly, the proposal that clothing impregnation is safer and longer lasting than dusting, although true, is a lesser argument than that the former will achieve a greater compliance and acceptance from the target population and therefore give better results in terms of protection. In a recent paper World states that entomologists as well as field laundries are an essential part of the logistic support to those operating in areas so affected (World, 1993).

One obstacle to a rapid response that needs to be addressed as a matter of urgency is the question of registered use of insecticides. This can limit their deployment in emergency situations.

It is considered that two options should be made available, either that:

a. such projects are organised and directed by personnel qualified in vector control who can exercise their professional judgement to ensure responsible practices in the interests of the community at risk.
b. in emergency situations registered use can be advised locally by suitably qualified staff with practical experience from an appropriate UN lead agency.

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