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Ross River Virus Disease – A Focus On The Problem[1]

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Abstract
This is review of Ross River Virus (RRV) disease and its impact on military forces. In particular, the review will look at the impact of RRV on the Anny elements of the Australian Defence Force.

Introduction
In 1997, Hueston et al. reported cases of RRV disease in military exercises conducted in Queensland, a region where many deploying units undertake annual exercises for the purpose of military training.

Due to the disease's relevance for this particular population, and prevalence in the region, the increasing incidence of RRV disease in Defence Force personnel over the past few years deserves further investigation. One explanation for this increase in reports may actually be the improved surveillance and testing techniques.

Although the numbers of reported cases of RRV disease in this population is not large, the morbidity from this non-life-threatening infection is significant and is of serious social and economic concern. The impact of such debilitation on both the service member and the ADF has not yet been investigated. No studies have investigated the costs of this health problem, although various Australian commentators have proposed that the costs are high.

The literature stresses the importance of individual preventive measures against infection. There is strong rationale for the implementation of a preventive health program for all ADF personnel. Such a health program would be both beneficial in improving the awareness of service members to RRV disease and reducing further ADF cases in the Queensland region.

History
Gambel et al. have indicated that, throughout history, arthropod-borne disease has had devastating effects on military operations.[2] Even when disease was not transmissible, 'nuisance bites alone have caused a variety of physiological reactions, psychological stress and secondary infections, affecting both individual and unit performance.

By their very nature, operations are undertaken in field conditions, such as jungle environments, which expose non-immune soldiers to significant non-battle health risks. Although insect bites may be considered just minor nuisances, and go relatively unnoticed, some bites could result in serious infections requiring medical evaluation, treatment and possibly even evacuation. This ultimately limits warfighting capability.[3]

Disease

Endemic to Australia, RRV disease was first isolated in the early 1960's in Queensland.[4] RRV disease (also referred to as Epidemic Polyarthritis) is mosquito-borne arbovirus whose major hosts are thought to be macro pods such as wallabies and kangaroos. Many species of mosquito are thought to transmit the disease, particularly pools of the Aedes species such as Aevigilax, Aefunereus and Aeprocax.[5]

With an incubation period of 3-11 days, this self-limiting disease presents with polyarthritis and/or polyarthralgia (similar to rheumatoid effects) lasting from a few days to a few months. The disease primarily affects the small

joints of the extremities, particularly wrists and ankles, and symptoms gradually improve without destructive changes. There may also be a maculopapular rash (usually non-pruritic) affecting the trunk and limbs, which usually resolves within 7-10 days and is followed by a fine desquamation. Fever is commonly absents Both Mackenzie et al and Russell state that there have been reported cases, with remissions and exacerbation's of decreasing intensity, of symptoms lasting for more than a year.[6.7] There is no evidence of transmission from person to person, with recovery followed by lasting immunity.

Major outbreaks (epidemics) of RRV disease have occurred across Australia, chiefly in New South Wales (1996 and 1997); Western Australia (1991-1992 and 1995-1996): Queensland (1996); and Victoria and South Australia (1993 and 1997). Increased reporting tends to occur mainly during the January-May period when mosquito activity is greatest.[6] Sporadic cases of RRV disease have also been reported in other coastal regions of Australia, Papua New Guinea and the Pacific Islands.[4.5]

The Australian National Notifiable Diseases Surveillance System (NNDSS) maintains surveillance of more than 40 communicable diseases or disease groups, including RRV disease. Disease notifications are initially made to individual State and Territory health authorities who then supply the data for further analysis to the NNDSS.[9] Various criticisms, however, have been made of this system. These include a lack of uniformity between State and Territory reporting systems, with some using laboratory reporting solely and others relying on clinical diagnosis; under reporting of cases, with the patients' not presenting with subsequent infections as they realize there is no specific treatment or cure; lack of uniformity between laboratories in their diagnostic techniques, and variations in interpretation of results and reporting criteria.[9] Whilst various factors may contribute to inaccurate reporting of cases, a new series of national clinical and serological definitions, with guidelines for testing and reporting, have been proposed recently which may address this problem.[6]

Russell concludes his paper by indicating that "for reasons associated with mosquito and human ecology, the risks of RRV disease is in creasing for many communities ... with the virus likely to continue as a public health problem" for the foreseeable future.[7]

Prevention

As there are no treatment measures, the issue of prevention of RRV disease falls to educating individuals in personal preventive measures and community orientated mosquito-reducing capabilities. The Australian Defence Force Publication (ADFP) 717 (Health Series Preventive Medicine Manual) outlines a three-step system to protect against arthropod-related disease. Referred to as Personal Protective Measures (PPM's). The three-tier system recommends the use of insect repellent containing DEET (N, N-diethyl-m-toluamide). The wearing of appropriate field clothing, and the Permethrin (a contact toxicant for insects) impregnation of field clothing.

ADFP 717 strongly advocates that, due to the mobility and dispersion of 'modem fighting armed forces', there is a need for each individual service member to take responsibility for protecting themselves against a health threat.[10] It is also recognized that the use of established military PPM's by each individual requires reinforcement training and stringent supervision by leaders in the ADF in order to work.

Literature Review

As personal measures are one of the comer stones of maintaining the health of ADF personnel against arthropod-related diseases, it is important to assess the effectiveness of the recommended measures. A review of the literature reveals a distinct paucity of studies of RRV disease and the Australian Defence Force. Although there are various anecdotal and unpublished reports.

A study by Hueston et al. describes the presence of RRV disease in a large combined Australian/United States of America military exercise at Shoalwater Bay Training Area in south-eastern Queensland during March 1997.[1] It was

recognized that there was a significant threat to the health of US troops, due to a lack of previous exposure to RRV disease by these forces and personnel were trained in military protective measures against mosquito biting prior to deployment to the high-risk area. Unfortunately, this study does not outline the education and health promotion program used for US service members. In addition, there was no indication as to whether Australian troops received the same or a similar education prior to deployment.

Surveillance revealed 19 suspected clinical cases with 6 diagnosed serologically by the Deployed Public Health Laboratory (DPHL).[1] The DPHL had been deployed into the field for the purpose of preventative medicine as well as disease and vector surveillance. Cases were diagnosed using 1gM enzyme-linked immunosorbent assay (ELISA) techniques. A large scale post-deployment serosurvey was also undertaken to establish whether undiagnosed RRV disease infections occurred during the exercise. Of the six diagnosed cases of RRV disease, five were American and one Australian. Anecdotal evidence noted that despite predeployment health promotion, some US personnel were still observed to as an example, dig trenches with no upper body field shirt covering.

In 1998, Gambel et al. performed a survey on the knowledge, attitudes and practices regarding personal protective measures of soldiers in the United States Army.[2] The rationale for the survey was to focus interventions toward improving service members' ability to use PPM's appropriately, and effectively, and as an aid to developing other repellent products. Utilising a cross-sectional approach, the survey included US military personnel, either active duty or reserve, attending one of 13 Army courses at 7 installations in continental US. Participation was voluntary and informed con sent obtained from each participant. Students were from a cross-section of the Army with a range of experience from 4-15 years of service for enlisted soldiers and 6-18 years of service for officers.[2]

Participation in the study focused on four general categories of students, based on military occupational specialties (MOS)[2] with the categories including:

- soldiers trained for direct combat (military sciences);
- soldiers considered a prior to be most knowledgeable regarding arthropod-borne diseases and PPM's (health sciences);
- soldiers involved in distributing supplies or maintaining soldiers in the field (logistics); and
- 'other' soldiers, included the remaining eight general MOS categories and survey participants who did not identify their specific MOS.

Measurement of knowledge, attitudes, beliefs and practices of PPM's was via a written questionnaire (n= l 007) or group interview of 4-6 students (n=65). Perception of the effectiveness and availability of US military repellent products and the degree of command emphasis on PPM's were also assessed.

Group interviews provided an interactive approach with the opportunity for deeper probing and clarification of comments on specific topics, investigation of common themes and patterns, and exploration of areas beyond the scope of the questionnaire. For example, this included the social contexts in which information on PPM's is provided, the degree of command emphasis on PPM's in the field, and suggestions for improving use of PPM's.

Of the 1,007 service members who completed the survey questionnaire, 63% were enlisted soldiers and 37% were officers. The majority (88%) was active duty Army, with smaller representations of Army National Guard, Army Reserve, and other services.

The survey found that there was a lack of knowledge about the different types of DEET containing repellents and the use of Permethrin, with less than one-third of all respondents answering correctly. The highest average scores were by soldiers in the military sciences followed by soldiers in the health sciences. These findings are supported by a questionnaire survey undertaken by Gambel et al. who examined the US soldier's knowledge of the military's system of PPM's and use of PPM's in general while on deployment in three military operations: Operation Vigilant Warrior in Kuwait (1994); Operation Uphold Democracy in Haiti (1995); and Operation Joint Endeavour in Bosnia (1996).[11] The most common MOS represented in the surveys were from the military sciences or direct combat

troops. Approximately 40% of respondents correctly identified the 33% extended-duration DEET containing repellent in a tube as the US military's topical insect repellent, while approximately the same proportion accurately identified Permethrin as the agent used to treat the field uniform.

With regard to attitudes and beliefs, approximately one-quarter of survey participants were undecided which product (commercial versus military issue) was more effective, while almost three-quarters of participants indicated that they felt that they did not have enough or any information regarding the US military doctrine of PPM's. A similar proportion stated that they believed that, in general, the use of a repellent is necessary and its application is less of a nuisance than suffering insect bites.[2]

The majority of respondents reported use of a combination of both commercial and military issue repellents, with the highest proportion of combination use evident in the military sciences. Survey findings indicated that nearly three times as many respondents used commercial repellents alone as compared to military repellents alone. The reasons for this were not outlined, although it was indicated that less than one-quarter of respondents were able to accurately discern the major differences (duration, plasticising effect, greasiness and smell) between two types of military issue topical repellent, one containing 75% DEET and the other containing the more current 35% extended-duration DEET. Of note, the study states that "almost 70% of those in the military sciences, the MOS category expected to have the most field experience, reported never having been ordered to use PPM's".[2]

A summary of results for group interviews indicated that, apart from predeployment health threat briefings only one service member recalled unit training on PPM's. Information on the importance of use in the field appeared to move horizontally through mostly informal channels. Decisions of which repellent to use appeared to be commonly made from both a combination of advice from others in the unit (peers) and personal experience. Most respondents were surprised to learn that military issue extended duration repellent containing 35% DEET is actually identical to a known commercial product except for tubing colour. Respondents were also only vaguely aware of the currently existing method of treating field clothing with Permethrin. Most interviewees also indicated that they had heard or witnessed other service members using 'dangerous methods' such as wearing flea collars and drinking dilute turpentine in an attempt to prevent insect bites. Most believed, that if PPM's are so important, they should be handled like any other military task by training to standard and testing for competence.[2]

Other points consistently mentioned during group interviews included:[2]

- prevention of nuisance bites rather than prevention of disease was the primary motivator for utilising insect repellent;
- focus tended to be more on the effectiveness of a product to prevent insect bites, rather than on concerns regarding product toxicity or side-effects; and
- the responsibility for enforcing the use of PPM's in the field was unclear, with neither enlisted soldiers nor officers believing that enforcement of measures was their responsibility.

The authors' discussion focused on a few key points. Whilst not being as a valid sample of the US Army overall, the authors believed that this group with at least recent experience in the field would more likely display a greater degree of knowledge of the military preventive measures regimes than the average soldier.[2] Although the MOS of military sciences displayed a greater degree of knowledge than others (including health sciences), results obtained generally indicated that knowledge deficits consistently existed across all ranks and military MOS's surveyed.[2]

Study Results

To address the issue, two small focus groups (n=11) were arranged with the members of a combat-orientated Army Reserve unit. Verbal consent was obtained from participants prior to running the focus groups. The focus groups addressed pre-established risk factors believed to contribute to the incidence of RRV disease in Army personnel. These factor were lack of education, poor knowledge base and lack of compliance with PPM's. The risk factors were presented to participants with the aim to canvas a range of opinions on RRV disease and PPM's in this particular unit. The demographic details of the group are in Table 1.

Characteristics	Focus Group
Sex	Male 11, Female 0
Rank	Private 10, LCPL I
Age	22-32
Years of Army Service	1-1
Army Employment Service	Raider 10, Combat First Aider I
Civilian Education	HSC 6. TAFE 3, University Degree 2
Service in Previous Army Units	Health services I, Military Services 3. Training I

Table 1: Focus group demographic details

The participants of the focus groups identified a health problem as being any injury, illness or threat to health. As a broad category, the field was identified as an area where the threat to health may increase, with the suggestion that the farther away from support the individual is, the greater the perceived risk. As mobility is an essential component for achieving operational objectives, operations can place the soldier some distance from the usual established health support services for various periods.

The most prevalent health risks identified by participants of the focus groups during the field phase included infection, injuries/accidents, unforeseen circumstances, and hygiene and self-maintenance problems inclusive of insect bites, ticks, snakes and leeches. It was generally agreed that if a health problem existed, the effectiveness of the team would decrease with a domino effect occurring, thus placing stress on other members of the team and consequently increasing their risks. The group also strongly advocated, however, that the 'buddy system' should occur, where looking out for 'one's mate' should aid in pre venting the health problem occurring or be coming worse.

Themes identified by the participants thought to contribute to the health risk of RRV disease on an individual level included:

- lack of education regarding PPM's;
- perception and attitude of the individual;
- individual compliance with preventive measures;
- being poorly equipped for an exercise, in appropriate equipment, lack of ‘common sense' and poor planning and preparation predeployment; and
- lack of knowledge regarding arthropod related diseases.

Interestingly, these risk factors generally correlated with the proposed risk factors. Consequently, a random selection of contributing risk factors was presented to the participants for further exploration. Those identified as relevant by the participants were consequently categorised into predisposing, enabling and reinforcing factors where applicable.

Identified risk factors and contributing risk factors included:

Lack of Education - Formal training avenues possibly not achieving their full potential, thus allowing for a revision of the strengths and weaknesses of the current system regarding arthropod-related diseases and PPM's.

Enabling

- Missed opportunities to provide knowledge and training during formal military courses, possibly related to tight schedules and timing of formal courses, thus at times necessitating the 'missing’ of a health lecture over something regarded of greater importance.
- Education (and other) initiatives. A possible lack of focus and interest on RRV disease hence leading to the question of how do we maintain interest in promoting this health problem? In addition, how can the effectiveness of educational opportunities during formal training courses and in house unit training be enhanced?
- Lack of practice and testing procedures. As PPM's are not currently testable procedures for practice purposes, no standard for comparison exists.

- Recommendations could be suggested to improve this possible weakness in the chain of ensuring effective use of PPM's.
- Who is responsible for ensuring ongoing training/education in individual units?

The focus group strongly advocated that individuals should be educated according to risk level, with an emphasis on the risk for the individual. Education should also be 'situation specific' and relevant to current climate and geographic deployment location. The general indication was that medics are viewed as the ones to be seen as being responsible for ongoing training and providing updates of studies on PPM's.

Poor Knowledge Base - Of arthropod -related diseases such as RRV disease and use of PPM's in prevention.

Predisposing

- "It won't happen to me" attitude. Possibly related to poor understanding of perceived versus actual health threat to the individual.

Enabling

- Poor knowledge of mosquito-borne diseases in general.
- Poor knowledge/awareness of measures for prevention against mosquito-borne diseases in general.
- Poor knowledge of recommended military regime of PPM's against infection at the individual service member level.

The focus groups identified a need for a standardised knowledge base. The group believed they only require a basic knowledge of RRV disease, with more focus being placed on the how's and why's of PPM's. The principles outlined behind the how's and why's included: how the regime works in terms of preventing/reducing the health risk, with studies on the demonstrated effectiveness of the individual components; why it is important to comply with the PPM's, and why they are effective.

Lack of Compliance **-** With PPM's against infection by RRV disease.

Predisposing

- Perceived health threat by the individual, for example, "I can die from that, but can only get sick from that".

Enabling

- knowledge deficits of available military resources;
- issue of military repellent;
- use of Permethrin impregnation for field clothing predeployment to a high-risk geo graphic location; and
- studies on products outlined in the military regime of individual PPM's.
- responsibility for ensuring compliance.

Reinforcing

- Habits myths and anecdotes by both peers and role models.
- Lack of continuing reinforcement, role model compliance, and so forth.
- Responsibility for ensuring compliance.
- Previous exposure/ past experiences.

The focus groups identified a need for a uniform awareness and compliance level with regular education and opportunities for assessment/testing and practice prior to deployment. There was strong consensus that the individual was responsible for compliance with preventive measures and thus ensuring their own health.

There was a suggestion by a few participants that they believed that a different mentality may exist between reserves versus regular soldiers and within individual unit in the Army. This, therefore, poses an interesting question for any pilot study as to whether to separate the two populations or perform an overall cross-section of the target group.

Risk markers (factors having impact on the health problem but not necessarily directly contributing to the identified problem) were also identified in recognition that, while focus in this needs assessment report remains on the individual and PPM's, it is only one aspect of a wider scale health problem.

Identified Risk Markers included:

- Climate - humidity /temperature; season; rainfall; global warming issues.

- Geographic location - region of Australia: inland /coastal areas; incidence of RRV disease (endemic areas and epidemic out breaks); surveillance systems; epidemiological reporting systems.
- Military field operations - mission; sources of infection (vectors and hosts); time spent in location (length of exposure to health risk); terrain.
- Availability of resources - current funding allocation; knowledge of current studies on repellents and Permethrin used in the military system; logistics support; knowledge base of logistic support staff.
- Identification issues with symptoms of RRV disease.
- Mixed interpretation of testing procedures and reporting criteria (Notification System) through the chain of command.

Conclusion

The results of these focus groups indicate that further investigation of this health problem, through a pilot study, may provide some interesting data on the current status quo of the Army system. A preliminary survey such as this may prove beneficial in assessing the strengths and weaknesses of the current system while allowing for relevant and appropriate strategies for interventions in accordance with available resource allocation. Preexisting resources and programs could be identified, with utilisation of existing skills, knowledge and expertise in the area. Involvement of the health side of the ADF would be an essential prerequisite, along with securing funding for any health program initiatives.

Above all, the awareness that health education and awareness/promotion is an important first step in promoting 'healthy' behaviour and therefore improving overall health. By increasing the awareness of military personal protection measures for prevention of arthropod-related diseases, the individual service member may accept the responsibility for maintaining and protecting their own health. By the very nature of field phases of military exercises and deployment to high-risk geographic locations, the significant risk to all non-immune ADF personnel is worthy of efforts to improve the knowledge, attitudes, beliefs and practices of service members' to PPM's.

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