



**GULF HEALTH:  
INFORMATION GUIDE FOR HEALTH  
PROFESSIONALS**

## CONTENTS

<b>Section</b>	<b>Title</b>	<b>Page</b>
1	Introduction	1
2	Key Points	3
3	Gulf Veterans' Medical Assessment Programme (GVMAP)	5
4	Gulf Veterans' Illnesses Research.	9
5	Potential Exposures	17
Annex A	MOD Publications on Gulf Veterans' Illnesses	21
Annex B	References	23

## **INTRODUCTION**

*Twice over the last decade and a half, large numbers of UK military personnel have been called to active service in the Gulf region. In health terms, this service presented considerable challenges, including those from: terrain; endemic infectious agents; climate; and the threat of chemical and biological warfare agents. In addition there was unprecedented media interest and speculation in relation to all aspects of the campaign, including health issues, before, during and after the conflicts. Already many participants, regular and reservists, have returned to civilian life and increasingly more will do so.*

This guide is produced by the Veterans' Policy Unit (VPU) of the Ministry of Defence (MOD). It is intended to provide health professionals, both service and civilian, with information that they may find useful in dealing with the health concerns of veterans from these operations in the Gulf.

**1990/1991 Gulf Conflict:** Around 53,000 UK Servicemen and women served in the 1990/1991 Gulf Conflict. At least two thirds have now left the Armed Forces and responsibility for their health care falls to the National Health Service, in particular to their GPs. There are ex-Service Gulf veterans living in all parts of the UK, and many GPs will have veterans among their patients. Since returning from the Gulf, some veterans have become ill. In some cases this is due to disorders which are unrelated to service. Others have recognised medical conditions such as Post Traumatic Stress Disorder (PTSD) where service links are accepted. A third group reports the multi-system, multi-organ, non-specific, symptoms and illnesses which epidemiological evidence confirms are not specific to, but are more common in, those who served in the Gulf in 1990/1991.

**2003 and subsequent operations in the Gulf:** Over 80,000 UK Servicemen and women have served in operations in the Gulf since January 2003. It is too soon to know whether any health issues will emerge following these operations but learning from experience of the 1990/1991 Gulf Conflict, the MOD has put in place a range of measures to monitor the health of returning personnel and investigate any concerns quickly.

The Government and MOD considers its people its greatest resource and there is therefore considerable concern about the health and well-being of personnel both during and after service. The Government is committed to addressing the complex and difficult issue of why some veterans have fallen ill since returning from the 1990/1991 Gulf Conflict and has adopted three principles in its approach to the subject:

- First, that all Gulf veterans will have prompt access to medical advice.
- Second, there will be appropriate research into veterans' illnesses and factors which might have a bearing on these.
- Third, the MOD will make available to the public any information it possesses which is of potential relevance to this issue.

To oversee the Government's response to Gulf veterans' illnesses, in 1997 the MOD established a Gulf Veterans' Illnesses Unit. The unit, which is now part of the Veterans Policy Unit, acts as a focal point for Gulf veterans who are ill or worried about their health and is responsible for conducting relevant reviews, providing support to research teams and answering public correspondence on this subject.

Further information on Gulf veterans' illnesses, and copies of MOD publications on this subject, can be obtained by calling the VPU Gulf helpline on 0800 169 4495; by visiting the Gulf veterans' illnesses website at [www.gulfwar.mod.uk](http://www.gulfwar.mod.uk); or by writing to:

VPU GVI  
7<sup>th</sup> Floor Zone H  
Ministry of Defence Main Building  
Whitehall  
London SW1A 2HB

February 2005

**KEY POINTS ABOUT GULF VETERANS' ILLNESSES**

- The MOD accepts that since returning from the 1990/1991 Gulf Conflict, some personnel have become ill. The health of those who served in the Conflict remains a high priority.
- In some cases veterans' illnesses are due to disorders which are unrelated to service. Others have injuries or recognised medical conditions such as PTSD, where service links are accepted. A third group reports the multi-system, multi-organ, non-specific, medically unexplained symptoms and illnesses which epidemiological evidence shows are not specific to, but are more common in, those who served in the Gulf in 1990/1991.
- The consensus of the medical and scientific community is that the ill health reported by some veterans of the 1990/1991 Gulf Conflict cannot be characterised as a discrete syndrome because similar symptoms are seen in non-Gulf veterans. The difference is that in those who served in the 1990/1991 Gulf Conflict these symptoms are more common and more severe.
- This pattern of ill health is not unique to UK Gulf veterans, and is repeated amongst 1990/1991 Gulf veterans from the other coalition countries. This is regardless of the specific experiences and exposures of the personnel concerned, which were not the same for all participants. Similar symptoms and illness are also reported by some who did not actually deploy.
- Only a minority, albeit an important minority, are ill. We want to know why this is.
- Monitoring shows that there is no excess in overall mortality for veterans of the 1990/1991 Gulf Conflict in comparison to a similar control group of personnel that did not deploy.
- Veterans of either the 1990/1991 Gulf Conflict or of operations in the Gulf since January 2003 can be referred by their GPs or Service Medical Officers to the Gulf Veterans' Medical Assessment Programme (see section 3).
- The MOD has funded and continues to fund appropriate research into the ill health suffered by veterans of the 1990/1991 Gulf Conflict (see section 4).
- It is too soon to know whether any unusual health issues will emerge following the recent and continuing operations in the Gulf. The MOD takes the health of its people very seriously and has put in place a range of measures to monitor the health of returning personnel and investigate any concerns quickly (see section 4).
- The MOD is committed to providing information to Parliament and to veterans on matters relevant to the issue of Gulf veterans' illnesses (see section 5).

- Gulf veterans who are concerned about their health are invited to contact the MOD's Veterans Policy Unit on Freephone 0800 169 4495 for advice.
- A considerable amount of information about the Ministry of Defence's approach to Gulf veterans' illnesses is available on our website at:

*For veterans of the 1990/1991 Gulf Conflict: **[www.gulfwar.mod.uk](http://www.gulfwar.mod.uk)***

*For veterans of operations in the Gulf since 2003: **[www.mod.uk/issues/optelic\\_health](http://www.mod.uk/issues/optelic_health)***

## **THE GULF VETERANS' MEDICAL ASSESSMENT PROGRAMME (GVMAP)**

The GVMAP was established in July 1993 to examine UK Gulf veterans who were concerned that their health had been adversely affected by service in the 1990/1991 Gulf Conflict. The GVMAP is located at St Thomas' Hospital, London.

On 7 May 2003, MOD Ministers announced in Parliament that the GVMAP's remit would be extended to include those who had taken part in operations in Iraq since January 2003.

### **Who is the GVMAP for?**

The GVMAP is open to all Servicemen and women, irrespective of whether they are still serving or not - as well as MOD civilians - who served in the Gulf at any time between August 1990 and July 1991, or who believe that their health has suffered as a direct result of the Gulf Conflict. Individuals who worked for contractors providing direct support to UK operations during the Gulf Conflict may also be seen. The programme is not intended to cover other UK citizens who may have been in the Gulf region at the time.

The GVMAP is also open to those who were deployed to operations in the Gulf on or after 20 January 2003 (Operations TELIC and RESINATE). The facility is also available to attached voluntary aid society personnel, contractors working in direct support of UK operations in theatre and embedded journalists. Contractors, some Voluntary Aid Society Personnel and embedded journalists will be asked to pay a fee to cover the cost of the assessment and tests carried out at the GVMAP.

### **What is the purpose of the GVMAP?**

The GVMAP has two main purposes:

- First, to investigate patients' medical complaints and, so far as possible, to diagnose what they are suffering from and recommend appropriate management, or provide reassurance if no illness is found.
- Second, the GVMAP collates statistical information, which is available in an anonymised form as a resource for researchers who have obtained the appropriate ethical clearance. This has proved useful in helping to determine whether there are particular patterns of ill health associated with service in the Gulf. (No information about named individuals will be given to third parties without express written consent). A paper on the first 284 service and ex-service patients examined at the GVMAP was published in 1996<sup>1</sup>, a paper on the first 1,000 service and ex-service patients was published in January 1999<sup>2</sup>, a paper on the second 1,000 patients was published in June 2001<sup>3</sup>. Work analysing the third 1000 patients and an overview on all the first 3,000 patients was published in October 2002<sup>4</sup>. Analytical work continues.

## **Where is the GVMAP?**

The GVMAP is based at St Thomas' Hospital in central London. The location provides access to a wide range of facilities and enables interdepartmental referrals and laboratory or medical tests to take place without undue delay, and the Capital is well served by rail and air links to all parts of the country. However, in order to improve our service to some Gulf veterans, who find travelling to London difficult or inconvenient, the GVMAP physician holds a clinic at Northallerton, North Yorkshire every two months for patients who might find that location more convenient.

Rarely, special arrangements can be made for individual veterans who are unable to travel either to London or to Northallerton.

## **Why should I refer my patient to the GVMAP?**

Doctors are encouraged to refer to the GVMAP any patients who are concerned that their health may have suffered as a result of their Gulf Service and who fulfil the criteria for being seen. This will allow the patient to have a thorough assessment by a consultant physician with considerable knowledge of Gulf veterans' illnesses issues and experience of dealing with Gulf veterans. The GVMAP physician will then provide a report to the referring doctor including, as relevant, any diagnoses made and recommendations for treatment, or provide reassurance if no abnormalities are found. Satisfaction surveys indicate that the service provided by the Programme is well regarded by patients. The GVMAP physician is happy to answer questions from health professionals and can be contacted on 020 7202 8322 or Freephone 0800 169 5401, or by email to [map@gstt.sthames.nhs.uk](mailto:map@gstt.sthames.nhs.uk)

## **How do I refer my patient to the GVMAP?**

Veterans who are still serving in the Armed Forces can be referred to GVMAP by their Service Medical Officer. Personnel who have left service and civilians who have concerns about their health and possible links to Gulf service should contact their GP to access the GVMAP.

If the GP or Service Medical Officer thinks that referral to the GVMAP is appropriate, he or she should write to the Head of GVMAP at: The Baird Health Centre, Gassiot House, St Thomas' Hospital, Lambeth Palace Road, London, SE1 7EH. The referral letter should include details of past medical history, present health problems and any treatment that the patient is currently having, together with information (where applicable) on the branch of the Armed Forces in which the veteran served and the veterans' former service number if known.

## **Does the GVMAP see everyone referred?**

In the case of a very small number of patients referred, there is nothing to be gained from them being seen at the GVMAP – for example, because it is clear that their condition is being appropriately managed or they have been seen before and nothing new would be gained by a further visit. The physician at the GVMAP therefore does not automatically see everyone referred. When a decision is taken not to see a patient, the referring doctor is told why and given a brief update about Gulf health issues. If the

physician at GVMAP decides not to see a veteran, this does not preclude him from seeing that veteran at a later date if circumstances change.

### **What happens at the GVMAP?**

The GVMAP is currently staffed by a civilian consultant physician and supporting staff. Patients referred to the GVMAP are given a full interview and medical examination and a range of laboratory tests; investigations routinely undertaken for all patients include: urinalysis; haematological; biochemical; biological and serological tests; ultrasound scan of the abdomen and electrocardiography. These tests are carried out on the day of the appointment and take approximately four hours. Additional investigations will be carried out if they are clinically indicated. Referrals to other consultants/specialists may be required.

### **What about psychological assessments?**

Amongst veterans of the 1990/1991 Gulf Conflict, there are some who suffer from psychological conditions. Of over 3,000 patients who have been to GVMAP, about 20% were diagnosed as psychiatrically unwell with a range of symptoms and illnesses. Since 1999, the GVMAP has utilised, where appropriate, a country-wide network of psychiatric assessment centres with staff with specialist knowledge of the psychological injury of conflict and PTSD. The GVMAP pays for this, including the patient's travel costs. As a result of such referrals, a study of outcomes has been carried out and, at the time of publication of this guide, is in press<sup>5</sup>.

### **Is there a long waiting list?**

No. Our aim is that all patients referred to the GVMAP will be sent an appointment letter within 5 days; and that as far as possible the date of the appointment will be within 6 weeks of the patient's referral, provided that this is convenient for the patient. If the patient cannot attend on the date shown, every effort will be made to rearrange the appointment as soon as possible.

### **Funding arrangements?**

The examination and clinical tests will be provided free of charge except in the case of contractors, some voluntary aid personnel and embedded journalists who accompanied deployments since January 2003. The MOD will also pay for further tests which the GVMAP physician believes are necessary to carry out the assessment.

With the exceptions detailed above, the cost of the patient's travel to the GVMAP from within the UK will be met by MOD (normally we will provide rail warrants in advance). The MOD will also reimburse up to £10 for a snack or light lunch. Where necessary (if the length of the journey precludes the possibility of a return trip within a single day) accommodation costs and the cost of breakfast and an evening meal at the hotel will also be met by MOD.

Accommodation will be booked by MOD. Veterans will not be able to claim reimbursement for accommodation they have booked themselves. Any special requirements resulting from the veteran's medical condition (for example, for a carer to

accompany him/her) must be notified to the GVMAP in advance and supported by a note from the patient's GP.

### **What happens after my patient is seen?**

The GVMAP itself does not provide treatment. Its role is to assess patients and recommend treatment as appropriate. Implementation and follow-up, via the Defence Medical Services (for serving personnel) and the NHS for those who have left service, will be for the individual's own doctor.

The GVMAP consultant will write to the referring doctor after the consultation with a copy of the assessment report with test results following within six weeks. Patients who wish to see their report and who have signed a consent form are automatically sent a copy of the medical assessment report and test results at the same time as the results are sent to the referring doctor.

We ask doctors to co-operate in taking forward treatment recommendations and in responding to any enquiries about a patient's progress. GVMAP will send a standard follow up letter to all GPs who refer patients, asking for information on the patient's condition and subsequent treatment. This is usually done 6 months after the GVMAP appointment.

## **GULF VETERANS' ILLNESSES RESEARCH IN THE UNITED KINGDOM**

### **1990/1991 Gulf Veterans' Illnesses Research Programme**

MOD's current 1990/1991 Gulf veterans' illnesses research programme, with the exception of the Vaccines Interactions Research Programme which is described on page 13 of this guide, is being carried out independently of MOD. The Vaccines Interactions Research Programme is being conducted partly at the Defence Scientific and Technology Laboratory at Porton Down. To ensure that this research is conducted in an objective and scientifically sound manner, it is being overseen by an Independent Panel (consisting of scientists and doctors, two of whom were nominated as representatives of the Gulf veterans).

Researchers are welcome to submit proposals for additional research to MOD at any time. These will be passed either to the Medical Research Council (MRC) who provide independent advice on the merit of proposals and the direction Gulf veterans' illnesses research should be taking, or, if appropriate, to the Independent Panel overseeing the vaccines interactions research, for independent scrutiny. Recommendations of the MRC or Independent Panel are normally considered favourably by MOD.

The MOD has funded or contributed to the funding of the following research studies:

#### **Morbidity and Mortality**

An epidemiological study by a team led by Professors Nicola Cherry and Gary Macfarlane at Manchester University aimed to determine whether Gulf veterans are experiencing greater ill-health than Service personnel who did not take part in the 1990/1991 Gulf Conflict and to identify possible exposures and predisposing factors associated with any distinctive pattern of symptoms which may be found. The randomly selected study group for this survey was composed of two groups of 4,800 Gulf veterans, plus a control group of 4,800 personnel who did not deploy to the Gulf. The research team also investigated whether service in the Gulf is associated with increased mortality, by looking at all deaths that occurred in the 8 year period from 1 April 1991 to 31 March 1999 in the total Gulf cohort of 53,462 and in a similar sized group, randomly selected from among those who did not deploy.

The results of the morbidity study were published as two papers in the May 2001 edition of *Occupational and Environmental Medicine*<sup>6 7</sup>. The research found that, although the overall severity of symptoms was not high, Gulf veterans reported a greater severity of symptoms than those who were not deployed to the Gulf. There was no evidence of any illness unique to Gulf veterans and the various symptoms reported were ranked in generally the same order by both groups. The researchers found no evidence of a "Gulf War Syndrome". The research also found weak associations between some reported exposures (handling pesticides, vaccinations and exposure to oil fire smoke) and particular types of ill health.

The results of the mortality study were published in *The Lancet* on 1 July 2000<sup>8</sup>. The study found that the number of deaths and the causes of death in the comparison group who did not deploy to the Gulf were similar to those recorded amongst Gulf veterans.

There was however a small excess of deaths amongst Gulf veterans attributable to accidents, particularly road traffic accidents. Since the publication of the study, the MOD has monitored the mortality of both the Gulf and control groups and has published updated statistics every six months. The Defence Analytical Services Agency, who provide analytical and statistical services for the MOD, are responsible for this data and it can be viewed on their website: [www.dasa.mod.uk/natstats/gulf/intro.html](http://www.dasa.mod.uk/natstats/gulf/intro.html)

## **Reproductive Health**

A team led by Dr Patricia Doyle and Dr Noreen Maconochie at the London School of Hygiene and Tropical Medicine carried out a very large epidemiological study of the reproductive health of Gulf veterans and their partners, and the health of their children. Specific areas of interest were fertility, pregnancy outcomes and child health as well as information about specific occupational and environmental exposures. A paper entitled "The study of reproductive outcome and the health of offspring of UK veterans of the Gulf war: methods and description of the study population" was published in *BioMed Central* on 10 January 2003<sup>9</sup>. The paper describes in detail the method used for the study and provides information about response rates.

Papers reporting reproductive outcomes and male fertility were published in 2004. In "Miscarriage, stillbirth and congenital malformation in veterans of the first Gulf war"<sup>10</sup> the researchers reported that for male veterans of the 1990/1991 Gulf Conflict, they found no evidence for increased risk of stillbirth, chromosomal malformations, or congenital syndromes. Some associations were reported between fathers' service and increased risk of miscarriage and other less well-defined malformations. For female veterans, the number of stillbirths and malformations were too small to allow meaningful analysis and there was no effect on miscarriage. In a paper published in the *British Medical Journal Online First*<sup>11</sup> the researchers examined whether male Gulf veterans suffer increased risk of infertility. The researchers found a small increased risk of reported infertility and that pregnancies fathered by Gulf veterans who did not report problems also took longer to conceive. They could not however conclude that this association was caused by service in the Gulf.

Although the study has primarily focussed on reproductive health, a member of the research team also published a paper in *BioMed Central*<sup>12</sup> which looked at the general health reported by veterans. The findings of this supported that of Cherry *et al* described above.

## **Study of UK Gulf Veterans**

A further epidemiological study looking at whether service in the Gulf in 1990/1991 is associated with increased illness in UK veterans has been funded by the US Department of Defense and carried out by a team led by Professor Simon Wessely at the Institute of Psychiatry, King's College, London. Although this study was carried out independently of MOD, the Department co-operated with the research team by providing essential data to the researchers. This study involved 4,248 Gulf veterans and two control groups: one of 4,246 personnel who served during the Gulf Conflict but did not deploy there, and another of 4,250 personnel who have served in Bosnia. The results from phase one of the study, which involved the completion of a health questionnaire, were published as two papers in *The Lancet* in January 1999<sup>13 14</sup>. The

papers said that UK Gulf veterans reported symptoms of ill-health up to three times more frequently than the other groups, although the symptoms did not appear to be unique to this group, and the authors concluded that these findings did not support a unique Gulf illness. The findings included a hypothesis that multiple immunisations are associated with later self-reported ill health in Gulf veterans. A further paper published in May 2000<sup>15</sup> provided a more detailed analysis of that hypothesis. The research did not find an association between ill health and the individual vaccines given in the 1990/1991 programme. Nor did it link ill health to a particular combination of vaccines. Multiple immunisations before deployment to the Gulf do not seem to be associated with self reported ill health, whereas multiple immunisations given during the deployment do seem to be associated with ill health. The suggestion in the paper is that this different outcome is stress mediated. However, this is no more than a hypothesis.

Phase two of the study aimed to validate some of the findings of phase one by conducting clinical examinations and medical tests on a proportion of the study group in order to further define their conditions. The results of this work have been published as several papers in peer reviewed scientific journals. A paper on Antinuclear Autoantibodies (ANA) in Gulf War Related Illness and Chronic Fatigue Syndrome (CFS) patients was published in *Clinical and Experimental Immunology* in August 2002<sup>16</sup>. The authors noted that the most common symptoms of Gulf veterans overlap with those of CFS patients. The study tested the hypothesis that CFS and Gulf veterans' illnesses were associated with a particular type of ANA, (autoantibodies to nuclear envelope antigens) which have been associated, albeit rarely, with autoimmune disorders. The authors found no significant difference in the prevalence of ANA across the study groups and that none of the patients or veterans studied had ANA of the nuclear envelope type. A paper entitled: "The Mental Health of United Kingdom Gulf War Veterans: A Two-Phase Cohort Study" was published in the *British Medical Journal* in September 2002<sup>17</sup>. The paper's conclusion was that the majority of disabled Gulf veterans do not have a formal psychiatric disorder. PTSD is not increased in Gulf veterans and psychiatric disorders do not fully explain self-reported ill health in Gulf veterans. A paper on cognitive functioning and disturbances of mood in UK Gulf veterans was published in the November 2002 issue of *Psychological Medicine*<sup>18</sup>. The paper concluded that there was no evidence of major neuropsychological disturbance in Gulf veterans. Test performance in unwell veterans was impaired compared with well Gulf veterans, but was generally within the normal range.

A third phase of research consisting of a longitudinal study of the changing health of Gulf veterans over time, and a further analysis of the health of the Bosnia cohort examined in the earlier study, has been funded by MOD. The work is complete and a number of papers<sup>19 20 21</sup> have been published as a result. They report that, at follow up:

- Gulf veterans continue to report poorer health than other military personnel, but the overall health gap has narrowed slightly;
- poorer health is associated with being older, having more severe symptoms at baseline, having psychological distress and believing that one is suffering from "Gulf War Syndrome";
- reporting of hazards is not static, and is associated with current health perception.

### **Neuromuscular Symptoms Study**

MOD funded a clinical study which was carried out under Dr Michael Rose and Dr Mohammad Sharief at King's College, London. The study investigated the hypothesis that symptoms of fatigue, weakness, muscle pain and sensory disturbance which have been reported by some Gulf veterans might be due to disturbance of the nerve or muscle function. It focused on those veterans who have, according to their response to the epidemiological study carried out at King's under Professor Wessely, significant neuromuscular symptoms. Two papers have been published. The first, entitled "Neurophysiologic analysis of neuromuscular symptoms in UK Gulf war veterans"<sup>22</sup> reported that there was no objective evidence for a specific neuromuscular junctional disorder that could be linked to service in the 1990/1991 Gulf Conflict. In the second, "Evaluation of Neuromuscular Symptoms in UK Gulf War Veterans. A Controlled Study"<sup>23</sup>, the researchers report that there was no correlation between subjective complaints of weakness/fatigue and statistical and dynamic quantitative strength and fatigue measures, and that muscle biopsies did not find abnormalities in any group of veterans tested. There was clinical evidence that symptomatic Gulf veterans did find an exercise bicycle test more effortful than other groups of veterans tested, reflecting some inefficiency in the muscle tissue. However, the cause of the inefficiency is unclear.

### **Systematic Literature Review**

MOD has funded, through the MRC, an independent systematic literature review of world-wide published research relating to Gulf veterans' illnesses. The review was carried out by a team led by Professor Glyn Lewis. The first paper entitled "Psychiatric disorder in veterans of the Persian Gulf War of 1991" was published in the *British Journal of Psychiatry* in May 2003<sup>24</sup>. The authors compared the prevalence of psychiatric disorder in Gulf veterans in 20 published papers which included data on psychiatric disorders to prevalence in the comparison groups used in those studies. They found an increased prevalence of Post Traumatic Stress Disorder and common mental disorders in Gulf veterans compared with the control groups. Publication of similar systematic reviews on reproductive health, mortality and hospitalisations, multi-symptom conditions and pain are awaited.

### **Cancer Study**

MOD has funded work led by the University of Manchester on the incidence of cancers in Gulf veterans as recorded on the NHS central registers for England and Wales and for Scotland. The researchers concluded in their paper "Incidence of cancer among UK Gulf war veterans: cohort study"<sup>25</sup> that there is no current excess risk of cancer overall nor of site specific cancers in veterans of the 1990/1999 Gulf Conflict. Specific exposures during deployment do not appear to have resulted in a subsequent increased risk of cancer. The long latent period for cancer however necessitates continued follow up.

### **Paraoxanase work**

Findings on the levels of paraoxanase (PON1) (an enzyme that metabolises organophosphates) in Gulf veterans undertaken by a team at Manchester Royal Infirmary (MRI) were published in September 2000<sup>26</sup>. The MRI researchers found that a self-selected group of 152 ill Gulf veterans had paraoxanase activity levels 50% less

than those of healthy civilians in a control group. MOD felt that the results were sufficiently important to warrant further study and made arrangements for MRI to analyse blood samples collected by King's during their Phase 2 clinical studies (described above) to see if the original MRI results would be replicated in a blinded study. The MOD contributed towards the cost of the work. In a paper published in the *Journal of Occupational and Environmental Medicine* in July 2003<sup>27</sup>, the researchers report that they found that PON1 activity in Gulf veterans was lower than in the control groups used. The study however found no statistically significant differences between PON1 activity in ill Gulf veterans and in healthy Gulf veterans.

### **Study of the Social Construction of “Gulf War Syndrome”**

The MOD has part-funded, with the Economic and Social Research Council, a study by a PhD student in Medical Anthropology at the University of London into the Social Construction of “Gulf War Syndrome”.

The study is based on interviews with Service and ex-Service Personnel and their families about “Gulf War Syndrome”. The first in a proposed series of papers was published in the August 2004 edition of *Anthropology & Medicine*<sup>28</sup>. This paper discusses the way in which individual veterans may look to “Gulf War Syndrome” to make sense of life events and illness, and the part that dialogue with others can play in the veteran’s view of “Gulf War Syndrome”.

### **Vaccines Interactions Research Programme**

MOD has also funded a programme of research at the Defence Science and Technology Laboratory (Dstl) Porton Down to investigate the possible adverse health effects of the combination of vaccines and tablets which were given to troops in the 1990/1991 Gulf Conflict to protect them against biological and chemical warfare agents.

The first phase of this investigation, involving guinea pigs, did not identify any remarkable findings with the combination of ten vaccines and pyridostigmine bromide (PB) (the active ingredient in Nerve Agent Pretreatment Sets tablets) examined, but helped to determine the appropriate vaccine doses for use in the subsequent phases. Results from the study were published in the *Journal of Applied Toxicology* on 21 January 2001<sup>29</sup>.

The next phase of this study was conducted in a small primate, the marmoset, using a complex experimental design. A number of sensitive indices, including cognitive performance, electroencephalogram, sleep, endocrinology, biochemistry and immune responsiveness, were monitored for eighteen months following the co-administration of the ten vaccines and PB. Preliminary results from the first 3 months of the study were presented by means of posters at two scientific conferences in April 2003. These preliminary findings indicated no apparent adverse health consequences 3 months following the administration of vaccine and/or pyridostigmine bromide. The main programme is complete and it is expected that final findings will begin to be submitted for publication in early 2005.

Work has also been undertaken at the National Institute for Biological Standards and Control to validate a 1990 study which reported that the combination of anthrax and

pertussis vaccines produced an adverse response in one strain of mouse. This study was undertaken in the light of a decision taken during the Gulf Conflict to offer immunisation against anthrax and to use pertussis vaccine as an adjuvant to enhance the immunisation effect. The new study included a range of genetically diverse strains of mouse to examine whether genetic factors may have a role to play in such a complex interaction. An outline of the findings of the first phase of this work was presented at the "Conference on Dangerous Pathogens" in September 2002. The study is now complete and the full results were submitted for publication in 2004.

### **Research on Organophosphate Pesticides**

In addition to MOD's Gulf veterans' illnesses research programme, research funded jointly by the Department of Health, the Department for the Environment, Food and Rural Affairs and the Health and Safety Executive is studying the long-term health effects of low level exposure to organophosphate (OP) pesticides in the context of the health concerns of some farm workers. This may help us to understand the possible effects of potential OP exposures during the Gulf Conflict, although in general the military and agriculture settings provide different usage and dose levels.

### **MRC Review of Gulf Veterans' Illnesses Research**

Following a request from MOD, the MRC undertook a review of Gulf veterans' illnesses research. The MRC's report was published in May 2003 and is available on the MRC's website at: [www.mrc.ac.uk](http://www.mrc.ac.uk)

Key points of the report are;

- There is no unique "Gulf War Syndrome".
- The same symptoms seen in Gulf veterans are also seen in personnel who did not deploy, but around twice as many Gulf as non-Gulf veterans (24% compared to 10%) report having them, and suffer more severely.
- Thorough medical examinations and physical, psychological and psychiatric testing of ill veterans have detected no abnormalities. There is no correlation between how badly people think their memory and concentration has been affected and how well they do in tests.
- Gulf veterans who report more severe symptoms are more likely to recall having had more inoculations and exposure to pesticides, but their perception of their health is known to influence recall.
- There is little evidence that vaccination was a cause of veterans' illnesses. No commonly accepted mechanism could account for immune system related symptoms more than 10 years on.
- Symptoms do not fit the expected pattern for damage to peripheral nerves of nerve/muscle junctions caused by exposure to organophosphates.

The MOD has taken note of the Review's conclusions and recommendations and is

working with the MRC to take these forward:

- The University of Manchester has been commissioned to carry out a short study looking at the relationship between mortality & reported exposures.
- In July 2004, the MRC issued a call for proposals for rehabilitative studies and related work. The MOD hopes to commission work in early 2005.
- On neuro-imaging, the MRC has carried out a further review of the international literature and other available information, especially from the US, to decide the way forward.
- It is also anticipated that a workshop on paraoxonase studies will be held in early 2005.

### **Research and Monitoring of service personnel returning from Operations in the Gulf since 2003**

It is too soon to know whether any unusual health issues will emerge following operations in the Gulf since 2003. The MOD has however put in place a range of measures to monitor the health of personnel returning from the Gulf and investigate any concerns quickly.

Recognising the need for prompt action as a lesson learnt from the 1990/1991 Gulf Conflict, MOD commissioned a package of research into the health of veterans of the recent operations, which is being overseen by an independent Review Board. The largest piece of research in this package is a study of the physical and psychological health of personnel, which is being conducted by the King's Centre for Military Health Research under Professor Wessely. Around 19,000 personnel will be assessed by questionnaire, including regulars, reserves, civilians and journalists, both deployed and non-deployed. Questionnaires are being mailed out and base visits are underway. Initial findings should be available in late 2005.

Qualitative research on personnel is underway as part of the work being done by King's College, led by Professor Christopher Dandeker. Around 250 personnel deploying in November 04 will be interviewed before, during (by postal questionnaire in theatre) and after deployment to examine the sociological issues. Additional work will be undertaken looking at the effect on wives and families, with funding for this being provided by the Economic and Social Research Council. A further non-MOD funded study on alcohol use in personnel has been funded by the Joseph Rowntree Foundation.

The research package also includes a study of exposure to Depleted Uranium (DU) across the battlefield. A sample of 700 personnel including clean-up personnel, medics and support staff from the main Health study will be asked to give urine samples, to assess the possible exposure to DU across the various theatre roles. Sample collection began in the Autumn of 2004 and the sub-study is expected to report in 2005. Personnel are also eligible for biological monitoring for urinary DU. More information on this can be found in section 5.

A major difficulty with scientific study of the Gulf 1990/1991 cohort is the poor

contemporary records, with much based on individual recall which has been shown to vary with time. For veterans of the recent operations, a project is underway with the MRC's Institute of Environment and Health at Leicester University, to record a database of exposures and locations.

When the initial results of these studies have been examined, further clinical studies may be commissioned on the advice of the Health Review Board. This may include research into reproductive health where appropriate.

The MOD also plans to monitor the mortality of veterans compared with a control group and publish figures every 6 months on the Defence Analytical Services Agency website.

## **POTENTIAL EXPOSURES**

### **Introduction**

In addition to the stresses associated with preparation for, and participation in, armed conflict, UK troops in the 1990/1991 Gulf Conflict may potentially have experienced a number of exposures which have been suggested by some as possible causes of illness among Gulf veterans. Whilst there is currently no consensus among the scientific and medical communities on the aetiology of Gulf veterans' illnesses, the MOD is aware that veterans have health concerns about a number of possible exposures.

The MOD is committed to providing information to Parliament and to the public on matters of potential relevance to the issue of Gulf veterans' illnesses and a series of reports have been published, listed at Annex A to this document. The research programme following operations in the Gulf in 2003 includes work on exposures.

The current state of knowledge relating to the potential exposures that may have taken place is as follows:

### **Medical countermeasures/other vaccinations**

In the 1990/1991 Gulf Conflict, British troops were offered vaccination against anthrax and plague, as protection against the possible use of these agents for biological warfare purposes by Iraq. Pertussis vaccine was also given as an adjuvant to the anthrax vaccine. In addition, where troops did not have a current immunisation, they were likely to have received routine vaccinations against yellow fever, tetanus, typhoid, poliomyelitis and cholera at about the same time. Particular categories of Service personnel e.g. health staffs will have received Hepatitis B vaccine. There is evidence that some troops also received meningitis vaccine; additionally, Hepatitis A immunoglobulin may have been given to some individuals. MOD is aware of one individual who was vaccinated against smallpox by private arrangement and another who was vaccinated against Japanese Equine Encephalitis for a possible deployment to the Far East.

British troops were given Nerve Agent Pretreatment Sets (NAPS), consisting of tablets containing 30mg pyridostigmine bromide. One tablet was to be taken orally every eight hours. Pyridostigmine reversibly blocks the enzyme acetylcholinesterase to which many nerve agents irreversibly bind. Many individuals would have taken anti-malarial prophylactics, namely Paludrine (proguanil hydrochloride) and chloroquine, for a short period, although the available evidence suggests that most individuals would have stopped taking them shortly after arriving in the Gulf. Further information on the origin and implementation of the medical countermeasures programme is contained in MOD publications C & I at Annex A.

Personal medical records were generally not taken to the Gulf, and were therefore unavailable for the recording of vaccination details. In many cases, this means that the vaccination records of Gulf veterans are incomplete. A paper has been produced which gives details of the Service medical documentation system, how it is designed

to operate in the three services and explains why a number of problems arose with medical record keeping during the 1990/1991 Gulf Conflict. The paper also explains how Gulf veterans or their representatives can gain access to their medical records, why there may be delays in gaining access, and from where assistance may be obtained. (See publication M at Annex A).

Service personnel, including those deployed to the Gulf in 2003, are currently offered a range of immunisations to protect against disease as appropriate. These include standard service immunisations, immunisations for deployment to areas with specific health hazards, immunisations to help protect personnel against the effects of biological weapons, and immunisations for personnel in specific occupational or “at risk” groups. The anthrax vaccine is offered to UK personnel. Poliomyelitis, tuberculosis, meningococcal meningitis, typhoid, tetanus, diphtheria, hepatitis A, yellow fever, rabies, hepatitis B, rubella and smallpox are also offered as appropriate. As in the 1990/1991 Gulf Conflict, UK service personnel were given NAPS tablets. All immunisations are offered in accordance with General Medical Council guidelines on consent.

### **Chemical and biological warfare (CBW) agents**

There is no confirmed evidence of the offensive use of CBW agents by Iraq during the 1990/1991 Gulf Conflict. A number of chemical agent alarms did occur, but were followed up at the time and were not substantiated. However, MOD has reviewed incidents where CBW exposure is alleged to have occurred, and the results of such reviews are reported in MOD Publications D, E, H, J - L and O at Annex A.

Further information about how Chemical Warfare Defence was organised in the UK during the Gulf Conflict is given in MOD publication G at Annex A.

### **Oil well fire pollution**

No evidence has emerged to suggest that pollution caused by oil well fires in Kuwait during the 1990/1991 Gulf Conflict could be responsible for ill-health among Gulf veterans. Pollutant levels from the fires appear to have been relatively low. The health of individuals working in the proximity of oil well fires in the Gulf was closely monitored and a number of reports were produced detailing the findings of this monitoring. The US Presidential Advisory Committee on Gulf War Veterans' Illnesses reached similar conclusions in a report published in December 1996. A report published in the United States by the RAND corporation<sup>30</sup> reported the results of a review of the health effects of the oil well fires. It concluded that the cumulative doses of relevant pollutants would fall below doses known to cause adverse health effects. It also concluded that there are no data to suggest that the symptoms of some veterans of the 1990/91 Gulf Conflict are associated with oil fire exposure.

### **Organophosphate (OP) pesticides**

An investigation into the use of OP pesticides by UK forces during the 1990/1991 Gulf Conflict was carried out in 1996, and is reported in MOD Publication A (see Annex A). This found that Fenitrothion (C<sub>9</sub>H<sub>12</sub>NO<sub>5</sub>PS) - based pesticide was used routinely for residual insecticide spraying in the Gulf during late 1990 and early 1991.

There was also extensive use of two insecticides based on Azamethiphos ( $C_9H_{10}ClN_2O_5PS$ ) as fly bait. Malathion ( $C_{10}H_{19}O_6PS_2$ )-based dusting powder was used to treat some hundreds of Iraqi prisoners of war (for lice). There was also evidence of local purchase of unidentified residual insecticides. One of the latter pesticides, which may have been based on Diazinon ( $C_{12}H_{21}N_2O_3PS$ ), was used for a limited period by some environmental, and possibly unit hygiene, personnel although the total quantity involved was probably small.

Pesticides would have been used by Service personnel who had been trained in the safe use of these products. When considering possible exposures to pesticides during the Gulf Conflict it is important to distinguish between spraying surfaces with a residual insecticide and space, or swing, fogging using direct contact insecticide with a knockdown effect in a thermal fog to clear areas out of doors or whole buildings. OP pesticides are used for the former, but not the latter purpose.

### **Depleted uranium (DU)**

There have been a number of claims about the health effects of DU, many of which are exaggerated or groundless. During the 1990/1991 Gulf Conflict, a 120mm DU-based round was used in the UK's Challenger 1 tanks. MOD's assessment is that UK tanks fired fewer than 100 rounds against Iraqi military forces during hostilities, although additional rounds were fired during earlier work-up training in Saudi Arabia. MOD is not aware of any UK personnel who sustained shrapnel injuries from DU-based ammunition in the 1990/1991 Gulf Conflict. There is no evidence to suggest that the illnesses being experienced by some UK Gulf veterans are linked to exposure to DU. Further information on DU is available on the MOD website: [www.mod.uk/issues/depleted\\_uranium/index.htm](http://www.mod.uk/issues/depleted_uranium/index.htm).

Following a consultation exercise, and recognising that veterans of the 1990/1991 Gulf Conflict and Balkans are concerned about their possible exposures to DU in theatre, MOD has funded the development of a retrospective test for DU in urine, which is being implemented by the independent DU Oversight Board (DUOB). A pilot exercise commenced in March 2004 and the main testing programme was launched in September 2004. Progress of the programme can be viewed on the DUOB website at: [www.duob.org.uk](http://www.duob.org.uk). Those interested in the test receive factsheets on DU and the test with their application form. Results of the tests with general advice on interpretation will be issued to participants by appropriate health professionals and a copy sent to the participant's GP, where consent is given. A telephone helpline (01527 532198) is available for those requiring further advice on the implications of their test result.

British Forces deployed to the Gulf in 2003 had DU munitions available as part of their armoury, and used them as necessary. 1.9 tonnes of DU were expended by British Challenger tanks. Since January 2003, all regular and reservist Service personnel and MOD civilians who are deployed to a theatre of war where DU is used are entitled to receive a urine test for DU if they have any concerns. The small numbers who may have received relatively high exposures are positively encouraged to do so. Contractors' personnel, aid workers and embedded journalists will also be able to receive the test. To provide a baseline for comparison, we have commissioned the Institute of Occupational Medicine in Edinburgh to carry out a

study to establish normal values in a military population who did not deploy.

How do I request a urinary DU test for my patient?

If your patient served in the **1990/91 Gulf conflict**, they may apply directly and without referral for the DUOB developed retrospective test. Details including an application form are available on the DUOB website: [www.duob.org.uk](http://www.duob.org.uk). Alternatively, they can write for an application form to:

DUOB Secretariat  
Floor 7, Zone H  
Main Building  
Whitehall  
London SW1A 2HB

If your patient served in the **2003 Iraq conflict (Op TELIC)**, you can request a urinary uranium test from the Defence Radiological Protection Service (DRPS). The point of contact at DRPS, to whom requests for urine sampling are to be directed, is given below. Request forms, containers and instructions on the collection of urine samples will be issued by DRPS as required. Results of tests carried out will be returned with appropriate comment. Where results are considered to require specialist interpretation, additional comment on the medical aspects will be included from the Institute of Naval Medicine's Radiation Medicine specialist.

For urine sample bottles and information on testing	For advice on results (GPs or Occupational Health only)
DRPS Dosimetry Section Institute of Naval Medicine GOSPORT Hampshire PO12 2DL  Mil: 9380 Ext 68162 or 68267 Tel: 02392 768162 or 768267 Fax: Ext 68150	Duty Radiation Medicine Specialist Institute of Naval Medicine GOSPORT Hampshire PO12 2DL  Mil: 9380 68026 Tel: 02392 768026 Fax: 02392 504823

**MOD PUBLICATIONS ON GULF VETERANS' ILLNESSES**

- A. **Organophosphate Pesticide Investigation Team (OPPIT): Substantive Report.** 6 December 1996. Investigates the circumstances in which organophosphate (OP) pesticides were used during the 1990/1991 Gulf Conflict.
- B. **Gulf Veterans' Illnesses: A New Beginning.** 14 July 1997. Set out the how MOD intended to address the Gulf veterans' illnesses issues and underpins our approach today.
- C. **Background to the use of Medical Countermeasures to protect British Forces against biological and chemical warfare agents during the Gulf Conflict (Operation GRANBY).** 28 October 1997. Explains the basis on which various medical countermeasures, principally vaccines and nerve agent pre-treatment tablets, were used to protect British troops during the 1990/1991 Gulf Conflict.
- D. **Kuwaiti Girls' School Case Narrative.** 19 March 1998. Joint UK/US review of what has become known as the "Sabahiyah" incident, in which a large tank of liquid, initially thought to contain Iraqi mustard agent, was found in Kuwait after the end of the 1990/1991 Gulf Conflict.
- E. **Dead animals during the Gulf Conflict: A review of the circumstances in which UK forces reported the presence of groups of dead animals in theatre during Operation GRANBY in 1990/91.** 6 April 1998.
- F. **Testing for the presence of depleted uranium in UK veterans of the Gulf conflict, the current position.** 19 March 1999.
- G. **British Chemical Warfare Defence During the Gulf Conflict.** December 1999. A background paper detailing how Chemical Warfare Defence was organised in the UK at the time of the 1990/1991 Gulf Conflict.
- H. **Review of Events Concerning 32 Field Hospital and the Release of Nerve Agent Arising from US Demolition of Iraqi Munitions at the Khamisiyah Depot in March 1991.** December 1999. A review of the possible effects on UK units, in particular 32 Field Hospital, of possible exposure to very low levels of nerve agent which may have been released as a result of US demolition activity at the Khamisiyah depot in Iraq. See also publication O.
- I. **Implementation of the Immunisation Programme against Biological Warfare Agents for UK Forces during the Gulf Conflict 1990/91.** 20 January 2000. A detailed overview of the UK's anti-biological warfare immunisation during the 1990/1991 Gulf Conflict.
- J. **A Review of the Suggested Exposure of UK Forces to Chemical Warfare Agents in Al Jubayl on 19 January 1991.** 20 January 2000, a review of events in Al Jubayl on 19 January 1991 during the Gulf Conflict, where veterans have suggested that they were exposed to chemical warfare agents.

**K. A Review of the Activities of the 1 Field Laboratory Unit and Suggested Biological Warfare Agent Detections during Operation GRANBY.** 18 May 2000. A review of events during the Gulf Conflict where veterans have suggested that they were exposed to biological warfare agents.

**L. A Review of UK Chemical Warfare Agent Alerts during the 1990/1991 Gulf Conflict.** 20 July 2000. A review of UK chemical warfare agent alerts from August 1990 to March 1991.

**M. Medical Records in the Gulf.** October 2001. An explanation of the relevant parts of the Service medical documentation system which describes how it operated in the Gulf Conflict, how veterans may obtain copies of their records, and why there may be difficulty in accessing records.

**N. The 1990/1991 Gulf Conflict: Health and Personnel Related Lessons Identified.** 4 November 2004. This paper focuses on the health and personnel related issues resulting from the 1990/1991 Gulf Conflict, with the aim of learning from the problems identified. The paper identifies what the Ministry of Defence has already done to improve procedures and assesses how these have been applied to the current Iraq deployment (Operation TELIC). It also indicates where improvements are still required.

**O. Review of Modelling of the Demolitions at Khamisiyah in March 1991 and Implications for UK Personnel.** 27 January 2005. The only known release of nerve agent during the 1990/91 Gulf conflict was following the demolition of Iraqi rockets at Khamisiyah in March 1991. A substantial amount of work has been done in the US to model this incident, with the latest results published in 2002. This paper details the MOD's assessment of the US model.

Copies of all the documents listed above and further information on Gulf veterans' illnesses can be obtained by calling the VPU Gulf helpline on 0800 169 4495; fax 020 7218 1482, or by writing to VPU, 7<sup>th</sup> Floor Zone H, Ministry of Defence, Main Building, Whitehall, London SW1A 2HB. They are also available at: [www.gulfwar.mod.uk](http://www.gulfwar.mod.uk)

## REFERENCES

- 
- <sup>1</sup> W J Coker. A Review of Gulf War Illness. *Journal of the Royal Naval Medical Service* 1996; 82: 141-146
- <sup>2</sup> Coker WJ, Bhatt BM, Blatchley NF, and Graham JT. Clinical Findings for the first 1000 Gulf War veterans in the Ministry of Defence's medical assessment programme. *BMJ* 318:290-4, 1999.
- <sup>3</sup> Lee HA, Gabriel R, Bale AJ, Bolton P, Blatchley NF. Clinical Findings of the second 1000 UK Gulf War Veterans who attended the Ministry of Defence's Medical Assessment Programme. *J R Army Med Corps* 2001; 147: 153-160.
- <sup>4</sup> Lee HA, Gabriel R, Bolton JPG, Bale AJ, Jackson M. Health Status and clinical diagnosis of 3000 UK Gulf War Veterans. *J R Soc Med* 2002; 95: 491-497.
- <sup>5</sup> Lee HA, Gabriel R, Bale AJ. Clinical outcomes of Gulf Veterans' Medical Assessment Programme (GVMAP) referrals for Gulf veterans with post traumatic stress disorder to specialised centres. In Press.
- <sup>6</sup> Cherry N, Creed F, Silman A, Dunn G, Baxter D, Smedley J, Taylor S, Macfarlane GJ. Health and exposures of United Kingdom Gulf war veterans. Part 1: The pattern and extent of ill health. *Occupational and Environmental Medicine* May 2001, Vol 58, No 5, p291-298.
- <sup>7</sup> Cherry N, Creed F, Silman A, Dunn G, Baxter D, Smedley J, Taylor S, Macfarlane GJ. Health and exposures of United Kingdom Gulf war veterans. Part 2. The relation of health to exposure. *Occupational and Environmental Medicine* May 2001, Vol 58, p299-306.
- <sup>8</sup> Macfarlane G J , Thomas E, Cherry N. Mortality among UK Gulf War veterans, *Lancet*; 356: 17 – 21 2000.
- <sup>9</sup> Maconochie N, Doyle P, Davies G, Lewis S, Pelerin M, Prior S, Sampson P. The study of reproductive outcome and the health of offspring of UK veterans of the Gulf war: methods and description of the study population. *BMC Public Health* 2003,3:4.
- <sup>10</sup> Doyle P, Maconochie N, Davies G, Maconochie I, Pelerin M, Prior S, Lewis S. Miscarriage, stillbirth and congenital malformation in the offspring of veterans of the first Gulf war. *International Journal of Epidemiology* 2004; 33: 74-86.
- <sup>11</sup> Maconochie N, Doyle P, Carson C. Infertility among male UK veterans of the 1990-1 Gulf war: reproductive cohort study. *BMJ*, doi: 10.1136/bmj.38163.620972.AE (published 14 July 2004)
- <sup>12</sup> Simmons R, Maconochie N, Doyle P. Self-reported ill health in male UK Gulf War veterans: a retrospective cohort study. *BMC Public Health* 2004, 4:27 doi: 10.1186/1471-2458-4-27
- <sup>13</sup> Unwin C, Blatchley N, Coker W, Ferry S, Hotopf M, Hull L, Ismail K, Palmer I, David A, and Wessely S. Health of UK servicemen who served in the Persian Gulf War. *Lancet* 353:169-78, 1999.
- <sup>14</sup> Ismail K, Everitt B, Blatchley N, Hull L, Unwin C, David A, and Wessely S. Is there a Gulf War syndrome? *Lancet* 353:179-82, 1999.
- <sup>15</sup> Hotopf M, David A, Hull L, Ismail K, Unwin C, Wessely S. Role of vaccinations as risk factor for ill health in veterans of the Gulf war: cross sectional study. *BMJ*,320: 1363-1367, 2000.
- <sup>16</sup> Skowera A, Stewart E, Davis E T, Cleare AJ, Unwin C, Hull L, Ismail K, Hossain G, Wessely S C, Peakman M. Antinuclear autoantibodies (ANA) in Gulf War-related illness and chronic fatigue syndrome (CFS) patients. *Clinical and Experimental immunology*, volume 129, issue 2, August 2002.
- <sup>17</sup> Ismail K, Kent K, Brugha T, Hotopf M, Hull L, Seed P, Palmer I, Reid S, Unwin C, David A S, Wessely S. The mental health of UK Gulf war veterans: phase 2 of a two phase cohort study. *BJJ* 2002;325:576.

- 
- <sup>18</sup> David AS, Farrin L, Hull L, Unwin C, Wessely S, Wykes T. Cognitive functioning and disturbance of mood in UK veterans of the Persian Gulf War: a comparative study. *Psychological Medicine* 2002 32:1327-1370.
- <sup>19</sup> Hotopf M, Anthony DS, Hull L, Nikalaou V, Unwin C, Wessely S. Gulf war illness – better, worse or just the same? A cohort study. *BMJ* 13 December 2003, Vol 327, p1370
- <sup>20</sup> Hotopf M, David A, Hull L, Nikalaou V, Unwin C, Wessely S. Risk factors for continued illness among Gulf War veterans: a cohort study. *Psychological Medicine* 2004: 34: 1-8
- <sup>21</sup> Wessely S, Unwin C, Hotopf M, Hull L, Ismail K, Nikalaou V, David A. Stability of recall of military hazards over time. Evidence from the Persian Gulf War of 1991. *British Journal of Psychiatry* 2003, 183, 314-322.
- <sup>22</sup> Sharief M , Priddin J, Dalamont R S, Unwin C, Rose MR, David A, Wessely S. Neurophysiologic analysis of neuromuscular symptoms in UK Gulf War veterans. *Neurology* volume 59, Number 10, November 26, 2002.
- <sup>23</sup> Rose MR, Sharief M , Priddin J, Nikolaou V, Hull L, Unwin C, Ajmal-Ali R, Sherwood R, Spellman A, David A, Wessely S. Evaluation of neuromuscular symptoms in UK Gulf War veterans. *Neurology* volume 63, Number 9, November 9, 2004.
- <sup>24</sup> Stimpson NJ, Thomas HV, Weightman AL, Dunstan F, Lewis G, Psychiatric disorder in veterans of the Persian Gulf War of 1991 systematic review. *British Journal of psychiatry* 2003, 182,391-403.
- <sup>25</sup> Macfarlane G, Biggs A-M, Maconochie N, Hotopf M, Doyle P, Lunt M. Incidence of cancer among UK Gulf war veterans: cohort study. *BMJ* 13 December 2003, Vol 327, p1373.
- <sup>26</sup> Mackness B, Durrington PN, Mackness MI. Low paraoxanase in Persian Gulf War Veterans self reporting Gulf War Syndrome. *Biochem Biophys Res Commun* 2000 Sep 24; 276(2): 729-33.
- <sup>27</sup> Hotopf M, Mackness MI, Nikolaou V, Collier D, Curtis C, David A, Durrington P, Hull L, Ismail K, Peakman M, Unwin C, Wessely S, Mackness B. Paraoxonase in Persian Gulf War Veterans. *Journal of Occupational and Environmental Medicine* 2003: 45(7):668-675.
- <sup>28</sup> Kilshaw S. Friendly Fire The construction of Gulf War Syndrome narratives. *Anthropolgy & Medicine* Vol 11, No.2 August 2004, pp. 149-160.
- <sup>29</sup> Griffiths GD, Hornby RJ, Stevens DJ, Scott LAM, Upshall DG. Biological Consequences of Multiple Vaccine and Pyridostigmine Pretreatment in the Guinea Pig. *J. Appl. Toxicol*, 21, 59-68 (2001).
- <sup>30</sup> Spektor D.M., A Review of the Scientific Literature as it pertains to Gulf Veterans Illnesses, Volume 6, Oil Well Fires, RAND 1998.