Gulf War:
a legacy of suspicion

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"In essence, GWS [Gulf War Syndrome] merely is a convenient descriptive term that describes a phenomenon: GWV [Gulf War veterans] reporting suffering from medically unexplained health related symptoms. In the sense, it shares much with the other medically unexplained syndromes encountered in practice. The real debate surrounding medically unexplained conditions is not whether or not they exist, but defining their cause. In this regard, investigators fall into two camps. One camp insists that the conditions are caused by a yet-to-be-discovered medical problem, rejecting out of hand the possibility of a psychologic origin. The other camp insists the conditions are fundamentally psychogenic, rejecting the possibility of an undiscovered medical condition. The evidence shows, however, that the conditions exist, the suffering is real, and the causes are unknown."
(Gronseth, 2005)

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1. Executive Summary

1.1 Of the 53,500 troops deployed to the Gulf War 1990-91 there are now close to 7,000 who have received a payment or are in receipt of a War Pension for illness or injury relating to their preparation to deploy or active service in the Gulf (SPVA, 2007).

1.2. The Gulf War has been labelled the most toxic war in history. Troops were exposed to a range of vaccinations, pyridostigymine bromide, organophosphates (and other pesticides), nerve agents, depleted uranium, environmental hazards, stress and smoke from burning oil wells.

1.3. Gulf War veterans are more than twice as likely to report symptoms of ill health, and to be suffering more severely from them, than their military contemporaries of equivalent age, gender, rank and branch of service (Gray *et al.*, 1998). However, the range of symptoms is not unique to Gulf veterans and there is no distinct medical condition (MRC, 2003).

1.4. Symptoms affecting Gulf War veterans largely fall into four categories – musculoskeletal symptoms, neurological symptoms, respiratory symptoms and psychological symptoms (although there are illnesses and symptoms that fall outside these categories) (Simmons *et al.*, 2004).

1.5. Epidemiological studies used to investigate causal links with illness have been hampered by the lack of accurate data, including service records and medical and/or vaccination records (MRC, 2003). Further barriers to effective investigation into the causes of Gulf War illnesses are in place because health surveillance was not carried out during deployment, or with the benefit of hindsight, immediately post deployment (KCL, 2006).

1.6. The main suspects in the search for the causes of Gulf War illnesses are: medical countermeasures [including vaccinations and Nerve Agent Pre-treatment Sets (NAPS)]; depleted uranium; organophosphates; exposure to chemical weapons (sarin and cyclosarin); and stress and psychological factors. Completed research in the UK has now discounted most of these as the single cause of Gulf War illnesses (MRC, 2003); however, work is currently underway in the US, and elsewhere, investigating the possible "cocktail effect" of these multiple exposures.

1.7. There were multiple administrative problems with the programme of medical countermeasures in the lead-up to and during deployment of British troops to Kuwait and Iraq. These included omitting vaccinations from medical records (Bach, 2003), breaches of the policy of voluntary informed consent (MoD, 1997), the use of unlicensed and unproven vaccinations and ignoring medical advice from the DoH (Bach, 2003).

1.8. There has been some inconclusive evidence on possible links between self-reported use of organophosphate pesticides and ill health (Cherry *et al.*, 2001). There is a need for further work regarding the hazard of occupational exposure to organophosphates (OPs) and any additional effects on people with reduced activity of the enzyme paraoxonase 1 (PON1).

1.9. The government gave a misleading assurance to Parliament in 1994 that only a small number of Iraqi prisoners i.e. no UK personnel, were exposed to organophosphates and other pesticides. A subsequent investigation, in 1996, found that a considerable number of UK troops, and their equipment, had been treated with OPs and that some products had been purchased locally - there is conflicting evidence regarding whether or not they were

used correctly. However, it is undeniable that the false statement to MPs caused a significant delay and hindered meaningful research.

1.10. There has been disagreement among different agencies regarding the plume modelling carried out on the destruction of chemical weapons at Khamisiyah (GAO, 2004). However, there is agreement that no further modelling of the plume should take place without significant improvements to the source data (MoD, 2005). The government has concluded that around 9,000 UK troops were located in the area of possible exposure, but that any possible exposure would be at an extremely low level (MoD, 2005). This lack of reliable exposure data has again hindered research which attempts to link exposure with health outcomes. Again, delays in identifying the scale of the incident have reduced chances of establishing reliable results.

1.11. Mortality data does not demonstrate an increased number of deaths among Gulf War veterans (the comparison group consisting of Armed Forces personnel of similar profile in terms of gender, service, regular/reservist status and rank, who were in Service on 1 January 1991 but were not deployed to the Gulf). However, there are small increases in the number of deaths caused by suicide and road traffic accidents.

1.12. There is a recognised need for research into rehabilitation, health and social care models that can improve the quality of life for Gulf War veterans and their families (MRC, 2003); and a range of models should be investigated.

1.13. The US continues to make significant investment into research on Gulf War illnesses (VA, 2005). The programme is segregated into five different areas, these are: brain and nervous system function; environmental toxicology; immune function and infectious diseases; reproductive health; and symptoms and general health. While the UK has a process for monitoring the results of this research, the results need to be regularly reported to veterans in an easily understood format.

1.14. Gulf War veterans are currently compensated through the War Pensions Scheme for illnesses or injuries relating to Service. This is the same scheme that operates for all other veterans who became ill or sustained an injury before April 2005.

1.15. The government have argued that the label "Gulf War Syndrome" should not replace the label Signs and Symptoms of Ill-Defined Conditions (SSIDC) on War Disablement Pensions because it would exclude the use of "Gulf War Syndrome" for those with recognised medical conditions. The government has also rightly discounted the use of a positive list of symptoms or disorders. However, it should be possible to use the label "Gulf War Syndrome" as a replacement for SSIDC, and, as an umbrella label for a range of recognised medical conditions.

1.16. The government has continually stated that the time is not right for a public inquiry into the causes of Gulf War illnesses and the handling of the surrounding issues. The reasons given for this have been the ongoing scientific and medical investigations (Crawley, 2004). However, some scientific and medical experts have now concluded that further clinical or causal investigations will probably not produce any further useful outcomes (MRC, 2003). The government now needs to make a definitive statement regarding a public inquiry.

1.17. In 2004, Rt. Hon. Lord Lloyd of Berwick made a recommendation for an *ex gratia* payment for Gulf War veterans. An *ex gratia* payment should now be offered – based on the government's failure to protect veterans, the treatment they have received and the resulting anxiety. This payment should be set at £10,000 (in line with other UK *ex gratia* payment schemes), and should not be confused with compensation for illnesses or injuries.

The payment should be awarded to all Gulf War veterans who have received a Gratuity or War Disablement Pension, Gulf War widow(er)s in receipt of a Widows Pension and children of Gulf War veterans who are in receipt of a War Orphans Pension.

2. Policy Priorities

2.1. The government should commission research into the health effects of organophosphate exposure and reduced activity of the enzyme paraoxonase 1 (PON1), under the guidance of the Medical Research Council (MRC).

2.2. The MRC should be formally asked by the government to consider the preliminary work being carried out in the US into multiple exposures to neurotoxins and stress and their synergistic effects, and to make recommendations for UK studies in this area.

2.3. Studies evaluating a range of differing rehabilitation, health and social care models, which aim to deliver improvements to quality of life and general health, should be commissioned by the government as soon as possible.

2.4. The two research proposals recommended by the Gulf War Group should be funded by central government, subject to satisfactory peer review by the MRC.

2.5. Updates on the US research programme should be provided to all Gulf War veterans in receipt of a War Disablement Pension; this should be provided as a service by the Service Personnel & Veterans Agency (SPVA); it should be regular and in an easily understood format.

2.6. The government should agree how the term "Gulf War Syndrome" should be applied to War Disablement Pensions. Once agreed, all Gulf veterans in receipt of a War Disablement Pension should be formally informed of the policy and how they can have the term applied – this process need not involve any reassessment of awarded War Disablement Pensions.

2.7. The government should announce whether or not there is any possibility of a public inquiry now or in the future. This would also be an ideal opportunity for the government to make a formal apology to Gulf War veterans for their treatment since their return from active service.

2.8. *Ex gratia* payments of £10,000 should be paid to Gulf veterans, widow(er)s and children in receipt of a War Pension (Disablement, Widow(er)s or Orphans respectively), which is in any way linked to Service in the Gulf 1990-91.

1. Introduction

This document examines the issues surrounding Gulf War illnesses and the current support provisions for veterans of the 1990-91 Gulf War. It is intended to inform policy makers, and those with an ongoing interest in the issue, on the progress that has been made to date, the issues that remain outstanding and how they might be resolved.

Recently, Gulf War veterans and those campaigning on their behalf have been calling for "closure". However, "closure" is a very personal consideration for veterans and what constitutes "closure" will be wide ranging and unique to the individuals involved. Therefore, while this paper looks at what might constitute a fair solution to some of the issues, veterans' groups will work towards improved treatment and support for many years to come.

2. Background

The Gulf War occurred between September 1990 and February 1991. The war was a response to the Iraqi invasion of Kuwait in August 1990. Over the period approximately 53,500 British troops were deployed. By far the biggest contingent was from the US, who deployed close to 700,000 Service personnel to the area. Troops from France, Canada and Australia were also present.

Due to the possible use of both chemical and biological weapons, medical countermeasures were taken to protect British troops. These included the provision of Nerve Agent Pre-treatment Sets (NAPS). NAPS contain pyridostigymine bromide (PB), and are used to block nerve gas agents long enough for them to be broken down by the body. NAPS were accepted for use in the Armed Forces in 1981. In addition to the normal vaccination regime prior to deployment, British troops were also vaccinated for anthrax and plague. The Ministry of Defence (MoD) maintain that anthrax and plague vaccinations were given with informed consent. However, this has been disputed by many veterans.

The Gulf War has been coined the most toxic war in history – labelled as such because troops were exposed to an unprecedented range of toxic substances while in theatre. In addition to medical countermeasures, toxins included organophosphates, used to control environmental hazards, dust, nerve agents including sarin and cyclosarin, depleted uranium used in armour piecing munitions and smoke from burning oil wells.

Since 1993 veterans have been reporting a range of illnesses. In September 2005 there were 2,920 (Lord Drayson, 2006) veterans in receipt of a War Disablement Pension (ongoing compensation payments under the War Pension Scheme for an illness or injury linked to Service) and by March 2004 there had been 2,235 (Lord Lloyd, 2004) Gratuities awarded under the War Pension Scheme.

These figures have since risen - in April 2007, the Service Personnel & Veterans Agency (SPVA) stated that there were 6,718 Gulf veterans who had received an award under the War Pension Scheme (War Disablement Pension or Gratuity), and that 1,598 of them had claimed that their condition/s were related to Gulf War illnesses. There were 42 widows in receipt of a War Widows Pension and 2 children in receipt of a War Orphans Pension.

The MoD has not reported the number of veterans claiming a War Disablement Pension for Gulf War illnesses or "Gulf War Syndrome", as the figure can only be quantified through the examination of each individual case. However, in November 2006, Lord Drayson made the following statement:

> *"I gave an answer earlier relating to the number of Gulf War veterans for whom the Gulf War illness issue is of most concern. Our understanding in the Ministry of Defence, through liaison with the representatives of those Gulf War veterans, is that it is approximately 1,300 people."*

Among Gulf veterans suffering from illness, the most commonly reported post-conflict symptoms are chronic fatigue, sexual dysfunction, headaches, muscle pain, joint pain, mood swings, loss of concentration, memory loss, tingling and depression; however, this is not a definitive list.

3. The extent of Gulf War illnesses

Epidemiological studies are those that research the incidence, distribution and control of disease in a population. In 2003, the MRC had the following to say about UK epidemiological studies carried out into Gulf War illnesses (MRC, 2003):

> *"Epidemiology looks at the patterns and distribution of disease in different groups of people, to find out what its causes are and identify factors that make some people more susceptible than others.*
>
> *"The MRC/MoD Gulf Veterans' illnesses research programme funded several epidemiological studies. These set out first to look for common factors specific to Gulf Service that might explain GVs' illnesses, so that any promising leads could then be further investigated to pin down the causes.*
>
> *"Independent records or measurements showing precisely what people were exposed to, produce the strongest epidemiological evidence. A dearth of such details about the 1991 Gulf conflict has consistently impeded later epidemiological studies. For this reason, most research has had to rely on GV's recollections, often more than five years after their Service."*

UK epidemiological studies, the results of which have now been widely accepted, show that Gulf War veterans are more than twice as likely to report symptoms of ill health, and to be suffering more severely from them, than non-Gulf War veterans (24% vs. 10%) (Gray *et al.*, 1998). Studies typically compare the Gulf veterans with a control group of non-Gulf War veterans, being military contemporaries with equivalent age, gender, rank and branch of Service.

The MRC have also concluded that more than 10 years after deployment Gulf War veterans continue to suffer ill health, but that the range of symptoms is not unique. In short, Gulf War veterans report similar symptoms and symptom groupings as non-Gulf veterans, albeit in greater numbers and with greater severity.

The largest epidemiological study into morbidity among Gulf War veterans was carried out in 2004 (Simmons *et al.*, 2004). This study asked both Gulf War veterans and a comparable cohort of non-Gulf War veterans to detail, in free-text, any change in health status since 1990. The questionnaire also asked the question "Do you consider that you have 'Gulf War Syndrome'?" The paper reported on 42,818 male responders to the questionnaire. The results of the study included:

> *"61% of GWV [Gulf War veterans] reported at least one new medical symptom since 1990 compared with 37% of NGWV [non-Gulf War veterans]."*
>
> *"For over 85% of categories of ill health, symptom/disease prevalence was higher among GWV. Strongest associations with Gulf War Service included mood swings, memory loss/lack of concentration, night sweats and sexual dysfunction."*
>
> *"In terms of the nature of self-reported ill health, we found similar results to the range of symptoms that have been reported elsewhere. Gray et al. study of GWV found that over 50 percent of diagnoses could be classified into four large categories: diseases of the musculoskeletal system and connective tissue (19.0%), mental disorders (14.7%), diseases of the respiratory system (10.5%) and diseases of the skin and subcutaneous tissue (9.4%). In our study the same four categories accounted for 50.3 per cent of all reported symptoms/*

diseases and this figure rises to over 70 per cent when the categories of fatigue and nervous system disorders are included."

What these two different studies [one being a population based questionnaire study, the other based on medical examinations of US Gulf veterans participating in the US equivalent of the Gulf Veteran Medical Assessment Programme (GVMAP)] show is that symptomatic Gulf veterans tend to experience symptoms associated with the:

1. musculoskeletal system;
2. nervous system;
3. respiratory system; and
4. psychological symptoms.

Simmons *et al*. also reported that in answer to the question regarding 'Gulf War Syndrome', 5.6% of responders believed that they had Gulf War Syndrome, while 40.9% stated that they were unsure. The high number of responders stating that they were "unsure" could possibly be attributed to the confusion over the term and its use; particularly its meaning and status as a recognised medical condition.

It has been reported that Gulf War illnesses are not connected to the branch of the Armed Forces veterans served in, the proximity to combat or the job that was being performed. There are equally no links between illness and gender or being a regular or reserve member of the Armed Forces. When considering these factors, it seems that anyone who served in the Gulf War was equally at risk of illness (KCL, 2006). One small study in the US (cohort of 1,548 veterans), has linked excess health problems, in Gulf veterans from Kansas, with the type of Service performed (Steele, 2000):

"The prevalence of Gulf War illness was lowest among PGW [Persian Gulf War] veterans who served on board ship (21%) and highest among those who were in Iraq and/or Kuwait (42%). Among PGW veterans who served away from battlefield areas, Gulf War illness was least prevalent among those who departed in June or July of 1991 (41%). Observed patterns suggest that excess morbidity among Gulf War veterans is associated with characteristics of their wartime service…"

The limitations of epidemiological research in investigating Gulf War illnesses need to be highlighted further; touched on by the MRC in 2003. The majority of epidemiological studies carried out on the health outcomes of Gulf War veterans have compared them to the health outcomes of other military comparison groups. The link with Service in the Gulf has usually been verified through the use of nominal rolls, although these have been found to be inaccurate (Glass *et al*., 2006). The levels and types of exposure to harmful agents has also been extremely difficult to quantify due to the unavailability of reliable data; including the lack of written consent for vaccinations, lost medical records, absence of health surveillance and uncertainty surrounding chemical weapon plume modelling.

This has led to the development of other methods of linking ill health with exposures related to Service in the Gulf. Self-reported questionnaires have been the most used method of exposure assessment, used because of the lack of exposure evidence collected during the conflict and the inaccuracy of nominal and medical records. These, and other problems, have led to continuing

questions relating to reported exposures to harmful agents and links to the symptoms reported by Gulf War veterans. The need for improved methods for future studies into post-combat disorders has been identified (Glass *et al.*, 2006):

> *"The application of any of these exposure methods will be most effective if planned before deployment and the investigations take place during the deployment or soon after veterans return from theatre."*

The question that has not been asked, is that if the government knew that troops would be exposed to serious health risks, including known toxins such as nerve agents, pesticides, insecticides, rodenticides, depleted uranium (previously unused), smoke and exhaust fumes, why were these risks not better controlled – and more importantly – why was health surveillance not carried out at the time?

This is particularly pertinent considering that "post combat syndromes have arisen after all major wars over the last century, and we can predict that they will continue to appear after future conflicts" (Jones, 2006).

4. Investigations into the prime suspects

As stated, personnel deployed to the Gulf in the early 1990s were exposed to a number of harmful agents. These have since become the prime suspects in the search for an explanation to the increased number of veterans experiencing more severe illnesses post Gulf War; they are:

1. medical countermeasures (including vaccinations and NAPS);
2. depleted uranium (DU);
3. organophosphates (OPs);
4. exposure to chemical weapons (sarin and cyclosarin); and
5. stress and psychological factors.

4.1. Medical Countermeasures (vaccinations and NAPS)

Due to the high risk of chemical and biological weapons being used during the Gulf War, extensive medical countermeasures were undertaken both prior to deployment and in theatre. At the time, British Service personnel were routinely given vaccinations, including yellow fever, tetanus, typhoid, poliomyelitis, cholera and hepatitis B; some personnel also received meningitis and hepatitis A.

To offer troops some protection against biological weapons, they were also inoculated with plague and anthrax. The anthrax vaccine was given in combination with the whooping cough (pertussis) vaccine to boost the immune response. The MoD later explained that the boost was required due to the short time available between administering the vaccine and the expected start of hostilities (Bach, 2003).

The MoD, in their document entitled "Background to the Use of Medical Countermeasures to Protect British Forces during the Gulf War (Operation GRANBY)" (October 1997) noted:

> *"The overall policy was that these vaccines should be administered on the basis of voluntary informed consent. The MoD is aware that many veterans regard this policy as having been breached in practice."*

Many veterans recall being ordered to take medical countermeasures and it is important to see this in a Military context i.e. failure to comply resulting in disciplinary action.

Problems relating to the administration of medical countermeasures have been compounded by the lack of evidence in this area. In October 2003 Lord Bach explained:

> *"As you know, personal medical records (F Med 4) were generally not taken to the Gulf during the 1990-91 conflict, and were therefore unavailable for the recording of vaccination details. However, the names of those who received vaccinations should have been recorded on temporary nominal rolls compiled in theatre. Whenever possible, details should also have been recorded on form B Med 27, but many personnel who deployed to the Gulf did not carry these documents. The details recorded on nominal rolls and B Med 27s should have been transcribed onto F Med 4s on return from the Gulf. In many cases this did not happen, and the vaccination records of many Gulf veterans are incomplete as a result. Estimates of the precise extent to which vaccination schedules were complied with in practice, therefore, are not readily available. Similarly, the extent to which Defence Medical Services staff discussed with patients issues such as what other medication individuals were receiving is not readily available."*

For these reasons, it is now impossible for the MoD to replicate the exact exposures to medical countermeasures experienced by Gulf War veterans. During the Gulf War there was little control over what vaccinations or NAPS were administered or when; how consent should be sought and recorded; or what medical information should be given to Service personnel to enable them to give informed consent. Having said this, the government continues to claim that research conducted into the health effects of medical countermeasures replicate the experiences of Gulf War veterans.

The Parliamentary Under Secretary of State and Minister for Veterans, Mr Derek Twigg, recently (October 2006) announced the final results of the Vaccines Interaction Research Programme. In his statement he concluded:

> *"The overwhelming evidence from the programme is that the combination of vaccines and tablets that were offered to UK Forces at the time of the 1990-91 Gulf Conflict would not have had adverse health effects."*

The key word in this statement is "offered", as the study could not replicate the combination of vaccines and tablets actually taken, because they are simply not known. A point confirmed during oral evidence to the Lord Lloyd Inquiry (2004) by the Chairman of the group overseeing the research, Professor Donald Davies stated:

> *"I should emphasise, this was not an attempt to set up or reproduce conditions experienced by personnel in the Gulf. It was simply to look at the interactions of vaccines and the interactions of the vaccine with that chemical. That was the specific question for this research."*

The Vaccines Interaction Research Programme included three studies into the interactions of vaccines and NAPS. The main study involved monitoring marmosets for up to 18 months (equivalent to long-term health monitoring in humans) after being administered with vaccines and/or pyridostigmine bromide (the active ingredient in NAPS).

However, an important element not included in the study was the compound or additive effect of stress. Again, during oral evidence to the Lord Lloyd Inquiry (2004), Professor Banatvala, who carried out the final phase of the Vaccines Interactions Research Programme, said:

> *"There is one other point, sir, which I think is relevant because the problem of stress has been brought out among the Gulf War veterans time and again, and in publications and so forth, and Simon Wessley, I believe, is going to talk to you. One thing that we could not do and would not wish to do was to stress our animals. That is the one major difference."*

The Vaccines Interactions Research Programme, including the 18-month study involving marmosets, rules out medical countermeasures, when given in accordance with conventional medical procedures, as the cause of Gulf War illnesses. However, for the reasons outlined here they cannot be ruled out as a contributory factor for ill health in Gulf War veterans.

King's College London (KCL, 2006) also recently reported on epidemiological and immunological studies which did link reported symptoms of ill health in Gulf War veterans and multiple vaccinations and stress. They concluded:

"Yes, there is a link between multiple vaccination and ill health, but we have not confirmed that this operates via the immune system. Perhaps it is mediated by stress, or there remains an outside possibility that despite every effort, it is still a question of bias in memory records. We probably cannot take this story any further in studies on Gulf War veterans, but new animal studies, and US studies in new recruits, may still shed further light."

Whether or not medical countermeasures are the cause or contributed to Gulf War illnesses, the investigation into how vaccinations and NAPS were administered has brought into focus other issues for concern. The first of these was the use of unlicensed products on UK troops. The MoD (1997) took this decision:

"A number of the medical countermeasures used during Op GRANBY were unlicensed in the UK at the time. In each case the decision to use an unlicensed product reflected the need to protect British troops against a specific threat in the absence of an appropriate UK licensed alternative."

It is reasonable to expect that faced with a specific threat, the government would choose to take extreme action to protect our Armed Forces personnel. However, there is further evidence which demonstrates that during the licensing process concerns were raised with regard to using the whooping cough vaccine in combination with the anthrax vaccine. Specifically, at the time, whooping cough vaccine was not recommended for use in adults, and not recommended for use as an adjuvant (a substance to accelerate the immune response).

For this reason the National Institute for Biological Standards and Controls (NIBSC) carried out some preliminary work to investigate the health effects. The NIBSC gave one standard human dose (SHD) to a mouse, which is approximately 160 times the human equivalent on the basis of body weight. The NIBSC found that there was severe loss of condition and weight in the mice. However, despite the massive dose, the NIBSC still raised concerns with the Department of Health (DoH).

The DoH brought these concerns to the attention of the MoD. However, there is no evidence that the research findings were taken into account (Lord Bach, 2003). Then in 1998, credibility was given to the work carried out by the NIBSC back in 1990. This occurred when the manufacturers of the anthrax vaccine, the Centre for Applied Microbiology and Research (CAMR), applied to extend the shelf life of the product. The request was made through the NIBSC to the Medicines Control Agency (MCA).

On 3 February 1998, the NIBSC wrote to the MCA to give advice on extending the shelf-life of the anthrax vaccine. The NIBSC recommended to the MCA that the shelf life be extended, but not beyond November 1998. This advice was given based on the results of their earlier study on mice in 1990 and the age of the vaccine (Lord Bach, 2003). The MCA later issued an approval letter, in this letter they stated:

"The vaccine is to be used alone. There is no evidence for safe use in combination with other vaccines or medicinal products."

Then in 1998 the MoD's Advisory Group on Medical Countermeasures (AGMC) finally recommended that UK Forces, due to deploy, should be offered immunisation against anthrax,

but without an adjuvant (without the whooping cough vaccine). In March 1998, in readiness for Operation BOLTON, the MoD announced that vaccination against anthrax would again begin and it made clear that "no other vaccine will be co-administered with the anthrax vaccine."

Further, the then Secretary of State for Defence, in a letter to all personnel stated:

> *"…administering it on its own avoids any possibility of side-effects caused by interactions with another vaccine used as an adjuvant."*

Finally, in 2003 the MoD removed their advice on the co-administration of the anthrax vaccine; they stated that the original recommendations were made because the precautionary principle was being adopted, and due to the age of the batches in question; the advice now read (Lord Bach, 2003):

> *"Anthrax vaccine must not be mixed with any other vaccine or other medicinal product in the same syringe. If necessary, anthrax vaccine may be given at the same time as other vaccines. Other injectable vaccines should be administered by separate injections into different anatomical sites and, ideally, into different limbs."*

Anthrax and the whooping cough vaccine could again be used in combination – 13 years after they were first given to those deploying to the Gulf.

4.2. Depleted uranium (DU)

DU is a by-product of the separation process used on natural uranium to produce Enriched uranium. DU is 1.7 times more dense than lead. This dense material is used in armour piercing weapons – such as the tank penetrating rounds used by the UK Challenger 2.

DU is radioactive, but only slightly; it is 40% less radioactive than naturally occurring Uranium, and with a chemical toxicity roughly equivalent to other heavy metals such as lead. When DU weapons strike a target, the DU undergoes spontaneous combustion and substantial amounts of DU are converted into a cloud of particles which can be inhaled and ingested. This is generally how DU enters the body; however, it can also enter the body if a person receives a DU shrapnel wound, where the metal remains embedded.

Exposure to DU through "friendly fire" incidents was particularly felt by US troops. During a very short period in 1991, 115 US troops were mistakenly fired upon by US forces by weapons using DU metals. There were 11 fatalities and 50 casualties from these particular incidents.

For the wounded tank crew members, and those that rescued them, there were particularly high risks of DU contamination from inhalation and ingestion, wound contamination and embedded DU shrapnel. These veterans, referred to as "DU-exposed" have been the subject of ongoing clinical assessments in the US. The method used to measure levels of exposure is the excretion of DU through urine. The most recent article on this cohort reported (Squibb *et al.*, 2006):

> *"The Baltimore VA [Department of Veterans Affairs] DU Follow-up Program continues to conduct health surveillance in a cohort of Gulf War soldiers exposed to DU when they were in or on vehicles hit by friendly fire involving munitions with DU penetrators. Urine U [uranium]*

concentrations remain elevated in veterans with embedded DU fragments, demonstrating a chronic systemic exposure to U in this group of soldiers. Not all soldiers in the 'DU-exposed' Gulf War friendly fire cohort have embedded DU fragments; thus potential health effects from DU exposure by inhalation, ingestion and wound contamination alone are also being monitored through this programme. With the exception of the elevated urine U excretion, no clinically significant, expected U-related health effects have yet been identified in veterans with or without embedded fragments, though subtle changes in renal function and genotoxicity markers in soldiers with urine U concentrations greater than 0.1µg-1 creatinine have been observed."

In the UK, work has also taken place. The Depleted Uranium Oversight Board (DUOB) has very recently reported on its work over the past five years. The programme has been assessing veterans for significant exposures to DU.

After establishing analytical and verification methods for the study, veterans were invited to provide urine samples for testing; this began in September 2004 and continued until January 2006.

The Minister of State, Ministry of Defence, Lord Drayson announced the results in March 2007:

"The Depleted Uranium Oversight Board (DUOB) was established in 2001 to oversee a screening programme for veterans of the 1991 Gulf conflict and subsequent Balkans operations concerned about possible exposure to depleted uranium. Testing based on the analysis of urine samples for trace quantities of uranium isotopes was offered between 2004 and 2006. A total of 496 applicants completed the test.

The board was unable to achieve complete consensus on the interpretation and significance of the test results; however, no evidence of the excretion of depleted uranium was found in the urine of any of the test participants. According to mainstream scientific and medical opinion, this means that none had suffered an exposure to DU of sufficient magnitude likely to cause a risk to their health."

The DUOB were also asked to consider the potential for epidemiological studies of exposure to DU and associations with health outcomes and the scope for commissioning of such research. However, the DUOB concluded that "once it became clear that any detectable exposure would be extremely rare, this idea was abandoned." (DUOB, 2007).

4.3. Organophosphates

The use of organophosphate during the Gulf War, and the illnesses that have since been reported, are closely linked to the use of other neurotoxins used during the conflict. This is because they all belong to a single class of compounds that adversely affect the nervous system. This group of nerve agents include OPs, sarin and NAPS.

Organophosphates (OPs) are a group of synthetic chemical compounds that affect the transmission of nerve signals in the body. Nerve signals are transmitted by a molecule called N-acetylcholine. When ingested or inhaled, organophosphates inhibit the enzyme acetylcholinesterase (ACE) which breaks down acetylcholine in the body. This inability of the body

to break down acetylcholine causes a build up of N-acetylcholine at nerve junctions and disrupts the physiological processes.

Reported symptoms of organophosphate poisoning include fatigue, memory loss, blurred vision, cold sweats, weakness, hypotension, joint and muscle pain and depression. These are generally related to low-level exposures over an extended period. The MRC, in 2003, reported that "the immediate effects of OP poisoning are headaches, diarrhoea and paralysis". With reference to the potential exposures to OPs during the Gulf War the MRC stated:

> *"[T]here is little information on the quantity of OP pesticides handled, or how these were used [during the Gulf War]. No cases of acute OP poisoning were reported at the time, making it unlikely that exposure levels were ever high enough to account for the kinds of symptoms experienced later."*

However, one of the UK epidemiological studies did make a weak link with self-reported ill health among Gulf veterans and the handling of organophosphates. The study reported (Cherry *et al.*, 2001):

> *"The relations between exposures and ill health were generally weak. Consistent, specific and credible relations, warranting further investigation, were found between health indices and two exposures, the reported number of inoculations and days handling pesticides."*

The lack of presentation of illness at the time, particularly symptoms of headache and diarrhoea, could be attributed to a number of factors. Namely, the fact that these illnesses were probably common during the conflict, not presented for medical treatment, or not presented in connection with the use of pesticides. Additionally, as already stated, the government has admitted to the absence of complete medical records, and therefore, the statement that "no cases of acute OP poisoning were reported" cannot be made with absolute certainty.

There are also substantial reasons for mistrust regarding the use of organophosphates during the Gulf War. On 11 July 1994, the government stated in written answers that: "No organophosphate insecticide or pesticide sprays were used by British Forces." By October 1996, the government were willing to accept that there had been use of organophosphate chemicals in the Gulf and announced that they would conduct an investigation into both the use of OPs during the Gulf War and how previous parliamentary questions had been answered. On 10 December 1996, the Minister for State for the Armed Forces, Mr Nicholas Soames made a statement:

> *"…[T]he investigation team discovered that OP pesticides were indeed used by our troops in the Gulf to deal with the serious threat posed by fly-borne disease on a much wider scale than previously reported. Secondly, the investigation team discovered that, with the exception of the possible small-scale use of pesticides obtained incorrectly, there is no evidence that they were incorrectly used."*

Then on 26 February 1997, Mr Soames announced the conclusions of the further investigation – these were:

> *"a) The answers to six PQs [parliamentary questions] in 1994 concerning pesticide usage during Operation GRANBY were incorrect because Ministers were given flawed advice by Service and Civil Service staff, who had obtained and used inaccurate information when preparing the draft answers.*

"b) The submission of flawed advice concerning pesticides to Minsters in July 1994 and again in November 1994, together with repeated submissions of the same inaccurate information at later dates, constituted a fundamental failure of the working practices adopted by Service and Civil Service staff within the area of MoD concerned.

"c) As a result of internal confusion about the subject, the MoD gave incomplete information to the HCDC in a memorandum dated 9 December 1994 concerning the non-OP pesticides which had been used during Operation GRANBY.

"d) In the course of 1995, MoD Service and Civil Service staff received a number of indications that during the Gulf War British troops might have obtained locally and also used some OP pesticides, but this information was neither assessed nor followed up properly.

"e) No later than early June 1996, some MoD Service and Civil Service staff knew that OP pesticides had been used more extensively during Operation GRANBY than had previously been reported and that this new information would embarrass the Department. However, appropriate action was not taken.

"f) Although new information concerning OP pesticide usage during Operation GRANBY had emerged much earlier, MoD Service and Civil Service staff failed to provide Ministers with appropriate written advice on the subject until 25 September 1996. Thereafter Parliament was informed at the earliest opportunity that incorrect statements had been made."

The lack of information about the quantities used, the names of the commercial products or even country of origin of the pesticides and insecticides used during the Gulf War, makes further sound epidemiological research extremely difficult; also the conclusion of the MRC (2003).

However, given the lack of information about the most basic of facts, it is also difficult to reconcile the government's position that "there is no evidence that they were used incorrectly". The counter argument being that there is also no evidence to suggest that OPs were used in accordance with Safety Data Sheets or even that the correct personal protective equipment was used. The Government's position was also challenged by Paul Tyler MP in 2003:

"Claims that OPs were used only by trained operatives, with proper precautions and protective clothing, have been specifically challenged by Sergeant Tony Worthington, who has clear photographic evidence. He has shown that operatives were exposed to massive doses of OPs and other pesticides in vapour form. We still do not know whether those OPs, apparently bought locally in Saudi Arabia, were of a type that was banned for use in the UK. We can be sure, however, that any warnings and instructions for use were in a language that was unintelligible for those unsuspecting Service personnel."

There was an attempt made to shed some light on the amount of OPs used during the Gulf War, in 1997 the Laboratory of the Government Chemist reported on tests of tent materials aimed at detecting residues in tent materials. Lord Lloyd included this evidence in his Inquiry report in 2004:

"Of twelve samples analysed one was found to contain residues of the pesticide fenitrothion in low concentrations. The authors point out, however, that greater contamination could have been present six years before."

The Pesticide Safety Directorate considered the report and concluded that "…any likely human exposure would be well within acceptable limits for this compound" (Lord Lloyd, 2004).

More recently, findings from both UK and US research have suggested that some people might be more susceptible to the adverse effects relating to OPs and other nerve agents. It has been reported that people with a reduced activity of the enzyme paraoxonase 1 (PON1) might be more likely to suffer ill health if exposed. The MRC (2003) reported:

> *"The significance of these findings is not yet clear. PON1 breaks down different OPs at different rates and has a number of other functions that relate to common health problems, e.g. cardiovascular disease."*

In 2005 the Health and Safety Executive (HSE) commissioned from the University of Manchester entitled "Genetic variation in susceptibility to chronic effects of organophosphate exposure" (Cherry *et al.*, 2005). The principal objective of the study was:

> *"…to determine whether sheep farmers with self-reported disabling chronic symptoms contain a greater proportion of individuals with dysfunctional polymorphisms at positions 192 and 55 of human serum paraoxonase than sheep farmers without these symptoms."*

The study was carried out by comparing people who used sheep dips containing organophosphate and self-reported chronic ill-health (which they attributed to sheep dip) – "the case" – and compared them with a nominated person of similar age (not a blood relative) who had a similar dipping history and who they believed to be of good health – "the referent". The study reported:

> *"Results from this study indicating that there were differences in the case and referent population in not only the PON1 genotype but also diazoxonase activity are thus consistent with the study hypothesis that OPs contribute to the reported ill health of people who dip sheep."*

In relation to the specific symptoms of depression, a further study carried out at the University of Bristol concluded (Lawlor *et al.*, 2007):

> *"These findings suggest that the association of PON1 Q192R with symptoms of depression in occupationally exposed groups may be driven by exposure to toxins that everyone in the general population is exposed to rather than exposure to toxins specifically used by sheep dippers or Gulf War veterans, or that other mechanisms underlie the association. This is because the study population in which we have found an association consisted of British women aged 60-79, few of whom where sheep dippers or Gulf War veterans. When using genotype-outcome associations to infer causality with respect to an environmental exposure modified by the genotype, it is important to examine these applications in general populations and in those specifically exposed to the putative agent. The possible role of PON1 Q192R in psychiatric morbidity requires further examination."*

The only thing that remains clear is that further investigation is needed.

The MoD has already carried out two studies in this area. The first study carried out by Manchester Royal Infirmary (MRI) was published in 2000 and "found that a self-selected group of

152 ill Gulf veterans had paraoxonase activity levels 50% less than those of healthy civilians". The second study, again at MRI, reported in 2003. This study also found that PON1 activity in Gulf veterans was lower than in the control groups used.

However, the MRC (2003) have recommended more work in this area:

> *"The possibility of paraoxonase enzyme genotype studies should be explored. Comparing non-exposed and exposed individuals, with or without symptoms, might show whether symptom severity correlates with particular enzyme subtypes."*

In January 2006, the MoD stated that they were reviewing a proposal for a clinical study of the levels of paraoxonase in Gulf veterans with the MRC. It is hoped that this study can progress quickly.

Studies have been carried out, which aimed to detect evidence of OP toxicity by looking at the nervous system. King's College London (KCL) carried out neurological testing in ill veterans who reported poor health or symptoms that might indicate neurological testing. A technique and very sensitive test called single fibre electromyography (SFEMG) was used (KCL, 2006):

> *"The results were largely normal. Although the ill veterans reported symptoms that might indicate damage to the peripheral nervous system, this could not be confirmed on the sophisticated tests (Sharief et al., 2002). Overall there was no evidence of any damage to the peripheral nerves, neuromuscular junction or muscles. Two years later a much larger study of US Gulf veterans and their families have confirmed these results (Davis et al., 2004)."*

4.4. Exposure to chemical weapons (sarin and cyclosarin)

The most notable exposure to chemical weapons during the Gulf War resulted from the US demolition of weapons at Khamisiyah on 4 March 1991. What were initially thought to be conventional weapons were later identified as chemical weapons containing sarin.

The plume that was created in the destruction of these weapons has since become the topic of some debate. The need to know size and the areas which the plume covered is important because it is directly related to the number of potential exposures to sarin, and the outcomes of epidemiological studies in this area.

The MoD did not collect any meteorological data or other source data during the Gulf War that would enable any plume modelling of the incident at Khamisiyah. The UK government has instead relied on the composite model developed by the Department of Defence (DoD) and the Central Intelligence Agency (CIA).

In 2004, the US Government Accountability Office (GAO) evaluated the validity of the DoD, Department of Veterans Affairs (VA), and the MoD conclusions about troops' exposure. They reported:

> *"DoD's and MoD's conclusions about troops' exposure to CW [chemical warfare] agents, based on DoD and CIA plume modeling cannot be adequately supported. The models were not fully developed for analyzing long-range dispersion of CW agents as an environmental hazard. The modeling assumptions as to source term data – quantity and purity of the agent – were inaccurate because they were uncertain, incomplete, and nonvalidated."*

The GAO went on to outline the MoD position:

> *"The MoD concluded from the 1997 DoD and CIA composite model of the Khamisiyah demolitions that the maximum concentration of agent that British troops might have been exposed to was below the level that the most sensitive British warning device could have been expected to detect. Moreover, according to the MoD, the highest theoretical dosage troops received would have been 3.6 times lower than the level at which the first noticeable symptoms occur. Finally, the MoD said, this level of exposure would have no detectable effect on health.*
>
> *"The MoD also determined that a number of British troops were within the boundary of the plume in the DoD and CIA composite model, and it estimated that the total number of British troops potentially exposed was about 9,000.]…[However, since the MoD relied exclusively on DoD's modelling and since we found that DoD could not know who was and who was not exposed, the MoD cannot know the extent of British troops' exposure."*

The MoD position is easily understood, as it was based on the best possible information available at the time. However, the GAO investigation also concluded that any exposure estimates based on the DoD and CIA model could not be supported.

Significantly, in April 2002 the DoD published their final Khamisiyah report with a revised model, which took into account improvements in modelling and analysis techniques. However, the DoD did continue to highlight the lack of source data as a problem. The revised 2002 DoD report, and model contained within it, was not considered by the GAO because it was deemed to be beyond the scope of their study.

Since then, MoD scientists have evaluated the 2002 DoD model, and "welcome the modelling improvements implemented by the DoD" (MoD, 2005). While supporting the improvements, the MoD considered that the DoD source data assumptions were too broad and "result in a model which overstates the size of the plume footprint". However, there is one thing that all agencies seem to agree on (MoD, 2005):

> *"Without major improvements in the quality of the source data, which are unlikely to emerge, the size and nature of the hazard potentially experienced by troops in the Gulf will remain a matter of debate. Despite disagreement over the size and nature of the plume, both the DoD and GAO agree that no further modelling of the events at Khamisiyah should be undertaken."*

While maintaining that the modelling used is based on limited source data and that the plume footprint presented by the DoD is too broad, the MoD have used the model to make an assessment of exposure of UK Armed Forces personnel to chemical agents (MoD, 2005):

> *"MoD's assessment concludes that approximately 9,000 Service personnel were located within the possible area of exposure and considers that it is possible (though not probable) that an extremely low level exposure could have occurred within this area."*

4.5. Stress and psychological factors

Three-quarters of ill Gulf War veterans "have no recognised psychiatric disorder" (MRC, 2003). As with other symptoms, Gulf War veterans report "more psychiatric symptoms, and symptoms of

greater severity" than non-Gulf veterans (MRC, 2003). When considering Post Traumatic Stress Disorder (PTSD) it has been found that only around 3% of Gulf War veterans suffer from this disorder; not nearly enough to provide an explanation for the ill health of this group of veterans (Lord Lloyd, 2004).

However, recognised psychiatric disorders are not the only consideration. The affect of stress on physical wellbeing, as well as synergistic effects also need consideration. These effects are considered in the paper "Reflections on Gulf War illnesses" (Wessley & Freedman, 2006):

> *"During the Desert Storm, there were several thousand documented chemical alarm alerts. Subsequently, the consensus of opinion is that none was a true positive, and that Iraq did not use its CBW arsenal. But at the time each alert had to be assumed to be genuine. Thus, even if traditional military stressors were not a prominent feature of the active campaign, a well-found and realistic anxiety about the threat of dread weapons could still be important. It does not take much imagination to accept the potent psychological effects of operating in an environment where one could be subject to chemical attack, or the damaging effects of believing, even erroneously, that one has been the victim of such an attack (Fullerton & Ursano 1990; Riddle et al., 2003). Believing oneself to be exposed to such weapons has been found frequently to be associated with the development of symptoms (Unwin et al., 1999; Nisenbaum et al., 2000), sometimes very strongly (Haley et al. 1997; Proctor et al., 1998; Stuart et al., 2003)."*

4.6. The cocktail effect

Whilst a great deal of work has been completed on each of the suspected causes of Gulf War illnesses, little has been done on the health effects of multiple stressors and chemical exposures. During 2005 two studies in the US examined how pesticides, vaccines and stress interact with a variety of enzyme systems. The first of these studies carried out on mice (Wang *et al.*, 2005) concluded:

> *"Our current studies suggest that stress, vaccination, and PY [pyridostigmine] may synergistically act on multiple stress-activated kinases in the brain to cause neurological impairments in GW1 [Gulf War 1990-91 veterans]."*

The US Department of Veterans Affairs (VA) reported in 2006 that:

> *"These experiments are the first steps in better defining the risks (and underlying mechanisms) represented by multiple exposures."*

However difficult it may now be – given the extensive official delays – it is essential that the potential inter-relationship and interaction of various individual causes of these illnesses. For some veterans it may well have been the combination, rather than any one specific cause, that has caused a chronic condition.

5. Additional UK Research

5.1. Gulf Veterans Medical Assessment Programme (GVMAP)

The Gulf Veterans Medical Assessment Programme (GVMAP) was established in 1993 to investigate the medical complaints, to diagnose and recommend appropriate treatment or management. The GVMAP also collated statistical information; articles have been published in 1996, 1999, 2001 and 2002. The most recent analysis was published in 2005: "An observational study on diagnoses of 3,233 Gulf veterans (Op GRANBY, 1990-91) who attended the Ministry of Defence's Medical Assessment Programme 1993-2004" (Bale and Lee, 2005). They reported:

> *"This is the result of an observational study on 3,233 Gulf veterans who have attended our medical assessment programme. We wanted to determine as a result of in-depth interviews, full medical examination and appropriate investigations, whether there was any unique Gulf war related medical condition.*
>
> *"Over a period of 10 years, 3,233 veterans have been assessed. All diagnoses have been made according to ICD-10 classifications. All psychiatric diagnoses have been confirmed by consultant psychiatrists.*
>
> *"75% of veterans were well. Of the 25% unwell, 83% of ill health was accounted for by a psychiatric disorder. 3% of veterans had organic conditions which could be linked to Gulf deployment. The most common of these were respiratory disorders, followed by digestive disorders, injuries and skin disorders. Only 11 of these cases could be linked to the use of medical countermeasures. A further, 51 cases (41 respiratory disorders, 6 infections, 2 skin disorders and 2 eye conditions) could be linked to environmental conditions.*
>
> *"All veterans seen with health problems could be identified as per ICD-10 classification of disease. We did not find any medically unexplained conditions. We found no evidence of a unique 'Gulf War Syndrome'."*

With reference to diagnoses of skin disorders, one health outcome that has been noted is an excess of seborrheic dermatitis. This is of interest simply because "of its associations with immune dysfunction" (KCL, 2006).

5.2. Mortality Statistics

The first study into mortality data was published in 2000. The study found similar results of deaths and causes of death between deployed Gulf veterans and the comparison Group (the comparison group consisting of Armed Forces personnel of similar profile in terms of gender, Service, regular/reservist status and rank, who were in Service on 1 January 1991 but were not deployed to the Gulf) (Macfarlane *et al.*, 2000). However, there was a "small excess of deaths amongst Gulf veterans attributable to accident, particularly road traffic accidents" (MoD, 2005). There have also been reports of increased rates of suicide and more broad accidental deaths (KCL, 2006).

Since the publication of this study in 2000, the Defence Analytical Services Agency (DASA) has reported mortality statistics every six months – it has recently been agreed to change the reporting period to 12 months (February 2007).

5.3. Reproductive Health

Several studies have been carried out in the UK on reproductive health. The first published in 2003 reported a higher number of pregnancies from both male and female Gulf War veterans when compared with the control group – although no conclusions were drawn from this (Maconochie *et al.*, 2003).

There were also two papers published in 2004 on male fertility. The first reported that there was no evidence for increased risk of stillbirth, chromosomal malformations, or congenital syndromes amongst male veterans, although some links with fathers' Gulf Service and an increased risk of miscarriage and other less well-defined malformations (Doyle *et al.*, 2004). The second reported on increased risk of infertility, the researchers concluded (Maconochie *et al.*, 2004):

> *"We found some evidence of an association between Gulf War Service and reported infertility. Pregnancies fathered by Gulf veterans with no fertility problems also reportedly took longer to conceive."*

5.4. General Health

With regard to health in general, in 2006 King's College London (KCL) reported an increase in hypotension in ill Gulf veterans compared with healthy Gulf veterans. They also found that these veterans were more likely to be "overweight, and had higher levels of a particular enzyme (gamma GT) which is associated with alcohol intake, but is also a marker for obesity" (KCL, 2006). More broadly they reported:

> *"It is possible that all of these reflect the influence of problems such as fatigue and lack of exercise, which may be part of a vicious circle of ill health, fatigue, lack of exercise, and hence increased weight, leading to more fatigue and even less exercise."*

5.5. Central Nervous System

Lastly, worth mentioning is the UK study looking into damage to the Central Nervous System (CNS), which used standardised tests of neuropsychological functions. The researchers compared ill Gulf veterans to a group of healthy veterans. The results were broadly similar for both groups demonstrating a difference in "subjective complaints and objective tests" (KCL, 2006). However, there was one test where ill Gulf veterans fared worse (KCL, 2006):

> *"Only on one particular test, called the Purdue Pegboard, a test of motor skills, were sick Gulf veterans impaired, suggesting an impairment of motor dexterity, which might indicate some subtle neurotoxic damage."*

6. Further UK Research

> *"There is as yet no single, definitive, explanation for what has been observed. It is my opinion that this is unlikely to change with the passage of time, and that the delay in commencing serious scientific study of the problems has meant that any chances that once existed of providing better answers on aetiology have probably vanished."* (Wessley, 2006)

The conclusions and recommendations of the MRC Review of Research into UK Gulf Veterans' Illnesses in 2003 stated:

> *"Further studies to characterise symptoms and illnesses of UK GVs based on self-reported exposures are not necessary and epidemiological studies of existing data are unlikely to lead to greater understanding.*
>
> *"Most of the potential hazards have already been investigated in sufficient detail."*

However, the MRC did recommend in their report that "research aimed at improving the long-term health of GVs with persistent symptoms should take priority" over any other recommended work. The government has repeatedly stated that in order to maintain and to demonstrate the scientific credibility and independence of their research programme they have been guided by the advice and support of the MRC.

The MRC also stated that preliminary US neuroimaging studies should be replicated in the UK. This work is almost due to report and it is hoped that if the studies report useful outcomes, that this can be replicated in the UK very quickly. The MRC also recommended that "studies of measurable symptoms should be piloted to see whether nervous system changes are also present".

6.1. Rehabilitation

Professor Simon Wessley, Co-Director of Kings College Centre for Military Health Research, said in a press release dated 24 March 2006:

> *"An enormous amount of money and effort have been expended on understanding Gulf War Illnesses worldwide. These reviews make it clear that there is no single cause, rather there are a range of factors likely to be responsible. I believe there is little value in conducting further research into the causes. We should now focus our resources on rehabilitating those people who are ill as a result of Service in the Gulf War."*

While opinions differ on the need for further investigations into the causes of Gulf War illnesses, it is agreed that work to improve health and quality of life are needed. Some work has been instigated in the US, particularly using cognitive behavioural therapies (CBT), but did not report due to the number of veterans that pulled out of the study. However, there may still be merit in this type of work, if combined with pre-selection testing to gauge susceptibility. The MoD are also currently looking to commission work in this area.

In the UK some work has been carried out on a wider group of people, but did also include Gulf War veterans. This work comes under the Expert Patient Programme (EPP), which delivers help with self management through the Chronic Disease Self-Management Course (CDSMC). By 2006 the EPP had delivered 2,700 community courses to over 35,000 people living with long-term

health conditions. Results from the EPP pilot internal evaluation indicate the following trends (EPP, 2006):

- 45% said they felt more confident that they would not let common symptoms (pain, tiredness, depression and breathlessness) interfere with their lives;
- 38% felt that such symptoms were less severe 4-6 months after completing the course;
- 33% felt better prepared for meetings with health professionals.

In terms of access to health services, the EPP has reported a:

- 7% reduction in GP visits;
- 10% reduction in outpatient visits;
- 16% reductions in admissions to Accident and Emergency Departments; and
- 9% reduction in physiotherapy use.

The ex-Service voluntary sector is currently looking at how this model could be used or adapted for interested Gulf War veterans.

6.2. Proposals from the Gulf War Group

The Gulf War Group is constituted by representatives of Gulf War veterans, parliamentarians and relevant experts on Gulf War illnesses and related issues. The Gulf War Group monitors the progress of both UK and US research, and has forwarded two outline proposals for further UK research to the MRC for their advice. They are:

- A comparison of endocrine abnormalities in patients with Gulf War Syndrome (GWS) versus those with Chronic Fatigue Syndrome (CFS). The study will look at the dynamic pituitary response of patients with symptomatic CFS to determine if the hormonal response is specifically abnormal in GWS, particularly for ACTH and growth hormone.
- Gulf War Syndrome (GWS): investigation of pathogenesis by determining the specific gene expression signature and identification of protein biomarker using mass spectrometry. The study aims to elucidate the pathogenesis of GWS in terms of the gene expression signatures of messenger RNA and to identify protein biomarker that could be developed toward a diagnostic test for GWS.

7. United States (US) Research

7.1. Research Advisory Committee on Gulf War Veterans' Illnesses (RACGWI)

The Research Advisory Committee on Gulf War Veterans' Illnesses (RACGWI) was established in 2002 by the US Secretary of Veterans Affairs to advise on research relating to the health consequences of service in the Gulf War. Their report issued in 2004 "Scientific Progress in Understanding Gulf War Veterans' Illnesses: Report and Recommendations" outlines their key findings – those of interest to UK Gulf veterans are outlined below:

- A substantial proportion of Gulf War veterans are ill with multi-symptom conditions not explained by wartime stress or psychiatric illness;
- Treatments that improve the health of veterans with Gulf War illnesses are urgently needed;
- A growing body of research indicates that an important component of Gulf War veterans' illnesses is neurological in character;
- Evidence supports a probable link between exposure to neurotoxins and development of Gulf War veterans' illnesses;
- Other wartime exposures may also have contributed to Gulf War veterans' illnesses;
- The health of Gulf veterans must be carefully monitored to determine if Gulf War Service is associated with excess rates of specific diseases, disease specific deaths, or overall mortality;
- Important questions concerning the health of children and other family members of Gulf War veterans remain unanswered.

7.2. US Federally sponsored Research on Gulf War Illnesses for 2005

In June 2006 the Department of Veterans Affairs (VA) made their Annual Report to Congress on the Federally Sponsored Research on Gulf War Illnesses for 2005. The following provides a brief update on the progress made during 2005.

The United States (US) research programme is divided into five focus areas, these are:

- Brain and nervous system function;
- Environmental toxicology;
- Immune function and infectious diseases;
- Reproductive health;
- Symptoms and general health.

7.2.1. Brain and nervous system function

The majority of reports in this area were concerning physical and psychological effects of combat exposure.

One epidemiological study on amyotrophic lateral sclerosis (ALS) [motor neurone disease (MND) in the UK] was corrected in 2005 "after correcting for under-ascertainment the risks of ALS remained elevated among deployed veterans" (Coffman *et al.*, 2005). However, a study on ALS mortality data found a higher risk for men born between 1915 and 1935 who served in the military in general, compared with those who had not served (Weisskopf *et al.*, 2005). Additionally, a literature review found no consistent link between exposures to pesticides/insecticides or chemical solvents, or increased rates of death from ALS in Gulf War veterans (Wicklund, 2005).

With regard to the study demonstrating elevated incidences of ALS, or MND as it is known in the UK, KCL considered these results and reported (2006):

> *"…one study from the USA reports that US Gulf veterans are more likely to be suffering from a rare neurological condition known as amyotrophic lateral sclerosis (ALS).]…[However, this finding is controversial since as (sic) MND is a terrible disease that is usually and fairly rapidly fatal, one would expect this to be reflected in higher death rates, which have not been found.]…Whether or not the American data is correct, MND is still a very rare condition in Gulf veterans, and cannot account for the large health effects that have been found."*

There were several studies on Post Traumatic Stress Disorder; they noted that early intervention and documentation of experiences was beneficial to treatment (VA, 2006).

7.2.2. Environmental toxicology

The 2005 research reports in the grouping environmental toxicology focused on DU and sarin.

The clinical studies on veterans have already been outlined; the studies conclude that "no clinically significant uranium-related health effects were observed in these veterans" (VA, 2006). Several studies in the US on animals exposed to DU for 6-9 months discovered changes to behaviour and some health effects. However, the length of exposure should be noted in relating to how Gulf veterans would have been exposed to DU.

Studies have also been carried out on animals exposed to low doses of sarin, some including exposure to pyridostigmine bromide (NAPS). The VA reported the following (2006):

> *"Exposure to animals to low (non-lethal) doses of sarin, with or without pyridostigmine bromide, produced transient, but not permanent, alterations in blood flow and metabolic activity in the brain (Scremin et al., 2005), as well as dose-related changes in body weight and blood acetylcholinesterase activity (Langston et al., 2005)]…[Sarin was also found to alter gene expression profiles for proteins in the brain involved in neurotransmission (Block-Shilderman et al., 2005; Damodaran et al., 2006)]."*

There was a further study, which found some limitations in using mice for neurotoxicology studies (Li *et al.*, 2005) (VA, 2006):

> *"They demonstrated that mice, unlike humans, have substantial amounts of soluble acetylcholinesterase as well as butyrylcholinesterase (BChE) in their blood plasma. Thus the metabolism of systemically administered drugs and toxicants may differ."*

7.2.3. Immune function and infectious diseases

The VA reported on a UK study, which looked at the anthrax and pertussis vaccine combinations in mice. While the researchers found that the vaccine combinations cause splenomegaly and significant weight loss, they also stated that (Rijpkema *et al.*, 2005):

> *"The relatively high vaccine dose used, together with the low sensitivity of mice to anthrax toxin, emphasises that caution should be exercised in applying these results to human recipients of these vaccines."*

7.2.4. Reproductive health

The VA reported that four studies were published on reproductive health during 2005. Two studies involved animals with implanted DU; one looked at the effects of the anthrax vaccine on reproductive health and the other the incidence of infants born with Goldenhar syndrome. "None of the studies detected an adverse impact of Gulf War related Service on reproduction" (VA, 2006).

7.2.5. Symptoms and general health

The US carried out a study which medically examined 1,061 Gulf veterans and 1,128 non-deployed veterans for 12 different medical conditions – these were fibromyalgia, Chronic Fatigue Syndrome, dermatologic conditions, dyspepsia, physical health-related quality of life, hypotension, obstructive lung disease, arthralgias, and peripheral neuropathy. Of these, four were more prevalent among Gulf veterans – fibromyalgia, Chronic Fatigue Syndrome, dermatological conditions and dyspepsia (Eisen *et al.*, 2005).

There was also a study into motor vehicle accidents (MVA) which illustrated that those involved in MVAs were more likely to be younger, less educated, not married, enlisted, and deployed to the Gulf War when compared to controls (Hooper *et al.*, 2005). These findings corroborate the work done in the UK.

8. Research Funding and Monitoring

From 1996 to 2005 the US DoD spent USD $182 million on research into Gulf War illnesses. In the same period the Department of Veterans Affairs (VA) spent USD $68 million and the Department for Health and Human Services (HHS) spent US$10 million (VA, 2006). Federal funding totalled USD $260.6 million by 2005 (around GBP £156.4 million) - these figures exclude research undertaken between 1992 and 1995.

Over the period 1992 to 2005 the DoD, VA and HHS sponsored a total of 300 distinct research projects on Gulf War veterans' illnesses. At the end of the 2005 financial year there were still 90 projects either new or ongoing.

In comparison, the UK has spent a total of £8.5 million pounds on research on the causes of Gulf War illnesses; a very large proportion of this was spent on the Vaccines Interactions Research Programme.

The higher spend in the US is understandable due to the much larger number of troops deployed to the Gulf. Comparing research spend based on numbers of troops deployed, the US has spent GBP £223 per person, while the UK has spent £158 per person. The UK also continues to fund a Gulf Health Liaison Officer, based in Washington, to monitor the US research programme. However, the government do not produce regular updates on the progress of US research in an easily digestible format for veterans. When asked directly how veterans are being kept informed of progress, Lord Drayson replied (November 2006):

> *"…they [veterans] will be kept informed through a number of mechanisms. First, there is the publication of the results in peer review journal, which we bring to the attention of veterans through their representative organisations, through Members of this House who represent veterans, and through the Ministry of Defence website. We also need to go further, as I have said. We need to write to those veterans for whom this is most relevant. We need to do so when we are clear about the issues that will achieve final closure. I feel that there is not sufficient clarity about what that closure would be based on. We need to do more, and we are prepared to do that."*

9. Current Compensation Arrangements

The compensation arrangements for Gulf War veterans do not differ from those for any injury or illness caused by Service. Compensation payments are awarded through the War Pension Scheme (WPS) in the case of illness, injury or death, which occurred before April 2005. The scheme is legislated by the Naval, Military and Air Forces Etc. (Disablement and Death) Service Pensions Order 2006 (SPO06). Ongoing payments awarded (for a whole body disablement of 20% or more) are referred to as a War Disablement Pension.

As stated the number of Gulf veterans in receipt of a War Disablement Pension (level of whole body disablement 20%-100%) is around 2,920 (Lord Drayson, 2006). Those who claim through the WPS, but are assessed as having a whole body disablement of less than 20% are awarded a Gratuity, or one-off payment. As at March 2004 the number of Gulf War veterans who had received a Gratuity was 2,235 (Lord Lloyd, 2004). The WPS also allows for other allowances to be paid, for things such as lower earnings potential, age, unemployability and carers.

The latest figures from the Service Personnel & Veterans Agency (23 April 2007) report that there are 6,718 veterans who have received any type of disablement award made for recognised conditions, and 1,598 of these are for conditions related to Gulf War illnesses.

10. Labels applied to War Disablement Pensions

For the majority of injuries or illnesses, the label that is applied to a War Disablement Pension is quite straight forward. In the case of illness, the name of the medical condition is applied e.g. Chronic Fatigue Syndrome together with the level of disablement. However, where a claimant has symptoms of illness that cannot be attributed to a medical condition the situation becomes more complicated. The burden is on the claimant to prove the existence of a particular medical condition based on reasonable doubt.

For disabling conditions/symptoms that are not covered by recognised conditions or diagnostic labels, it has become regular practice for the SPVA to apply the term "Signs and Symptoms of Ill-Defined Conditions" (SSIDC). SSIDC is a diagnostic category within the ninth edition of the World Health Organisation Classification of Diseases (WHO ICD). This term has been replaced in the tenth edition of the WHO ICD by Symptoms, Signs and Abnormal Clinical and Laboratory Findings Not Otherwise Classified (SSACLFNOC). However, while it has been replaced the SPVA continues to use the SSIDC label as the diagnostic label for symptoms and illness where there is no identifiable underlying disease. It is important to note that even if the SPVA was to adopt the new label, SSACLFNOC, the change would not apply retrospectively, and it would not affect any level of award given.

It has been argued that Gulf War veterans who suffer from a range of symptoms of illness should apply the term "Gulf War Syndrome" instead of using the SSIDC label. It is thought that even though "Gulf War Syndrome" is not a recognised medical condition the SPVA could use it as a descriptive "umbrella" label in the same way that SSIDC is used. Or put another way, the label "Gulf War Syndrome" could be applied to signs and symptoms of illness that are not a discrete medical condition, but that can be linked to Service in the Gulf.

11. The Application of the Label "Gulf War Syndrome"

It has been stated on many occasions, and is agreed by all parties, that "Gulf War Syndrome" is not in itself a discrete medical condition. However, it is worth noting that there have been claims for Gulf War Syndrome allowed by the Pensions Appeal Tribunals (PAT).

Where War Disablement Pensions have been awarded to veterans for accepted conditions, the phrase "Gulf War Syndrome" has been used as a descriptive label, with a list of accepted medical conditions or symptoms of illness listed beneath. The MoD have recently highlighted some difficulties in applying the label "Gulf War Syndrome" to particular signs and symptoms of illnesses; in particular, they are not clear in how it can be used in any other way – because:

- Using it as a replacement for Signs and Symptoms of Ill-Defined Conditions (SSIDC) would mean that those with defined medical conditions would not be able to use it; the MoD rightly feel that applying the label to all Gulf War veterans who wanted it to be applied would be an important step toward closure.

- Using it as a term for a basket of disorders, signs or symptoms of illness would require a definitive list to be drafted. This could lead to some people being excluded if their symptom was not on the positive list. Additionally, as yet, we do not have an agreed set of conditions identified.

However, it could be argued that the two are not mutually exclusive - this is not an either/or issue. It is possible for the term "Gulf War Syndrome" to be used in more than one way. It could be used as a replacement for SSIDC, or, in the way it is being used now, as a label covering a number of conditions associated with the Gulf War. When giving evidence to the Lord Lloyd Inquiry into Gulf War Illnesses (2004) Dr Harcourt Concannon (PAT President) made the following points:

> *"Whichever you call it, whether Gulf War Syndrome or 'Symptoms and Signs of Ill Defined Conditions' the label is, he said, [Dr Harcourt Concannon] no more than a wrapper for accepting a set of symptoms."*
>
> *"Secondly, the label Gulf War Syndrome as favoured by the veterans, or 'Symptoms and Signs of Ill Defined Conditions' (SSDIC), as favoured by the Government, are both 'umbrella labels'. They encompass a whole array of separate symptoms. The symptoms have to be defined before you can go onto the second stage of the process, as already explained, in assessing, in a particular case, which symptoms have been included in the accepted condition of disablement."*

12. Calls for a Public Inquiry

The Royal British Legion and others have been calling for a full Public Inquiry into the causes of Gulf War illness since the mid-1990s. In answer to a question by the Rt. Hon. Lord Morris of Manchester on 26 February 2004 regarding calls for a Public Inquiry into Gulf War illnesses, Baroness Crawley stated:

> *"My Lords, The Royal British Legion and others continue to campaign for such an inquiry. However, the Government are still not convinced that a public inquiry would help. The possibility that we may look again at this matter has not been ruled out. However, in the present circumstances, it is only through the programme of research initiated by the Government that we are ever likely to establish the causes of Gulf veterans' illnesses."*

In the continued absence of such an inquiry, on 14 June 2004, it was announced that Lord Morris had asked Lord Lloyd to chair an independent Public Inquiry. In the process of carrying out this inquiry, Lord Lloyd wrote to the then Secretary of State for Defence for their cooperation. His response came from Mr Ivor Caplin MP, Parliamentary Under Secretary of State for Veterans, it stated:

> *"The Government has carefully considered the merits of an official inquiry and while we have not ruled out such an inquiry for the present, we remain of the view that the only way we are likely to establish the causes of ill health in some Gulf veterans is through scientific and medical research."*

In his report, Lord Lloyd commented on this response:

> *"In other words the Government's view is that although it is now over thirteen years since the Gulf War, the time for a Public Inquiry is not yet ripe. This is a view which they have expressed on many occasions."*

It is now 16 years since the end of the Gulf War, and the government has still not announced any intention to conduct a Public Inquiry.

Significantly, the progress of scientific and medical investigation into the possible causes of Gulf War illnesses has also now deteriorated – this is particularly the case with the publication of the final reports of the Vaccines Interaction Research Programme and the Depleted Uranium Oversight Board.

Further, on 30 January 2006 the MoD wrote regarding further research into the causes of Gulf War illnesses, they stated:

> *"They [the MRC] did not recommend further work on clinical aspects or causes of Gulf illness. The majority of their recommendations have now been addressed."*

It seems that it is now the view of the MRC, and the government, that the limitations of scientific and medical research might have been reached, and that the only work of substance that remains outstanding relates to improving the health of veterans with persistent symptoms.

If this is the case, the question must once again be asked – is now the right time for a Public Inquiry?

13. Future Compensation Arrangements

The Lord Lloyd Inquiry (2004) report recommended that veterans suffering from Gulf War illnesses should be awarded an *ex gratia* payment.

It should be made clear from the outset that the call for an *ex gratia* payment is not a request for additional compensation for illness or injury, as this type of payment is made under the War Pension Scheme.

The grounds for *ex gratia* payments are the sustained failures of the UK government to fulfil their duty of care to this group of veterans, including delays in investigating exposures to harmful agents and medical research. The UK government had, and continues to have, an obligation to ensure the wellbeing of Armed Forces personnel, so far as it is reasonably practicable. In the case of Gulf War veterans, they have been negligent in this duty, and as a direct result, veterans have become the victims of ill treatment and suffered real hardship.

The following points illustrate the failure of government to protect and properly treat this group of veterans:

- The government denied for six years that veterans' illnesses were caused by the Gulf War; while since accepting that illnesses are linked to Service in the Gulf.

- This delay in accepting a new post-combat disorder also delayed the commissioning of serious scientific research; this has significantly reduced likelihood of ever finding the cause or causes of Gulf War illnesses. King's College London recently commented that "back in 1995 the UK government was not convinced of the need for the study we proposed "(KCL, 2006). In 2005 it was reported (Hotopf & Wessley, 2005):

  "Unlike many health problems, the window of opportunity to properly investigate post-deployment health problems is brief."

- The MoD disposed of or lost medical records and temporary nominal rolls compiled in theatre (B Med 27s); as a result some veterans may never know how many vaccines or other medical countermeasures they were given, and/or in what doses.

- The MoD failed to ask or get written consent during the administering of medical countermeasures, or inform Armed Forces personnel of the possible health risks. The fact that anthrax was not licensed for use with pertussis as an adjuvant was not communicated.

- The MoD failed to act on advice supplied by the National Institute for Biological Standards and Control (NIBSC) that preliminary tests into the use of the anthrax vaccine with pertussis as an adjuvant were a cause for concern.

- The government initially denied that OPs were used during operations in the Gulf. The subsequent investigation, six years later, found that there had been extensive use of OPs, including locally purchased products. This forced a U-turn by the government on the use of OPs.

- Gulf War veterans were exposed to a number of harmful neurotoxins and other toxins including organophosphates, sarin, cyclosarin, smoke plumes from burning oil wells. They

were also exposed to stress. The dose rates and combinations that veterans were exposed to may never be known. Health risks associated with exposure to these agents were well known, as was the likelihood of post-combat disorders, however, no control measures or ongoing health surveillance were undertaken as protection from this combination or "cocktail" of toxins. Health surveillance was also not carried out when personnel returned, even after the benefit of hindsight to the range of toxic exposures (KCL, 2006):

"One of the reasons that we don't know, and will never know, exactly when problems started is because there was no systematic monitoring of the health of the Armed Forces on either side of the Atlantic after 1991."

- The government has not offered an apology to veterans for this treatment.

This *ex gratia* payment should be set at £10,000 in line with other *ex gratia* payment schemes, and be payable to all veterans in receipt of a War Disablement Pension or Gratuity for conditions relating to their service during the Gulf War; widows and widowers whose spouses have died of an illness or injury relating to Service in the Gulf War; and children in receipt of a War Orphans Pension.

14. Conclusions

There is no denying that Gulf War veterans are suffering from ill health and that they do so in greater magnitude and with greater severity than other groups of veterans. The failure to properly control risks from exposure and carry out appropriate health surveillance both during and post conflict has meant that meaningful research into the causes of these symptoms has not always been possible. Research must now focus on improving the health and quality of life for Gulf veterans, and should include further clinical investigations, using objective tests, on individuals that are suffering from illnesses.

Progress on this issue has been continually hampered by multiple failures by the government to properly address this issue. Successive governments also seem to have the inability to take responsibility, rectify past problems and gain the trust of veterans. More significantly, this has exacerbated the frustrations felt by veterans and those that campaign on their behalf. All of this has resulted in a legacy of suspicion, to which significant steps must now be taken to rectify.

References

Lord Bach, The Parliamentary Under-Secretary of State, Ministry of Defence, Gulf War 1990-91: Vaccines, 9 October 2003.

Bale, A. J., and Lee, H. A, (2005) An observational study on diagnoses of 3,233 Gulf Veterans (Op GRANBY) 1990-91) who attended the Ministry of Defence's Medical Assessment Programme 1993-2004. J. R. Nav. Med. Serv. 91:99-111.

Cherry, N., Creed, F., Silman, A., Dunn, G., Baxter, D., Smedley, J., Taylor, S., Macfarlane, G., J., Health and exposures of United Kingdom Gulf war veterans. Part II: The relation of health to exposure., Occup. Environ. Med., 2001.

Cherry, N. M., Durrington, D. N., Mackness, B., Mackness, M. I., Smith, A. E., Dippnall, M., and Povey, A. C., (2004) Genetic variation in susceptibility to chronic effects of organophosphate exposure, Health and Safety Executive, Research Report 408.

Coffman, C. J., Horner, R. D., Grambow, S. C., Lindquist, J., (2005), Estimating the occurrence of amyotrophic lateral sclerosis among Gulf War (1991-1991) veterans using capture-recapture methods. Neuroepidemiology, 24:141-150.

Baroness Crawley, House of Lords oral answers, Gulf War: Illnesses, 26 February 2004: Column 335-8W.

Davis, L., *et al.* (2002) clinical and laboratory assessment of distal peripheral nerves in Gulf War veterans and spouses. Neurology, 61:742-749.

Department of Veterans Affairs (VA), Annual Report to Congress, Federally Sponsored Research on Gulf War Veterans' Illnesses for 2005, Deployment Health Working Group Research Subcommittee, June 2006.

Depleted Uranium Oversight Board (DUOB), Final Report of the Depleted Uranium Oversight Board, 9 February 2007.

Doyle, P., Maconochie, N., Davies, G., Maconochie, I., Pelerin, M., Prior, S., Lewis, S., (2004), Miscarriage, stillbirth and congenital malformation in the offspring of veterans of the first Gulf war. International Journal of Epidemiology, 33:74-86.

Lord Drayson, House of Lords, Written Answers, 10 July 2006 & November 2006.

Lord Drayson, The Minister of State, Ministry of Defence, Written Statements, Armed Forces: Depleted Uranium, 26 March 2007.

Eisen, S. A., Kang, H. K., Murphy, F. M., Blanchard, M. S., Reda, D. J., Henderson, W. G., Toomey, R., Jackson, L. W., Alpern, R., Parks, B. J., Kilmas, N., Hall, C., Pak, H. S., Hunter, J., Karlinsky, J. Battistone, M. J., Lyons, M. J., (2005), gulf War veterans' health: medical evaluation of a US cohort. Ann Intern Med., 142:881-890, VA-002C.

Ewing, A., Member of Parliament, House of Commons, 5 February 2003: Column 83WH.

The Expert Patients Programme, Chronic Disease Self-Management Course, Tutors' Manual, Department of Health, England, 2006.

Glass, D. C., Sim, M. R., (2006) The challenges of exposure assessment in health studies of Gulf War veterans, Philosophical Transaction of The Royal Society, 361, 627-637.

Gray, G. C., Hawksworth, A. W., Smith, T. C., Kang, H. K., Knoke, J. D. and Gackstetter, G. D., (1998) Gulf War Veterans' Health Registries. Who is Most Likely to Seek Evaluation? American Journal of epidemiology Vol. 148, No. 4: 343-349.

Griffiths, G. D., Hornby, R. J., Jagger, C. P., Brown, A. P., Stoten, A., Pearce, P. C., Scott, L., and Pritchard, D. I., (2006) Development of methods to measure humoral immune responses against selected antigens in the common marmoset (Callithrix jacchus) and the effect of pyridostigmine bromide administration, International Immunopharmacology, Volume 6, Issue 12, 5 December 2006, Pages 1755-1764.

Gronseth, G. S., (2005) Gulf war syndrome: a toxic exposure? A systematic review. Neurol Clin 23:523-540.

Gulf War Group, The Royal British Legion, Minutes of the Meeting held 20 February 2007.

Hooper, T. I., DeBakey, S. F., Lincoln, A., Kan, H. K., Cowan, D. N., Gackstetter, G. D., (2005) Leveraging existing databases to study vehicle crashes in a combat occupational cohort: epidemiologic methods. Am J Ind. Med.. 48:118-127, DoD-102.

Hotopf, M., Wessely, S., (2005) Can epidemiology clear the fog of war? Lessons from the first Gulf War. Int, J. Epidemiology, 34:791-800.

Hornby, R. J., Pearce, P. C., Bowditch, A. P., Scott, L., and Griffiths, G. D., (2006) Multiple vaccine and pyridostigmine bromide interactions in the common marmoset (Callithrix jacchus): Immunological and endocrinological effects, International Immunopharmacology, Volume 6, Issue 12, 5 December 2006, Pages 1765-1779.

Jones, E., (2006) Historical approaches to post-combat disorders, Philosophical Transaction of The Royal Society, 361, 533-542.

King's College London, University of London, King's Centre for Military Health Reseearch: A Ten Year Report, What has been achieved by a decade of research into the health of the UK Armed Forces, September 2006.

Lawlor, D. A., Day, I. N. M., Gaunt, T. R., Hinks, L. J., Timpson, N., Ebrahim, S., and Smith, G. D., (2007) The association of the paraoxonase (PON1) Q192R polymorphism with depression in older women: findings from the British Women's Heart and Health Study, Journal of Epidemiology and Community Health, 61:85-87.

Li, B., Sedlacek, M., Manoharan, I., Boopathy, R., Duysen, E. G., Masson, P., Lockridge, O., (2005) Buyrylcholinesterase, paraoxonase, and albumin esterase, but not carboxylesterase, are present in human plasma, Biochem. Pharmacol., 70:1673-1684.

The Rt. Hon. Lord Lloyd of Berwick, The Lloyd Inquiry: Independent Public Inquiry on Gulf War Illnesses, 2004.

The Rt. Hon. Lord Lloyd of Berwick, The Lloyd Inquiry: Independent Public Inquiry on Gulf War Illnesses, 2004, Oral Evidence, Professor Banatvala and Professor Donald Davies.

Macfarlane, G. J., Thomas, E., Cherry, N., (2000) Morality among UK Gulf War veterans, Lancet, 356:17-21.

Maconochie, N., Doyle, P., Davies, G., Lewis, S., Pelerin, M., Prior, S., Sampson, P., (2003) 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, 3:4.

Maconochie, N., Doyle, P., Carson, C., (2004) Infertility among male UK veterans of the 1991-1 Gulf war: reproductive cohort study. BMJ.

Medical Research Council (MRC) Review of research into UK Gulf veterans' illnesses, MRC, 2003.

Ministry of Defence, Background to the Use of Medical Countermeasures to Protect British Forces during the Gulf War (Operation GRANBY), October 1997.

Ministry of Defence, Correspondence to The Royal British Legion, 30 January 2006.

Ministry of Defence, Gulf Health: Information Guide for Health Professionals, February 2005.

Ministry of Defence (DOD), Review of Modelling of the Demolitions at Khamisiyah in March 1991 and Implications for UK Personnel, January 2005.

Research Advisory Committee on Gulf War Veterans' Illnesses (RACGWI), Scientific Progress in Understanding Gulf War Veterans' Illnesses: Report and Recommendations, September 2004.

Rijpkema, S. G., Adams, T., Rigsby, P., Xing, D. K., Corbel, M. J., (2005), Investigation in a Model System of the Effects of Combinations of Anthrax and Pertussis Vaccines Administered to Service Personnel in the 1991 Gulf War, Human Vaccines, 1:165-169.

The Royal Society, Press Release 24 March 2006, No single cause for Gulf War Illness – rehabilitation not research is needed.

Service Personnel & Veterans Agency (SPVA), Gulf War Statistics, Monthly Update, 23 April 2007.

Sharief, M., Pridden, J., Delamont, R., Rose, M., Unwin, C., Hull, L., David, A., Wessely, S., (2002) Neurophysiologic evaluation of neuromuscular symptoms in UK Gulf War veterans. A controlled study. Neurology, 59:1518-1525.

Simmons, R., Maconochie, N. and Doyle, P., (2004) Self-reported ill health in male UK gulf War veterans: a retrospective cohort study, BMC Public Health 2004, 4:27.

Soames, N., Secretary of State for Defence, Member of Parliament, Ministry of Defence, Written Answers, 26 February 1997, Column: 254

Squibb, K. S., and McDiarmid, M. A., (2006) Depleted uranium exposure and health effects in Gulf War veterans, Philosophical Transactions of The Royal Society, 361, 639-648.

Steele, L., (2000) Prevalence and Patterns of Gulf War Illness in Kansas Veterans: Association of Symptoms with Characteristics of Person, Place, and Time of Military Service, American Journal of Epidemiology Vol. 152, No. 10: 992-1002.

Twigg, D., The Parliamentary Under-Secretary of State for Defence, Ministry of Defence, 1990-91 Gulf Veterans' Illness – Research, 19 October 2006.

Twigg, D., The Parliamentary Under-Secretary of State for Defence, Ministry of Defence, Final Report from The Depleted Uranium Oversight Board, 26 March 2007.

Tyler, P., Member of Parliament, House of Commons, 5 February 2003: Column 74WH.

US General Accounting Office (GAO), Report to Congressional Requesters, Gulf War Illnesses – DOD's Conclusions about US Troops' Exposure Cannot Be Adequately Supported, GAO-04-159, June 2004.

Wang, D., Perides, G., Liu, Y. F., (2005), Vaccination alone or in combination with pyridostigmine promotes and prolongs activation of stress-activated kinases induced by stress in the mouse brain. J. Neurochem, 93:1010-1020, DoD-139.

Weisskopf, M. G., O'Reilly, E. J., McCullough, M. L., Cale, E. E., Thun, M. J., Cudkowicz, M., Ascherio, A., (2005), Prospective study of military service and mortality from ALS, Neurology, 64:32-37.

Wessely, S., and Freedman, L., (2006), Reflections on Gulf War illness, Philosophical Transaction of the Royal Society, 361, 721-730.

Wicklund, M. P., (2005), Amyotrophic lateral sclerosis: possible role of environmental influences. Neurol. Clin. 23:461-484.

"A debt of honour is long overdue to Gulf War veterans. Indeed, a government who send soldiers to war have a duty of care towards them. It was not exercised in the first Gulf War conflict. That was compounded by the fact that the UK government have refused since then to take real measures to help those veterans." (Ewing, 2003)

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