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Why Do UK Military Personnel Refuse the Anthrax Vaccination?

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The purpose of this study was to understand the reasons why some UK military personnel refused the anthrax vaccination. Data were collected from 5,302 members of the UK Armed Forces who had been deployed to Iraq since 2003 and had been offered the anthrax vaccination. As part of a larger questionnaire, information was collected on acceptance or refusal of the vaccination. Twenty-eight percent of participants refused the anthrax vaccination; of these 51% indicated that they refused vaccination because of concern that it was being offered voluntarily. Reasons differed between those deployed during the war-fighting phase in Iraq, who were concerned about being supplied with insufficient or unclear information (75% vs. 66%), and those involved on subsequent deployments, who felt that there was no longer a risk that biological weapons would be used against them (61% vs. 43%). Thus, refusal rates were related to perception of the threat. In addition, our results indicated the importance of providing individuals with relevant information to aid them in making decisions to receive the anthrax vaccination or not. The findings provide evidence that for some people, the policy to increase confidence in the anthrax vaccination program may have led to a decrease in levels of trust.

During preparations for the 2003 invasion of Iraq, the UK Armed Forces regarded the threat from chemical and biological weapons as serious, so achieving broad protective coverage against the threat of anthrax was a priority for the UK Armed Forces.

In the aftermath of the 1991 Gulf War, reports of ill health among service personnel who had taken part in the conflict began to emerge on both sides of the Atlantic. Soon veterans' accounts and media stories focused on the anthrax vaccination as a possible source of ill health. Systematic research on the health of Gulf War veterans found modest associations between receipt of the anthrax vaccination and reporting of physical symptoms.[1,2] However, associations have not been replicated in other cohorts of UK, U.S., and Canadian service personnel that were not limited to Gulf war veterans.[3-6]

In the preparation for the 2003 Iraq war, the UK Armed Forces took the decision to immunize its troops against attack from weapons-grade anthrax. Although anthrax vaccination had previously been voluntary and given under implied consent, from 2002 onwards it was further supported by a program of video and written information, known as the Voluntary Immunisation Programme (VIP). After receiving this information, personnel were given a "cooling off" period before being offered the vaccination, after which they were asked to sign a consent form. The aim of this program was to restore confidence in the anthrax vaccination and ensure a high level of coverage.

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The information provided as part of the VIP program made clear to service personnel the dangers of anthrax when it is used as a biological weapon. It described the threat posed by biological weapons as very real and said that the vaccination was safe and free from serious side effects. Service personnel were told that minor side effects, such as a sore arm or flulike symptoms, were common but not serious. Also, the information stated that the vaccination was different from the one administered to American troops. The information strongly advised service personnel to receive the vaccination but made clear that if they refused the vaccination they would not face any disciplinary actions.

In an earlier article, we explored the concerns that UK service personnel had about the anthrax vaccination.[7] Common concerns were related to the anthrax vaccination's being associated with the ill health observed in Gulf War veterans, problems related to fertility, and the possibility that the vaccination would not adequately protect against biological anthrax weapons. These issues were not addressed by the information provided to service personnel.

The principal concern was a lack of trust. Service personnel distrusted the new policy and, in particular, the fact that the anthrax vaccination was administered differently from other routine vaccinations, with a specific information consent procedure. The vaccination policy of the UK Armed Forces is to ensure high coverage of all vaccinations offered to provide protection against diseases for service personnel while they are on deployment. All vaccinations are offered voluntarily. The majority of vaccinations (including tetanus, typhoid, and hepatitis A) are offered routinely each year, with boosters where appropriate. The anthrax vaccination was treated differently, as it was only offered to those personnel who were about to deploy to areas deemed to be at risk. This may have increased anxiety about the vaccination, a situation reported by the media.[8,9]

We recently published evidence to show that there has not been an adverse health effect among UK service personnel who received the anthrax vaccination before their deployments to Iraq since 2003.[10] However, in the build-up to the 2003 Iraq war, the legacy of the ill health observed in Gulf War veterans and the vaccination being implicated may have led many to be suspicious of the health consequences of the vaccination.

When a policy decision is taken to launch any vaccination program, it is always desirable that uptake is as high as possible, and so understanding reasons for refusal will always be useful information for policymakers. Although anthrax protection has largely been an issue for specific occupational groups (eg, armed forces, tanners of leather and hides), the 2001 anthrax attacks in the U.S. showed that there are circumstances in which more widespread population protection against anthrax or other biological weapons might become necessary. Indeed, evidence suggests that offering the anthrax vaccination prior to an attack may be cost-effective within certain populations.[11]

We have previously reported data to suggest that individuals can reliably recall whether they received the anthrax vaccination,[10] a finding that has been replicated in the U.S.[12] Therefore, we were confident that individuals would be able to recall accurately whether they chose to receive the anthrax vaccination or not. In the same article, we identified sociodemographic variables associated with refusal to receive the anthrax vaccination. These included not being in the Army, being of lower rank, being male, being younger, or having a regular full-time enlistment status.

In this article we report on the reasons UK military personnel deployed to Iraq gave for refusing the anthrax vaccination. We compared the reasons for refusing the anthrax vaccination given by personnel deployed to the 2003 Iraq war with those given by military personnel involved in subsequent deployments to Iraq.

METHOD

The current study was the first phase of a cohort study of UK Armed Forces personnel in service at the time of the Iraq war. Data were collected through detailed questionnaires completed by individuals between June 2004 and March 2006. The sampling frame was a random sample of those who deployed to Iraq during the initial war-fighting phase of the Iraq conflict (named Telic 1 by the UK Armed Forces) and an equivalent number of those who did not deploy to Iraq at that time; these groups were named Telic and Era, respectively. The sample was weighted 2:1 to oversample reservists in both groups. In practice many of the groups who were not deployed to the war-fighting phase may later have been deployed to Iraq during subsequent operations (named Telic 2, Telic 3, etc). Full details of the sampling methods, participants, and measures used are reported in an earlier article.[13]

A total of 10,272 individuals (61%) returned completed questionnaires. We approached those in the sample at least 3 times to elicit completed questionnaires. Questionnaires were collected via a postal survey, visits to more than 50 military bases, and further tracing and telephone contacts. Individuals were advised that their participation was voluntary and that their answers were confidential. In a previous publication, we presented data showing that nonresponse was largely due to our difficulty in contacting individuals, with no significant differences between responders and nonresponders in terms of health and rates of medical "downgrading" (a measure of medical employment status used by UK military health professionals).[13,14]

Questionnaire

The questionnaire contained a section related to participants' last major deployment in which we asked a number of questions about the anthrax vaccination, including ques-

tions about whether participants had been offered the vaccination and whether they had accepted it. If they had not accepted the vaccination, they were asked to choose from a list of 9 possible reasons for not doing so. Participants were asked to rate the amount of influence that the different reasons may have had on their decision to refuse the anthrax vaccination.

The list of possible reasons for refusing the vaccination was generated following extensive pilot work interviewing service personnel about their experiences with the anthrax vaccination. In addition to the list of options for refusing, there was an "other reasons" option, where personnel could describe their reasons for refusing the vaccination. Of those who responded, 364 individuals filled out other reasons. However, when these "other reasons for refusing the vaccination" were analyzed, it was found that the majority (86%) could be amalgamated with the other specified options. The remaining 14% were mainly responses like "do not like needles."

We also asked for permission to access vaccination records.

Analysis

For the purposes of this article, we have restricted our analyses to participants who had deployed on any Telic operation to Iraq and who had therefore been offered the anthrax vaccination as part of their preparations. We report the overall refusal rates for the anthrax vaccination and how frequently participants endorsed the different reasons for vaccination refusal as having had an influence on their decisions. This was repeated, stratifying between whether participants had deployed on Telic 1 or had deployed on later Telic operations to Iraq (on Telic 2 or later). This was done because the threat level changed dramatically between Telic 1 and later Telic operations.

Logistic regression models were fitted to identify differences in reasons given for refusal between participants who had deployed on Telic 1 and those who had deployed on later Telic operations. Analyses were weighted to take into account sampling fractions and were adjusted for service (Naval Services, Army, and RAF), rank (whether an officer or not), gender, age, medical fitness, enlistment status (regular or reserve), and number of days that had passed between individuals' completing their last deployment and completing their questionnaire. All analyses were conducted using STATA 9 (Stata Corp, College Station, TX, USA).

The study received approval from the Ministry of Defence personnel research ethics committee MOD(N)PREC (ref 11-03-219) and King's College Hospital's local research ethics committee LREC (ref 150/034).

RESULTS

A total of 10,272 participants provided responses to the questionnaire: 62.3% were from the Telic group (who deployed on Telic 1), and 56.3% were from the Era group (who did not deploy on Telic 1 but may have deployed on later Telic operations). In total 5,302 individuals had deployed to Iraq since 2003 and reported having been offered the anthrax vaccination as part of their preparation. These included 4,358 who had deployed on Telic 1 and 944 on later Telic operations. These 5,302 are therefore the sample for this article. Of these, 13% were in the naval services (including the Royal Marines), 68% in the Army, and 19% in the Royal Air Force (RAF); 91% of the sample was male, 17% were commissioned officers, and 12% had a reserve enlistment status. The median age was 32.2 years (interquartile range 26.4-38.2).

Of those who were offered the anthrax vaccine, 1,481 (28%) participants chose not to receive it. The factors they reported as influencing their decisions to refuse the vaccination are described in Table 1. The most commonly cited

Table 1. Rate of Anthrax Vaccination Refusal and Factors Influencing Reasons for Refusal

Factors Influencing Refusal	*n/N*	*%*[a]
Refused the anthrax vaccination	1,481/5,302	28
Reasons for refusal	N = 1,352	
Insufficient/unclear information about vaccine	959	72
Concern that it was voluntary	688	51
Concern about side effects	1,184	88
Did not think NBC/CBW attack was risk	684	50
Influence of partner/family	195	15
Influence of colleagues	366	27
Influence from chain of command	171	13
Adverse publicity	688	51
Previous bad experience with vaccine	122	9

[a]Percentages adjusted to take account of sampling fractions.

reasons for refusing were: concern about side effects (88%), concern about being supplied with insufficient of unclear information about the vaccination (72%), concern that the vaccination was voluntary (51%), adverse publicity (51%), and not thinking that a nuclear, biological, or chemical attack or a chemical or biological weapon was a risk (50%).

Because of the change in threat level associated with a possible anthrax attack, we repeated the analyses, stratifying by whether participants had deployed during Telic 1 (the initial invasion) or later Telic operations. Table 2 describes differences in the reasons given for refusing the anthrax vaccination between personnel deployed on Telic 1 and those deployed on Telic 2 or later. Individuals deployed on Telic 2 or later were more likely to refuse the anthrax vaccination (59% vs. 22%). Significant differences were present in the pattern of reasons given for refusing the vaccination. Participants deployed on Telic 1 were more likely to have concerns about the vaccination being offered voluntarily and concerns about side effects. When analyses were unadjusted, concern about being supplied with insufficient information when choosing to receive the vaccination or not and concerns about adverse publicity were cited as reasons for refusal of the anthrax vaccination. These 2 reasons became marginally insignificant after adjustment. The overwhelming reason for refusing the anthrax vaccination for personnel deployed on Telic 2 or later was that they felt there was no longer a risk of a nuclear, biological, or chemical attack or a chemical or biological weapon being used against them.

Discussion

Refusal rates of the anthrax vaccination by UK military personnel deployed to Iraq were higher than those observed when the vaccination was offered during the 1991 Gulf War. More than a quarter of service personnel chose not to receive the vaccination. The reasons for refusal of the vaccination were different between those personnel who deployed during the war-fighting phase of the Iraq conflict and those who deployed on later operations. Those who deployed during Telic 1 primarily gave reasons related to the administration of the anthrax vaccination and were worried about the 1991 Gulf War legacy that was perceived as linking the vaccination to health problems observed in some veterans from that conflict.[1,2]

A different picture emerged for personnel who had deployed on later operations to Iraq. It quickly became apparent that the threat of attack from biological weapons had been overestimated. This was reflected in our findings: we observed that personnel no longer felt that an attack from such weapons was a threat and chose to refuse the anthrax vaccination for this reason. This was also reflected in our finding that rates of refusal almost tripled from 22% to 59% between Telic 1 and later operations to Iraq.

The decision to single out the anthrax vaccination by offering it within a program to promote informed choice was aimed at improving confidence in the vaccination program and addressing its legacy following the 1991 Gulf War. The change in policy from administering the anthrax vaccination largely with implied consent to offering it on a voluntary basis within a framework of informed choice reflected similar changes that have occurred in public health. The medical profession is under increasing obligation to provide informed choice to patients when offering medical interventions.[15] The results reported here provide evidence that, for some individuals, the policy that emphasized voluntariness may have paradoxically led to refusal to accept the vaccination.

Table 2. Rates of Anthrax Vaccination Refusal between Telic 1 and Later Telic Operations and Comparison of Reasons

	Telic 1		*Telic 2 or Later*		*Unadjusted Odds Ratio*		*Adjusted Odds Ratio*[b]	
	n/N	*%*[a]	*n/N*	*%*[a]	*OR*	*95% CI*	*OR*	*95% CI*
Refused the anthrax vaccination	927/4,358	22	544/944	59	4.98	4.29-5.80	5.52	4.51-6.76
Reasons for refusal[c]	*N* = 784		*N* = 568					
Insufficient/unclear information about vaccine	589	75	370	66	0.64	0.51-0.82	0.77	0.55-1.06
Concern that it was voluntary	418	54	270	48	0.79	0.63-0.98	0.73	0.54-0.99
Concern about side effects	700	89	484	85	0.69	0.50-0.97	0.50	0.35-0.76
Did not think NBC/CBW attack was risk	334	43	350	61	2.12	1.70-2.66	2.74	1.99-3.78
Influence of partner/family	115	15	80	14	0.94	0.69-1.28	1.11	0.73-1.68
Influence of colleagues	204	26	162	29	1.12	0.87-1.43	1.15	0.81-1.63
Influence from chain of command	96	12	75	14	1.10	0.85-1.42	1.24	0.85-1.79
Adverse publicity	426	54	262	46	0.73	0.58-0.91	0.86	0.64-1.16
Previous bad experience with vaccine	75	10	47	9	0.89	0.60-1.30	0.97	0.56-1.66

[a]Percentages adjusted to take account of sampling fractions.
[b]Adjusted for age, sex, service, rank, fitness, regular/reservist status, and time passed between deployment and completing questionnaire.
[c]An odds ratio below 1 indicates that the reason given was more frequently endorsed by Telic 1 personnel than by Telic 2 or later personnel. An odds ratio over 1 indicates the opposite.

Data were collected with a median of 19 months (interquartile range 15-23 months) after participants had made their decision to refuse the anthrax vaccination. We cannot rule out the possibility that some respondents forgot the reasons they refused the vaccine, but we adjusted in the analysis for duration in time from deployment to completion of the questionnaire, which might have confounded associations between reason for refusal and timing of deployment. We do not think that this is a major consideration. Previous work has suggested that reporting of deployment-related exposures (including vaccines) may change over time, but the extent of changes in reporting over time are smaller than those seen here.[16]

One limitation of the study is that we did not collect data about further Telic deployments from personnel deployed on Telic 1. These data would have shown us if personnel changed their minds about the vaccination between deployments. However, the number of service personnel deployed more than once over the studied period would be small for helpful analysis because of the deployment policies followed by the majority of the Armed Forces, which recommends an 18-month period of nondeployment following deployment.

Our data show net changes over time in a representative sample of the British Armed Forces. In addition, while the majority of the options personnel were given for refusing the vaccination were unambiguous statements, some may not have been. For example, "concern that it was voluntary" could be interpreted to have more than one meaning. During pilot interviews the emphasis placed on the vaccine being voluntary was a commonly cited reason for refusing or feeling anxious about the vaccination. We have previously shown that the principal concern that service personnel held about the anthrax vaccination was a lack of trust in the vaccination program.[7] We suggest that this concern about the vaccination being voluntary reflected a general lack of trust.

The study benefited from a large, randomly selected sample, including participants from all three services. Participants were offered the anthrax vaccination under identical consent procedures and over a period of time when the threat level posed by biological attack shifted from high to low. Because we were able in a previous publication to ascertain that recall of the anthrax vaccination is reliable,[10] we are confident that participants could accurately recall whether they had received the vaccination or not.

Implications

We now know that there was no serious threat from biological attack to troops in Iraq. However, prior to the invasion of Iraq, the UK Armed Forces rated the threat as high, so it was decided to immunize service personnel with the anthrax vaccine. An anthrax attack is likely to cause a high fatality rate, so ensuring high vaccination coverage was a priority.[17-20]

The anthrax vaccination was administered differently from other routine vaccinations. It was offered within a program aimed at supporting personnel in making informed choices about whether to accept the vaccination. During the initial fighting phase of the Iraq war, the reasons personnel gave for refusing to receive the anthrax vaccination could be attributed partly to the historical context of the vaccination following the 1991 Gulf War and partly to faults with the program. In particular, people criticized the lack of relevant information they were provided when making their choices. A similar finding was observed in U.S. troops; the authors recommended enhanced training and education to increase understanding about the anthrax vaccination.[21] Providing individuals with correct information was vital—hence the VIP program. However, the provision of such information may have come at a cost, singling out the vaccine as "special" and thereby reducing uptake. But we do not know the risk/benefit ratio of the VIP program, as some personnel might not have accepted the vaccine without the additional information provided in the program.

This is an area that could be improved for future vaccination programs. The content of this information should not only address the scientific data concerning safety, efficacy, and side effects, but it also should address other concerns individuals may have, including the legacy of the 1991 Gulf War where the anthrax vaccination was linked in the media to a range of health and fertility problems. It could be of value, before beginning an anthrax vaccination program, to canvas opinions via focus groups to identify the concerns of the target population and then tailor information to address these directly.

Factors beyond the control of policymakers include the perceived level of threat. We found that refusal rates almost tripled after Telic 1, which corresponds with a reduction in the threat level posed by biological attack. This finding indicates that unless an anthrax attack is perceived as likely, then the acceptability of the vaccination will be low. The evidence reviewed in this article supports the policy decision by the UK Ministry of Defence to change how the anthrax vaccination is offered to troops: the anthrax vaccination is now not offered through a separate program but is being offered in the same way as other routine vaccinations.

Conclusions

The historical context of the anthrax vaccination proved problematic for the UK Armed Forces when offering the vaccination to its personnel, an experience shared by other armed forces around the world.[8,9] The introduction of a

voluntary vaccination program may have resulted in decreased trust on the part of many UK service personnel. The policy may have led to increases in the number of individuals who chose not to receive the anthrax vaccination during preparations for the 2003 Iraq war. Following the initial phase of the operation, the proportion of personnel refusing the anthrax vaccination increased dramatically, suggesting that when the perceived level of threat posed by a biological attack is low, the acceptability of a program of medical countermeasures to protect against the consequences of an attack will also be low.

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REFERENCES

1. Unwin C, Blatchley N, Coker W, et al. Health of UK servicemen who served in Persian Gulf War. *Lancet* 1999; 353(9148):169-178.
2. Wolfe J, Proctor SP, Erickson DJ, Hu H. Risk factors for multisymptom illness in US Army veterans of the Gulf War. *J Occup Environ Med* 2002;44(3):271-281.
3. Hunter D, Zoutman D, Whitehead J, Hutchings J, MacDonald K. Health effects of anthrax vaccination in the Canadian forces. *Mil Med* 2004;169(10):833-838.
4. Lange JL, Lesikar SE, Rubertone MV, Brundage JF. Comprehensive systematic surveillance for adverse effects of anthrax vaccine adsorbed, US Armed Forces, 1998-2000. *Vaccine* 2003;21(15):1620-1628.
5. Sato PA, Reed RJ, Smith TC, Wang L. Monitoring anthrax vaccine safety in US military service members on active duty: surveillance of 1998 hospitalizations in temporal association with anthrax immunization. *Vaccine* 2002;20(17-18):2369-2374.
6. Enstone JE, Wale MC, Nguyen-Van-Tam JS, Pearson JC. Adverse medical events in British service personnel following anthrax vaccination. *Vaccine* 2003;21(13-14):1348-1354.
7. Murphy D, Dandeker C, Horn O, et al. UK armed forces responses to an informed consent policy for anthrax vaccination: a paradoxical effect? *Vaccine* 2006;24(16):3109-3114.
8. BBC News. Australian troops scared by vaccine. February 14, 2003. http://news.bbc.co.uk/1/hi/world/asia-pacific/2760253.stm. Accessed July 17, 2008.
9. BBC News. Troops' fears over anthrax vaccine. January 8, 2003. http://news.bbc.co.uk/1/hi/health/2638125.stm. Accessed July 17, 2008.
10. Murphy D, Hull L, Horn O, et al. Anthrax vaccination in a military population before the war in Iraq: side effects and informed choice. *Vaccine* 2007;25(44):7641-7648.
11. Hopkins RJ, Waytes TA, Zink TK. Preattack vaccination against anthrax may be cost-effective in certain populations. *Arch Intern Med* 2008;168(1):114-115.
12. Smith B, Leard CA, Smith TC, Reed RJ, Ryan MA, Millennium Cohort Study Team. Anthrax vaccination in the Millennium Cohort: validation and measures of health. *Am J Prev Med* 2007;32(4):347-353.
13. Hotopf M, Hull L, Fear NT, et al. The health of UK military personnel who deployed to the 2003 Iraq war: a cohort study. *Lancet* 2006;367(9524):1731-1741.
14. Tate AR, Jones M, Hull L, et al. How many mailouts: could attempts to increase the response rate in the Iraq war cohort study be counter-productive? *BMC Med Res Methodol* 2007;7:51.
15. Gray JA. Postmodern medicine. *Lancet* 1999;354(9189): 1550-1553.
16. Wessely S, Unwin C, Hotopf M, et al. Stability of recall of military hazards over time: evidence from the Persian Gulf War of 1991. *Br J Psychiatry* 2003;183(4):314-322.
17. Holty JE, Bravata DM, Liu H, Olshen RA, McDonald KM, Owens DK. Systematic review: a century of inhalational anthrax cases from 1900 to 2005. *Ann Intern Med* 2006; 144(4):270-280.
18. Jernigan JA, Stephens DS, Ashford DA, et al. Bioterrorism-related inhalational anthrax: the first 10 cases reported in the United States. *Emerg Infect Dis* 2001;7(6):933-944.
19. Plotkin SA, Brachman PS, Utell M, Bumford FH, Atchison MM. An epidemic of inhalation anthrax, the first in the twentieth century. I. Clinical features. *Am J Med* 1960; 29:992-1001.
20. Brachman PS, Plotkin SA, Bumford FH, Atchison MM. An epidemic of inhalation anthrax: the first in the twentieth century. II. Epidemiology. *Am J Hyg* 1960;72:6-23.
21. Pica-Branco D, Hudak RP. U.S. military service members perceptions of the anthrax vaccine immunization program. *Mil Med* 2008;173:429-433.

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