Assessing Exposures in the United Kingdom's Armed Forces - A Review of Systems that Collect Data Useful for Exposure Assessment

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ABSTRACT

The ability to assess the exposure of individuals or groups is a critical element in any effective health surveillance system, as it provides the opportunity to identify the causes of ill health, the levels of exposure resulting in ill health and, through controlling exposures, to protect the health of Service personnel. As part of a wider programme to enhance the health surveillance capabilities of the Defence Medical Services, a project was undertaken to assess the collection and retention of data for exposure assessment in the United Kingdom's Armed Forces. The systems investigated include those for health, safety and environment policy, personnel and pay, medical records, environmental and occupational monitoring and historical records. It was found that the use of many systems for exposure assessment would be hampered by inconsistencies in the data collected, poor accessibility and linkage, and variability in the retention of the data. This paper highlights some of the problems that limit the usefulness of the record systems for exposure assessment and summarizes the principal recommendations made for enhancing the systems to better facilitate health surveillance.

Keywords: Exposure data, exposure assessment, health surveillance, epidemiology, occupational health, Ministry of Defence.

Introduction

Health surveillance is a critical element of any comprehensive military health care system and should facilitate "...the routine systematic collection, analysis, interpretation and reporting of standardised, population based data for the purpose of characterising and countering threats to the military population's health." (1). The ability to identify, define and assess the exposure of individuals or populations to health hazards is a central element to such a health surveillance system. This is essential in order to be able to identify the causes of ill health, the levels of exposure resulting in ill health and to protect the health of Service personnel, through controlling exposures and evaluating control strategies.

Exposure is defined as a contact over time and space between a person and one or more biological, chemical or physical agents (2); to this we would also add psychological agents. Assessing exposures not only requires data to characterise the exposure of concern, but also data to identify the population of interest, to link the population with the exposure of concern (e.g. by using job title, location or deployment data), and to link to any potential health outcome. These data need to be of adequate quality and type, sufficiently accessible and retained for long enough that, ideally, any potential health outcome, with any latency period, can be investigated with respect to the exposures of concern (3). Indeed a lack of exposure data is frequently cited as the principal limiting factor in establishing exposure-response relationships in studies of occupational health (4) and, consequently, in establishing causality.

As part of a wider project to enhance the health surveillance capability of the Defence Medical Services, a project was commissioned, by the Health Surveillance Steering Group of the Surgeon General's Department, to objectively assess systems in the United Kingdom's (UK) Armed Forces for the collection and retention of exposure data. The main objectives of the study were to:

- determine current practice for both the collection and retention of exposure data and consider how these may be improved;
- identify the linkages and overlaps with health data and information collected in other systems within the Armed Forces;
- consider the design and complexity of research for which exposure data might be required; and
- provide recommendations for the format, collection and retention of exposure data.

This paper summarizes the principal findings and recommendations of the study (5).

Methodology

In order to assess systems for collecting exposure data, a series of visits to Ministry of Defence (MOD) Units, with potential involvement in the collection and retention of exposure data, and some selected examples from civilian industry, were made to:

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- establish what systems (procedures, record and computer systems) are used that collect exposure information;
- gain a detailed understanding of each system; and
- evaluate each system for the purpose of exposure assessment.

The MOD Units visited were identified by a variety of means based on knowledge of the data necessary for exposure assessment, consultation with staff of the Defence Evaluation and Research Agency (DERA), recommendations made by Units visited and the Internet. Civilian industries were selected on the basis of comparability to the Armed Forces and through professional contacts (information derived from these visits are not discussed here).

Before visiting a Unit or industry a summary, outlining the project's aims and objectives, was sent together with a letter explaining the purpose of the visit. During each visit a semi-structured interview was conducted with key staff to gain an understanding of each system that collected exposure information. A standard interview checklist was developed and used in all the

interviews to minimise interviewer bias, facilitate consistency and comparability between interviews and to ensure important issues were not omitted. After each visit, a draft visit report was sent back to each Unit or industry, in order that the report's accuracy could be checked and commented upon. Most Units and industries returned these draft visit reports and any comments received were taken into account. Where no reply was received, it was assumed that the interpretation in the draft was correct.

The visit reports were used as the basis to qualitatively assess each of the systems that intentionally or incidentally collect data relevant to exposure assessment. The systems were assessed according to the type of data collected, the accessibility of the data, linkage of data to health or other records and the retention and archiving of data for future use. Based on the assessment of each system, recommendations were developed as to how the collection and retention of exposure data in the UK Armed Forces could be enhanced.

In total 33 visits were made between May 1999 and October 2000. Table 1 lists the Units and industries visited, sub-divided into seven categories.

Table 1. Ministry of Defence Units and civilian industries visited

Ministry of Defence Unit / Civilian Industry

Health, safety and environment policy

Directorate of Safety, Environment and Fire Policy
Chief Environment and Safety Officers (Army and Royal Air Force (RAF))
Army Medical Directorate, Medical Intelligence
Directorate of Defence Logistics Safety

Personnel and pay administration systems

Armed Forces Personnel Administration Agencies (Army - Worthy Down; Royal Navy - Centurion; RAF - Innsworth)
Unit Computing System (Army)

Medical Records

Surgeon General's Department
Army Medical Directorate
Director of Health, HM Naval Base Portsmouth
Directorate of Primary Health Care, RAF Innsworth

Occupational exposure and environmental monitoring data

Defence Evaluation and Research Agency Radiological Protection Service
Medical Operational Planning
Defence Logistics Organisation Equipment Support (Land), Hazardous Materials
Army Environmental Monitoring Team, Keogh Barracks
Army Environmental Health Team, Imphal Barracks, York
Occupational Health Centre, HM Naval Base Portsmouth
Institute of Naval Medicine
Flag Office Surface Flotilla Health and Safety Team, HM Naval Base Portsmouth
RAF Institute of Health

Historical records

Army, Naval and Air Historical Branches

Users of Armed Services information systems

War Pensions Agency
Gulf Veterans' Illness Unit
Defence Analytical Services Agency (two visits)

Examples of occupational health and exposure data systems in civilian industry

Rolls-Royce
Imperial Chemical Industries
Westlakes Scientific Consulting Ltd
Health and Safety Executive (National Exposure Database)

Results

Every attempt has been made to ensure that the data represented here are as correct and complete as possible. Due to the time available for the project it was only possible to make a limited number of visits, and hence not all systems that collect relevant data may be represented here. Furthermore, during the project it was clear that some systems were due to be changed or were undergoing change - the following results pertain to the systems at the time of our visits.

Health, safety and environment policy

There is limited direct collection of exposure data amongst these Units. However, the visits provided an understanding of how Safety, Health, Environment and Fire (SHEF) policy is interpreted and implemented and the influences on exposure data collection policy in the Armed Forces. The primary influences on the collection or exposure data in the Armed Forces are:

- protection of the health of Service personnel and enhancement of business efficiency, in order to maximise the number of individuals operationally fit; and
- legislative requirements for health and safety, which may involve collection of exposure data to demonstrate compliance with regulatory limits or procedures.

Other influences can include such issues as ensuring fair and appropriate compensation.

The source of all policy underpinning the collection of exposure data in the area of SHEF is the Directorate of Safety, Environment and Fire Policy. Once policy is agreed it is written into a Joint Service publication (JSP), for example JSP 375, the MOD Health and Safety Handbook, and applies equally in the UK and overseas. The implementation of the policy within the MOD is the responsibility of the Top Level Budget holders. In each Service the responsibility is delegated to each Service Chief Environment and Safety Officer, and each Service implements the policy according to their own arrangements. For example, the Royal Air Force (RAF) and Royal Navy (RN) interpret the requirements of JSP 375 into Service specific publications i.e. Air Publication 400 and Book of Reference 9147 respectively, whereas the Army use JSP 375 directly. This can lead to variations in the implementation of the policy between the Services, and hence inconsistencies in the collection of some exposure data. An example of this occurs in the accident reporting between Services: the RAF have a single accident reporting form on which all accidents, regardless of severity, are reported, whereas the Army currently has 24 ways in which accidents can be reported and choose only to report accidents resulting

in one or more hours off duty. The variations in interpretation and implementation of policy also lead to variations between the Services in the retention and archiving of records that may contain useful exposure data. There is, however, increasing emphasis on standardisation of policy and practice and, at the time of our visits, JSP 375 was being revised, which may lead to changes in the organisation and implementation of policy across the Services.

Personnel and pay administration systems

The Armed Forces Personnel and Administration Agencies (AFPAAAs) collect a large amount of data relevant to exposure assessment, including information necessary to identify individuals and enumerate a cohort, job task and job history data, and movement and location data, all of which may be used as surrogates for exposure in health surveillance and epidemiology.

Identifier information collected by the AFPAAAs include the Service number, which is a unique identification number issued to every member of the Services. The structure of this number differs between the Services, and between officers and ranks. The number may also change during an individual's career, should they be commissioned as an officer. This is most pronounced in the Army and RN where, on commissioning, a completely new Service number is issued, whereas in the RAF the number only changes slightly by the proximal character moving to become the terminal character. National Health Service (NHS) numbers, which could also be used as a unique identifier, or to link exposure records to civilian health records, are inconsistently recorded between and within the Services. For example, in the Army and RAF only NHS numbers for officers are held on the mainframe computer; for ranks they are only recorded in their paper personnel records.

The job task and job history information collected is largely in the form of a list of postings, training records and in some cases job titles (particularly in the RAF and RN), which define approximately the tasks an individual may have been expected to perform. However, a job title or training may not necessarily reflect the actual tasks an individual carried out, since this is ultimately at the discretion of the Commanding Officer of the Unit.

The AFPAA systems also collect some movement and location data. For all Service personnel, their postings are recorded, although, in practice, this may not correlate to their actual geographical location, and a posting may span a period of several years. More detailed movement and location data may be recorded at a Unit level, but this may not be included in the main AFPAA systems. An exception to this is the RN, for whom

Table 2. Archiving of personnel and pay data in the UK Armed Forces

Service	Records	Archiving of records
Army	Personnel and pay files	Computer records retained. Paper personnel file retained until no Reserve value, then archived.
Royal Air Force	Personnel and pay files	<i>Officers:</i> Computer records archived. Paper personnel files retained indefinitely. <i>Airmen/Airwomen:</i> Computer records archived. Paper personnel records retained for seven years after last entry, and then destroyed. An A3 Summary sheet for each individual is retained indefinitely.
Royal Navy	Personnel files	Computer files printed out and both computer and paper file archived
	Pay Files	Data progressively weeded until 10 years post discharge, when record archived.

location determines pay allowances. Hence, when an individual changes location, for example, from sea to shore, a Movement Occurrence Report (MOR) is made, which notifies the Pay system of the change of location and alters the individual's pay allowances accordingly. These MORs are stored as part of the individual's Pay file.

The retention and archiving of the pay and personnel records is variable between the Services and between officers and ranks and is summarised in Table 2.

Medical records

Collection of data relevant for exposure assessment in medical records is limited, not surprisingly, because their primary function is to provide a medical history. Medical records are made on a series of F Med forms (paper records) that are used in a standard manner across all three Services. An individual's medical records are retained in a *Personal Medical Record* (F Med 4) which, on discharge, is archived indefinitely. Computer medical records may also exist, although their use is variable across the Services, and they do not usually provide a complete primary health care record. On discharge, the computer medical records are also archived indefinitely. Medical records are usually stored and archived according to name and Service number.

Medical records of relevance to exposure assessment include vaccination records, periodic medical fitness assessments (which may record smoking status and alcohol intake), and records of health or medical surveillance. In particular, the *Radiation Medical Examination Record* (F Med 291C), *Control of Substances Hazardous to Health (COSHH) Medical Surveillance Record* (F Med 143A), *COSHH Regulations - Personal Exposure and Health Surveillance Record* (MOD Form 933F), and *Audiogram* (F Med 242) all identify a hazardous exposure(s) and give some indication of the location and nature of the work resulting in the exposure, although only the F Med 291C provides any quantitative exposure data.

Occupational exposure and environmental monitoring data

Chemical exposure data: A considerable amount of data on exposure to chemicals is collected throughout the Armed Forces under the Control of Substances Hazardous to Health (COSHH) Regulations 1999, and similar statutory instruments, such as the Control of Lead at Work Regulations 1988. Under COSHH, assessments are made for all substances used in the Armed Forces that are identified under COSHH as hazardous to health. The assessments effectively constitute a paper record of an assessment of exposure and include data on the substance(s) of concern, the route(s) of exposure, the process(es) resulting in exposure and the location of the process(es). The individuals or jobs likely to receive exposure are not recorded. The assessments are made on a standard MOD form (*COSHH Assessment Form*, MOD Form 911), and are retained locally and reviewed periodically. They are not generally linked to personnel or medical records. Only the current assessment for a substance/process is retained; unless there has been an accident, old assessments are discarded.

Some direct measurements of exposure are collected, particularly where a COSHH assessment is complex, there is a need to demonstrate compliance with exposure limits, or there is a general concern about exposure. This is usually in the form of routine air monitoring, biological monitoring, or a discrete study of a particular exposure issue. Routine air monitoring is recorded on a *COSHH - Routine Exposure Monitoring Form* (MOD Form 933E), and records details of the substance(s) and individuals or process(es) monitored, the location of monitoring, and the results of the monitoring. On completion, the form is retained by the line manager concerned, alongside the relevant COSHH assessment. Individuals exposed to substances such as lead, mercury or thallium may have their exposure assessed by biological monitoring. The results of lead biomonitoring should be included in each individual's medical

records, and all biomonitoring results are reported back to the line manager concerned. Storage and retention of these exposure data are variable, depending on the type of data, and the Service. Finally, some exposure data are collected as a result of ad hoc studies on particular exposure issues of interest or concern. The data generated are generally presented in a discrete paper report, copies of which are provided to the customer and retained by the Unit making the measurements.

Data on exposure to asbestos are not routinely collected. However, if an individual suspects that they have been exposed to asbestos, they may choose to complete an *Asbestos Personal Record Annotation* form (MOD Form 960). This is a self-certification form, a copy of which is retained in the individual's personnel records, and the individual may also choose to have a copy placed in their medical records.

Other areas of routine chemical exposure data collection include the continuous and periodic monitoring of atmospheres in submarines. These data are recorded in a submarine *Atmosphere Control Log* that, on completion, are entered into a database and retained indefinitely by the Institute of Naval Medicine (INM). Drinking water samples are also collected from ships and submarines (subject to assistance from the fleet), quarterly for bacteriological analyses and annually for chemical analyses, with the results being retained indefinitely at the INM.

A number of environmental chemical measurements are made on an ad hoc basis to address specific pollution incidents, problems or concerns, or as part of an ongoing MOD assessment of land quality. In these cases, the results of the monitoring data are recorded in a paper report and retained by the Unit requesting and the Unit undertaking the measurements.

Noise and vibration exposure data:

There are two areas of noise exposure data collection in the Services. These are the routine *Noise Assessment Record* (MOD Form 945), and specialist noise assessments. Routine noise assessments are made under the Noise at Work Regulations 1989 and record the noise levels measured, the location of the assessment, an estimate of the number of employees exposed and the duration of exposure. The assessments are retained by the line manager responsible for the area and a copy should be forwarded to a Service specific recipient (e.g. INM or Command Principal Medical Officer (RAF)), as specified on the form. The assessments should be reviewed every two years and a repeat assessment carried out every five years. The serial number (consisting of the Unit Identification Number and a reference number) of a repeat assessment should be recorded on the previous assessment and

vice versa, thus creating a continuous noise assessment record for a location, process, or piece of equipment. Individuals or job tasks exposed are not recorded.

Specialist noise surveys are carried out where an initial assessment indicates that noise levels exceed a daily personal exposure level of 105 decibels, or the noise assessment requires particular expertise, for example, for weaponry, impulsive, pure tone, infra- or ultra sound. Other specialist assessments may include some environmental noise monitoring. Assessments of vibration are all specialist assessments and usually include assessments of equipment or transport. These specialist assessments are reported as discrete paper reports to the Unit requesting and the Unit making the measurements.

Radiological exposure data: Monitoring of radiological exposures of Service personnel is co-ordinated by the DEFRA Radiological Protection Service (DRPS). Dosimeters are issued, on a monthly basis to all Service personnel, who have been identified as being routinely exposed to radiation. The results of the monitoring are maintained at DRPS as paper records, on a microfiche and on an Oracle database. The dose record for each individual includes comprehensive personnel details, a yearly apportioned dose breakdown, results of every dosimetre analysed, and details of all changes made to the record. Where individuals have been exposed to radiation from previous employment, a summary of their dosimetry record is obtained from the previous Approved Dosimetry Service and incorporated as part of their dosimetry record. Hence DRPS maintain a complete record of an individual's lifetime occupational exposure to radiation until they leave the Service. These records are not linked to personnel records, but are linked to medical records through the F Med 291C. It is current MOD policy to retain dosimetry records indefinitely.

In addition to the personal dosimetry, some monitoring of environmental radiation may be carried out, for example, for indoor radon. However, the maintenance of the records of such monitoring is the responsibility of the Unit carrying out the monitoring and not DRPS.

Historical records

Historical records are made by each of the Services, and although not a primary source of exposure data, they can contain useful information pertinent to exposure assessment, such as data on exceptional unusual exposures, for example, accident incidents resulting in casualties, operational duties etc. These records are Unit based and differ considerably in their content, frequency and period of completion and their retention. Examples of the main

Table 3. Summary of principal historical records made by the UK Armed Forces

Record	Completion	Content	Retention
Army Commander's Diary	Completed in times of operation on daily basis	Summarises major events at Unit level	Retained at Unit level until being archived at Hayes
Unit Historical Record (Army)	Completed on an annual basis	Non-operational report summarising major events at Unit level	Retained at Unit level until being archived at Hayes
Ship's Log	Completed three times each day	Record of ship's location and brief details of events	Sent through Fleet to Admiralty archive at Hayes
Report of Proceedings (Royal Navy)	No fixed time period for completion	Narrative account of activities of Unit	Sent to relevant Flag Office and the Naval Historical Branch
RAF Operations Record Book	Completed on a monthly basis	Standard form giving an account of a Unit's activities, and details of any significant flights made	Sent to Air Historical Branch and after 30 years forwarded to Public Records Office, security considerations permitting

historical records produced are summarised in Table 3.

Other records

Other areas that may be pertinent sources of exposure data include procurement records and records pertaining to chemical weapon exposures. However, due to the constraints of time, it was not possible to assess these areas.

Discussion

All the systems assessed had some limitations with respect to the collection and retention of data for exposure assessment. However, this is not altogether surprising since, for most of the systems assessed, the use of the information in exposure assessment is only a secondary use of the data, and probably was not anticipated in the original design of the system. The comments or criticisms presented below are solely from the perspective of exposure assessment.

A summary of the main strengths and weaknesses of each area of data collection assessed is presented in Table 4. In particular, systems often had limitations with respect to the type, accessibility, linkage and retention of data useful for exposure assessment; examples of these limitations, and some of the main recommendations from our study are given below. A complete discussion and list of the recommendations can be found in the full report (5).

There were a number of common limitations that were identified in the majority of the systems assessed. In particular, different systems were often used in the different Services for the same purpose, for example, three different pay and personnel systems, and usually little consideration had been given to the potential secondary uses of the data collected when the systems were designed. These limitations would hinder any tri-Service study of exposure and health and important data

necessary to assess exposures may not have been collected in all the systems. **Hence, we suggest that, where possible, consideration should be given to the development of tri-Service data systems, with a common data set. Also the purpose of each data item collected should be clearly defined, with full consideration given to the potential secondary uses of the data.**

Type of data collected

A broad range of data useful for exposure assessment are collected throughout the UK Armed Forces, including demographic data and data on exposures to specific hazards. However, a significant limitation is the lack of a unique means of identifying an individual throughout their Service career. This is not provided by the Service number because the number changes on commissioning, or if an individual moves between Services. Hence complete follow-up of such individuals for epidemiological study would be difficult. An alternative identifier could be the NHS number, which would remain consistent throughout an individual's career, and which would also facilitate follow-up in civilian life. **We, therefore, propose that there should be a unique way of identifying each individual that does not change throughout his or her Service career (and possibly beyond).**

There is also a lack of detailed data pertaining to the jobs or tasks carried out by individuals, and the location and movements of individuals. Much health surveillance and exposure assessment requires such data to define groups needing surveillance and as a basis to infer or assess exposures. The current lack of detailed data would impede health surveillance if, for example, it was necessary to study the health of those returning from a particular deployment or location (e.g. the Gulf), or undertaking specific tasks (e.g. assisting with disposal of foot and mouth

Table 4. A summary of the strengths and weaknesses of data systems of the UK Armed Forces from the perspective of exposure assessment

Area visited	Generic function/ purpose of Units	Exposure data collected/system used	Strengths of data/ system	Weaknesses of data/ system
Health, safety and environment policy	To interpret and implement health, safety, environment and fire policy	Mainly policy orientated work, hence limited direct collection of exposure data	Single source of policy on Safety, Health, Environment and Fire issues	Separate interpretation of policy may lead to variations in implementation
Personnel and pay administration systems	To assess correct pay and pension entitlement for Service personnel and provide a system to underpin the posting of personnel.	Pay and personnel systems that collect and store demographic, identifier, job task, job history, and movement and location data	Comprehensive collection and retention of demographic data collected on all Service personnel	Service numbers not necessarily a unique identifier. Variations in data collected between officers and ranks and between Services. Variations in retention and archive policy between officers and ranks and between Services
Medical records	To provide complete primary health care record for all Service personnel	Vaccination data, and medical and health surveillance data resulting from exposure to specific hazards e.g. radiation. Additional data may include confounder data e.g. smoking status and alcohol consumption	Identical medical forms used across all three Services	Access to records according to an exposure or health endpoint is difficult. Little or no linkage of health surveillance data with personnel or exposure records
Occupational exposure and environmental monitoring data	To help control the exposure of Service personnel to hazardous agents	Data on exposure to chemicals, noise, vibration, radiation and other more generic hazards	Considerable amount of data collected on exposures through risk assessments and routine monitoring of exposures	Little or no linkage with personnel or medical data (where applicable). Limited central access to available data and reports
Historical records	To collect historical records and to respond to official and public queries	Data collected may include exposure data pertaining to rare or unusual events, e.g. accidents	Useful source of data on unusual or rare exposures, or exposures encountered in operational situations	No unified system for recording historical data across the three Services

infected animals). We, therefore, suggest consideration should be given to the development of a classification system that more accurately reflects the jobs and task carried out. We also propose that posting, movement and detachment information should be more comprehensively and consistently recorded.

Accessibility of data

The ability to readily access data is vital in order to assess exposures of groups or individuals, and to facilitate epidemiological study. Generally, the accessibility of data useful for exposure assessment was found to be poor, especially retrospectively. For example, a large number of exposure measurements are made both routinely, for example, as part of COSHH assessments, or more infrequently, for example, specialist assessments. However, there is no easy way of accessing this data, since much of it is stored on paper records or disaggregated databases. Problems similar to this have been overcome in civilian industries through the development of central databases, such as the National Exposure Database, maintained by the Health and Safety Executive (6). Consideration should, therefore, be given to developing a centralised tri-Service database of exposure measurements, and/or exposure reports with a

well-defined minimum dataset, and data quality criteria, to facilitate greater access to the available data.

Linkage of data

Linkage of disaggregated data is vital so that it is possible to retrospectively assess exposure (1), to relate the exposures to individuals or groups, and to corresponding data on health outcomes. Currently there is little linkage of exposure data with either personnel or medical records. An example of this can be seen in the variety of risk assessments made for COSHH, noise and more generic risks. None of these records identify those exposed, nor are they linked to medical assessments carried out as a result of such exposures, for example, audiometry or health surveillance under COSHH. This lack of linkage between exposure, personnel and health records would significantly hinder attempts to monitor the effect of a particular exposure on health. **Therefore, record systems should be developed in such a way that they can be readily linked to, and share data with, each other to facilitate exposure assessment and avoid duplicate data collection.**

Retention and archiving of data

Retrospective studies of health are often necessary since there are varying latency

periods between an exposure of concern and the manifestation of a health effect, for example, cancer. The retention of data useful for exposure assessment within and across the Services is variable. The data that should be potentially of most use, for example, COSHH assessments, noise assessments etc, are often only retained as long as they are current and are then discarded. This would particularly hinder retrospective studies. Furthermore, the retention of personnel and pay data is particularly variable, according to status (i.e rank), and between Services. This would bias retrospective studies of the effect of exposures on health, and could lead to misleading results, as exposures between ranks and officers may differ considerably. **To avoid these problems a clear retention and archiving policy for all records across all Services, and procedures for implementing such a policy, should be developed.**

Conclusions

Current collection and retention of data useful for exposure assessment in the UK Armed Forces is variable and, without substantial manual effort, would only allow limited health surveillance and epidemiological study of occupational health. The usefulness of many records is hampered by inconsistencies in the data collected, poor accessibility and linkage, and variability in the retention of the data. The use of these records could be greatly improved if the secondary uses of data were given greater consideration when developing primary data systems. Implementation of the suggested recommendations from this project would

not only better enable exposure assessment, health surveillance and epidemiology, but would also improve the primary function of the data systems as well as potentially benefiting the health of Service personnel.

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References

1. Bricknell MCM. Options for future military health surveillance systems. *JR Army Med Corps* 1999; **145**: 80-83.
2. WHO. Human exposure assessment. International Programme on Chemical Safety, Environmental Health Criteria, 214, Geneva: World Health Organisation; 2000.
3. Rushton L, Betts D. Report from a workshop on the development of recommendations for the collection and retention of data by industry for future epidemiological purposes. Luxembourg: European Commission; 1997.
4. Checkoway H. Rapporteur's summary of epidemiologic evaluation of exposure-effect relationships. In: Rappaport SM & Smith TJ, editors. *Exposure assessment for epidemiology and hazard control*. Michigan: Lewis Publishers; 1999. p. 67-73.
5. IEH. An objective assessment of systems for the collection and analysis of exposure data. Unpublished Report for the Defence Evaluation and Research Agency; 2000. Available from: URL <http://www.le.ac.uk/ieh/>
6. Beaumont PL, Dalrymple HL. A standard for the presentation of occupational exposure data. *Am J Occup Hyg* 1992; **36**: 79-98.