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DOI:
10.5455/jeos.20140921104241

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Litchfield, I 2014, 'National Register of Radiofrequency Workers: Exploring health effects of occupational radiofrequency radiation exposure', *Journal of Environmental and Occupational Science*, vol. 3, no. 4, pp. 190-192. https://doi.org/10.5455/jeos.20140921104241

Journal of Environmental and Occupational Science
www.jenvos.com
DOI: 10.5455/jeos.20140921104241

Short Communication

GESDAV

National Register of Radiofrequency Workers: Exploring health effects of occupational radiofrequency radiation exposure

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Received: July 01, 2014
Accepted: September 21, 2014
Published October 01, 2014

ABSTRACT

Background: Radiofrequency (RF) radiation continues to proliferate in the workplace. However, there is a broadly acknowledged need for additional research exploring the potential health effects of occupational exposure to RF. **Aims:** The aim was to establish a register of workers occupationally exposed to RF, in line with the recommendation of the Independent Expert Group on Mobile Phones. This database is to be used as a resource for the investigation of any potential health effects of RF exposure. **Methods:** Following a series of consultations with industry and other relevant organizations, the Health and Safety Executive (HSE) established a Steering Group in 2002 to manage the establishment of the National Register of individuals potentially exposed above public RF exposure guidelines. The Steering Group selected the University of Birmingham to administer the recruitment process. Recruitment and the first wave of analysis are due to finish in 2015. **Results:** The recruitment of a cohort of some 2500 individuals is near completion, and the initial study, a long-term follow-up of the cohort investigating mortality and cancer incidence is underway. **Conclusions:** The National Register of RF Workers provides the basis to explore potentially adverse health outcomes from occupational RF exposure. Funded by, key industry sponsors and supported by the University of Birmingham and HSE, the collaborative nature of the register provides an exemplar of how studies of occupational health can continue to be funded and managed.

KEY WORDS: Occupational epidemiology, occupational exposure, radiofrequency radiation or non-ionizing radiation

INTRODUCTION

Since the introduction of radio broadcasting in the 1930's, the use of radiofrequency (RF) radiation has proliferated to encompass a range of applications across many sectors. Combined with the increase of the wireless office and the growth of mobile telecommunications, the number of persons exposed to RF radiation has rapidly increased and has led to continuing concerns over potential health effects. Though no adverse health outcomes are consistently apparent, its ubiquity means an undetected effect may yet become a serious public health problem.

So far, few epidemiological cohort studies have investigated the effects of RF exposure in occupational settings [1-3] and there remains a need for improved research into potential health effects of long-term exposure to RF in the working environment. In classifying RF as 2b "a possible carcinogen" based on studies of mobile phone users, the International Agency for Research into Cancer acknowledged that evidence from previous studies exploring the impact on health of occupational exposures was "inadequate" containing methodological limitations and inconsistent results [4].

In the UK, the need for robust research into potential health effects of occupational RF exposure was recognized back in 2000 with the publication of the Independent Expert Group on Mobile Phones' report on mobile phones and health [5]. Several recommendations were made for future research and policy, one of which advised a "register of occupationally exposed workers be established, and that cancer risks and mortality be examined to determine whether there are any harmful effects." As this group was exposed to the highest levels of RF, so any adverse health effects would be visible in this group in advance of the general public. In response, the Health and Safety Executive (HSE) established the National Register of RF Workers, a resource for independent researchers to investigate potential or emerging health effects relating to occupational exposure to RF.

METHODS

Following a series of consultations with representatives from a range of industry sectors and other relevant organizations, HSE created a Steering Group in September 2002 to manage the register and develop a recruitment strategy and in turn, the University of Birmingham was selected to administer the register.

Individuals with the potential to be exposed to RF above guidelines for public exposure established by the International Commission on Non-Ionizing Radiation Protection are eligible to join the register [6]. However, finite resources meant the Steering Group has to make a series of strategic decisions on which groups of workers would be pursued for inclusion. The management structure of the Register and the groups of eligible workers are described in Figure 1.

Once identified, potential participants are provided with information leaflets allowing them to provide informed consent (see results for more on ethical approval). Identifying particulars are collected alongside work history information including job title, year first employed in the RF industry, and incidents where knowingly exposed to RF above occupational guidelines. Recruitment and the first set of analyses are scheduled to finish at the end of December 2015. In considering the estimated number of eligible individuals and acknowledging the decline in participation in rates in epidemiological studies [7] we conservatively estimate that at this point, the cohort will consist of a minimum of 2500 participants.

RESULTS

The first study to use the register is now underway, following the favorable ethical opinion of the National Research Ethics Service, West Midlands (The Black Country). Led by the University of Birmingham, the long-term follow-up study will explore mortality and cancer incidence. The study team will receive copies of death certificates and cancer registration (incidence) details from the Health and Social Care Information Center. Cancer registrations and mortality data (underlying cause and multiple-cause coding) will be supplied according to the tenth revision of the International Classification of Diseases [8].

Job title and sector will be used as surrogate for exposure and informed by existing exposure data, job descriptions and the input of our partners in industry and the HSE, individuals will be allocated one of three bands of exposure; high, medium, or low. Standardized mortality ratios (SMRs) will be calculated as the ratio of observed to expected numbers of deaths expressed as a percentage. In calculating *P*-values and confidence intervals, it will be assumed that deaths occur following a Poisson distribution. Any significance tests will be two-tailed. Similar analyses will be performed on the cancer registration data to calculate standardized registration ratios (SRRs). It is possible that SMRs and SRRs can differ from national expectation for reasons other than occupational factors. For example, a healthy worker effect may lead to low-risk estimates whereas socio-economic effects may lead to higher risk estimates. The use of internal comparisons should assist in mitigating such influences and evidence will be sought of any trends in disease risk with levels of estimated cumulative RF exposure.

Calculations of statistical power for the size of the register forecast ($n = 2500$) are shown in Table 1. These estimates are shown for follow-up ending both at 2015 and 2025, and for true relative risks of 1.5 and 2.0 (equivalent to SMRs of 150 and 200).

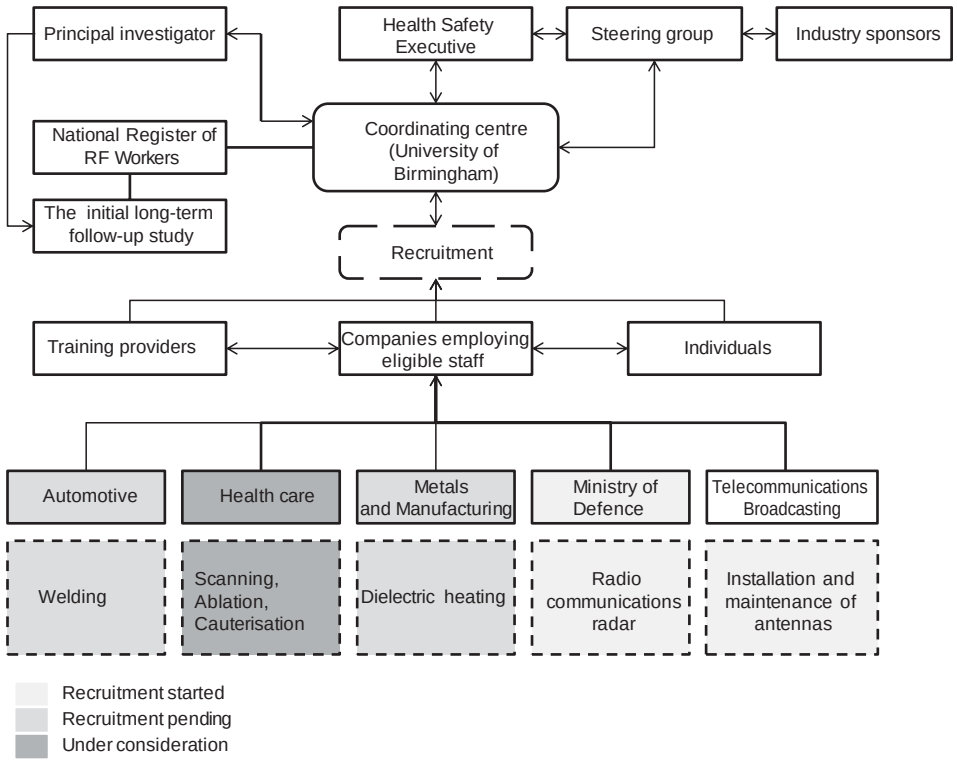

Figure 1: The flow of information within the register showing management structure and recruitment strategy

Table 1: Predicted expected numbers and statistical power at different periods of FU for register

Cause of death	2015 FU			2025 FU		
	Expected number[a]	Statistical power[b] (%)		Expected number[a]	Statistical power[b] (%)	
		RR=1.5*	RR=2.0**		RR=1.5*	RR=2.0**
All causes	55.27	92	100	223.99	100	100
All neoplasms	15.80	42	90	70.83	96	100
Brain cancer	0.92	5	12	3.08	9	27
Leukemia	0.55	5	10	2.01	9	22

[a]The register is predicted to consist of 2500 employees by December 31st, 2015, [b]Based on mortality rates for England and Wales, *Probability of observing a statistically significant excess using a two-tailed test of significance at the 5% level, if the underlying risk is increased by 50% (i.e., RR=1.5), **Probability of observing a statistically significant excess using a two-tailed test of significance at the 5% level, if the underlying risk is doubled (i.e., RR=2). FU: Follow-up, RR: Relative risk

DISCUSSION

The Register provides a valuable long-term framework for research into potential health effects of occupational exposure to RF radiation across a range of industries. The complexity of recruiting participants from disparate workforces is not tantamount to saying these groups of workers should not be included. Notwithstanding the relatively small numbers, the register retains the potential to become a valuable resource for multiple studies, of various designs. Able to offer the opportunity to investigate any emergent health effects over the coming years, it is foreseen that evidence from the register will ultimately be considered together with similar databases elsewhere. By continuing to work closely with our partners in HSE and industry, the numbers enrolled are expected to increase further as the EU EMF) Directive (EU/35/2013) approaches transposition, and additional eligible groups are identified.

One lesson already learned from the register is how to manage the demands of various stakeholders in collaborative projects exploring occupational health. For industry, research partnerships are considered as an important channel of information transfer [9] and in other areas such as manufacturing or engineering research agreements between academia and industry are commonplace, yet they remain the exception in occupational health research [10]. With funding from groups such as the British Occupational Health Research Foundation no longer available, the pooling of resources and knowledge within industry, government bodies, and academia, provides the best opportunity to meet demands for a healthier working population [11].

ACKNOWLEDGMENTS

The author would like to thank Prof. Tom Sorahan for his tireless work in both overseeing the beginning of the register and maintaining it in its formative years. His help has been invaluable in both the register and this article.

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Source of Support: The register and the associated study are funded by Arqiva, Babcock International Group Plc, Balfour Beatty Utility Solutions, Crown Castle UK, Eve Group, Everything Everywhere Ltd., Health and Safety Executive, Link Microtek Ltd., National Grid Wireless Ltd., National Transcommunications Ltd, RJC (UK) Ltd, **Conflict of Interest:** None declared.