The health of health care workers

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ABSTRACT—The health of health care workers is mentioned in the early occupational health literature but the significance of these populations in occupational health has only recently received widespread attention. The health care industry now employs about 5% of the national workforce and, despite its size and the multiplicity of its occupational hazards, little systematic enquiry has taken place to quantify these risks. The occupational health services available to health service staff are often rudimentary. Current health concerns include evidence that the mortality experience of subgroups is not as favourable as for comparable socio-economic groups. Specific areas of concern are occupational exposures to biological agents such as HIV and hepatitis B, pharmaceutical products, allergens, violence, electromagnetic fields and chemical carcinogens. Psychosocial factors and excessive hours of work may, in part, explain the high suicide rates experienced by some subsections of the workforce. New initiatives to investigate and monitor this complex working environment are clearly needed.

Historical perspective

Little serious study of the occupational hazards of health care workers predates 1950, but the subject now commands considerable interest.

An early reference to the second oldest profession can be found in Ramazzini’s classic work [1] of 1713 de Morbis Artificium. His reference to doctors was uncharacteristically cynical:

Doctors fare better [than other learned men] ... it is as though their profession gave them special privileges. This I would not ascribe to any particular precautions on their part, but rather to their taking a good deal of exercise and to their cheerful frame of mind when they go home with their pockets full of fees.

Thackrah (1795–1833) in his treatise of occupational diseases [2] was more realistic: he recorded syphilis among surgeons and obstetricians and struck a peculiarly modern note as well:

Anxiety of the mind does more, I conceive, to impair health, than breach of sleep, nocturnal exposure, or irregularity of meals.

Thackrah also notes the effects of medical school training on the students:

Students who come out of the lecture room at the end of the session [medical school course], we should scarcely recognise as healthy young men, who entered it a few months before. Complaints of the stomach and bowels are common and pulmonary consumption is by no means infrequent. The effects of wounds in dissection are well known to be very serious, and often fatal.

Thackrah died of pulmonary tuberculosis which he probably acquired whilst a dresser at Guy’s (a fellow student and sufferer was John Keats). A wound inflicted at dissection killed John Darwall, the Birmingham physician who also wrote a treatise on occupational diseases [3] ten years before Thackrah’s more substantive account. My interest in health care workers arose from the need to update Reid’s work highlighting an excess incidence of tuberculosis in laboratory workers, whilst a member of my staff has recently been awarded her PhD for work investigating injuries and accidents in post-mortem room workers. The circle thus completes itself.

The significance of health care workers as an occupational risk group

The health care industry has a number of features which warrant special attention. These are its size, the multiplicity of its occupational hazards, the patchy attention it has thus far received from investigators, its unique culture and the opportunities it affords for advancing knowledge on occupational health problems which would be applicable elsewhere.

Size of the workforce

The health care industry employs a large sector of the workforce in most countries. In the United States of America in 1984, there were seven million health care
workers (HCW) and this figure is estimated to rise to 11 million by 1990 [4]. In the United Kingdom, the current figure is one million, which makes the Department of Health the largest employer of labour in Western Europe. In many countries the HCW population is about 5% of the total workforce, though most work outside the hospital environment [5].

Multiplicity of occupational hazards

The range of hazards to which the HCW may be exposed is vast. It covers not only a wide variety of physical agents—fires, explosions, gassings, electrocutions, radiation, noise, many chemical substances including carcinogens, allergens, mutagens and narcotics—but also mechanical and ergonomic issues, and psychological problems such as work patterns and job stress. Theoretically, all the microbiological hazards are possible.

An under-investigated population

Given the range and complexity of the health care industry, the published literature does not accurately reflect these occupational health risks and hazards. Much of the early literature was anecdotal until the advent of non-communicable disease epidemiology. Even thereafter the populations studied have been either those where tracing procedures were relatively easy or those for which the researchers had a particular—perhaps egocentric—interest [6]. The surfeit of studies of physicians epitomises this patchy coverage. On the other hand, there is some evidence that the level of accidents [7–11] and sickness absence [12] is extremely high among HCWs but little systematic work has been undertaken to follow up these important observations.

A unique culture

Attitudes to health and safety are modified by the culture within which a group of employees works. Emmett and Baetz [7] have summarised these features for HCWs. They include a concern with a curative rather than a preventive approach in their own professional dealings, combined with a low personal concern for their own well being. Both these features are closely related to the role of caring for the health of others. Many employees are resident at the site of work. On the other hand, few health industry managements have established high quality occupational health services. Indeed, management attitude to occupational health is frequently primeval compared with their counterparts in major industries.

Epidemiology opportunities

The health care industry affords potential exposure to some uniquely interesting agents: in particular, infectious agents, occupational rather than therapeutic exposure to chemotherapeutic agents, and exposure to chemicals of current concern such as ethylene oxide, glutaraldehyde and formaldehyde. Furthermore, the professional associations which represent many of the subgroups of the workforce—physicians, nurses, radiographers, physiotherapists—have a membership which remains stable throughout their working life. The health care industry thus remains a suitable case for epidemiological study [13].

Current health concerns

General

The simplest but perhaps crudest measure of occupational health is the standardised mortality ratio for employment groups. This figure summarises the mortality experience of an index population compared with a standard population—usually the national rates. National mortality experience itself, of course, varies by age, sex, geography and socio-economic class. Medical practitioners are classified in the top socio-economic stratum and, as such, have tended to enjoy the relatively low mortality rates associated with the wealthier sections of employed society. Their SMR for all causes of mortality is at least 20% better than for the general population. It is particularly low for cancer but particularly high for suicide. Similar low mortality trends have been noted in the United States of America [14], Finland [15] and Japan [16]. However, when allowance is made for socio-economic class, physicians do not do so well. In Japan, physicians have a 28% excess mortality compared with social economic class 1 [16]. Doll and Peto [17] have shown that general practitioners have higher rates for smoking-related diseases than specialist physicians and surgeons.

Radiologists and radiotherapists are at potential risk of cancer from the agents they use to treat their patients. Two classic studies of radiologists, one by Court-Brown and Doll in the United Kingdom [18], and the other by Seltsel and Sartwell in the United States [19], suggested that, if a risk of radiation induced cancer exists, it is more likely to affect the older radiologists who started work before modern radiation protection techniques were universally enforced. Recent follow-up studies in the United States have confirmed this view. The excess risk of leukaemia appears to be decreasing but increasing excesses of lymphoma and multiple myeloma have been noted [20]. In China, radiologists have a 50% excess cancer rate compared with other medical specialists—the highest risks were for leukaemia and bone cancer [21].

Anaesthetists also have been the subject of a number of cancer mortality studies. A recent review, however, notes a lack of consistency in the findings [22]. No clear-cut cancer excess has been shown in a follow-up UK study [23] although reproductive outcome studies do point to an occupational factor which will be discussed later.

Mortality studies of a group of pathologists followed
since 1974 show a significant excess of brain tumours in the cohort [24]. The biological significance of this finding—indeed the biological plausibility for an occupational risk factor—remains to be seen, but increasing interest has been focused in recent years on brain tumour excesses in certain occupational groups [25]. A flippant summary of current epidemiological evidence on brain tumours by occupations would be that the more one uses one's brain, the greater the risk of brain cancer!

Although nurses are the largest occupational subgroup of HCWs, few epidemiological studies of this population have been undertaken. One recent mortality study from Wisconsin relied on a proportional mortality analysis but found little of note apart from an excess risk of suicide [26]. The other large subgroup, maintenance and ancillary workers, have been subject to even less attention. A recent paper by Balarajan [27] analysed the difference in mortality experience between health sector workers. Allowing for socio-economic status, doctors (and dentists) had a 30% deficit in mortality, whilst for lung cancer there was a five-fold difference between hospital porters (SMR 185) and doctors (SMR 33). Within their socio-economic groups, doctors, nurses, and particularly nurses, fared worse than the groups as a whole. Death from cirrhosis of the liver and suicide was in excess for these groups by a factor of 2. Of particular note, however, is the author's comment that mortality differentials between occupational groups have widened more than the general population figure over the past decade. He notes:

The National Health Service is under a special obligation to promote the health of its staff. Public health and occupational physicians should concern themselves with the problems within the organisation just as much as with those outside it.

In short, although doctors seem to be relatively healthy compared with the general population, few studies here have been undertaken on many of the other subgroups of HCWs. The existing data suggest that nurses and hospital ancillary staff do not compare well with their peers and that, even for the apparently healthy doctors and dentists, alcohol abuse, mental illness and possibly some cancer risks are particular issues requiring closer attention.

Specific health concerns

**BIOLOGICAL**

- Infectious agents
- Pharmaceuticals
- Allergens

**PHYSICAL**

- Manual handling
- Accidents
- Electromagnetic fields

**CHEMICAL**

- Teratogens
- Carcinogens

**PSYCHOSOCIAL**

- Stress
- Addiction
- Hours of work

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**Biological**

**Infections**

Both Ramazzini [1] and Thackrah [2] comment on the relative immunity of doctors from infections. Nevertheless, occupationally acquired infections are a real risk—a fact recognised by the Prescribed Diseases Regulations which list tuberculosis as a state compensatable occupational disease for HCWs. In the 1950s in Britain, Reid [28] reported that medical laboratory staff experienced a nine-fold excess risk of acquiring the disease. Two decades later, we noted that the excess risk was still five-fold [29]. Recent surveys of UK health service employees [30,31] suggest that, although the risk is now comparable to UK national rates, mortality attendants remain a high risk group. Salmonella infections are still regularly reported as causing occupational infections in laboratory based staff—particularly in microbiology.

The main risk to HCWs of acquiring workplace infections comes from the inadvertent exposure to unsuspected infectious materials. Traditionally, this risk has been documented as greatest for medical laboratory technicians. The first human case of a number of infections not infrequently involved laboratory workers [32]—sometimes at the cost of their lives.

Current concern with life-threatening infections centres on viruses such as hepatitis B [33] and human immunodeficiency virus (HIV) [34]. Despite the publicity surrounding the latter, hepatitis B is a much more serious threat to health. The epidemiology of this infection is also more clearly delineated. Exposure to the virus results in high (10–30%) sero-conversion rates and a 2% mortality, but a safe and effective vaccine is available. For HIV infection, the transmissibility of the virus is much lower. This is due partly to a lower infectivity rate but also to the fact that each millilitre of infected blood contains, on average, 10^6 fewer virus particles than a millilitre of blood infected with hepatitis B. Sero-conversion rates following needlestick injuries are less than 0.5%, but when it occurs it is likely to lead to full-blown disease which is, at present, invariably fatal. The true sero-conversion rate is probably much lower than 0.5% even for high risk HCWs, as needlestick injuries are grossly under-reported [35]. A survey carried out last year by one of our medical students suggested that medical students experience between 600 and 1,000 injuries from needles or during theatre sessions per 1,000 person-years. Injuries whilst assisting in the operating theatre contributed 36% of all reported injuries [36]. Other blood-borne hazards in the theatre include blood splashes into the eyes. One study suggested that such conjunctival contact with a patient's blood occurs in 25% of operations [37].

In short, occupationally acquired infections remain a serious health risk to HCWs. The current concern with HIV transmission is not supported by the epidemiology which suggests that hepatitis and tuberculosis are still greater risks worldwide. Gastroenteric infec-
tions of occupational origin are still a problem for laboratory staff.

**Pharmaceutical products**

This group of workers has held a particular fascination for me since we investigated a population of oral contraceptive formulators in Puerto Rico in 1978 [38]. This study was more straightforward than most because the plant was new, employed a previously unexposed population of workers, handled only two therapeutically active materials and had a high incidence of health effects.

For most pharmaceutical plants the workers rotate around the jobs, the work is 'campaign driven'—that is, one drug may be formulated for only a few weeks before a switch to another—and there is good occupational hygiene control. Nevertheless, the workplace contains agents which are, by definition, biologically active, frequently so at concentrations orders of magnitude lower than more common agents in chemical plants. Furthermore, the pharmacodynamics of these therapeutic agents are well known for the oral or parenteral routes but frequently little is known concerning the 'effective dose' for inhalation. The potential health effects from occupational exposure are thus legion [39].

Several recent papers have addressed the issue of airborne exposure limits in general terms [40,41] but, following a study by one of my staff on occupational exposure to an animal growth promoter [42], we reviewed the problems inherent in arriving at a justifiable approach to establishing numerical standards for airborne concentrations [43]. For this occupational group, the problems are as difficult as they are fascinating.

**Allergens**

The list of occupational agents which can cause allergies in HCWs grows at a steady rate [44]. Well known examples include animal products such as dander and excreta, enzymes such as pancreatic extracts and *Bacillus subtilis*, drugs such as penicillin, methyldopa and cephalosporins, and sterilants such as hexachlorophene and, the latest to cause concern, glutaraldehyde [45,46].

Glutaraldehyde is an effective cold sterilising agent and as such has been increasingly used for cleaning delicate instruments. The fear of spread of infectious diseases in the wake of the HIV scare has led to stricter efforts to maintain sterility of equipment. A study of endoscopes used in patients with AIDS noted that 35% of the unwashed instruments were contaminated by HIV [47].

Recently, two new intriguing sources of occupational allergies have arisen from unexpected quarters. Chiroprodists are occupationally exposed to airborne human nail dust which, in addition to being proteinaceous may also be contaminated with fungi—especially *Trichophyton rubrum* [48]. From a different group comes the suggestion that dental hygienists may suffer from respiratory and nasal symptoms associated with aerosols generated during dental procedures—particularly during the use of air turbine and ultrasonic scalers [49].

**Physical**

**Accidents**

Problems of manual handling have already been mentioned in the context of needlestick injuries; but cuts and lacerations are also real dangers not only to surgeons but also to post-mortem room workers [50] and domestic staff [8]. The domestic and maintenance staff have been called 'the forgotten majority'. Pines et al. [8] noted that they had the highest accident rates in their three-year study of a hospital employing 3,000 people. The main features of these accidents were falls and injuries to the limbs.

Nurses, although at risk of some of these problems, are the group most at risk of back disorders of one sort or another. There are many epidemiological difficulties in studying back pain, given that 80% of the population will experience this symptom at some stage in their lives. Furthermore, as lifting patients seems to be a major hazard in this context for nurses, it is difficult to design a mechanical procedure to cope with such loads, given the wide variety of circumstances in which a nurse will have to move or lift a patient. Nevertheless, work practice approaches to the problem are likely to be more successful in limiting the injuries than pre-employment evaluations [51].

**Electromagnetic fields**

The current controversy over whether electric fields or magnetic fields cause human disease remains heated but unresolved [52]. Allegations of childhood leukaemia arising from living near overhead power lines might seem an irrelevance to HCWs. But the advent of nuclear magnetic resonance machines in hospitals has undoubtedly provided the opportunity for HCWs to be occupationally exposed to magnetic fields which are orders of magnitude greater than many such exposures in industry or from neighbourhood exposure. Epidemiologically, the task of studying these populations is fraught with difficulties, mainly because the exposed populations are small and scattered and it is difficult to secure an accurate measure of magnetic field 'dose'.

**Ionising radiation**

The occupational risks to radiologists have already been mentioned. Indeed, the control of occupational exposure to ionising radiation is probably better organised and more efficiently monitored than most hazards in hospitals. A recent study from Poland highlights a previously unrecognised hazard to certain HCWs from ionising radiation—namely the risks fac-
ing hydrotherapists working in mineral water spas [53]. The main risks appear to be associated with radon-222 and its decay products, and measurements suggest that internationally acceptable maximum exposure limits have been exceeded by some workers at some of the spas. However, limiting such exposures in the future would be no easy task short of closing down the highly radioactive sources.

Chemicals
Excluding the allergenic and toxic risks from the myriad of chemicals to be found in the health care environment, the greatest risk to health probably arises from exposure to carcinogens and teratogens [54]. Although the clinical toxicology of anti-neoplastic drugs is well documented for patients, little information exists on the risks to health of those who administer these drugs [55]. Out of 28 specific chemicals listed by IARC as group 1 carcinogens, eight are chemotherapeutic agents. Indeed, it has been known for a decade [56] that oncology nurses can and do absorb enough of these agents to produce increased mutagenicity in their urine. Measurable amounts of cyclophosphamide or platinum have also been noted in their urine. Nevertheless, studies showing adverse health effects such as on pregnancy outcome [57] or neoplasia are exceedingly difficult to mount given the small numbers of workers in any hospital, the wide variety of agents handled and the long latency required to induce neoplastic change. The large-scale mortality studies described earlier could well mask specific risks to smaller subgroups of the workforce.

The health care worker group which has received the greatest attention so far as pregnancy outcome is concerned has been anaesthetic room staff, but critical reviews of the literature are few and far between. The conclusions drawn after such a critical review in 1986 perhaps summarise the present state of knowledge and highlight many of the epidemiological problems inherent in studying even a well delineated group of HCWs [22]:

In the interpretation of epidemiological studies, attention must be paid to both the quality and the quantity of the data. If quantity alone were important, we could conclude that occupational exposure to anaesthetic gases does indeed present serious reproductive hazards, and possibly a number of other health effects. On closer examination, however, many of the studies present considerably flawed data, subject to strong confounding and reporting biases which severely limit the conclusions which may be drawn from their findings.

First, none of the surveys considered here appears to have solved the problem of finding a suitable control group, and, second, no epidemiological study specifically implicates anaesthetic gases alone as a factor in disease causation.

Studies of the working environment of anaesthetists have started to appear more frequently of late [58-59]. If anaesthetic gases are the cause of abnormal pregnancy outcome and other adverse health effects in this population and if these hygiene studies are valid, then much remains to be done to clean up the operating theatre as a workplace.

Psychosocial
The stress of work and hours of sleep in the health care industry is a matter of some concern. There is considerable evidence to suggest that the high sickness absence rate among nurses—perhaps even their excessive smoking habits—is symptomatic of their distaste for some of their current work practices. Much of the nurses’ absenteeism has thus been construed as a withdrawal from a physically and emotionally demanding job [60]. Their high suicide rate [27] would support that view.

Most of the work on stress in HCWs has concentrated on doctors. Murray [61] showed that doctors suffer from more mental illness than other comparable professionals. The disorders cited were neurosis or affective psychosis and Murray postulates that physicians who cared for patients were more neurotic than those who did not. Anxiety may be heightened by therapeutic failure, diagnostic difficulties, disrupted family life and the death of young patients. Similar conclusions were drawn from two recent studies [62,63]. These stressors seem to start at the most junior levels in hospital [64]. Excess alcohol consumption is one coping strategy which seems to be evident even at medical school [65]. Many of these studies, however, lack a good epidemiological basis for their conclusions and the response rates to such attitudinal studies rarely exceed 50%.

Long hours of work are blamed for many of the ills and complaints of junior doctors. We recently reviewed the literature on the subject [66] and discovered that little work had been done to study the effects of fatigue on doctors and even less on developing appropriate performance tests for sleep-deprived doctors. Clearly, sleep deprivation will lead to fatigue. What is of crucial importance is the effect of fatigue on performance. For example, in such circumstances and in a subsequent emergency, do doctors work slowly but carefully or do they work inaccurately or dangerously but at speed?

Nevertheless, concern for the junior doctors and their performance does little to address the problems which might follow the ageing process. How safe or effective are older surgeons, physicians or obstetricians? It is clear that medically qualified practitioners (as well as dentists and nurses) have high suicide rates, exhibit evidence of alcohol and drug abuse, have excess divorce rates and more mental illness. Much remains to be studied, even the fundamental question of whether self-selection of inherently unstable people into the professions is the root cause of the observed effects. Sick doctors are a problem to themselves and for their patients. It is time we grappled more effectively not only with management of the sick doctor but also with ways of preventing such illness in the first place.
Conclusions and recommendations

Although it would be impossible here to cover the whole field of occupational health problems among health care workers, many questions of current interest have been raised, with perhaps few answers. The risks that have been highlighted are either life threatening, such as neoplasm or suicide, or expensive, such as back pain or dermatitis.

New initiatives are clearly required. The European office of the World Health Organisation in its Report on Hospital Hazards in 1982 listed a number of priority areas [67]:

1. Better data collection on staff health
2. Improved environmental surveillance of workplace hazards
3. Universal health surveillance at work
4. Specific research initiatives concerning infections, pregnancy outcome, stress
5. Better methods for the organisation of work practices for all groups of workers

Such proposals echo the conclusions of a Report of a Joint Committee of the Ministry of Health and the Scottish Home & Health Department (The Tunbridge Report) published in 1968.

The hospital ought to be not merely a centre where sick people come for treatment but a place where positive attitudes towards the maintenance and improvement of health care are propagated. We do not believe it can become such a place until the health and welfare services provided for hospital employees are at least as good as the best that can be found elsewhere. In an organisation devoted to the treatment of the sick and their restoration to health it is absurd that the health needs of their employees should continue to be as neglected as they are at present.

Thackrah [2] would have supported that view. He stated:

The work people are less thought of than the machinery. The latter is frequently examined to ascertain its capabilities and the former is scarcely ever.

However, Thackrah's comments made over 150 years ago apply to the National Health Service today and the Tunbridge Report has not been implemented. A recent leading article in the British Journal of Industrial Medicine [68] described the lack of provision of high quality occupational health services to the NHS as a 'disgraceful state of affairs.' Yet the facts are that universal occupational health services are not available, regional or district consultants are a rarity, and, with some notable exceptions, the quality of occupational health practitioners in the service leaves much to be desired.

Progress is being made, but it is painfully—perhaps dangerously—slow. Whilst some responsibility for this obviously lies with Government and the Health Authorities, financial constraints do impose impossible choices on budget controllers. The Faculties of Public Health Medicine and Occupational Medicine have a job to do as well. They need to publicise the attractions of their specialty to the young doctors and nurses and then they need to provide high class training for the aspirants. There is no point in bemoaning the lack of financial resource if good quality practitioners are not available to use whatever resources are available.

The health care industry is big business and employs huge numbers of workers in all developed countries. The hazards of work are legion and the risks not inconsiderable. The provisions of health care at work for those health care workers should be available and, in general, are not. It is a challenge which the College and its Faculties need to take up at a political level with the Government and at a practical level to ensure a steady flow of specialists to do the job.

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