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Occupational health problems among nurses

by Cheng C Tan, MBBS, MSc¹

TAN CC. Occupational health problems among nurses. *Scand J Work Environ Health* 1991;17:221-30. Nurses are an integral component of the health care delivery system. In discharging their duties, nurses encounter a variety of occupational health problems which may be categorized into biological hazards, chemical hazards, physical hazards, and psychosocial hazards. A review of some examples of each of these four types of hazards is presented in this article. Particular attention has been devoted to hepatitis B, acquired immunodeficiency syndrome, tuberculosis, cytotoxic drugs, anesthetic agents, needlestick injury, back pain, and stress.

Key terms: acquired immunodeficiency syndrome, anesthetic agents, assault, back injury, back pain, burn-out, cytotoxic drugs, hepatitis B, needlestick injury, tuberculosis.

Since the dawn of civilization, virtually all types of occupations have had health hazards. In some jobs, the associated health problems are more dangerous than in others. Some occupational hazards are common to many vocations, while others are more peculiar to certain trades.

In the nursing profession, the types of health hazards encountered are varied. Some have existed since the birth of the nursing industry, but due recognition has only been accorded them recently. Other health problems are new, mostly a consequence of the rapid advancement in the health care field in recent times.

For convenience, occupational health problems among nurses may be categorized into four types, namely, biological hazards, chemical hazards, physical hazards, and psychosocial hazards. The order of presentation of the various hazards in the ensuing paragraphs does not reflect their relative importance.

Nurses have been selected to be the focus of attention in this article because they constitute the largest category of health care workers in most countries (1). In addition, they have a critical role in the health care delivery system. They generally serve as the primary interface with patients. It would be fair to state that the health care delivery system would cease to function in the absence of nurses.

In this article, an attempt is made to review some of the occupational health problems of nurses. This article is by no means an exhaustive account of all the literature on this subject. The coverage is restricted to papers and articles published in the English language.

Biological hazards

Broadly, biological hazards comprise various infectious diseases. According to Lunn (2), a report on occupational hazards in hospitals by a working group from the World Health Organization (WHO), Regional Office for Europe, emphasized that the fear of contracting serious infections at work remained uppermost as a hazard for most health care workers.

Hepatitis B

Hepatitis B is a recognized occupational hazard among hospital personnel. A WHO review of this hazard showed that hospital personnel had prevalence rates which were three to six times higher than those of the general population (2).

A study of sera from 3770 employees of the Medical School of Hannover in Germany found that 20.1 % of the nurses had evidence of previous exposure to hepatitis B virus (HBV) (3). This proportion was second only to that of hospital cleaners (26.3 %), which surpassed that of physicians (18.2 %). When matched for age and gender, nurses showed a significantly ($P < 0.01$) higher rate of hepatitis B infection than a reference group with less exposure to infected material. The same study also revealed that persons who had been nursing patients with hepatitis B were significantly ($P < 0.05$) more likely to be carriers of the hepatitis B surface antigen (HBsAg) or to have antibodies to HBsAg (anti-HBs) than a comparable group.

The most common mode of transmission of HBV is blood (2). Thus it is not surprising that inoculation injuries from contaminated needles and scalpels, as well as contamination of skin abrasions and wounds by infected blood, pose a significant risk. The rate of seroconversion after the percutaneous injection of blood or serum from HBsAg-positive patients has been quoted to range from 12 to 17 %, even after passive immunization of recipients by immune serum globulins (4).

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With the advent of effective and safe hepatitis B vaccines, namely, the human plasma-derived type (5–7) and the recombinant yeast vaccine (8), the occupational risk of acquiring this infection is likely to diminish greatly in health facilities where nurses are given the complete course of vaccination.

However, the risk will not be completely eradicated since studies have shown that approximately 4 % of nurses fail to seroconvert (9). In addition, the duration of immunity of those who have seroconverted is still a matter of much debate. Recommendations on the necessity of booster doses of the vaccine and the manner of determining the optimal timing of the same vary between researchers (6, 10–11). A recent study showed that 38 % of hospital employees had anti-HBs levels which were less than the theoretical protective level of 10 mIU/ml three years after the primary hepatitis B vaccination (12). From the foregoing, it is obvious that recommended guidelines for preventing HBV transmission to health care personnel must be followed (13).

Hepatitis non-A non-B

Apart from HBV, nurses are also at risk of getting hepatitis non-A non-B (HNANB). The latter may account for up to 90 % of all cases of posttransfusion hepatitis in facilities where all blood donations are screened for HBsAg (14). Transmission of HNANB following needlestick injury has been reported (15).

A recently discovered single-stranded ribonucleic acid virus, designated hepatitis C virus (HCV) (16), has been identified as a cause of HNANB (17–18). A specific immunoassay for detecting antibodies to HCV (anti-HCV) has been developed (17). Anti-HCV have been captured in up to 85 % of prospectively followed patients with posttransfusion HNANB and in 60 % of patients with chronic hepatitis or cirrhosis with a history of blood transfusion (18).

Among Spanish patients with hepatocellular carcinoma, anti-HCV have been found in 75 % of patients, a significantly ($P < 0.001$) higher proportion than that determined for referents (7.3 %) (19). The prevalence of anti-HCV in Italian patients with hepatocellular carcinoma has been reported to be 65 %, with no relation to the presence or otherwise of HBsAg (20). These findings point to a possible role for this newly unveiled virus in the pathogenesis of hepatocellular carcinoma.

To date, I have not come across any published study relating to the prevalence of anti-HCV among nurses. On the basis of current knowledge, it would be reasonable to surmise a significant seroprevalence rate of anti-HCV in health care workers, particularly those with frequent contact with blood. Unless recommended guidelines similar to those for the prevention of HBV transmission are adopted by nurses, HCV infection may well gain prominence in the near future as an occupational hazard in the health industry.

Acquired immunodeficiency syndrome

As of 30 June 1990, a total of 266 098 cases of acquired immunodeficiency syndrome (AIDS) had been reported to WHO by 157 countries from all continents (21). This dreaded modern-day pandemic caused by human immunodeficiency viruses can be transmitted in health care settings through inoculation injuries from contaminated needles or exposure of abraded skin or mucous membrane to blood or body fluids infected by a human immunodeficiency virus (HIV) (22–25). In fact, needlestick injury has been identified as the most important mechanism of transmitting HIV to health care workers (25). In many ways, the major modes of spreading a HIV bear a close resemblance to those of HBV.

In view of the escalating magnitude of the AIDS pandemic and reports of transmission of HIV to health care workers during work, it is understandable that concern has surfaced among nurses about the occupational risk of HIV infection. Fortunately, the current available data indicate that this risk is low (26) and less than that of occupationally acquired HBV infection (4). It has been estimated that the probability of seroconversion following percutaneous or mucous membrane exposure to HIV-infected blood has an upper 95 % confidence limit of 0.76 (4). For parenteral exposure per se, the risk ranges from 1.3 per 1000 to 3.9 per 1000.

However, AIDS is still a cause for concern. In spite of intense efforts by researchers worldwide, no cure or vaccine has yet been found to surmount or prevent this lethal disease. Thus recommended guidelines must be observed (13). An American study showed that 40 % of occupational exposures to HIV-infected blood could have been prevented if health care workers had taken the necessary precautions (27).

Tuberculosis

Tuberculosis (TB) continues to remain a serious public health problem in many developing countries. It has been estimated that these countries account for over three-fourths of the some 8–10 million new cases of TB in the world each year (28). There is evidence that some of these countries are experiencing a rise in the incidence of TB in recent times. In such places, the risk of infection to nurses is indeed real, especially from undiagnosed TB cases.

In contrast, the incidence of TB in many developed nations has declined dramatically over the last few decades (28). Concomitantly, the occupational risk of contracting TB among nurses in such localities has greatly receded. A Canadian study of notified cases of active TB in female nurses in British Columbia for the period 1969–1979 found a mean annual incidence of 2.6 per 10 000 nurses, a figure similar to that of other women, adjusted for age and birthplace (29).

However, recent data suggest a reversal of this favorable trend in the United States (30). This resur-

gence of TB has been partially attributed to the HIV pandemic. Recent literature has also revealed a strong association between TB and HIV-I infection (28). In fact, TB is now recognized as one of the most common opportunistic infections in patients seropositive for HIV-I. In view of this new development, nurses in countries with high HIV-I infection rates will probably experience a greater risk of contracting TB in the future unless preventive measures are taken. These measures include setting up a screening and surveillance program and immunizing tuberculin-negative health personnel with the Bacillus-Calmette-Guerin vaccine.

Other infections

Viral infections with known teratogenic effects are hazards of concern to nurses in the reproductive age group, especially those who are pregnant. Cytomegalovirus (CMV) infection and rubella infection are two such examples. However, in the case of CMV, reviews of the medical literature by groups in Canada (31) and Scotland (32) led to the conclusion that infection with CMV is not an occupational hazard among those caring for infants and young children. Nonetheless, the need for careful handwashing cannot be overemphasized. With regard to rubella, seronegative nurses of childbearing age who are not pregnant should be given the rubella vaccine.

Another viral infection with an established occupational risk for health care workers is herpetic whitlow (33). It is a herpes simplex viral infection of the digits resulting from contact with secretions containing the virus.

The transmission of *Clostridium difficile* infection from a patient to three nurses has been reported (34). The authors believed that this infection may be an important hazard to health care workers.

Chemical hazards

Chemical hazards in the health care setting include certain classes of drugs and some agents used in equipment sterilization. With the introduction of more chemical-based substances into medical practice, it is likely that more of the same will enter the list of suspected or confirmed occupational hazards to nurses in due course.

Cytotoxic drugs

The safety of cytotoxic drugs to nurses who handle them has been the subject of much debate. The finding of increased mutagenic activity in the urine of nurses who handled these agents has triggered caution about the possible adverse effects of such drugs to persons who deal with them (35). However, the significance of this finding has been questioned. A similar finding was detected for smokers and for persons

having ingested certain drugs and dietary items (36—37). Furthermore, its presence did not appear to be a constant feature among exposed personnel (36—37).

However, in another study, cyclophosphamide was found in urine specimens of two oncology nurses involved in the preparation of this drug (38). This finding raises the possibility that significant absorption of the drug by the two oncology nurses could have taken place. It was suggested that the increased levels of mutagenicity observed in urine specimens of oncology nurses might have arisen in part from metabolites of cyclophosphamide. In view of the known side-effects of cytotoxics, such as second malignancies, this finding is important.

Norppa and his co-workers reported increased frequencies of sister chromatid exchanges in lymphocytes of nurses who handled cytostatic drugs (39). Nikula et al (40) disclosed that nurses with long-term exposure to cytostatic agents had significantly higher numbers of chromosome-type breaks in their lymphocytes as compared with a reference group of unexposed laboratory workers and hospital clerks (40). Another study involving 24 oncology nurses or pharmacists and an equal number of matched referents found that the frequency of in vivo mutations in lymphocytes was significantly increased in the former and appeared to be related to the duration of exposure (41). Such findings lend weight to the suspicion that these drugs pose a potential carcinogenic risk to exposed nurses. However, to date, I have not come across any prospective study showing clear-cut neoplastic effects on exposed nurses.

A Finnish study of three head nurses with long-term exposure to cytostatic drugs revealed histological evidence of portal hepatitis with piecemeal necrosis in one of them and hepatic fibrosis in the others (42). Findings from follow-up biopsies from the same subjects after the cessation of drug exposure seemed to suggest that the long-term handling of cytostatic drugs may lead to irreversible hepatic fibrosis.

Occupational exposure to antineoplastic drugs might pose a hazard to reproduction among female nurses (43). In their case-referent study involving nurses in 17 Finnish hospitals, Selevan and her co-workers (43) found a statistically significant association between fetal loss and occupational exposure to antineoplastic drugs during the first trimester of pregnancy (odds ratio 2.3, 95 % confidence interval 1.20—4.39).

In view of the aforementioned potential adverse effects, care must be exercised in handling both these drugs and the waste products of patients undergoing cytotoxic chemotherapy. The need for the latter was highlighted by Venitt et al (44), who showed that the urine of patients receiving cisplatin contained appreciable amounts of the drug. Recommendations for the safe handling of cytotoxic drugs have been made by various authorities, such as the Health and Safety Executive in Great Britain (37).

Anesthetic agents

Adverse health effects which have been attributed to occupational exposure to anesthetic agents include unfavorable reproductive outcome, liver diseases, kidney ailments, and interference with vitamin B₁₂ metabolism (45). Most studies exploring the link between anesthetic gas exposure and spontaneous miscarriage among health care workers have relied on questionnaire surveys comparing retrospectively the reproductive outcomes of those who have been exposed with those who have not been exposed. A major problem associated with such studies is the possibility of recall bias. Furthermore, the response rates in many studies were rather low. In some studies, differing response rates between the groups being compared generate further doubts about the validity of the findings. Even after considering these limitations, Vessey & Nunn (45) concluded that exposed women had an increased risk of about 40 % for spontaneous abortion.

Layzer (46) described a neurological disorder resembling subacute combined degeneration of the spinal cord in 15 patients who had prolonged exposure to nitrous oxide (46). This finding led to the suggestion that nitrous oxide exposure might affect the metabolism of vitamin B₁₂. Another study found evidence of bone marrow toxicity in 3 out of 20 dentists who were habitually exposed to mean nitrous oxide levels ranging from 159 to 4600 ppm (47). These figures overlap with those found in operating rooms in British hospitals, where exposure ranges from 30 to 3000 ppm (48). Thus, nurses who are exposed to these levels of nitrous oxide may be at risk of disturbed vitamin B₁₂ metabolism. The National Institute for Occupational Safety and Health in the United States has recommended a maximum exposure level of 2 ppm for halothane and 25 ppm for nitrous oxide (45).

It is reassuring to note that the evidence for other suspected hazards like malignancy, teratogenic effects, low birthweight, and infertility was deemed unconvincing (45). Furthermore, trace concentrations of anesthetics did not appear to impair psychomotor performance to any significant extent (49).

However, efforts must be made to ensure that the levels of anesthetic gases in the work environment of nurses are kept below recommended limits. Towards this end, it may be necessary to install effective scavenging systems (2).

Antibiotics

Sensitization to antibiotics, especially penicillins, among nurses is well documented (50, 51). In an interviewer-administered questionnaire study in Sri Lanka, sensitivity to penicillin and other substances was found to be more common among hospital staff nurses (33.7 %) than among a reference group of teachers (6.4 %) (51). Nearly one-third of those staff nurses who gave a history of allergy were allergic to penicillin only.

Of those who were allergic to penicillin, 51 % developed the allergy within 10 years of service.

Ethylene oxide

Ethylene oxide is commonly used in health care facilities as a sterilizing agent for heat-sensitive medical equipment. However, concern has been expressed about its safety. Ethylene oxide is suspected to be a carcinogen. The most vulnerable part of the body appears to be the bone marrow (52).

Finnish researchers have suggested that exposure to ethylene oxide may carry a risk of spontaneous abortion for sterilizing staff (53). In their study, the spontaneous abortion rate for exposed pregnancies was 16.7 % as compared with 5.6 % for unexposed gestations. This difference persisted even after adjustment for the effects of age, parity, decade of pregnancy, smoking habits, and intake of coffee and alcohol.

Formaldehyde

Formaldehyde irritates mucous membrane and impairs the mucociliary mechanism. In rare massive acute exposures, pulmonary edema may result (54). Among the disinfectants, formaldehyde has been found to be the most common cause of occupational dermatitis among nurses (50).

Occupational asthma resulting from exposure to formaldehyde has been documented for nurses (55). However, in a report by the Council on Scientific Affairs of the American Medical Association, no significant impairment in pulmonary function was noted in the few studies cited (54). However, the same noted that brief exposures could trigger nonspecific airway hyperresponsiveness.

The carcinogenic potential of this agent in humans remains controversial. Some studies have cited excesses of certain tumors among exposed workers, while findings for others were contradictory. Nevertheless, the Environmental Protection Agency and the National Institute for Occupational Safety and Health in the United States have classified formaldehyde as a possible human carcinogen (54).

Glutaraldehyde

In medical facilities, glutaraldehyde is an excellent disinfectant for the cold sterilization of endoscopes. Like other chemical agents mentioned in the preceding passages, its use is not without adverse effects. This agent seems to act both as an irritant and as an allergen. Recognized disorders following exposure to glutaraldehyde include rhinitis, asthma, and contact dermatitis (56).

Other chemical hazards

Chlorhexidine has been shown to be a cause of irritant contact dermatitis among nurses (50). In addition, cases of occupational asthma caused by chlorhexidine

and alcohol aerosols in a practical nurse and a midwife have been described recently (57).

Acrylic cement vapor has been incriminated as the cause of a case of corneal ulcer in an operation nurse (58). A case of occupational asthma in a nurse working in an orthopedic theater was attributed to methyl methacrylate, a constituent of acrylic cement (59).

Rubber gloves can sensitize users and cause local contact urticaria. A study in Finland revealed that the frequency of this allergy among doctors and nurses in operating units was 6.4 % (60). In addition, a case of asthma attributed to vapor given off by general purpose rubber gloves has been published (61). These findings are important in view of the fact that rubber gloves are worn as certain procedures are performed. This practice is likely to be more widespread in the current pandemic of HIV infection.

Psyllium is a constituent of bulk laxatives. Sensitization to psyllium following occupational exposure has been shown for nurses. The allergic manifestations in affected nurses include rhinitis (62) and asthma (63).

Physical hazards

In the execution of their duties, nurses face various hazards of a physical nature. According to Feldman (64) needle puncture, sprains, and back injuries were the most common injuries sustained by hospital employees in a study conducted by the National Institute of Occupational Safety and Health in the United States. Other physical hazards of note include assaults and radiation.

Needlestick injury

Needlestick injury is one of the most frequent occupational accidents among nursing professionals. McCormick & Maki (65) reported that needlestick injury accounted for one-third of all work-related accidents reported by hospital personnel at the University of Wisconsin. Nurses accounted for nearly two-thirds of the total reported cases of needlestick injury in two American studies (65—66). In terms of annual incidence rate, McCormick & Maki (65) reported the following results: 92.6 needlestick injuries per 1000 registered nurses, 127.0 per 1000 housekeeping staff, and 104.7 per 1000 laboratory personnel. In their study, Ruben et al (66) disclosed that the average annual incidence rate was highest for nurses (23 wounds per 100 nurses).

An important consideration in assessing findings based on records is the problem of underreporting (67), particularly with nurses who tend to make their own judgment regarding the extent of the injury (68). Thus, the actual magnitude of needlestick injury is probably much higher than the reported figures.

In a self-administered questionnaire survey among nurses in a regional hospital in Hong Kong, Tan & Yu (69) reported that 95 % of the nurses had experienced needlestick injury since joining the nursing profession.

In the week prior to the survey, 15 % of the nurses were injured by needlesticks. However, the low response rate (31 %) in this survey is a major limitation to consider in interpreting the findings.

Although the acute consequence of needlestick injury is usually a temporary disability, there is a serious risk of long-term repercussions which may result in permanent disability. The threat of contracting viral hepatitis and HIV infection has been noted earlier. Needlestick injury and cuts from sharp instruments account for 76 % of occupational exposures to HIV among health care workers (27). In addition, the transmission of other diseases ascribed to needlestick injury has been published, albeit few in numbers. These diseases include malaria (70), TB (71), and cryptococcoses (72). A case report has been published of an accidental injection of a human colonic adenocarcinoma cell line into an otherwise healthy female laboratory worker with subsequent growth of a tumor nodule at the site of injection (73). There is also a risk of sepsis following needlestick injury (68).

In an effort to reduce the incidence of needlestick injury, researchers have tried to unravel the associated factors. Some have examined the problem in terms of work activities, while others have looked into the types of devices which were involved. From the study by McCormick & Maki (65) and Ruben et al (66), four important activities leading to needlestick injury among nurses can be identified. These are recapping of used needles, disposal of used needles, venepuncturing, and administration of intravenous therapy. Together, they are responsible for nearly three-fourths of all activities known to be associated with needlestick injury. These findings suggest that the majority of needlestick injuries are avoidable if recommended precautions (65) are taken by nurses.

In another study in the United States, Jagger et al (74) disclosed that the three most common devices implicated in needlestick injury were disposable syringes, intravenous tubing and needle assemblies, and prefilled cartridge syringes. These devices accounted for 35, 26, and 12 %, respectively, of the 326 incidences of needlestick injury which were studied. The recapping of used needles was found to be the cause of one-third of the needlestick injuries. Competing hazards, such as the risk of disassembling a device with an uncapped contaminated needle, were cited as reasons for recapping. In addressing the problem of needlestick injury, Jagger et al stressed the need to modify the design features and handling requirements of devices with needles. They cited evidence that efforts to implement various recommended guidelines to overcome the problem of needlestick injury had thus far been disappointing. Their suggestion is reasonable since it is usually more effective to rely on an inherently safe device than to depend on human effort to change work habits. Nonetheless, both approaches have important roles to play in the attempt to surmount the problem of needlestick injury.

Back pain and back injuries

Back pain is a leading complaint among working people. It affects more than half of the working population at some time during their careers (75). Workers in the health industry, especially nurses, are particularly prone to develop back pain in the course of their work. In Israel, a survey of eight occupations found that only workers in heavy industries had a higher rate of back pain than nurses (76). High rates of back pain have also been documented among nurses in several other countries (77–79).

In the United States, attack rates of 52 and 37 % for six-month and two-week recall periods, respectively, were revealed in a questionnaire survey on occupational low-back pain among nurses (77). These rates were significantly ($P < 0.01$) higher than those reported by a reference group of unit service coordinators who performed clerical work in nursing units.

Finnish researchers reported that 79 % of qualified nurses and 85 % of nursing assistants had had at least one episode of low-back pain prior to their survey (78). The corresponding figures for the month preceding the study were 41 and 50 %, respectively.

In Great Britain, another questionnaire survey of back pain in the nursing profession found an annual prevalence (person) of 431 per 1000 nurses (79). The annual incidence (person) of back pain was 77 per 1000 nurses. The corresponding figures for back pain attributed to specific patient-handling incidents were 159 per 1000 nurses and 29 per 1000 nurses, respectively. Back pain and back injuries are important causes of morbidity among nurses. These problems are recognized as major sources of incapacity and ill-health retirement from the nursing profession. In their study, Harber et al (77) reported that 29 % of nurses had resorted to the use of analgesics to relieve their back pain in the preceding six months. In a five-year prospective survey of low-back injuries to nurses due to patient-handling which resulted in absence from work, 27 % of injured nurses had evidence of prolapsed intervertebral lumbar disc lesion (80).

In Finland, low-back pain leading to unfitness for daily tasks within the previous five years was indicated by 18 % of qualified nurses and 29 % of nursing assistants (78). Among all hospital nursing personnel in Ontario, back injuries accounted for more than 40 % of all time-lost claims (81). Stubbs et al (79) estimated an annual loss of 750 000 workdays among nurses in Great Britain as a consequence of back pain. Heap (80) reported that 12 % of nurses with low-back injuries had premature employment termination. With the current shortage of nursing personnel in many countries (82–84), the health industry can ill afford such high levels of morbidity.

In their endeavor to elucidate the associated factors of back pain among nurses, various researchers have identified the importance of a previous history of back pain, work activities, and job category. A past history of back pain was consistently found to be a signifi-

cant predictor of subsequent back pain (81, 85). The recurrent tendency of back pain in nurses is illustrated by the finding that 84.7 % of nurses with back pain have more than one episode (79).

Work activities have been found to be significantly associated with back pain in nurses (77, 81). The act of lifting patients has been documented to be the activity most commonly reported by nurses to be associated with back pain (77) and back injuries (86). Videman et al (87) revealed that poor patient-handling skill was one of the major risk indicators of back pain and back injuries in nurses. Findings from researchers in the United States suggest that nonpatient contact activities like moving hospital furniture or equipment are more closely associated with occupational back pain than patient contact activities (85). The former type of activities was also observed to be performed more frequently by nurses than the latter (88).

Within the nursing profession, nursing assistants seem to be at a greater risk of occupational back pain and back injury than registered nurses (78, 80, 81). However, this observation of an association between nursing job category and back complaints may be confounded by work activities since nursing assistants tend to have more lifting, bending, and rotating movements in their work than registered nurses (78). Nursing assistants also tend to carry heavier lifting loads (80). The study by Venning et al (81) gave strong support to the importance of job category as an associated factor of back injuries. After applying a forward stepping model of logistic regression, job category maintained significance ($P < 0.01$) as a predictor of back injury. The adjusted odds ratio observed was 1.77 for nursing assistants as compared with registered nurses and supervisory personnel.

In view of the fact that lifting has been incriminated as a major factor associated with back pain, it seems logical to assume that training in proper lifting techniques should be protective. However, the existing evidence on this issue is controversial. On one hand, several investigators have pointed out the ineffectiveness of training in safe lifting procedures as a means of reducing rates of back pain among nurses (77, 79, 81). On the other, advocates of such an approach argue that the lack of positive results may be due to the tendency of employees to disregard instructions (75). It has been suggested that the methods of training which were negatively evaluated were inappropriate and more likely to cause injury than to help avoid it (89).

Heap (80) stated that the retraining of nurses in the proper use of kinetic principles, coupled with regular reinforcement of the same, had contributed significantly to the control of low-back pain in nurses. In a recent interventional study, an improvement in patient-handling skills was noted after training (87). Nurses with bad or poor patient-handling skills had significantly ($P < 0.001$) more back injuries (24 %) than those rated as having good or excellent patient-handling skills (2 %). Thus patient-handling skills appear to offer

some protection against back injury. From the available knowledge of biomechanical principles, this assumption is indeed plausible. Perhaps the lack of evidence regarding the effectiveness of training has to do with quality, duration, and frequency of training.

Assaults

Nurses are at risk of assault during the course of their work. This statement applies to both hospital and community nurses (90). Among hospital nurses, the high risk areas include accident and emergency units (90) and psychiatric units (91).

Howie (90) reported that a questionnaire survey of the Health and Safety Executive in Great Britain among community and hospital nurses found that 17.5 % of 3000 respondents had been threatened in the year prior to the survey. About 11 % of the respondents had received minor injuries. Convey (91) noted that nurses were more likely than any other group of professional people to be victims of an attack. From the data published in Howie's article (90), nurses accounted for 54.2 % of major violent occurrences and 75.6 % of minor violent episodes. Assaults were also found to be underreported by nurses (91).

Although the vast majority of assaults on nurses result in no visible or minor injuries (91), assaults can have significant effects on the affected nurses. Among the adverse reactions experienced by assaulted nurses were anxiety, sleep disturbances, and symptoms consistent with a diagnosis of posttraumatic stress disorder (92). In some victims, these symptoms persist for more than two weeks.

Radiation

Radiation can be grossly divided into ionizing and non-ionizing forms. The potential adverse effects of exposure to ionizing radiation is well recognized. They include malignant diseases, genetic damage, unfavorable reproductive outcome, and radiation illness (93). Sources in the medical setting include equipment used in diagnostic radiology and therapeutic radiology, as well as radiopharmaceuticals (2). Thus nurses serving in units dealing directly with these sources are at risk if recommended protection guidelines are not followed. In addition, nurses in other units who have to accompany patients for procedures involving the aforementioned sources are also in potential jeopardy.

However, it is reassuring to note that a study which monitored nursing personnel staffing a coronary care unit over a three-year period found no evidence of a significant occupational hazard to nurses working in such units (94). The author stated that adherence to standard protective measures would preclude most exposure to machine-produced radiation.

One of the important types of nonionizing radiation used in health care facilities is laser beams. The application of lasers in the field of medicine is widespread

and increasing. The greatest risk from laser beams is retina damage, which can result from inadvertent exposure, either from a direct beam or indirectly from beams reflected off shiny surfaces (2).

Psychosocial hazards

Psychosocial hazards of concern to nurses include mental stress, and shift work. The risk of suicide is increased.

Stress

The task of tending to the needs of the sick, the disabled, and the dying can be very stressful. Employees in the health industry face significant risks of "burn-out" which involves emotional exhaustion, depersonalization, and low productivity associated with feelings of low achievement (95). A British study showed that 80 % of nurses suffered from moderate to severe burnout (96). Psychological burnout is a recognized hazard of caring for patients with terminal illness, including AIDS. In fact, with AIDS, the emotional demands of the patients seem to surpass those inherent in caring for patients with cancer (97). The fact that the majority of AIDS victims are in their prime of life adds to the stress experienced by many health professionals who care for them.

Among health care workers, nurses seem to have a higher level of stress than physicians and pharmacists. This finding was revealed in a study using the Health Professions Stress Inventory (HPSI) to compare stress levels among these three groups of health care workers (98). Another study showed significant variations in the levels of occupational stress experienced by health care workers in different units within a hospital (99).

Shift work

There is a variety of shift patterns employed in various health care facilities. The nature of the work performed by nurses makes shift work inevitable. However, shift work can have deleterious effects on affected workers. These effects include disruption of social and family life and the disentrainment of circadian rhythm (100). The latter may result in sleep disturbances, fatigue, and impaired work performance and safety awareness. In addition nurses with medical conditions such as diabetes mellitus, asthma, and epilepsy may have exacerbations of their illness due to a desynchronization of their body clock.

Suicide

The emotional stress which is inherent in the job of nursing appears to affect the mental health of nurses. Among all professional groups, nursing has one of the highest rates of suicide (101). A study in the United States on the mortality patterns of registered nurses

in Wisconsin for the period 1963-1977 revealed that the strongest association of cause of death to the occupation was suicides, reported to be 50 % higher than in other groups (102).

Related factors

The consequences of psychosocial hazards faced by nurses can also be costly to patients and health facilities. To patients, the quality of care may be affected, albeit unintentional, whereas health facilities stand to lose talents when affected nurses succumb to these hazards and opt out of their profession.

Presently, in many parts of the world, nursing staff shortages are a major problem reaching crisis proportions (82-84). Without doubt, psychosocial factors in the work environment of nurses have an important contributory role in fueling this problem.

In addressing the issue of nursing grievances, Delamothe (82) cited results of recent surveys which showed that psychosocial factors featured prominently as reasons given by nurses who had intentions of leaving their jobs. The shortage of nurses is in itself a source of stress since those who continue in this field will have to shoulder a greater burden. Thus a vicious cycle is in motion. There is clearly need for a concerted effort by health authorities and nurses to address psychosocial issues in the nursing industry. Otherwise, the current shortage of nurses will persist or worsen.

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