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Effects of Extended Work Shifts and Shift Work on Patient Safety, Productivity, and Employee Health

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ABSTRACT

It is estimated 1.3 million health care errors occur each year and of those errors 48,000 to 98,000 result in the deaths of patients (Barger et al., 2006). Errors occur for a variety of reasons, including the effects of extended work hours and shift work. The need for around-the-clock staff coverage has resulted in creative ways to maintain quality patient care, keep health care errors or adverse events to a minimum, and still meet the needs of the organization. One way organizations have attempted to alleviate staff shortages is to create extended work shifts. Instead of the standard 8-hour shift, workers are now working 10, 12, 16, or more hours to provide continuous patient care. Although literature does support these staffing patterns, it cannot be denied that shifts beyond the traditional 8 hours increase staff fatigue, health care errors, and adverse events and outcomes and decrease alertness and productivity. This article includes a review of current literature on shift work, the definition of shift work, error rates and adverse outcomes related to shift work, health effects on shift workers, shift work effects on older workers, recommended optimal shift length, positive and negative effects of shift work on the shift worker, hazards associated with driving after extended shifts, and implications for occupational health nurses.

The current shortage of nurses in the United States and around the world has stressed health care organizations. One of the ways that organizations have attempted to alleviate staffing shortages has been to create longer work shifts.

On May 1, 1886, the fight for the “Eight-Hour Work Day” led 1 million workers to leave their jobs and rally. In 1938, the American labor movement was successful

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in their support of the U.S. Fair Labor Standards Act, which defined the allowable hours of work each week (National Institute for Occupational Safety and Health [NIOSH], 2008). More than 70 years later, extended duration work shifts are once again a topic of concern. Although the literature supports extended work shifts, it cannot be denied that shifts beyond the traditional 8 hours have been associated with increased risk of errors, incidents, and accidents (Josten, Ng-A-Tham, & Thierry, 2003; Lockley et al., 2007; Richardson, Turnock, Harris, Finley, & Carson, 2007). Studies also indicate that extended work hours negatively affect employee health and well-being (Raediker, Janssen, Schomann, & Nachreiner, 2006) and result in increased fatigue for shift workers and decreased alertness and productivity (Fitzpatrick, While, & Roberts, 1999). Additionally, long work hours likely coincide with high job demands (van der Hulst, 2003) both physically and mentally;

Applying Research to Practice

Occupational health nurses must educate workers about ways to prevent adverse events and health care errors and improve patient safety. Occupational health nurses must be aware of signs and symptoms associated with long-term sleep deprivation and should identify workers who are not able to function safely. Occupational health nurses can identify workers whose critical thinking abilities are impaired due to exhaustion, being aware that employees who work extended shifts are at greater risk for on-the-job injuries and automobile accidents. When occupational health nurses observe employees who are too fatigued to function safely, they need to advocate that the employees be sent home.

some examples include merchant marines, truck drivers, nurses, and physicians.

DEFINITION OF EXTENDED WORK SHIFTS

Extended shifts represent a compressed work week defined as “any system of fixed working hours more than eight hours in duration which results in a working week of less than five full days of work a week” (Smith, Folkard, Tucker, & Macdonald, 1998, p. 217). Conversion to a compressed work week is often considered because of the perceived benefits for production and morale, reduction of sickness absence, and convenience of having fewer days at work (Smith et al.). Shift work refers to a work-hour system in which a relay of employees extends the period of production beyond the conventional daytime third of the 24-hour cycle (Levy, Wegman, Baron, & Sokas, 2006).

ERROR RATE AND ADVERSE OUTCOMES

Extended duration work shifts and shift work have adverse effects on patient outcomes and increase health care errors and patient injuries (Lockley et al., 2007). Recent research has demonstrated that physicians-in-training working traditional recurring 24-hour shifts made 36% more serious health care errors, made 5 times as many serious diagnostic errors, and had twice as many on-the-job attentional failures at night, suffer 61% more needlesticks and other sharps injuries, and are 300% more likely to make fatigue-related errors that lead to patients' death (Lockley et al.). In the United States, nationwide limits on the work hours of physicians-in-training were implemented in July 2003. Under the direction of the Accreditation Council for Graduate Medical Education, interns and residents are limited to an 80-hour work week averaged over 4 weeks; however, shift lengths up to 30 hours are still permissible (Mountain, Quon, Dodek, Sharpe, & Ayas, 2007).

Nurses working shifts in excess of 8 hours report more medication errors, difficulty staying awake and actually falling asleep during work hours, a decrease in productivity the last 4 hours of the shift, and an increased risk of errors and near errors associated with decreased vigilance (Lockley et al., 2007; Scott et al., 2007; Smith et al., 1998). Nurses and interns have both reported impairment in critical thinking abilities. The risk of an error almost doubles when nurses work 12.5 or more consecutive hours (Scott et al.). Nurses suffer more needlestick injuries during extended shifts and needlestick and biological fluid exposure rates increase during the last 2 hours of a 12-hour shift (Lockley et al.). The number of continuous duty hours that health care personnel are permitted to work are much higher than in other professions (e.g., nuclear power industry) (Mountain et al., 2007).

HEALTH EFFECTS

Extended duration shifts may affect the health of shift workers and make them more prone to chronic diseases (e.g., diabetes, cardiovascular disease, and hypertension) leading to disabilities that require early retirement (NIOSH, 2004). In addition, these workers may experience gastrointestinal, minor psychiatric, and sleep disorders, fatigue, and social problems (Workers Health Centre, 2005). These workers are at increased risk of musculoskeletal injuries resulting in permanent impairment. They are also more likely to be involved in motor vehicle accidents after extended work shifts (Robb, Sultana, Ameratunga, & Jackson, 2008). The extent to which shift work and extended shifts affect individual workers depends largely on their work tasks, individual characteristics, organizational and social environments, and features of the shift system (Josten et al., 2003; Smith et al., 1998).

Shift work and extended shifts interfere with the body's natural circadian rhythm. Humans by nature are designed to work during daylight hours and sleep during night hours. When working off hours, individuals are fighting their natural instinct to sleep, disrupting the body's internal clock and forcing it to alter its activity-rest cycle. Shift workers are more prone to smoking, drinking, and exercising less than recommended by the American Heart Association (van der Hulst, 2003; workershealth.com, 2008). Additionally, researchers have found a relationship between long work hours and depression of the body's immune system (van der Hulst).

FATIGUE

Fatigue is one of the most common concerns associated with shift work and extended duration shifts. Fatigue is a general term used to describe a wide variety of conditions. Acute fatigue can be classified as mental fatigue, due to mental overload or underload, or physical fatigue (Brake & Bates, 2001). Long-term or prolonged fatigue is irreversible and no longer responds to worker compensation mechanisms (Wadsworth, Allen, Wellens, McNamara, & Smith, 2006). Some of the most significant disasters of our time can be attributed to fatigue: the Three Mile Island accident in Pennsylvania, the Chernobyl nuclear power plant accident in Russia (Suzuki, Ohida, Kaneita,

Yokoyama, & Uchiyama, 2005), and the grounding of the oil tanker Exxon Valdez off the coast of Alaska (Wadsworth et al.). The concept of fatigue is difficult to quantify because fatigue is a subjective and personal experience (Richardson et al., 2007). Symptoms of fatigue can include muscle weakness, lethargy, inability to think clearly or concentrate, listlessness, decreased cognitive function, anxiety, and exhaustion. Working extended hours for long periods can increase damage to workers' health and well-being commensurate with the hours worked (i.e., total exposure to workload) (Raediker et al., 2006).

SHIFT WORK AND THE OLDER WORKER

Extended work hours and shift work more profoundly affect older shift workers. In the author's experience, older workers are less capable of working longer shifts because of the normal physiological changes that occur naturally with aging. They tend to have less stamina, are more prone to chronic illnesses, and may have a complicated home environment that interferes with rest between shifts (i.e., care of older parents, grandchildren, or ill spouses). Aging decreases the speed of circadian adaptation to night work, increases the risk of sleep disorders and negative health effects, and threatens safety in work environments designed for younger employees (Letvak, 2005).

One study suggested that older workers working 12-hour shifts had a higher incidence of absence, sickness, and intoxication (Smith et al., 1998). Younger workers are naturally fatigued at the end of a long workday. However, they are more capable of rebounding after the shift and tend to enjoy this work schedule because it rewards them with more days for social activities. One study found that satisfaction with working hours and free time increased (Josten et al., 2003) when working 12-hour shifts. Although older workers may enjoy more days away from work, they tend to prefer shorter shifts when given the choice of the two shifts.

WHAT IS THE OPTIMAL SHIFT LENGTH?

Both types of work patterns have positive and negative aspects. The 8-hour shift is safer than longer shifts (Mitchell & Williamson, 2000; Raediker et al., 2006). In one study, a significant relationship was found between duration of shift and total performance scores; working a shift of 8 hours or less resulted in higher total performance scores than when working 12- to 12.5-hour shifts (Fitzpatrick et al., 1999).

Richardson et al. (2007) found that working extended shifts and shift work may not be as significant a concern as the number of consecutive days worked or number of hours between shifts when rotating from one time period to another. It has been found that many workers agree that three consecutive day shifts and four consecutive night shifts should be the maximum number worked before a day off to rest (Richardson et al.). One study found that the majority of staff (66%) reported 24 hours as a safe period of time to be off duty after working a day shift and before starting a night shift. The rest time needed was longer after working night shifts and before starting day shifts. A safe period of time was viewed as 48 hours by

the majority of the staff (64%). The minimum number of 24-hour periods off after a night shift before returning to work should be two and the minimum number of 24-hour periods off after a day shift before returning to work should be one.

NEGATIVE ASPECTS OF EXTENDED SHIFT WORK

Many negative aspects are associated with working extended shifts and shift work, including an increase in accidents while on the job, reduced duration and quality of sleep, and sleepiness, fatigue, and less alertness while performing duties (Smith et al., 1998; van der Hulst, 2003). The worker may experience decreased reaction times and poorer work performance (Scott, Rogers, Hwang, & Zhang, 2006). The worker will have more days off but may feel ill many of those days and experience long-term adverse health effects. Night shift workers may have fewer opportunities to communicate with upper management. Managers often cannot find coverage for extended shifts when a worker is ill or injured (Knauth, 2007). If workers are in an environment with toxic exposures, they experience more time exposed during extended shifts (Knauth).

Workers may also experience difficulties at home with spouses and children because they are away for long periods. Also, these workers are more prone to automobile accidents after extended shifts. Nurses working extended shifts experience the following: the need to reorient after returning from several days away, short time between shifts, lack of continuity of patient care, reduction in quality of patient care, and stress associated with caring for demanding patients and families for more than 8 hours (Richardson et al., 2007).

POSITIVE ASPECTS OF EXTENDED SHIFT WORK

The positive effects of working extended shifts include the ability to work a second job, more days away from work, and more free time with family and friends. Nurses have more time for leisure and social activities, more time for domestic duties, fewer shift "hangovers," and less travel time to and from work. Organizations favor extended shifts because managers have to provide staffing for only two shifts instead of three, experience less staff turnover, and have less overtime. Nurses have less pressure to complete assignments in an 8-hour day and better continuity of care (Knauth, 2007; Richardson et al., 2007).

DRIVING AND EXTENDED WAKING HOURS

Concerns also arise when shift workers drive home at the end of their shifts. Studies have shown that the prevalence of sleep-related motor vehicle crashes is higher among individuals who are employed, work more than 60 hours per week, work irregular hours, work at night, and are sleep deprived (Robb et al., 2008; Scott et al., 2007). These workers are at more risk of a motor vehicle crash than the general population. In fact, studies have indicated that remaining awake for 19 consecutive hours slows cognitive function and reaction times to a level comparable

to that associated with a blood alcohol concentration of 0.05% (Scott et al.). Remaining awake for 24 consecutive hours slows reaction times to a level approximating an individual with a blood alcohol concentration of 0.1%, a concentration that exceeds the legal limit for operating a motor vehicle in most states (Scott et al.; Surani, Murphy, & Shah, 2007). Additionally, a linear relationship exists between the number of extended shifts per month and the subsequent occurrence of crashes (i.e., each extended duration work shift increased the crash rate by 9.1% [3.4% to 14.7%] over baseline and the risk of a crash on the commute from work by 16.2% [7.8% to 24.7%]) (Lockley et al., 2007). In addition, sleepy shift workers present a potential liability to their employers. Legal precedents in the United States hold both drivers and employers responsible for injuries resulting from motor vehicle collisions caused by fatigued drivers (Mountain et al., 2007); thus, if shift workers have accidents on the way home after work, the law may hold workers' employers as well as individual workers liable for injuries sustained in the accidents.

WORK-RELATED FATIGUE IN OTHER INDUSTRIES

Work-related fatigue is not unique to the health care industry. Many other industries use extended duration shifts and shift work to maintain production quotas and staffing. In the maritime industry, workers not only work 12- to 16-hour days, they live and sleep in the same environment in which they work. In addition, they may remain at sea for many weeks with little or no chance for rest, recreation, or recovery. Working at sea has one of the highest rates of occupational accidents and injuries of any occupation (Wadsworth et al., 2006). A study of merchant marine personnel on watch demonstrated that sleep was severely fragmented and most watch periods were associated with reduced sleep in the preceding 24 hours (Ferguson, Lamond, Kandelaars, Jay, & Dawson, 2008). In the construction industry, extended shifts and shift work have been associated with a higher incidence of on-the-job injuries (NIOSH, 2004). Police officers on both 8- and 12-hour night shifts showed significant decreases in subjective alertness from the beginning to the end of their shifts, but did not show these same losses when working 12-hour days (NIOSH). One study tested workers employed by United Auto Workers and found that those working extended shifts reported poorer performance on tests of cognitive and executive functions (e.g., planning, cognitive flexibility, and abstract thinking) (NIOSH). One study examining shifts in hot work environments also reported a slower pace of work compared to those working shorter shifts (NIOSH).

HIRING AND RETAINING STAFF

Barriers to hiring and retaining qualified staff are a challenge for all industries and have resulted in the need for extended work shift hours to maintain staffing and meet production quotas. As the work force ages and more educated and skilled laborers leave, organizations will be challenged to hire qualified candidates.

Retaining qualified staff is another challenge that organizations must meet if they are to maintain staffing and production guidelines. Some of the ways to retain qualified staff are to be flexible with work hours, offer job sharing when possible, provide opportunities for job advancement, and offer competitive salaries and benefits.

Shift workers and their employers can alleviate the negative impact of extended duration shifts in a variety of ways. Employers can ensure that work areas have adequate lighting and recreation facilities. They can ensure that workers do not work more than two consecutive night shifts or two to three consecutive 12-hour shifts. Employers can ensure that days off are distributed equally with workdays, and scheduling should allow at least two free weekends each month. Employers should allow time for breaks, to move around, and to interact with other workers. Employers might consider several shift lengths, and possibly shorter shifts when workloads are light. Employers could keep workers' schedules regular and predictable; this assists workers in planning home activities. Employers can ensure job rotation by moving employees to different tasks or responsibilities that allow them to use several muscle groups to perform their tasks or require varying degrees of mental concentration to complete tasks. Finally, the occupational health nurse can provide education about eating and sleeping patterns that counteract or minimize the effects of shift work or extended duration shifts (Salazar, 2006; Workers Health Centre, 2005).

Employers could allow employees opportunities for short sleep periods as a strategy for counteracting the effects of shift work (i.e., the longer the nap, the more beneficial and long-lasting the effects) (Ferguson et al., 2008). Employees who work extended duration shifts and shift work can ensure that their sleep settings are conducive to sleep by darkening the room, ensuring quiet white noise, and turning off telephone ringers. Workers should get proper exercise and nutrition and, most importantly, should notify family and friends of sleeping times and ask that they not stop by or call during those times.

The significance of extended duration shifts and shift work to employers and occupational health personnel is substantial. For employers, these types of staffing patterns increase their risk of liability associated with workers who may be fatigued. The longer the employer allows a shift worker to remain on the job, the greater the chance that the worker will err, resulting in an adverse outcome (e.g., permanent injury or death of a patient). Occupational health nurses must maintain constant vigilance to be aware of any changes in staff that might indicate a problem. They must ensure that education is readily available to all workers on the risks of caring for patients and ways to avoid these risks while working extended duration shifts.

IMPLICATIONS FOR OCCUPATIONAL HEALTH NURSES

The implications of extended duration work shifts for the occupational health nurse are many. When interacting with employees who work extended shifts, occupational

health nurses should focus their practice on the health and safety needs of workers under their care. The occupational health nurse should be aware of employees who are no longer able to function effectively during extended duration shifts and assist them in finding alternative working arrangements in the organization. The occupational health nurse should assist with workplace changes that can help the worker succeed (e.g., improving workplace lighting and providing canteen and recreation facilities) (Workers Health Centre, 2005).

Occupational health nurses should be aware that extended shift durations and shift work place employers at increased risk of liability if an accident or adverse event occurs; and they need to be aware of the needs of the employer as well as the needs of the workers. The occupational health nurse should be aware that shift workers are at high risk for disability retirement due to injuries sustained at work and should educate workers about the risks associated with prolonged wakefulness, their susceptibility to sustaining injuries due to fatigue, and ways to prevent these injuries.

Occupational health nurses must possess extensive knowledge of the effects of extended duration shifts and shift work on workers' physical, mental, and emotional well-being. The occupational health nurse must not only have knowledge of the signs and symptoms of adverse health effects associated with shift work, but also be able to assist workers to change their lives to eliminate risk factors.

Further research is needed into the effects of extended shifts on the health and safety of shift workers as they age. By the year 2050, the proportion of individuals 60 years and older is expected to double, and will account for 21% of the total global population (Kenny, Yardley, Martineau, & Jay, 2008). Nationally, from 2004 to 2014, "the labor force will continue to age, with the annual growth rate of the 55 and older group projected to be 4.1%, four times the rate of growth of the overall labor force" (Silverstein, 2008, p. 270). In addition, the age distribution of the labor force is shifting. By 2010, middle-aged and older workers will outnumber younger workers (Centers for Disease Control and Prevention, 2004). Additionally, further research is needed to identify the "optimal shift length" for a shift worker before errors, adverse outcomes, and health effects occur.

Extended shift durations and shift work have a profound effect on both shift workers and the organizations that use these types of staffing patterns. Shift work should be used with caution. Not all workers are capable of working these hours, nor do extended shifts work well in all settings. Despite the increased opportunities for leisure time on 12-hour and longer shift durations, the longer workday has the potential to contribute to human error and accidents in the workplace (Smith et al., 1998). If organizations are consistently using these staffing patterns, top management, as well as the workers, should be well educated about the risks of working these hours, ways to avoid adverse outcomes and errors, and signs and symptoms of health-related issues. Only with constant vigilance for signs of fatigue and health effects

on the shift worker can an organization successfully use extended shifts and shift work to meet its needs safely and productively.

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