Implications of circadian rhythm disruptions for nurse managers

著者	Yoshida Fumiko
journal or publication title	Saku University journal of nursing
volume	6
number	1
page range	65-74
year	2014-03
URL	http://id.nii.ac.jp/1050/00000129/

Creative Commons : 表示 - 非営利 - 改変禁止
http://creativecommons.org/licenses/by-nc-nd/3.0/deed.ja

Report

Implications of circadian rhythm disruptions for nurse managers

Yoshida Fumiko

Key words : circadian rhythms,　nurse manager,　shift work,　working schedule

Abstract

Background/Aim: Treatment errors are implicated among the devastating effects of shift work, which impacts our circadian rhythms and takes a toll on nurses' health and level of fatigue and safe practice. Therefore, an understanding of the role of biorhythms, especially circadian rhythms, is essential for nurse managers who must provide for "coverage" while also being responsible for issues affecting patient safety and staff health and satisfaction. This paper will outline implications of circadian rhythm disruption for nurse managers.

Methods: Review of the literature about circadian rhythms is followed by suggestions concerning shift work for nurses based on the writings of C. N. Hoskins. This concludes with a shared educational program for nurse managers.

Summary, Implication: The shift schedule is important; it is one of the causes of unnecessary cost, decreased workers' motivation, increased workers' health problems, sleepiness and giving up their night shift work. When nurse managers make shift schedules, they should be concerned with circadian rhythms; this will enable a decrease in treatment errors while increasing the status of workers' health.

Introduction

The Institute of Medicine's (IOM) study of treatment errors in United States hospitals documents the significance of such adverse events. The report estimates that errors result in 44,000 to 98,000 patient deaths annually, and the IOM investigators extensively discuss many of the factors contributing to such errors. However, the research has few references to either "Work load" or "Fatigue" (Kohn, 2000), as workforce-related factors (Cummings et al, 2010).

During the past many years, there has been an increasing tendency in hospitals to schedule shift work of up to 12 hours duration. It appears, however, that institutions did not study the potential changes in error rates prior to instituting these shift changes. Aeromedical practitioners are well aware of the effects of circadian rhythm fluctuations on performance, and have been concerned with the impact of shift duration and rotation on vigilance and error rates. The Bhopal chemical release, the Chernobyl and

Received 27 September 2013; accepted 13 February 2014.
Saku University School of Nursing, Department of Nursing

Three-Mile Island nuclear reactor incidents, the grounding of the Exxon Valdez, and the Space Shuttle Challenger accident each occurred during night shifts. Although anecdotal, these events indicate the need to consider circadian rhythm influences as well fatigue and other effects of shift work in evaluating the potential for errors by those performing shift work.

Nurses who perform shift work operate under very difficult situations, especially when overtime is compulsory. This mandatory overtime forces all nurses to switch frequently between day, evening and night shifts. Nurses then struggle with night shift sleepiness as a sleep disorder (Hospital Employee Health, 2013). Circumstances like these often have devastating effects on our bodies, constantly adjusting to schedule changes. The devastating effects on our circadian rhythms take a toll on nurses' health. A much-quoted review of shift work and health revealed that "10 per cent of people enjoyed night work, the majority put up with it and between 20 and 30 percent were forced to give up nights because of health considerations" (Christopher, 1996).

Therefore, an understanding of the role of biorhythms, especially circadian rhythms, is essential for managers who must provide for "coverage" while also being responsible for issues affecting patient safety and staff health and satisfaction. This paper will outline implications of circadian rhythm disruption for nurse managers.

Review of the Literature

Overview of Circadian Rhythms

Most research efforts in chronobiology (the study of biological rhythms) have focused on the twenty-four-hour cycles called circadian rhythms, from the Latin circa (around) and dies (day). The term "circadian" refers to the biologic variations that reflect a complete cycle in approximately twenty four hours. The most apparent of these circadian rhythms is the basic rest and activity cycle (BRAC) characterized by a period of quiescence or sleep alternating with a period of physical and mental alertness, which ordinarily correspond to the darkness and daylight of the environment (Hoskins, 1980). Circadian rhythms have three characteristics: peak of time (acrophase), over-all mean (mesor), and degree of excursion of wave of the rhythm (amplitude) for each variable (Hoskins & Halberg, 1983). Daily rhythms are a fundamental component of all biological organisms. In the late 1950's researchers found evidence of circadian rhythms in birds, insects and flying squirrels (Kawakami, 1984).

Starting in 1961, Aschoff began testing subjects in an "isolation" bunker. Subjects could turn a light off or on at will, but no external cues could reach them. The studies revealed a sleep-wake cycle of about twenty five hours. In 1959, Halberg found that humans have daily rhythms affecting sleep, temperature and urination (Kawakami & Kohsaka, 1984). Circadian rhythms help coordinate the timing of our internal bodily functions as well as our interactions with the external world.

Circadian abnormalities are being observed more frequently in older people suffering from various sleep, mental and physical disorders. There are four types of

International Classifications of Sleep Disorders (ICSD) established in 1990 (Okawa, 1994). The first type is "Delayed Sleep Phase Syndrome." This occurs when a patient is unable to fall asleep until two or three am, and then has trouble waking up in time for work or school. Disruption of daily performance and increased psychological stress often result in public concern (Bartlett et al, 2008). The second type of sleep disorder is called "Advanced Sleep Phase Syndrome" (ASPS). In this case, sleepiness begins in the early afternoon and results in an early bed time. Sufferers then wake up too early and are unable to go back to sleep. ASPS is most common among older adults and is just beginning to be recognized as a significant medical problem. The third type, "Non-24-Hour-Sleep-Wake Disorder," occurs when a persons' sleep-cycle is delayed one or two hours everyday, resulting in a circadian rhythm of twenty five to twenty six hours. The fourth type is "Irregular sleep-wake rhythm." A person who has this disorder falls asleep at random intervals. The sleep-cycle is not related to their environment. Bedridden patients tend to have this disorder.

People's body temperature has a circadian rhythm. The temperature rises with dawn and falls with sunset. People want to sleep when their body temperature falls. Conversely, when their body temperature keeps rising, they cannot sleep deeply. This sleep-wake rhythm disorder can be treated with chronobiological therapy, or "bright light" therapy. The best time for a patient to receive artificial sunlight is around 10 am. The purpose of this is to synchronize the patient's body temperature with his/ her circadian rhythm. Factors in a patient's life environment, such as bedmaking in the morning, taking a shower in the morning, and having breakfast in the morning assist in the synchronization process.

Night-shift work affects people's circadian rhythms. Their life styles are reversed by their work, especially their sleep patterns. Unfortunately, when workers have to work during the night, their circadian rhythms are not changed completely which causes stress. Jet lag is another example of circadian rhythm disruption in which people's circadian rhythms are changed, but the change takes about one week. However, night-shift workers' circadian rhythms are not changed even though they continue night-shift work for many years. Consequently they will have symptoms of insomnia, fatigue, lack of efficiency in their work, and loss of appetite. Circadian rhythms cannot change with night-work (Costa, 1997), therefore, people may keep their symptoms of disrupted rhythms until they quit night-shift. The night-workers' abuse of their circadian rhythms effects their body temperature, autonomic nervous system and immune system. Research shows that body temperature does not adapt to night work. Shift workers' body temperature tends to be low in the morning, but not low enough to sleep in the afternoon, and vice versa. Their body temperature rebounds easily when they change to a day shift from a night-shift.

Human beings live in a social community and cannot escape "social" time. Although,

the night-shift workers change their life style to night working, they are unable to escape from social time; if night workers want to change their body temperature to stay synchronized with their circadian rhythm, they would have to abandon social time.

Research shows that night-workers get sick more easily than day shift workers: when they catch a cold, they take longer to recover, they get ulcers, and back pain more frequently (Rutenfranz, 1982). Nakano (1982) shows that night workers' immune response is low: the T-cells are less active. All of these conditions are a result of the stress of "shift lag." These are all implications of circadian rhythms of which nursing managers should be aware.

Suggestion Concerning Shift Work for Nurses

According to Hoskins (1981), given the facts that are beginning to be known about the biologic and psychologic effects of shift work, the following steps might be followed:

1. Determine which shift staff members prefer, and on which they function best.
2. Require the smallest possible number of shift rotations within a specified time period.
3. When rotation is required, allow adequate period of time for entrainment to occur. If sufficient time to resynchronize is not permitted, performance will be well below standard. In a complete reversal of the light-dark cycle, that is, a 12 hour shift, circadian rhythms may require as long as ten to twelve days to resynchronize. As a general rule, most individuals adjust to a new circadian cycle at the rate of one day per one hour in time shift.

It would therefore require 8 days for re-synchronization to take place if you allowed 1 day for each "hour of change in work hours. For example, if a nurse changes from the day shift (7:00 AM-4:00 PM) to the evening shift (4:00 PM to 12:00 midnight), this reflects a shift of eight hours in her work time. Thus, one would allow 1 day for each of the eight hours for re-synchronization to be completed. Theoretically, the manager could then assume that a nurse could safely resume activities at the end of the 8 days" (C.N. Hoskins, personal communication, November 23, 2001)

4. Provide counseling in terms of practices that have been found to enhance the entrainment process.
5. When sleep disruption occurs, exercise enhances resynchronization of biologic and performance rhythms. It is the resynchronization that leads to an improvement in sleep pattern, not the exercise.
6. Body temperature may be monitored as one of the best indicators of circadian synchronization and desynchronization. It is useful for determining when an individual shifting from day to night work can safely resume major responsibilities.
7. Kidney function, as reflected in the circadian rhythm in urine excretion, may be monitored as a second indicator. Normally, males excrete the most sodium and potassium at midday, females toward late evening. Excessive excretion of these elements during desynchronization result in weakness and exhaustion, conditions that are obviously not conducive to optimal

performance.

8. During periods of desynchronization, the main meal of the day should be eaten as soon as possible after rising, a recommendation based on study of the periodicity in, and optimal time for, metabolic activity in relation to circadian rhythmicities in glucose, glycogen, and amino acids.

9. Individuals with diabetes, epilepsy, hypertension, asthma, or peptic ulcer should be counseled to seek informed medical attention before undergoing a shift in hours of work. Findings indicate that the synchronization of specific drug therapies with the circadian rhythms is essential, if these therapies are to be most effective. An oral dose of an antihistamine preparation, for example, will last 15 to 17 hours when administered at 4:00 AM but only six to eight hours when given at 7:00 PM.

10. Several days before a change in shift, the time of retiring should be an hour earlier each night. Using the general rule of one day for each hour of shift change, the time for starting the regimen may be determined.

Shift Work, Health Care Provider, and Impact Incidents and Treatment Errors

Shift Work Nurse and Incidents and Treatment Errors

Research supported by the Health Studies Fund, University of Utah School of Medicine, identified potential problems caused by the change to 12 hour shifts among hospital workers, as well as possible preventive interventions (Moser, 2001).

The authors asked representatives of the Federal Aviation Administration to participate in the study, and reviewed back volumes of journals such as Aviation, Space, and Environment Medicine to select materials relevant to the research.

The authors state that shift work is of particular concern with regard to accidents and compromised safety (Luna, French & Mitcha, 1997). Some studies have shown increased frequency or severity of accidents during night shifts. Notably, a study of emergency room physicians found those working a night shift were significantly slower at intubating mannequins and were more likely to commit errors as the shift progressed than those working the day shift (Costa, 1997). Various approaches have been suggested to combat circadian rhythm disruptions. Some have recommended that night shifts be permanent or rotated slowly every three to four weeks. This arrangement should allow a worker's circadian rhythm to adjust to the new work-sleep schedule. It should be noted, however, that those on a rotating or permanent night shift may have a "post-lunch" dip after the evening meal that may impair performance for up to an hour or more after the meal. This performance dip is seen in some night shift workers even when the circadian rhythm has adjusted to the new schedule.

Others have recommended rapid shift rotation (changes every two days) so that the circadian rhythm never changes from its daytime orientation. Other researchers (Horne, 1980; Niedhammer, Lert, & Marne, 1994; Boivin & James, 2005) have suggested shift schedules be moved clockwise in time to take advantage of the forward-moving tendency of the underlying twenty five

hour circadian rhythm. Of interest is a study that found a week of night shifts is of concern with regard to performance and accidents, with performance decreasing during consecutive nights at work (Knauth, 1995).

Shift Length and Occurrence of Errors

Studies of shift length do not provide definitive information regarding relationships between shift length and occurrence of errors. Some studies have demonstrated increased fatigue and decreased alertness during 12 hour shifts as compared to 8 hour shifts. Another study, however, indicated that operational errors were highest at the start of a shift and decreased during the remaining hours of 10 hour shifts (Della, 1999). Authors of the University of Utah School of Medicine Study cited several comprehensive reviews and noted that the consequences of extended shift length depended on several variables, including work characteristics, how and why the shift was implemented and whether the change was made for the financial benefit of the organization (Moser, 2001).

Difficulties in adjusting the circadian rhythm to a night schedule may contribute to the incidence of night shift hazards, but sleep deficit may also be a major problem. Study have shown that day sleepers sleep for shorter periods, have light sleep, and have more interruptions than workers sleeping at night (Gosta, 1997).

Rotating schedules may contribute to sleep deficits. A study of 635 Massachusetts nurses found more sleep/wake cycle disruptions in those working rotating shifts than those working only day or evening shift. Nurses rotating shifts had twice the odds of a reported accident or error related to sleepiness (Gold, Rogacz & Bock, 1992).

The literature review documented the necessity to consider shift schedules, shift length, circadian rhythm impacts, and sleep deficits in evaluating the potential for error by those providing care in a 24-hour, 7-day-a-week health care facility (Moser, 2001).

Education Program for Nurse Managers

A. Goal:

The purpose of this plan is to increase the level of understanding and knowledge about circadian rhythms on the part of nurse managers and the potential impact on patient safety.

B. Objectives:

1. Nurse managers will increase their knowledge about circadian rhythm by 75% within 3 months.
2. Nurse managers will change the schedule-making method based on their knowledge about circadian rhythms.
3. Incidents or treatment errors will decrease by 50% in 3 months, based on the new schedule-making.

C. Design:

1. Requirements of nurse managers.
   1) post flyers requesting nurse manager volunteers for the project;
   2) meet with potential nurse manager volunteers to discuss the project;
   3) obtain written commitments from nurse manager volunteers to participate in the project;
   4) meet with staff of the unit chosen to participate to explain project design and objectives;

5) have staff fill out Survey forms (Refer to Appendix A).

2. Education presentation

1) meet with nurse managers for the first of two scheduled one hour education sessions:
   (1) administer Pre-tests (Refer to Appendix B);
   (2) provide education (lecture/ discussion) including an overview of circadian rhythm theory, and the impact of duration (e.g. 8 or 12 hours) of shift and of shift work (day, evening, night) on error rates of health care providers;
   (3) provide individual copies of Hoskins (1981), Mason (1992) and Kohn &Corrigan (2000) articles for reference and review.
2) meet with nurse managers for the second scheduled education session:
   (1) review previous material;
   (2) question- answer period for clarification of material.
3) meet with staff in thirty-minute scheduled sessions:
   (1) provide education (lecture/ discussion) regarding circadian rhythm theory, with emphasis on understanding circadian rhythm disruptions;
   (2) provide information regarding body temperature measurements (8 am, 12 pm, 4 pm and 8 pm) and the level check of activation.
4) meet individually with each nurse manager to discuss utilization of data obtained from their staff and assistant managers to make shift assignments (Hoskins, 1981;Mason, 1992).
5) after three months, administer Post-test to nurse managers to determine any change in incidence of treatment errors.

D. Evaluation:

1. Nurse managers identify the symptoms of circadian rhythm disruption. On the Pre-test/ Post- test evaluation form, if nurse managers can answer question number 1 “Please name 7 symptoms of circadian rhythm disruption” their “understanding/ knowledge” score is 1 for each symptom. Answering “Fatigue, Sleepiness, Cannot think as clearly, Feel sleepy, Mood change, Difficulty falling asleep and Trouble making difficult decisions” yields a full score of 7. If question numbers 2 , 3 and 4 are correct, the score is 1 for each answer. This session’s full mark, therefore, is 10. I expect “understanding/ knowledge” to increase 75 % in the 3 months. Also the nurse managers will read articles that enhance what they learned in the education sessions.
2. Nurse managers can make schedules based on their knowledge about circadian rhythms; if nurse managers make schedules based on circadian rhythms, this objective has been achieved. If nurse managers and their nursing staffs have good cooperative relations, nurse managers can bring nurse-measured body temperature measurements to the second education session.
3. In 3 months, staff treatment errors will decrease 50%. If nurses made treatment errors, they can record the shift during which the error occurred. Then, the managers bring this result to the treatment

error administration. The administration might then research the effects of nurse schedule and work shift schedules. If nurses feel healthier, they will reduce the number of their treatment errors. There will be a decrease in treatment errors when nurses work according to circadian-rhythm- based scheduling.

Summary, Implication and Recommendation

The shift schedule is important; it is one of the causes of unnecessary cost, decreased workers' motivation, increased workers' health problems, sleepiness and giving up their night shift work. Using "common style" shift scheduling has been the convention since 1990. When nurse managers make shift schedules, they should be concerned with circadian rhythms; this will enable a decrease in human error while increasing the status of workers' health.

Future research and practice goals could be: Absence/ sick calls will decrease by 50% based on new scheduling practices. Although some nurses use sick calls for an extra day off, they may need extra time off because their schedule does not take account of circadian rhythms. Their sleepiness, lack of motivation and actual illness may be related to poor endocrine and immune function because they are not allowed to work according to their bodies' natural rhythms.

Another future plan could be to conduct a cross-sectional study to answer the question about how nurses' health differs in samples based on circadian-rhythm-scheduling as opposed to more usual scheduling. Future study could involve a longitudinal study concerning the effects of circadian-rhythm-scheduling on nurses' health and their rate of treatment errors.

References

Bartlett, D.J., Marshall, N.S., Williams, A, & Grunstein, R.R. (2008). Predictors of primary medical care consultation for sleep disorders. Sleep Medicine, 9, 857-864.

Boivin, D.B., & James, F. O. (2005). Light treatment and circadian adaptation to shift work. Industrial Health, 43, 34-48.

Christopher, H. (1996). A shift in time. Nursing Standard, 10(14), 22-24.

Costa, G. (1997). Shift work. Chronobiology International, 14(2), 89-98.

Cummings, G.G., MacGregor, T., Davey, M., Lee, H., Wong, C.A., Lo, E.,… Stanfford, E. (2010). Leadership styles and outcome patterns for the nursing workforce and work environment: A systematic review. International Journal of Nursing Studies. 47. 363-385.

Della, R. (1999). The role of shift work and fatigue in air traffic control operational errors and incidents-final report. U.S. Department of transportation, Federal Aviation Administration. Washington, D.C: Office of Aviation Medicine.

Gold, D. R., Rogacz, S, Bock, N et al,. (1992). Rotation shift work, sleep, and accidents related to sleepiness in hospital nurses. Am J Public Health 82(7), 1011-1014.

Horne, J.A. (1980). Circadian performance differences between morning and evening "types." Ergonomics, 23(1). 29-36.

Hoskins, C.N. (1980). Human behavior from a chronobiogical perspective. New York University Education Quarterly, Spring, 13-19.

Hoskins, C.N. (1981). Cronobiology and health. Nursing Outlook October 29(10), 572-576.

Hoskins, C.N. & Halberg, F. (1983). Circadian relations among level of activation, conflict, and body temperature assessed by chronobiologic serial section. Psychological Reports, 867-876.

Hospital Employee Health (2013). Nurses struggle with night shift sleepiness as a sleep disorder. Hospital Employee Health, 37(7)81.

Kawakami, M. & Kohsaka, M. (1984). Biolorhythms mechanisms. Tokyo: Rikougakusha.

Kohon, L.T. & Corrigan, J.M. (2000). To err is human-building a safer health system. Institute of Medicine. Washington: National Academy Press.

Knauth, P. (1995). Speed and direction of shift rotations. J Sleep Res,4, 41-46.

Luna, T.D., French, J . & Mitcha, J. (1997). A study of USAF air traffic controller shift work: Sleep, fatigue, activity, and mood analyses. Aviat Space Environ Med, 68, 932-938.

Moser, R. (2001). Impacts of shift work duration on error rates of health care providers. Journal of American Academy of Physician Assistants, 243, 11-15.

Mason, D.J. (1992). Measuring circadian rhythms actigraph versus activation checklist. Western Journal of Nursing Research, 14(3), 358-379.

Nagai, K. (1994). Circadian rhythm and treatment. Cure, 28(5), 84.

Nakano, Y. (1982). Shift work : Its practice and Improvement. Tokyo: Center for Academic Publications.

Niedhammer, I., Lert, F., & Marne, M. J. (1994) Effects of shift work on sleep among French nurses. A longitudinal study. Journal of Occupational Medicine, 36, 667-74.

Okawa, M. (1994). The international classification of sleep disorders. Cure, 28 (5), 93-97.

Polit, D.F. & Hungler, B.P. (1999). Nursing research: Principles and methods (6th ed.). Philadelphia: Lippincott.

Rutenfranz, J. (1982). Shift work: Its practice and improvement. Tokyo: Center for Academic Publications.

Appendix A

Survey

1. What shift are you working? Day Evening Night

2. How many hours do you work each shift? 8 hour 12 hour other

3. How long have you been working on this shift?
_____days _____weeks _____months _____years

4. Are you going to change to another shift? Yes No

5. To what shift will you move? Day Evening Night

6. Have you made any change to your shift before? Yes No

7. Please check each of the symptoms you have experienced during your work shift.

Fatigue_____.	Sleepiness_____.
Cannot think as clearly_____.	Feel sleepy_____.
Mood change_____.	Difficulty falling asleep_____.
Trouble making difficult decisions_____.	

8. How often are you able to change shift without having the above mentioned symptoms?

9. When you make shift schedules, do you question your staff about their shift preferences?
Yes No

10. Does your institution have stress counseling available for nurses?
Yes No

Thank you very much for your cooperation

Apppendix B

Pre-test / Post-test

1. Please name 7 symptoms of circadian rhythm disruption.

2. How many days will a nurse staff need to adjust to changing from an 8 hour day shift to an 8 hour evening shift?

3. When is the best time of day to schedule exposure to sunlight if one is suffering from circadian rhythm disruption?

4. What is the best time of day to schedule the main meal if one is in a period of desynchronization?

5. Which of the following pieces of literature have you read?

____a. Hoskins, C. N. (1981). Cronobiology and Health. Nursing Outlook October 29(10), 572-576.
____b. Mason, D.J. (1992). Measuring circadian Rhythms Actigraph Versus Activation Checklist. Western Journal of Nursing Research, 14(3), 358-379.
____c. Kohon, L.T. & Corrigan, J.M. (2000). To Err is Human-Building a Safer Health System. Institute of Medicine. Washington: National Academy Press.

6. How many incidents or treatment errors are you aware of that have occurred on your unit in the past 3 months?