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# The Effects of Extended Work Shifts on Healthcare Workers' Health and Risks to Patient Safety

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**Abstract**

The safety and quality of patient care may be compromised by fatigue and excessive workload carried by healthcare providers. In contrast to regulations for working hours of non-healthcare workers, no such standards stipulate work periods for physicians and nurses. There is a large body of scientific research produced on the topic of fatigue and performance, some of which has been generated because of recent requirements for residents, and also by work-hour changes for pilots. The investigators in this paper reviewed the literature on the effects of extended work on healthcare workers and provided recommendations for decision makers, workers, and future researchers. (Pérez-Francisco et al.2020)

It is difficult to make evidence-based determinations about the impact of extended work shifts on healthcare workers and patient safety. The goal is to match work schedules with work demands so that worker fatigue, errors, and accidents are minimized while addressing the medical needs of patients. There are many studies on which to base conclusions; however,

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many are limited to the short-term effects of completing extended work shifts, particularly relating to on-the-job performance. There are virtually no prospective data linking healthcare providers to patient safety indicators, so decisions are based on surrogate or laboratory tests. In addition, because most shift work limitations are derived from industrial settings, it is not clear under what circumstances they would be directly applicable to healthcare workers. Data from other shift work settings are used here, and where available findings are related to healthcare providers, to offer recommendations for readers. (Dreiher et al.2020)

**Keywords-**Sleep; Shift work; fatigue; healthcare; patient safety

## 1. Introduction

Medical knowledge is growing at an unprecedented rate, so there is increased pressure for healthcare workers to spend more time at work and in the workplace. Several factors, including cost-effectiveness, human resource management, and available technology, push the healthcare system towards extended work shifts for healthcare workers. Extended work shifts are known to be added to extended physician and nurse shifts in a particularly large fashion, and many healthcare workers handle a significant number of cases each day and week. This significantly increases the time during which these individuals remain awake; in addition, these work shifts are usually high-demand, high-stress periods. Extended work shifts in all industries are related to many well-documented health problems, increased risks for on-the-job injuries, and poorer job performance when compared with more traditional work schedules that provide more time off. (Brown et al.2020)

Extended work shifts in the healthcare industry have been the focus of increased attention since the recently implemented maximum number of work hours for medical residents was put into place. These changes were the result of evidence such as the following: Sleep-deprived physicians often function no better than alcohol-impaired drivers and may provide a quality of care that is equal to or poorer than care provided by intoxicated caregivers, extended work shifts decrease willingness to hand off specialized patient care responsibilities, and even when off the job, tired healthcare workers are often unwilling to accept help from colleagues in their efforts to arrange needed rest time. Legal mandates appear to be changing patterns of work hours in hospitals. (Mahajan & Velaga, 2020)

### 1.1. Background and Significance

Healthcare workers are coming under increasing pressure with recent reports warning of a crisis situation. One aspect of healthcare working conditions receiving little attention yet scientifically recorded is the extended work shift. While long work hours are an integral part of the healthcare industry, there is little consideration for work hour safety parameters. Research in various health sectors has identified inherent threats to healthcare worker health and patient safety from long work hours, fatigue, and problems in the patient care-giver

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interface. This paper looks to increase awareness of the topic by tracing the state of the present-day understanding of these effects, highlighting gaps and areas where further research is warranted. The purpose of this paper is to provide a list of current and future research with which extended work hours in healthcare can be examined, with future-focused scientifically investigated recommendations for interventions, leading to a safer health industry for all concerned. (Che et al.2020)

It is likely that well-researched fatigue and sleep medicine topics have crossed over recent years into health workplace research. However, publication volume in reputable sources on these health topics in health workers, together with healthcare-related activities conducted in a personal capacity to serve unsociable hours for societal protection, cannot be ignored. Added to this are workplace adaptations to cope with domicile obligations – currently handled by health workers. Their self-sacrificing attitude should be acknowledged by industry and society collectively. The vision that requires a 24-hour society expects representatives of this society to work in shifts. Healthcare workers are part of these societies, and in the health sector, they deliver services normally not specifically linked to the concept of a 24-hour society. (Bandyopadhyay et al.2020)

### 1.2. Purpose of the Study

To examine the potential health and patient safety risks of healthcare workers' extended shifts, a recent initiative to examine the relationship between extended work hours, healthcare worker health, and patient safety was undertaken. This multi-site study was conducted in an effort to provide the necessary empirical evidence to help inform the design and implementation of healthcare worker scheduling strategies. Relying largely on self-report survey data, the overarching purpose of this report is to address the following research questions: What is the nature and extent of extended work shifts that healthcare workers in hospitals work? In what ways are healthcare workers affected by these work hours (e.g., chronic fatigue, job satisfaction)? What are the perceived effects of extended work hours on patient care quality and safety?

A partnership was formed to guide the inquiry into healthcare workers' extended work schedules and related health and safety issues. The team was responsible for the design, performance, and coordination of the study and included researchers with expertise in nursing, epidemiology, sleep and other health outcomes, industrial relations and economics, patient safety, and survey research. The team advised and participated actively in developing the survey instrument, particularly its length, content, and the means of its administration.

## 2. Literature Review

Clinical and laboratory research demonstrates that performance on tasks requiring memory, attention, decision-making, or communication is significantly impaired following even a single

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night of acute total sleep deprivation, which is the functional equivalent of a blood-alcohol concentration of approximately 0.10%. These restrictions in performance are accompanied by changes in several physiological systems, including increased activity of the autonomic nervous system affecting both the cardiovascular and hormonal systems. It is therefore possible that working extended shifts, either consecutively or with short time off work, increases the potential for chronic interference with health and safety through a prolonged accumulation of fatigue, desynchronizing the effects of sleep loss and circadian variation in performance. (Honn et al.2020)

Since prior studies have determined that shift or non-day work behavior results in sleep duration unwarranted by the associated sleep opportunity, conclusions about day-to-day variability can also be extended to a state of chronic sleep restriction. Moreover, it has been documented in a large national survey that more than 50% of all healthcare personnel work shifts that differ from the traditional schedule. Finally, extended work shifts are increasingly common, especially when employers adopt alternative work schedules such as the 12-hour workday and the far less common 36-hour prolonged shift. As a result of the increased schedule flexibility engendered by a 12-hour hospital shift, for example, employees are able to achieve a higher work/family satisfaction, positively influencing job performance, job turnover, absenteeism, and worker stress. (Ghislieri et al.2021)

### 2.1. Definition of Extended Work Shifts

To fully understand the problems of extended work shifts, some definition of commonly used terms is in order. By extended work shifts, we mean work shifts that are longer than the standard eight hours in a day, five to seven days in a row, with no more than two days off in between. Existing laws restrict most workers to working eight hours on any one day, 48 hours in one week, and 60 hours in any one week. Of course, there are exceptions for certain occupations. To maintain a 24-hour society, extended work schedules are becoming increasingly common in many industries, including health care.

Extended work shifts are designed to provide longer periods of patient care in hospitals, clinics, or long-term care settings. These long work periods enable a limited amount of staff to handle unpredictable continuums of resident or patient care requirements, such as are common with critically ill patients and long-term care needs. With the growing shortage of health care professionals, the use of extended work shifts is increasing. Common shift lengths for nurses, for example, are 10, 12, and 16 hours. These long hours may have the positive effects of fewer hand-offs between workers and more time to observe patient responses to treatments.

### 2.2. Previous Research on the Effects of Extended Work Shifts

Based on a comprehensive review of the literature, work schedule interventions designed to mitigate medical errors and prevent needle-stick injuries, and an analysis involving critical care

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nurses, our team estimated that the impact of significant sleep deprivation from working an extended or overtime shift on the risk of a fatigue-related error that causes an adverse event was at least 300 percent. Research has closely evaluated the effects of 12-hour service shifts, which are widely used in healthcare and some other industries, for five types of adverse events: medical errors, vehicular crashes, slips and trips/falls, performance standard violations, and being involved in accidents. This research has focused on how working extended shifts affects safety outcomes, whether of extended shifts themselves or the interaction of hours worked and/or the amount of rest obtained during an extended shift.

Despite the evidence that shift duration and going without sleep over a long period of time put employee and patient safety at risk, extended shifts have negative consequences that are often more subtle. Extended shifts contribute to employee work-life balance, job burnout, job dissatisfaction, turnover, absenteeism, injuries and illnesses, and physical, cognitive, and emotional exhaustion. To some people, proposed significant and controversial changes in their work schedules may be particularly difficult to convince if, as it is often argued, healthcare worker fatigue and associated errors do not seriously affect patient safety. This paper reviews prior research on the relationships between work shifts and healthcare worker fatigue and the robustness of inferences, summarizes the state of practice concerning this issue in the period studied, and recommends directions for research and practical factors that managers should consider when striving to deliver high-quality patient health safety.

**3. Health Effects on Healthcare Workers**

Healthcare workers carry out a variety of tasks in the name of health and healing. Yet, as we are all too aware, our healthcare system is plagued with patient safety concerns and healthcare worker staffing shortages. It is sometimes hard to connect the health of healthcare workers and patient safety. However, the health and safety of healthcare workers can have an impact on the health and safety of the very patients they are caring for. Studies confirm that extended work hours result in decreased vigilance, attention, and reaction times, as well as shortcomings in decision-making. Workers also become more likely to disregard safety rules and show increased signs of cognitive failures and limitations, as well as adverse mood and physiological states. But what are the health effects of work hours on healthcare workers? Available evidence indicates that extended work hours have a clear differential effect. Not all healthcare workers suffer ill effects from extended work hours, and among those who do, there are a variety of consequences that are manifested in different ways. (Leso et al.2021)

Healthcare workers who perform extended work hours become more sleep-deprived, are more fatigued, and report more medical and physical symptoms. Nurses are the healthcare worker group most studied concerning the effects of work hours on health. Yet, even among nurses, researchers are still unable to make absolute conclusions about all of the effects on health.

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Nurses who work in hospital settings report irreparable effects on their personal lives, including disruptions in family and social activities, decreased academic or recreational activities, and effects on emotional and mental health. In addition to these effects, nurses who work night shifts experience more gastrointestinal health and well-being symptoms than day-shift workers, as well as a higher prevalence of diagnosed ulcers. In addition to these negative health effects, the 85-hour work week currently allowed under the 80-hour work hour restriction has resulted in increased potential for chronic sleep debt. This sleep debt results in adverse attentional and physiological responses and slow recovery from the fatigue effects of the shift schedule. Shift durations that are long, in addition to extended work schedules, have also been identified as having a detrimental impact on the health of young nurses. Such nurses were more likely to have increased burnout levels as extended work hours allowed them increasing symptoms of burnout as their experience level and age decreased. However, among more experienced nurses, extended work hours did not increase symptoms of burnout as observed in their younger cohorts. (Habiburrahman et al.2021)

### 3.1. Physical Health Impacts

Long hours, shift work, and patterns of circadian disruption may increase the risk of illness and injury, particularly where such conditions are chronic. Whereas each shift system has potential adverse health impacts, extended working hours make each of those impacts more likely. It can worsen health and safety issues, such as the heightened strains of high-demand work, the reduced ability to protect one's work, a need for controlling the pace of work, the decreased ability to protect one's work process, and the increased risk of errors or injuries. How directly work hours and sleep loss lead to negative health and social consequences, in addition to eroding other important opportunities for a satisfying life, is both complex and a primary part of the analysis of an integrated performance and health impact model. The simultaneous declines in mental and physical well-being and cognitive and physical function make it difficult to tease apart an accurate specification of cause-and-effect relationships.

While work hours are a useful marker, the health consequences of extended shifts are probably the result of increased sleep loss and decrements, abrupt temporal shifts in sleep or alertness, which can interfere specifically with the ability to cope with sleep loss, and interaction with a number of other workload factors for individuals who are fully employed, physically and/or cognitively demanding shifts, and high volume or critical responsibilities. Staffing problems that result in long hours are prevalent enough to make the consideration of shift duration relevant not only as a contributing factor to sleep outcomes but also as a cause of other negative health outcomes. Finally, quality of life issues, such as missed meals, family conflicts, and time limitations, reduce the time free for school, family, or social activities during a workday. Evidence shows that hours worked directly affect key elements of family life, such as mealtime availability and the time devoted to children.

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### 3.2. Mental Health Impacts

Several studies of nurses have reported that long work hours, several consecutive shifts, and rotating or irregular shift patterns are associated with a variety of adverse effects related to mental health and cognitive function. For example, nurses who worked twelve-hour shifts more frequently were more likely to experience more stress and reported less energy and cognitive function. Several other studies of nurses have reported similar findings. That is, the majority of nurses within their samples reported that they find it difficult to remain psychologically and physically alert during a twelve-hour shift. An important result has been reported in several nurse studies, regardless of shift length; for example, one study found that nurses working long hours reported higher levels of burnout and less time to recover between work shifts.

The majority of studies that have examined the relationship between extended work shifts, sleep and alertness problems, and safety and patient care have been conducted with nurses and are associated with effects that include inflammation, endothelial dysfunction, and decreased immune response. Fewer experiments have been conducted on the effects of and mechanisms behind sleep and alertness problems experienced by healthcare providers who work extended work shifts. In a study of healthcare providers who worked at least one shift that lasted 24 hours or more in a week, the percentage of positive reactions to a morning or afternoon maintenance of wakefulness test that takes place before the next night shift was greater compared to those who worked night shifts during the week.

## 4. Impact on Patient Safety

A common safety concern when consecutive 12-hour work shifts are performed is the cumulative impact on workers of fatigue and sleep loss. Fatigue is well studied in many industries, including healthcare, and is the symptom that has been most clearly linked to the adverse effects on health and safety that have occurred after workers have been exposed to extended periods of wakefulness on the job. In many industries, working long hours or consecutive shifts results in substantial withdrawal of sleep. Studies of nurses have determined that when nurses work 12 hours, only a short period of time is available for sleep between consecutive work shifts, and these episodes of short time for sleep occur over several consecutive days. Researchers have also determined that the long daily work schedules that are characteristic of healthcare, and the minimum 11-hour rest periods mandated by custom and practice in the industry, result in substantial cumulative sleep debt, which can only be partially recovered when a rest period longer than a hospital-mandated rest period is allowed to occur. (Che et al.2020)

When considering the nature of healthcare workers' jobs, and the potential 24/7 functional requirements to care for patients who are sicker at any point in time, healthcare must develop and implement safer work schedules. To date, few studies have examined how the risks of

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extended hours of work are manifest on patient care units staffed by workers with long work shifts. However, several recent publications provide a wealth of evidence that when healthcare professionals are fatigued, both the quality of care provided and the safety of patients are compromised. Reports link healthcare worker fatigue to patient falls. Data from an aggregate of published studies show relationships between nursing shifts that were longer than 12 hours and risks of workers harming themselves, risks of technical errors being made, low levels of alertness, absenteeism, and shift-to-shift problems in communicating important patient care information at unit change of shift report. Findings in only four of these reports suggest that the longer shifts were the likely cause of adverse effects, although evidence about the shift lengths that caused the adverse effects in disciplines other than nursing is incomplete. High levels of workplace effort and fatigue have been demonstrated to predict catastrophic breakdowns in vigilance and attention for workers in a variety of disciplines. The impact of longer shift length and resultant fatigue on other disciplines is an important area for further research.

### 4.1. Medication Errors

Recent studies have shown that healthcare providers can contribute importantly to errors, near errors, and other performance failures because of sleep loss and working extended shifts. Virtually none, however, have evaluated the role of extended shifts with schedules that apply to most U.S. healthcare providers over time. There are, on the other hand, a large number of studies in the social sciences, psychology, and traffic literature discussing the ways in which human performance, safety, and health can be degraded by extended work shifts and insufficient recovery time. This paper briefly reviews the scientific literature on this issue of working conditions, hours, and performance. We begin by discussing the risks of extended hours to patients that are faced by healthcare providers. The various kinds of job performance and safety significantly impaired by sleep loss are related to instances of impaired health, suggesting the importance of workplace policies that integrate work, sleep, job performance, and health. Thus, these findings strongly support further research and administrative policies that provide for reduced error and improved worker health as well as patient safety. Addressing one side of the equation without considering other consequences can result in policies that are counterproductive on balance. Policy changes designed to make the healthcare environment support the health and performance of the provider as well as the patients will almost always be synergistic in nature.

### 4.2. Communication Breakdowns

Researchers have posited three hypotheses related to nursing performance, errors, and communication breakdowns that are consistent with the negative effects observed in the present study associated with extended work shifts. These hypotheses are that nurses on extended work shifts will: (a) have decreased vigilance, (b) increase failure to pursue a lead, and thus commit

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errors of omission, and (c) experience problems with communication breakdowns. The first hypothesis is related to decreased vigilance. Sleepiness and lack of concentration are theorized to increase as work hours accumulate and cause decreased ability in an individual to remain alert and aware of detail. The second hypothesis involves nurses' failure to pursue a lead and can be thought of as an error of omission. Nurses are bombarded with bits of information from colleagues, patients, families, and the healthcare environment every moment of their workday. Healthcare workers—especially nurses who are employed in entry-level positions, regardless of the shift length—are entitled to adequate work breaks, meal periods, and timely rest without interruption because they can better fulfill their requirement of critical thinking. In the absence of these uninterrupted periods of rest and relaxation, the potential for worker burnout or compassion fatigue increases.

There is grave danger if nurses are unable to process and respond to important bits of information during periods of missing information. The third hypothesis involves some issues with communication breakdowns. Coordinated patient care involves the continuous, accurate exchange of patient information in real-time. In order to produce the best patient outcomes, it is important that the nurse communicate with a multitude of other nurses, doctors, technicians, family members, and the patient. There are specific areas in nursing care in which work duration has not been previously studied. First, very little is known about the effects of long shift lengths and staff satisfaction with patient care. Second, little has been published regarding nurses' communication patterns during variously scheduled work shifts. Finally, there is very little information about the effects of working extended work shifts on the outcomes related to surgery, patients of advanced age, or other high-acuity patients for whom specialized care is selected. Clearly, it is important that further research be conducted in these areas. In order to provide a safer environment for both the healthcare worker and the patients, the relationships between scheduled work shifts, extended work shifts, nurse job outcomes, and patient outcomes should be studied.

**5. Mitigation Strategies**

Because at least some of the risks associated with extended work shifts are due to acute sleep deprivation, there are both schedule design and sleep science-based countermeasures that can be employed to lessen the negative effects of extended hours of work. There is growing empirical evidence on the effectiveness of countermeasures for problems that are known to be results of poor sleep, such as depression and chronic sleep loss, and substantial evidence for predictive models that could be more widely used to identify workers at increased risk. Moreover, an indicator of the fatigue problem is that workers are choosing to sleep rather than take prescribed breaks. Many current work rotation patterns in health care and the 24-hour shift coverage require that workers work during night or early morning hours. (Hattatoğlu et al.2020)

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Prescriptive modeling techniques, predictive risk models, protocols for implementing changes, and tools for continuous model evaluation have been developed and validated in fields such as transportation, where the concept of Crew Resource Management has helped fly accident rates to historically low levels. However, such models that are data-driven and evidence-based are not widely applied outside of the airline industry. The goal of prescriptive models is not just to predict problems but to develop feasible countermeasures to prevent these problems. Model-driven countermeasures rely on a much more effective and efficient use of data for health systems delivery; however, only with innovations like proactive fatigue management can creativity drive treatments to match the epidemiological and etiological evidence for links between worker fatigue factors and deterioration of worker health and patient safety. Complete systems for running research into specifying predictions, management-based applications, and tools can be used to simultaneously gather, validate, and apply necessary data to other relevant health care delivery. (Seah et al.2021)

### 5.1. Workplace Policies and Regulations

States also have adopted regulations setting limits on work hours for physicians. In some states, these regulations are part of the disciplinary codes of practice set by the state boards; in other states, the labor laws limit the length of workdays and workweeks of non-resident physicians engaged in everyday practice outside of residency training. State laws and licensing bodies have mechanisms to both set limits on work time and evaluate and enforce compliance with these limits. Lack of awareness of these rules and fear of reprisal are obstacles to the effective use of these existing rules. Educational efforts need to be made to educate residents, department chairs, medical staff, regulators, and the general public about the risks of shift work and about the existence of rules that limit work hours. If these rules are to be used effectively for patient and medical professional safety.

The results vary by question and sample. Support was strong for the three aggregate indices—legislation to restrict work hours for surgeons, especially interns, during the first year of practice except when changes would not influence either patient safety or doctors' health. For non-surgeons, support was strong for limiting the work hours of interns during their first year of practice and reducing the hours of all doctors. The least support was obtained for whether the current standard of limiting work hours should be eliminated or replaced. This trend was consistent across the three different groups of people who judged the issues, irrespective of whether they consisted of non-physicians or doctors who were never interns.

### 5.2. Training and Education Programs

This Schedule-Human Factors Intervention is designed to increase alertness and enhance decision-making and workload management, particularly between 11 p.m. and 7 a.m. The program begins with a 6-hour training session that is conducted prior to the start of an EWS

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schedule and reinforced on site on a regular basis once the schedule begins. The training can be conducted by non-clinical supervisors. These materials consist of a stand-alone videotape of a narrated slide show which addresses the following topics: providing background on fatigue and performance degradation within the body's internal clock, managing workload, managing work-rest scheduling, managing other factors that affect shift performance, and acting by trying out new strategies. A brief reminder training session is presented within the first two hours of the shift.

Advice is given in weekly notes to the medical director on such topics as the use of caffeine and napping, motivation, help in asking for help, diagnosing the performance-limiting factor, and fitness for duty. Clinicians record leaving and returning work times, as well as sleep and the number and length of breaks on a written record of daily work and non-work activities. At the end of the shift, the recording worker rates their maximum degree of tiredness in their eyes, hands, or body, lack of alertness, and the demands of the shift by comparing their experience with baseline performance data. These data are useful for providing work performance feedback, so that they can make informed judgments about the adequacy of management directives.

## 6. Conclusion

There are a growing number of studies that have provided much-needed empirical data on the acute and chronic risks of shift work, particularly extended work shifts, in healthcare. Key findings are that: (1) work hours constitute the most consistent risk factor for increased safety and health problems; (2) research has documented that the consequences of various types of problems are evident both acutely during shifts, putting workers and patients at extreme risk, and chronically over time, particularly with regard to diseases associated with circadian rhythm disturbance that do not reverse completely in 1–2 nights between extended work schedules; (3) managing work hours needs to be considered within a broader framework that incorporates both concern about fatigue and concern about circadian disruption; (4) patient care responsibilities can result in difficulty applying current work-hour guidelines to healthcare workers. First, healthcare workers, particularly physicians and nurses, are currently working far longer hours than the guidelines specify. There is strong evidence that healthcare workers overestimate their skill at recognizing and responding to impaired performance associated with fatigue. The design and implementation of real-world sleep health interventions specific to the unique industry and occupational cultures are likely to make such safety-critical projects more successful. Creating opportunities for obtaining 6–10 hours consecutively in a safe and supportive environment will become the necessary final translation step as research has documented the performance implications of insufficient sleep for healthcare workers. There is also preliminary evidence that better sleep health supports safety and patient care outcomes. We need to transform this evolving knowledge base into practice guidelines and institutional

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policies that recognize that sleep is a foundational component of the health and safety of healthcare workers. (Rivera et al., 2020)

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