# Fatigue and its impact on performance and health

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## Abstract

An increasing body of evidence suggests that fatigue among healthcare staff is widespread, owing to a combination of high work intensity, long daytime hours and night-shift working. This has been linked to poorer outcomes for patients and longer inpatient stays, and to increased risks of work-related accidents, errors and injuries for practitioners. These include needlestick injuries and motor vehicle accidents, and other impacts on practitioner health, ranging from cancer, mental health problems, metabolic disorders to coronary disease. Other 24-hour safety-critical industries have fatigue policies that acknowledge the risks of staff fatigue and provide a system to manage it and mitigate harm, but these are still lacking within healthcare. This review explains the basic physiology behind fatigue and outlines its impacts on healthcare practitioners' clinical practice and wellbeing. It proposes methods to minimise these effects for individuals, organisations and the wider UK health service.

Key words: Circadian misalignment; Fatigue; Fatigue risk management; Healthcare shift work; Healthcare worker fatigue; Sleep restriction

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## What is fatigue?

Fatigue affects everyone. The feeling of mental or physical exhaustion that can result in deteriorating performance is caused by chronically shortened sleep, acute sleep deprivation, night working or high work intensity. Healthcare workers, especially night-shift workers, often experience all four (Ganesan et al, 2019). Alongside feelings of sleepiness and difficulty completing tasks, fatigue affects how a person thinks and behaves in ways that may not be noticed, including how we assess risk, make decisions, perform complex tasks, interact with colleagues and manage our emotions. Attention, memory, response times, vigilance, hand–eye coordination, arithmetic ability and impulsivity are all affected (Kayser et al, 2022). Despite this, inter-individual variation means that humans can also perform difficult tasks, such as emergency surgery (Quan et al, 2022), safely while sleep deprived. This makes fatigue management complex, with 'invisible' effects often being ignored or dismissed as part of the job, despite the risk.

Around-the-clock working is an inescapable part of healthcare. Therefore, it is vital that all stakeholders understand the impact of fatigue and that national policies reflect this. Healthcare is one of the few industries where fatigue management is not part of the safety systems and culture. Fatigue is omitted as a causative or contributing factor in NHS national error reporting systems, despite studies showing that fatigue in employees causes worse patient outcomes, poorer performance and increased risk of staff injury (Querstret et al, 2020).

Many notorious disasters are associated with fatigue (Gurubhagavatula et al, 2021). Senior managers in rail, aviation, nuclear power, road haulage, mining and other high-risk 24-hour industries use fatigue risk management systems within their safety management systems to manage staff fatigue. This is not the case in the UK's NHS, the world's third largest employer. This article explains the causes of fatigue in healthcare staff and its impact on staff, patients and society, and suggests ways to mitigate its effects.

## Cause of fatigue

Fatigue is caused by a combination of inadequate sleep and disruption of the normal circadian sleep–wake cycle. This affects cognitive, emotional and physical performance in shift workers, especially during night shifts (Querstret et al, 2020).

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Humans are diurnal animals (active in the day), with major physiological processes (digestion, sleep, blood sugar control, muscle strength and cognitive function) designed for this (Queensland Health, 2021). Our sleep is controlled by two physiological processes that work together so we can sleep at night and be awake in the day: levels of adenosine in the brain increase the longer a person is awake, and act on hypothalamic receptors in the forebrain to make a person feel sleepier; this effect is counterbalanced by the internal body clock (circadian rhythm), an approximate 24-hour cycle of alertness and sleepiness, which makes us more alert as the day goes on and then switches off at night, leaving us tired until the morning (Gurubhagavatula et al, 2021).

This gives most people a steady state of alertness in the daytime, with a slight peak in the evening, followed by a dip in alertness overnight. The 'phase' of our circadian rhythm takes about 24 hours to shift 1 hour if the timing of external light is altered by factors such as long haul flights, social jet lag (sleeping longer at weekends) or night-shift work. This explains why employees are often tired during night shifts and may have trouble sleeping in the day, as they cannot shift the phase of their internal clock to match their work demands (Ganesan et al, 2019).

Sleep is an essential physiological activity, strongly influenced by light, but night-shift workers get about 2 hours less sleep than day-shift workers. The long-term effects of living without synchronisation of our internal clock to external signals, particularly daylight, are increasingly being understood. It is now largely agreed that decreased sleep duration and exposure to light at night have negative impacts on the performance of night-shift workers. Working and eating at inappropriate times also leads to physiological stress, inflammation and, ultimately, ill health (Queensland Health, 2021).

## Sleep restriction, sleep deprivation and shift work

Sleep restriction is reduced duration of sleep for multiple, consecutive nights; sleep deprivation is a complete absence of sleep for at least one night (Kayser et al, 2022). Performance recovers relatively quickly after sleep deprivation with 'recovery sleep.' However, most shift workers do not get a full recovery sleep (Ganesan et al, 2019), leading to chronic sleep restriction and deprivation. A third of healthcare workers report getting insufficient sleep (Caruso, 2014). Hours of work and shift patterns compound this, particularly early starts and night shifts (Ganesan et al, 2019). Chronic sleep restriction reduces subjective feelings of drowsiness (Ganesan et al, 2019), a warning sign that our performance is deteriorating (Gurubhagavatula et al, 2021), which is particularly dangerous when driving.

## Performance

Performance is affected by prior sleep and time of day. Response to sleep deprivation, night-shift work and work intensity varies between individuals (Gurubhagavatula et al, 2021). Most studies demonstrate deteriorating performance between midnight and 8 am, during long shifts without adequate breaks, or with short rest times between shifts (Ganesan et al, 2019). Complex tasks involving working memory are completed more slowly and with less accuracy after night shifts (Ganesan et al, 2019). Cognitive assessment studies show that doctors' psychomotor function and attention worsen after a night shift (Adams and Venter, 2020), and simulator-based studies demonstrate increased operating times for surgeons post-call (Quan et al, 2022).

Prolonged time spent on tasks during the day can lead to decision fatigue: GPs prescribe more antibiotics towards the end of a clinic (Linder et al, 2014), and judges pass stricter sentences before, compared to after, a break (Danziger et al, 2011). Cognitive fatigue triggers preference for quicker and easier choices and reduced cognitive effort.

## Medical errors

Fatigued healthcare staff make more errors, with a human and financial cost to society. A 2022 survey of NHS doctors revealed that nearly 60% had worsened sleep during the pandemic, and a quarter felt that tiredness affected their ability to treat patients, with

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18% of this group reporting an error or near-miss as a result (Medical Defence Union, 2022). An Australasian study of anaesthetists found that 44% had made fatigue-related medical errors, with 3% resulting in direct patient harm (Stuetzle et al, 2018). Fatigued nurses have more injuries and musculoskeletal disorders (Querstret et al, 2020). The risk of anaesthetic adverse events increases later in the normal working day (Wright et al, 2006), and poorer hand asepsis was more likely in neonatal intensive care unit clinicians at the end of a long shift than a normal 8-hour day (Rittenschober-Böhm et al, 2020). Patients of nurses working shifts longer than 12 hours have higher rates of mortality and morbidity (Querstret et al, 2020). Practitioners working longer daytime hours or night shifts made more prescription errors (Querstret et al, 2020), and patients presenting to emergency departments at night were less likely to receive adequate analgesia (Choshen-Hillel et al, 2022).

A 2014 report, commissioned by the UK Department of Health, estimated the cost of unsafe healthcare in the UK at between £1 billion and £1.5 billion (Frontier Economics, 2014). Root causes of errors are not explored, but the scientific literature indicates that staff fatigue is likely to be a major contributor.

## Vehicle accidents

Driving simulations demonstrate deteriorating ability with increasing out-of-hours work (Arnedt et al, 2005). Night-shift workers are at increased risk of driving accidents after a night shift (Åkerstedt, 2019), and healthcare staff are also more likely than other workers to have accidents driving to work (Ponsin et al, 2020). Nurses (Westwell et al, 2021) and doctors (McClelland et al, 2017) have described accidents and near-misses when driving home after shifts, caused by sleepiness at the wheel. Fatigue is a factor in a quarter of fatal road traffic accidents (Westwell et al, 2021). Tragically, too many UK healthcare staff have died driving home after night shifts. There is no feedback mechanism to officially report these deaths, so the total number is unknown.

## Decision making, leadership and mood

Sleep restriction affects impulsivity, risk assessment, processing speed, working memory, cognitive control, visual attention and psychomotor vigilance (Kayser et al, 2022). The COVID-19 pandemic has highlighted the interrelationship between poor sleep and stress in healthcare workers and the impacts these have on decision making, psychological health and emotional reactivity. Inadequate sleep is associated with negative thoughts, stress and poor coping mechanisms (de Almondes et al, 2021). Our emotions become less regulated and more negative at night, with more fear, depression, anxiety and thinking biased towards self (Tubbs et al, 2020), leading to poorer teamworking and decision making (Quan et al, 2022).

## Long-term health risks of night shifts

Night-shift workers are at higher risk of type 2 diabetes, cardiovascular disease, mental health issues, accidents, injuries and cancer (Querstret et al, 2020; Rivera et al, 2020). The aetiology is multifactorial and not yet fully understood. Some of the proposed mechanisms include disruption to diet and exercise routines, sleep debt, exposure to light at night, hormonal disturbances, and lack of exposure to daylight during waking hours.

Type 2 diabetes risk rises in direct proportion to the number of night shifts worked (Vetter et al, 2018) and people make poorer food choices at night, owing to metabolic dysfunction (Tubbs et al, 2020).

Shift work affects the immune system, increasing levels of inflammatory markers and susceptibility to disease. Healthcare workers may be at increased risk of COVID-19 infection, triggered by immune compromise related to sleep disruption (de Almondes et al, 2021).

A 2018 meta-analysis estimated that shift workers were 17% more likely to have cardiovascular disease than day workers and 20% increased likelihood of cardiovascular mortality (Torquati et al, 2018). The risk of hypertension is increased (Patterson et al,

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2021), and night-shift workers taking antihypertensive medication have poorer blood pressure control (Park et al, 2019).

Long-term night-shift work increases risk of breast, prostate and colorectal cancers and has been classified as a class 2a carcinogen by the International Agency for Research on Cancer (Papantoniou et al, 2017; Rivera et al, 2020).

Shift work also significantly increases the risk of mental illness, particularly depression (Querstret et al, 2020). Medical students performing shift work lose about 2 hours of sleep, and sleep loss has a greater impact on mood than mood does on sleep duration (Kalmbach et al, 2018). Cases of suicide are relatively more common in the night-time dip of circadian alertness (Tubbs et al, 2020).

Long hours and shift work in pregnancy are linked to preterm delivery and small for dates babies (Rivera et al, 2020).

Shift workers are at increased risk of sleep disorders, and the COVID-19 pandemic has further worsened sleep and stress in healthcare workers (de Almondes et al, 2021). Nearly half of hospital doctors reported problems with poor-quality and non-restorative sleep during the pandemic (Liu et al, 2019).

## What can we do about it?

It is important that the concept of circadian and sleep health is understood, so that shift workers are recognised as an at-risk group. Individuals, their managers, families and employing organisations, along with national policies and regulatory frameworks, all play a part. Mitigating actions can be taken to address fatigue and decrease health and safety risks posed by shift work (Gurubhagavatula et al, 2021).

### Individuals

It is the individual's responsibility to understand the risk to which they expose themselves, their patients and society. Education about fatigue is therefore essential, as effective personal routines that allow adequate rest between and during shifts are the bedrock of good fatigue management.

Shift workers should sleep before night shifts, reducing their total time awake. Short 10–20-minute 'power naps' during night shifts may help decrease sleepiness and improve performance. Naps should be organised in a professional and collegiate way to ensure undisturbed rest, while maintaining patient safety (Gurubhagavatula et al, 2021).

During shifts, workers should be aware of their performance and take steps to reduce risk, advocating for themselves to get the breaks they need to do their job safely. Rest requirements differ between people, but some individuals become accustomed to a lifestyle that is supported by excessive working hours (Gurubhagavatula et al, 2021). Workers who understand the effects of sleep loss and circadian desynchrony may foster behaviours that support safer practice, such as taking breaks and napping before driving home.

After a night shift, employees should prioritise time for sufficient daytime sleep, and make appropriate arrangements for this. Most people become increasingly sleep restricted the more consecutive night shifts they work (Ganesan et al, 2019).

Meals should be eaten at similar times whether a person is working days or nights, as shift workers do not align their body clocks to the night (Manoogian et al, 2022). However, eating large meals at night causes raised blood glucose levels and may increase the risk of road traffic accidents on the way home (Gupta et al, 2021).

Night-shift workers may experience negative emotions, have less emotional control and may lose perspective. They may feel depressed, desperate, pessimistic and overwhelmed at night (Tubbs et al, 2020). Colleagues should support and remind each other that things look better in the day, especially after a sleep or rest. Early help should be sought if mood remains low.

Sleep disorders can affect the restorative quality of sleep, and employees should seek help from their GP or occupational health for suspected insomnia, restless legs, shift work disorder and obstructive sleep apnoea.

Finally, employees should engage with the employer's efforts to manage fatigue once these are instituted.

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### Managers

Managers should have a good understanding of fatigue (Gurubhagavatula et al, 2021) and use fatigue risk management systems. They should know how to spot signs that an employee is fatigued on arrival at work or during a shift and have processes to manage this, including breaks, working with a buddy or performing low-risk tasks. Managers should restrict sequential night shifts, and plan rotating shifts, with adequate time off between shifts (NHS Confederation, 2020). Shift length should ideally be reduced, but short rest periods between shifts or sequential long days should also be avoided, to allow adequate inter-shift recovery. Managers should include all team members in break management and provide suitable rest areas within their department (Gurubhagavatula et al, 2021). Employees should be encouraged to nap or lie down during night shifts in dedicated quiet, dark, safe rest areas (Gurubhagavatula et al, 2021), but also to be aware of sleep inertia. Fatigue management interventions should be audited; lessons learned and good practice should be shared to create a robust approach.

Approximately 20% of workers struggle with working at night and need proactive support. Managers should undertake fatigue risk assessments to identify at-risk groups, such as young female workers and female single parents, and be receptive to all employees raising concerns about fatigue. Mood disorders and stress should be identified early on, and shift workers referred to occupational health promptly if they are struggling.

### Organisations

Ultimate responsibility for fatigue risk management rests with the leaders of healthcare organisations (Dawson and Thomas, 2019). Senior clinical and non-clinical staff must understand that employee fatigue is inevitable and that it poses risks to society. They should be given resources to implement fatigue risk management systems, as they are scientifically proven strategies that provide a framework for proactively avoiding fatigue-related accidents and errors. Available guidelines include the Queensland Health (2021) fatigue risk management system, and the American Academy of Sleep Medicine guidelines (Gurubhagavatula et al, 2021). The employer is responsible if working arrangements do not adhere to standards that allow staff to work safely (eg take breaks and access suitable rest areas).

### Governments and national bodies

Implementation of the European Working Time Directive changed medical out-of-hours practice from on-call teams covering familiar wards to individuals working shifts and covering diverse patient groups throughout the hospital. Shift patterns amplified work intensity, rest areas were repurposed, nurses' perceptions of doctors' entitlements to rest changed, and the legislation inadvertently increased fatigue for many.

Working in understaffed, high-pressure environments creates fatigued, disillusioned workers who are at a high risk of making errors. National bodies, such as Royal Colleges, along with other medical and nursing organisations, must support open discussion about fatigue and circadian health in the healthcare workforce, to improve safety and wellbeing for everyone.

UK health and social care employers, along with the UK government, must understand that workforces need adequate resources to be safe. Ignoring fatigue may not be the most economical approach. Employing more staff may reduce the currently uncalculated cost of fatigue-related healthcare errors (Frontier Economics, 2014).

The Driver and Vehicle Licensing Agency and Health and Safety Executive should recognise road traffic accidents as work-related events if the driver is experiencing work-induced fatigue. Health and social care employers must be held accountable for silently condoning fatigue-promoting attitudes and working conditions.

## Conclusions

Fatigue affects everyone, shift and non-shift workers alike. It has negative impacts on psychomotor and cognitive functions, impulsivity and risk assessment, making it difficult for fatigued practitioners to provide good standards of care. Its effects are insidious as individuals lose perspective, sometimes with fatal consequences. Night shifts, long days and 'late' shifts are fatiguing, particularly in combination with long commutes.

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## Key points

- Fatigue is widespread in the healthcare workforce and is proven to have detrimental effects on patient care.
- Fatigue has demonstrable negative impacts on the health and wellbeing of workers in all industries.
- As a safety-critical industry, healthcare services must take steps to mitigate risks posed by fatigued workers. Other 24-hour safety critical industries use fatigue risk management systems, and healthcare systems should do the same.
- Individuals, managers, organisations, the wider NHS and regulatory bodies should all play a part in identifying and mitigating the impacts of fatigue.

Work intensity during shifts is increasing as a result of greater demand, staff sickness and declining workforce numbers. The COVID-19 pandemic and its aftermath has exacerbated work pressures, stress and anxiety, which are factors that all contribute to fatigue.

Fatigue has a human and financial cost. Other safety critical industries use fatigue risk management systems to manage employee fatigue, and UK healthcare, especially NHS employers, must adopt this approach. Everyone in the NHS, from chief executives to frontline workers, should adopt a 'fatigue-aware' culture. They should understand how to recognise fatigue in others and themselves, and know how to implement processes to reduce the risks. In the UK, 1 million people are treated in the NHS every 3 days, yet we are not measuring the impact of fatigue on the healthcare we deliver. It is no longer acceptable to ignore staff fatigue.

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**Conflicts of interest**

The authors declare that there are no conflicts of interest.

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