



Shift work, scheduling and risk factors

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There are increasing expectations that Senior Medical Officers (SMOs) spend more time out of hours in hospitals – through shifts, long periods of call, extended working days or weekend work. This paper summarises literature about shift work, with a particular focus on issues arising from doctors working at night in hospital emergency departments

Preventing and dealing with fatigue is a reality for medical specialists working in New Zealand's public health system. There is more and more pressure to deliver optimal health care with fewer resources, high expectations, 'presenteeism', stress and burnout. Working night shifts and the resultant fatigue can impair a person's ability to work safely and efficiently, as well as having an effect on individual and workforce morale.

This paper presents findings from a review of literature about shift work, looking particularly at issues arising from physicians working night shifts in hospital emergency departments (ED). These issues are relevant to senior doctors and dentists working in New Zealand's public health system, and merit further discussion.

The goal for the Association of Salaried Medical Specialists (ASMS) is to identify best practice recommendations that are supported by the literature. These can then be used to develop a shift work clause for ASMS members under Clause 19 of the multi-employer collective agreement (MECA) that covers district health boards. This will assist with the health and well-being of the physicians involved in ED shift work as well as the patients they attend to.

For the purposes of this paper, shift work is defined as a "method of staffing in which different employees work at different times during the day, including times outside the classic 0800-1800 hours. The 'shift' is the unit of work time scheduled per day" (Frank and Ovens 2002 p422).

The paper begins with a brief review of the impact of night shift work in physiological terms. It briefly describes the significance of night shift work for emergency department workers before moving on to discussing recommendations that are raised in the literature. It concludes by raising specific points for discussion and feedback.



Night shifts and circadian rhythms

It is well established that working hours which deviate from normal diurnal rhythms disrupt normal sleep cycles and social schedules (Dula, Dula et al. 2001). These disruptions, variously described as 'phase shifts' or 'circadian desynchrony' are cited as having negative consequences for cognitive and performance abilities as well as having serious physical and psychological implications (Kuhn 2001). For people working night shifts, or with part of their shift scheduled over 'night' hours, a key issue is attaining enough sleep and ensuring it is of good quality. It is estimated that night shift workers get on average 25-33% less sleep than day or evening shift workers (Frank and Ovens 2002).

Much literature is concerned with discussing the neurophysiological basis for the difficulties associated with working out of normal sleep cycles. Horowitz and Tanigawa (2002), for example, detail the importance of core body temperature (CBT) melatonin and cortisol levels and the relationship these levels play in the circadian alertness function. They further describe the importance of zeitgebers or environmental cues such as light, temperature, exercise and food which help maintain circadian phases. Altering these zeitgebers can assist with reorientating toward a different circadian schedule; for example, adjusting light exposure when undertaking transmeridian travel (see also Frank and Ovens 2002).

The literature notes the consequences of circadian desynchrony can be both physiological and psychological. Negative psychological effects can include high levels of stress, fatigue, irritability, and associated issues such as social isolation, high divorce rates, burnout and substance abuse (Kuhn 2001). In physiological terms, the consequences can include higher rates of gastrointestinal complaints, coronary artery disease and cardiac mortality as well as other serious physical illnesses (Frank and Ovens 2002). Kuhn (2001) notes that female shift workers are more likely to experience complications with their pregnancies as a consequence of working shifts, and have a significantly higher risk of pregnancy loss than women working day shifts (see Infante-Rivard, David et al. 1993). These findings emphasise the importance of making sure that people on night shifts work in optimal conditions.

Shift work in the context of emergency medicine

For physicians working in hospital emergency departments, the realities of their jobs require work outside of 'normal' working hours. Night shift work is recognised as being a particularly stressful factor for ED doctors. The negatives associated with this practice have been linked to ill health and the well-being factors discussed above, as well as contributing factor in high rates of attrition of ED workers and difficulties in staffing ED departments (Howlett, Doody et al. 2015). Indeed, the American College of Emergency Physicians state that "the effects of rotating shifts are cumulative, and represent the most important reason physicians leave the specialty" (ACEP 2003). Research by Shanafelt et al (2009) on burnout in American surgeons also found a strong association between the number of nights on call per week and burnout defined as "emotional exhaustion and depersonalization leading to decreased effectiveness at work" (p. 463).

Of particular concern for ED doctors is the recognition that work outside of normal sleep hours has a clear impact on how well people can function, both in cognitive and physical terms. Frank and Ovens (2002) emphasise the impact of circadian desynchrony in terms of time on task and the time of day

that the task is being undertaken. They acknowledge the considerable body of literature that suggests fatigue due to shift work-induced sleep deprivation is a key factor in the occurrence of adverse events. For example, disasters such as the Chernobyl and the space shuttle Challenger accident have been linked to human error while on night shift (Mitler, Carskadon et al. 1988). Burgess (2007) also cites research that found, on average, a 30% increase in human error incidents on night shift relative to morning shifts.

In the context of emergency medicine, Smith-Coggins, Rosekind et al. (1994) have documented the decline in physician performance as represented by speed of intubation and ability to correctly read charts as a consequence of working night shifts. Dula, Dula et al. (2001) similarly found in their research on the performance of emergency medicine residents that performance declined substantially over the course of the number of night shifts worked relative to physicians on day shifts. In the New Zealand context, Gander, Merry et al. (2000) reported a high level of recollection of fatigue-related errors amongst anaesthetists as a consequence of hours and time of work. It follows that emergency departments need sound guidelines to help decide staffing and shift work patterns. The following sections of this paper discuss issues with scheduling, shift duration, and recuperation time as well as ideas drawn from the literature that may assist with reducing fatigue-related errors.

Scheduling shift work, recuperation and length of shifts

The American College of Emergency Physicians (ACEP) usefully states that the starting premise for any shift work arrangement should be the emergency physician's well-being (ACEP 2010). It reports that creating a healthy and supportive working environment will generate positive flow-on effects to patients in these departments (see also ACEP 2003). Most of the literature reviewed on shift work agrees that the best schedules are those that help maintain diurnal circadian rhythms (Smith-Coggins, Rosekind et al. 1997). Accordingly, clockwise shift rotation patterns (mornings-afternoons-nights) are recommended. These forward-rotating shifts are more readily tolerated by shift workers and prevent phase-shifting circadian rhythms to nocturnal patterns (Whitehead, Thomas et al. 1992, Frank and Owens 2002).

Kuhn (2001) in her article on circadian rhythms and shift work describes the importance of understanding the rate of phase shifting and how speed of rotation and length of shift worked are crucial factors in preventing desynchronosis. Her research suggests that isolated night shifts are best as phase shifting generally occurs only after three days of concurrent night shifts. As a consequence, Kuhn recommends short strings of night shifts of no more than three consecutive nights. This recommendation for minimum numbers of consecutive night shifts is echoed by Frank and Owens (2002), who suggest that three nights should be a maximum with optimal numbers of consecutive night shifts being one or two. Both articles cite studies into shift work practices and biophysical issues associated with working night shifts (see for example Dorevitch and Forest 2000).

Burgess (2007) also supports the recommendation that night shifts should be scheduled over short blocks of no more than three concurrent days. She cites research which reports on the basis of a pooled average, the risk of negative events occurring increases exponentially according to night shifts worked (Folkard and Tucker 2003, Folkard, Lombardi et al. 2005). She states “the risk of a negative occurrence was approximately 6% higher on the second night, 17% higher on the third night and 36% higher on the fourth night” (p. 90). The graph below (taken from Folkard and Tucker 2003 p. 97) demonstrates this trend powerfully:

Research undertaken at Stanford University found a significant difference between the performance of ED doctors depending on whether they were working day or night shifts. This was assessed by comparing their ability to accurately review charts and the speed at which they performed a simulated intubation (Smith-Coggins, Rosekind et al. 1994). Other research by the same authors examined objective performance tests and subjective ratings of the physician’s levels of sleep and their moods. Although the research found no statistically significant difference in accuracy of ECG analyses, the vigilance reaction times, intubation speeds, amounts of sleep and mood ratings were all significantly worse when the physicians were on night shift (Smith-Coggins, Rosekind et al. 1997).

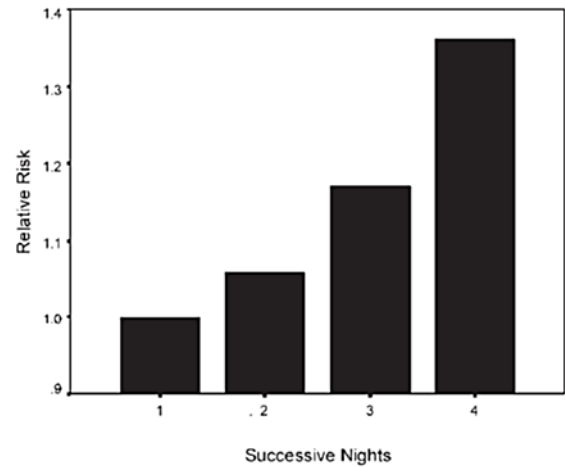


Figure 4. The relative risk over four successive night shifts.

The research by Folkard and Tucker (2003) also usefully describe trends pertaining to relative risk according to the type of shift worked (Figure 2), time of night (Figure 3), and successive hours worked (Figure 6). As Folkard and Tucker summarise, these findings suggest the importance of “attending to the number of successive night shifts, the length of the night shifts and the provision of breaks within them”(Folkard and Tucker 2003 p99). Research by Morrow, Burford et al. (2014) found a correlation between fatigue and having an unpredictable mixture of shifts and inadequate rest as well as high work intensity.

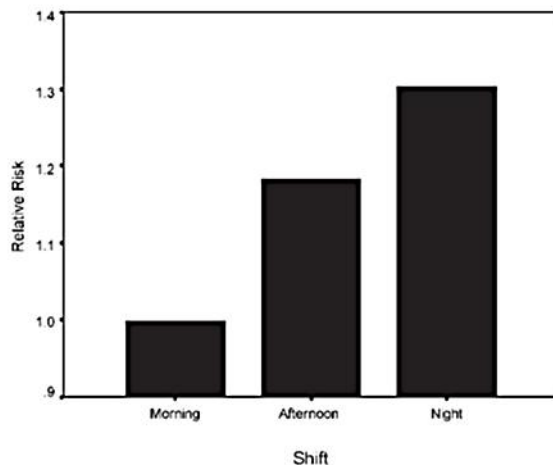


Figure 2. The relative risk across the three shifts.

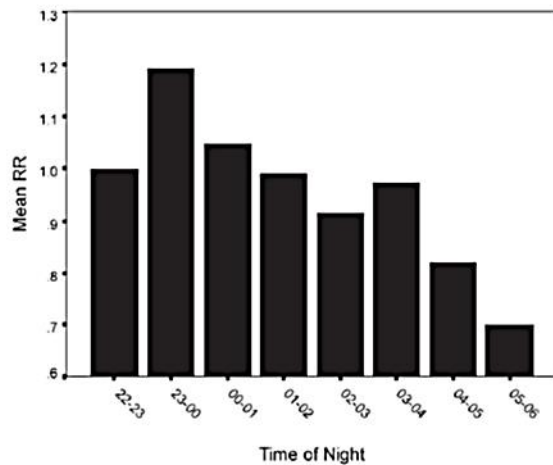


Figure 3. The relative risk over the course of the night.

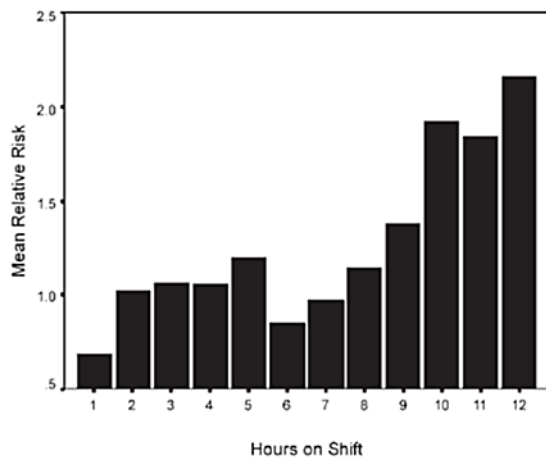


Figure 6. The mean relative risk over hours on duty.

As demonstrated in these graphs, there is a clear association between hours on duty and relative risk of negative occurrences. Folkard, Lombardi et al. (2005) suggest that relative to 8 hour shifts, 10 hour shifts are associated with a 13% increase in risk and 12 hour shifts with a 27% increased risk of negative occurrences (p21). Other research by Smith, Folkard et al. (1994) suggests that the optimal length of a shift should reflect the nature of the work conducted. Given the fast pace and complexity of the work experienced by ED physicians, they suggest an optimal shift length of eight hours (see also Frank and

Ovens 2002). Burgess (2007) also notes that in general 8 hour shifts are preferable over 12 hour shifts because the clockwise rotation principle is easier to implement. It is noted, however, that part of this risk can be attenuated by the provision of rest breaks. In the graph on hours on shift (above), for example, they suggest that the sudden dip in mean relative risk after the fifth hour may be in part due to the influence of a rest break (see Folkard and Tucker 2003 p98).

Research by Smith-Coggins, Howard et al. (2006) sought to determine whether taking planned naps during a night shift can improve alertness and reduce the risk of adverse effects for ED workers. They discovered that a 40 minute nap at 3am on a night shift significantly improved both performance and how the workers felt in terms of sleepiness as opposed to the workers who didn't take a nap. Their research supports assertions from other fields such as aviation, where the use of planned naps are now commonplace as a fatigue counter-measure (see Rosekind 1994). Gravenstein, Cooper et al. (1990) also suggest that policies which allow periodic breaks appear to produce a safer work environment for anaesthetists than those work environments that do not. The ACEP (2010) guidelines suggest that it is important to provide a place for end-of-shift workers to sleep prior to driving. The Australian Medical Association (AMA) guidelines on shift work and rostering emphasise the importance of maximising the opportunity to take breaks within shifts, although they don't specifically recommend the use of naps as a tool (AMA 2005).

Additional recommendations for shift scheduling are contained in the ACEP statement on shift work (ACEP 2010). ACEP acknowledges the diurnal orientation approach to shift scheduling but states that "the gold standard is never to rotate shifts... Without a permanent night worker the best shift rotation ... is to have group members work a long string of nights, 4 to 6 weeks". Other research reviewed, however, suggests that although a full circadian shift is technically achievable, one would have to ignore family and social commitments to attain and maintain this reorientation (for example Horowitz and Tanigawa 2002). In this respect, ACEP advises that it "is important for the night person to stay up even on their nights off so as not to lose their hard won night orientation". They further state that "[w]hile one may not see as much of their family during their time on nights they can spend proportionately more time during the remaining 10 to 11 months and be well rested and fun

to be around". It is not clear how ACEP's recommendation addresses the difficulties associated with sleeping during the day or the significance of patterns of light exposure for the adjusted sleep/wake cycle (Folkard, Monk et al. 1978, Horowitz and Tanigawa 2002). Further, there is a paucity of information detailing how successful this approach would be in reality and what the long term psychological effects would be of essentially cloistering oneself away from social activities for such a long period of time. Achieving this 'gold standard' is, as a consequence, likely to depend on the individual physician's circumstances and tolerance for working unsociable hours. It would require considerable social and physical isolation in order to make it feasible.

While there is no clear consensus over the ideal length of shift rotation, the literature reviewed supports the need for appropriate recuperation periods following night shifts. Reviews conducted by Kuhn (2001) and Frank and Ovens (2002), for example, all reach the conclusion that after one or more night shifts there should be at least 24 hours of recuperation. Three days, however, are recommended as the ideal amount of time in order to overcome the disruptions to sleep-wake cycles (Smith, Folkard et al. 1994). The time set aside for recuperation should also ideally include some weekends or at the very least allow opportunities for social interaction (Frank and Ovens 2002).

Another theme that is consistent in the literature is the importance of allowing the workers involved in shift work to have autonomy in terms of choosing when and how often they wish to work. Kuhn (2001) notes, for example, that physicians will have differing abilities to cope with shift work and some may have personal circumstances that allow them to work longer periods of night shifts than others. As a consequence, self-scheduling has shown to be positively associated with reductions in stress levels (Krakow, Hauswalk et al. 1994). In terms of other strategies and considerations, the Australasian College for Emergency Medicine (ACEM 2008) emphasises the need for preferential remuneration and/or the provision of other incentives to ameliorate and acknowledge in tangible terms the difficulties posed by night shift expectations.

There is an extensive literature dealing with relationships between age and night shifts. Kuhn (2001) and Burgess (2007) both cite research which suggests declining melatonin levels with age is a key factor in why older shift workers do not cope as well with the rigors of night shifts. Burgess further notes that workers older than 45 years have a reduced ability to adapt to night shifts as a consequence of being less able to sleep during the day. Other research suggests that the cognitive performance of shift workers declines according to age and the length of time that they have worked as a shift worker (Rouche, Wild et al. 2005). This supports the recommendations in the ACEM and ACEP guidelines that night shifts should be less common for those over certain ages, although the ACEM mentions no specific age and the ACEP guidelines speak of 'older' members.

Burgess (2007) also discusses the significance of considering gender in the context of shift work. She cites research that suggests female shift workers are more likely than their male counterparts to do domestic activities at the end of their night shifts, which further decreases the amount of sleep they are able to get during the day (see Gadbois 1981). As discussed earlier in this review, there are clear correlations between working night shift and pregnancy that should also be taken into consideration when arranging staffing for night shifts.

Key points for further consideration:

1. Clockwise shift rotation patterns to be adopted, with simple and predictable scheduling templates recommended where possible.
2. Number of consecutive days on night shift should be optimally one or two but no more than three days.
3. Shifts should ideally be 8 hours with 10 hour shifts as a maximum. 12 hour shifts not recommended due to high risk factors. End of shift handovers should be incorporated into this shift time.
4. Recuperation time should be at least 24 hours following one or more night shifts but optimally three days of recuperation time is required to overcome sleep-disruption.
5. Self-scheduling is recognised as an important tool in reducing stress in ED workers.
6. Naps are recommended as a tool to increase alertness during shifts (especially if shifts longer than 8 hours).
7. Contingent factors such as age and pregnancy should be taken into consideration when scheduling night shifts.

Did you know that...

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| Shift work is different from regular weekday rosters that characterise most (though not all SMO work). |
| Shifts are also different from after hours call. |
| Before shifts are introduced into any DHB department or service ASMS <i>must</i> be consulted, along with affected employees. (MECA clause 19.1) |
| Where shifts are in place T1.5 applies outside the hours of 1900 and 0800, and during weekends and public holidays. (MECA clause 19.2) |
| Other terms and conditions beyond those specified in the MECA may be agreed during the consultation period, and put in place prior to the introduction of shifts. |
| Suitable overnight accommodation must be provided to support rest breaks, sleep (where workload allows), and prior to travelling home. (MECA clause 53.2) |
| Overnight accommodation requirements are described in MECA clauses 53.2-53.4. |

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