EDITORIAL

THE SHIFT LENGTH, FATIGUE, AND SAFETY CONUNDRUM IN EMS

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Shift length and fatigue among emergency medical services (EMS) providers may increase error and injury.[1–3] Shift work is inevitable given the constant need for EMS, but the ideal length of shifts and rest intervals is uncertain. Are eight-hour shifts that rotate every 30 days (e.g., 0700–1500 transitioning to 1500–2300) really superior to a 24-hours-on, 48-hours-off schedule? Is a 24-hour shift with low call volume worse than an eight- or 12-hour shift with high call volume? How are we to address providers who work consecutive shifts at more than one EMS agency?

Many in EMS view these questions from different perspectives. Some point to longer shifts as necessary to achieve lower operating costs related to staffing, a compressed workweek, and the flexibility to have more time with family or on a second job. Others may presume that longer shifts can lead to poor care or poor provider health. There is limited support for or against the different perspectives because of a lack of data generated from studies of EMS clinicians.

We seek to form a common frame of reference for debate and decision making at all levels towards development of EMS shift and rest approaches. We propose that four essential questions help frame the issues related to fatigue and safety in EMS.

ESSENTIAL QUESTIONS

1. "Do extended shift structures in EMS result in fatigue and/or negative safety outcomes?"

EMS shift lengths often mirror the fire-service model of longer shift lengths instead of the law-enforcement model of rotating eight-hour shifts. Twelve- and 24-hour shifts are common shift structures in EMS.[4,5] One-third of EMS clinicians accumulate extended shift hours by ending a shift at one agency to begin another shift at a second EMS organization.[4] Some may believe that extended shifts (≥12 hours) result in poor sleep and fatigue that contribute to negative patient or provider outcomes (Fig. 1).

The theory in Figure 1 posits a mediation model,[6] where shift length alters outcomes by increasing fatigue. Support for the mediation model between EMS worker shift length, fatigue, and safety outcomes is limited by an absence of data. Testing the model in Figure 1 is limited by several factors. First, it is difficult to define shift work in EMS providers. *Shift work* broadly refers to "any arrangement of daily working hours other than standard daylight hours (7/8 AM–5/6 PM)."[7] Definitions and descriptions of shift work vary by service sector, duration of shift, method of rotation, duration of rotation, regularity/irregularity, and number of rest/work days.[7] Second, the amount of work an EMS clinician/crew performs in a given shift also varies and has the potential to impact the relationships in Figure 1. Third, many EMS clinicians work voluntary or mandatory ("forced") overtime, work shifts that rotate forwards or backwards, or are employed with second jobs sometimes both within and outside the public safety sector.[4] All of this complicates the definitions and assessments of impact.

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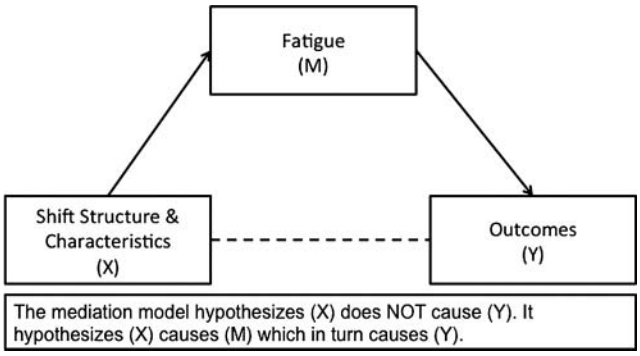

FIGURE 1. A mediation model between shift structure (X), fatigue (M), and outcomes (Y).

Furthermore, the data linking increasing shift length to fatigue and worse outcomes are limited and inconsistent.[1] Our most recent study found univariable associations between shift length, fatigue, and safety outcomes, but multivariate analyses found no independent relationship between shift length, fatigue, and safety outcomes.[4]

2. "How common is it for EMS providers to be fatigued while at work? What is the magnitude of the problem?"

Some reports find increased subjective or physiologic indicators of fatigue in small to moderate-sized samples of EMS clinicians.[4,8,9] The current data are hampered by varying sample sizes and possible selection bias, limiting the ability to generalize to a broader EMS workforce as a whole.[4,8,10,11] Nevertheless, these studies estimate that between 10% and 55% of EMS clinicians suffer from severe mental and/or physical fatigue.[4,8,10] For comparison, about four in 10 general U.S. workers self-report fatigue (38%; 95% confidence interval [CI] 37.4, 38.5).[12] Additional research with larger samples of EMS clinicians may refine these estimates.

We also need consensus on a reliable and valid gold standard for measuring fatigue. Currently, "*there is no standard way to assess fatigue*."[13] Fatigue is most often measured via self-report surveys.[13,14] Surveys usually measure two or more components of fatigue (i.e., mental and physical fatigue). Exactly how many dimensions of fatigue require measurement is unclear, limiting comparison across studies.[13,14] Some argue that fatigue is one-dimensional (e.g., just fatigue), whereas others insist that fatigue is a multidimensional construct (e.g., emotional, mental, and physical).[14–16] Decisions to measure one-dimensional versus multi-dimensional components affect estimated prevalence, and raise questions about the reliability and validity of individual studies.

Most fatigue questionnaires target specific medical conditions and patient populations (e.g., patients with cancer, depression, or Parkinson's disease).[17–19] Adapting measurement tools for use in EMS is a challenge and requires calibration to the setting and population of interest. A study may employ a "reliable" tool but reliably measure the wrong thing (i.e., have no validity).

Use of other indicators of fatigue, such as physiologic/objective measures, is limited because of cost and time. It is not often feasible to measure body temperature, heart rate, pupil dilation/movement, reaction time, errors in performing tasks, or test of cognition or memory in large study samples.[11,20–22]

At best, previous research suggests that multiple dimensions of fatigue (e.g., mental and physical) are common among EMS clinicians. Investigators and decision makers should address the methodologic gaps in this research, which are fundamental and foundational to any stance on fatigue and shift structure in EMS. Research should define benchmark thresholds separating safe/acceptable from unsafe/unacceptable levels of fatigue.

3. "What is the impact of fatigue on the EMS clinician and patient outcomes?"

Fatigue is related to performance in shift workers from manufacturing, aviation, long-haul trucking, and health care.[1,2,23,24] Studies exploring such links in EMS include Takeyama et al., 2009,[11] van der Ploeg and Kleber, 2003,[10] and our own research.[4] The 2009 study by Takeyama et al. enrolled 10 paramedics who worked 24-hour shifts in Japan.[11] The authors found no meaningful differences in subjective and objective measures of fatigue (e.g., reaction time, temperature, and heart rate) between subjects with shorter versus longer nap periods.[11] However, the frequency of complaints about drowsiness and local pain was higher at the end of the 24-hour shift among subjects with less nap time than among subjects with more nap time.[11]

Van der Ploeg and Kleber, in 2003, studied how fatigue was related to health symptoms.[10] In this study, 10% of EMS clinicians were at risk of fatigue-related sick leave or disability.[10] Subjective fatigue correlated with burnout and lack of social support from supervisors.[10] The authors concluded that improvements in social climate, acknowledging workers, and involving workers in decision making might curtail the negative findings of fatigue and health symptoms.[10]

Recently, we investigated the association between fatigue, work hours, and safety outcomes.[4] In a cross-sectional study design of 547 EMS clinicians, the adjusted odds of injury were 1.9 (95% CI 1.1, 3.3) times greater among the fatigued respondents than among

the nonfatigued.[4] The odds of committing an error or adverse event or of engaging in safety-compromising behaviors were 2.2 (95% CI 1.4, 3.3) times greater and 3.6 (95% CI 1.5, 8.3) times greater, respectively, among the fatigued EMS clinicians than the nonfatigued.[4]

It is unclear if poor sleep results in fatigue or if fatigue results in poor sleep among EMS clinicians. Poor or inadequate sleep affects between 29% and 35% of U.S. adults.[25,26] Sleep quality in EMS clinicians is worse among the fatigued than among the nonfatigued.[8] Research by Fernandez and associates (a conference abstract) leveraged the National Registry of Emergency Medical Technicians (NREMT) database to investigate the association between sleep and safety outcomes.[27] Daytime sleepiness measured with the Epworth Sleepiness Scale (ESS) was associated with self-reported incident reports related to patient care during the previous 12 months.[27] A separate study by Braude and associates identified a decrease in cognitive task performance from the beginning to the end of an air-medical shift, but this decrease was not related to sleep.[28]

How do we interpret the available research? Clearly the risk of fatigue among EMS clinicians is high. While fatigued or sleepy workers are a risk to safety in many settings, there are too few data to support or refute any relationship in the EMS setting.

4. "What would be the most effective intervention?"

Many in EMS work more than 40 hours per week.[29] Twelve- and 24-hour shifts are the most common type of EMS shift structure.[4,5] Simply altering shift structure may not alter the total number of hours worked per day. One-third of EMS clinicians work at more than one EMS agency because of low pay, limited benefits, and a growing trend among organizations of relying on part-time employment.[4,30,31] Furthermore, many EMS clinicians relate job dissatisfaction to pay, benefits, and opportunities for advancement, but not to fatigue or shift structure.[32] Many may ignore their fatigue because they are altruistic and see the occupation as exciting.[30,33] "*For better or worse, shift work is here to stay.*"[34]

DISCUSSION

Within-shift interventions that do not change the structure of 12- and 24-hour shifts are feasible options for EMS employers and clinicians. Examples include the use of designated rest periods during shift work, as has been used in other industries.[35] Oil-refinery workers, pilots, police officers, physicians, and nurses have decreased errors, improved performance, improved cognition, and improved alertness with work-related naps/rest.[36–40]

Smith-Coggins et al. showed that emergency physicians provided with a rest/nap for 40 minutes had better scores on select performance measures than a nonrest/nap group.[39] Takahashi and colleagues showed improvements in nurse alertness and lower heart rates with a two-hour nap opportunity.[40] Bonnefond et al. found that a one-hour rest/nap opportunity during the overnight shift was associated with improvements in self-reported satisfaction and reductions in self-reported fatigue.[41]

There is limited adoption of fatigue management in the EMS setting.[11] Rest periods for air-medical EMS systems are believed to be more common for pilots than for medical crews.[42] Use of and barriers to using a crew rest program in the EMS workplace are not well understood.[11,35,42,43] Even when offered, some workers may fail to rest for reasons unrelated to shift work (i.e., personal/home life factors), effectively removing any supposed benefit of workplace-approved rest.[28]

Many workers may not be good "nappers" and upon waking suffer from *sleep inertia*—a state where one feels groggy immediately after waking, affecting motor and cognitive functioning.[44] Studies show that sleep inertia can impact workers up to two hours after a nap.[40] Some have found that naps lasting 10 to 20 minutes may help reduce the occurrence of sleep inertia.[36,45,46] How to structure naps in the EMS setting is unclear but deserves attention.

The intervention that works for one EMS system may not work well for others. It is reasonable to believe that multiple interventions deployed in aviation and other sectors may be effective in the EMS setting. EMS agencies may decide to employ more than one strategy. Agency officials, medical directors, and investigators should work together to identify the most cost-effective strategy in diverse EMS operations (e.g., fire-based, hospital-based, third-service, and other models). Efforts to test these interventions may be well served by beginning with an analysis of successful and unsuccessful interventions deployed in other settings (e.g., aviation).[47]

CONCLUSIONS

There are limited empiric data assessing EMS worker fatigue and linking the data to patient outcomes or provider safety. We urge caution in making EMS workforce deployment decisions, especially surrounding scheduling of work and rest, absent a better understanding of these relationships.

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