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The Impact of Extended Working Hours and Shift Patterns on Paramedic Fatigue, Clinical Performance, and Patient Safety
A Structured Evidence Review

تأثير ساعات العمل الممتدة وأنماط المناوبات على إرهاق المسعفين والأداء السريري وسلامة المرضى: مراجعة منظمة للأدلة

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Abstract:

Background: Paramedics provide continuous emergency coverage through long, night, and rotating shifts. Occupational fatigue can compromise sleep, alertness, and safety-sensitive tasks, although measured workforce and patient outcomes differ.
Objective: To examine published evidence linking extended working hours and shift patterns to paramedic fatigue, clinical-performance indicators, occupational injury, and patient-safety outcomes, and to identify operational fatigue-risk countermeasures.
Methods: A structured narrative synthesis examined nine empirical publications and three secondary reviews published in 2012–2025. The source-selection framework specifies PubMed/MEDLINE, Scopus, Web of Science, PsycINFO, and CINAHL, with a 2010–2025 publication window and EMS-specific keyword groups. Evidence was organized by scheduling exposure, sleep/fatigue, performance, safety outcomes, and mitigation, with study-design and outcome differences addressed narratively rather than through statistical pooling.
Results: Insomnia was identified in 513 of 1,076 Saudi paramedics (47.67%); 55% of 717 Canadian paramedics reported fatigue at work. In 966,082 recorded US EMS shifts, shifts lasting >16–24 hours were associated with higher occupational injury/illness risk than shifts >8–12 hours (RR 1.60, 95% CI 1.22–2.10). Among 254 Japanese ambulance personnel, higher fatigue was associated with reported near misses (adjusted OR 3.19). Repeated assessments of 4,573 shifts identified peak fatigue around 03:00–04:00 during 24-hour duty.
Conclusion: Extended duty periods and irregular schedules are associated with fatigue and sleep disruption, while fatigue is associated with selected occupational and self-reported safety outcomes. Scheduling safeguards, opportunities for recovery, fatigue monitoring, and targeted education are reasonable risk-reduction measures. Direct effects on objectively measured patient harm require separate interpretation.

Keywords: paramedics; emergency medical services; shift work; occupational fatigue; working hours; sleep; clinical performance; patient safety; occupational injury.

الملخص

الخلفية :يقدم المسعفون تغطية مستمرة لخدمات الطوارئ من خلال مناوبات طويلة وليلية ومتغيرة. وقد يؤدي الإرهاق المهني إلى التأثير سلبًا في النوم واليقظة والمهام التي تتطلب مستويات عالية من السلامة، على الرغم من اختلاف النتائج المقاسة المتعلقة بالقوى العاملة والمرضى.
الهدف :دراسة الأدلة المنشورة التي تربط بين ساعات العمل الممتدة وأنماط المناوبات وإرهاق المسعفين، ومؤشرات الأداء السريري، والإصابات المهنية، ونتائج سلامة المرضى، مع تحديد التدابير التشغيلية المضادة لمخاطر الإرهاق.
المنهجية :تناولت مراجعة سردية منظمة تسع دراسات تجريبية وثلاث مراجعات ثانوية منشورة خلال الفترة 2012–2025. وحدد إطار اختيار المصادر قواعد البيانات التالية :PubMed/MEDLINE وScopus وWeb of Science وPsycINFO وCINAHL، مع اعتماد الفترة من 2010 إلى 2025 للنشر، واستخدام مجموعات من الكلمات المفتاحية المتخصصة بخدمات الطوارئ الطبية. ونُظمت الأدلة وفقًا للتعرض لأنماط المناوبات، والنوم والإرهاق، والأداء، ونتائج السلامة، وتدابير الحد من المخاطر، مع معالجة الاختلافات في تصاميم الدراسات والنتائج من خلال التحليل السردي بدلًا من الدمج الإحصائي.
النتائج :تم تحديد الأرق لدى 513 مسعفًا من أصل 1,076 مسعفًا سعوديًا، بنسبة بلغت 47.67%، فيما أفاد 55% من أصل 717 مسعفًا كنديًا بمعاناتهم من الإرهاق أثناء العمل. وفي تحليل شمل 966,082 مناوبة مسجلة لخدمات الإسعاف في الولايات المتحدة، ارتبطت المناوبات التي تتجاوز مدتها 16 ساعة وتصل إلى 24 ساعة بارتفاع مخاطر الإصابات والأمراض المهنية مقارنة بالمناوبات التي تتجاوز 8 ساعات وتصل إلى 12 ساعة (RR 1.60) ، وفاصل الثقة 95%: 1.22–2.10 .(ومن بين 254 من العاملين في خدمات الإسعاف اليابانية، ارتبط ارتفاع مستوى الإرهاق بزيادة حالات الأخطاء الوشيكة المبلغ عنها) نسبة الأرجحية المعدلة .(OR 3.19 كما أظهرت التقييمات المتكررة لـ 4,573 مناوبة أن ذروة الإرهاق تحدث تقريبًا بين الساعة 03:00 و04:00 خلال المناوبات التي تمتد 24 ساعة.
الخلاصة :ترتبط فترات العمل الممتدة وجداول المناوبات غير المنتظمة بالإرهاق واضطرابات النوم، في حين يرتبط الإرهاق ببعض النتائج المتعلقة بالسلامة المهنية ونتائج السلامة المبلغ عنها ذاتيًا. وتُعد ضمانات تنظيم جداول المناوبات، وتوفير فرص

كافية للتعافي والراحة، ومراقبة مستويات الإرهاق، والتثقيف الموجّه، تدابير معقولة للحد من المخاطر. أما التأثيرات المباشرة للإرهاق على الأضرار التي يتعرض لها المرضى والمقاسة بموضوعية، فتتطلب تفسيرًا وتحليلًا منفصلين.

الكلمات المفتاحية :المسعفون؛ خدمات الطوارئ الطبية؛ العمل بنظام المناوبات؛ الإرهاق المهني؛ ساعات العمل؛ النوم؛ الأداء السريري؛ سلامة المرضى؛ الإصابات المهنية.

Introduction

Prehospital emergency medical services (EMS) depend on a skilled workforce capable of rapid assessment and technically demanding decisions under unpredictable conditions. Unlike many other healthcare settings, ambulance personnel combine clinical tasks with emergency driving, scene risk assessment, manual handling, time-critical communication, and immediate transport decisions. These demands may arise during overnight hours, after multiple calls, or near the end of an extended duty period when biological sleep pressure is high.

Shift-based scheduling provides around-the-clock coverage but creates competing pressures. A 12- or 24-hour schedule may reduce the number of handovers and provide operational continuity, yet it may also extend continuous wakefulness and restrict recovery opportunities. The implications of shift duration cannot be separated from workload intensity, access to on-duty rest, frequency of night assignments, commuting time, and the spacing of shifts. An apparently identical 24-hour roster may have very different fatigue consequences in low-volume rural and high-volume urban services (Patterson et al., 2018b; Barth et al., 2022).

Prior research identifies an association between poor sleep, fatigue, and self-reported safety problems in EMS personnel. In one US multicenter survey of 547 respondents, poor sleep quality and severe fatigue were common, and fatigue was associated with errors/adverse events, injuries, and safety-compromising behaviors (Patterson et al., 2012). In Canada, Donnelly et al. (2019) reported that 55% of 717 paramedics were fatigued at work; fatigue was associated with several negative safety outcomes even when shift-duration variables were not consistently predictive. These findings suggest that fatigue is a proximal risk factor, while roster characteristics are upstream organizational contributors.

The Saudi context is particularly relevant. In a survey of 1,076 paramedics, Alruwaili and Alanazy (2024) found that work schedule and several work-related factors were associated with insomnia. Nevertheless, the cross-sectional design and reliance on self-report prevent causal inference, and the sample should not be taken as a national estimate for any one EMS employer. A careful synthesis is therefore necessary to separate measured associations from assumptions about direct clinical harm.

Accordingly, this review examines how long and irregular working hours influence fatigue and sleep, how fatigue relates to vigilance and clinical-safety indicators, and which practical interventions may reduce risk without undermining emergency-service continuity.

Literature Review

Shift Duration and Circadian Disruption

Long duty periods can increase cumulative wakefulness, and overnight or rotating schedules may conflict with circadian rhythms. In a systematic review covering 100 studies across EMS and other shift-worker groups, Patterson et al. (2018b) found generally more favorable outcomes with shifts shorter than 24 hours than with shifts of at least 24 hours, but most evidence was rated low or very low in certainty. Comparisons of 8- and 12-hour shifts were mixed. These findings therefore do not define a universally optimal roster length.

Barth et al. (2022) identified 12 publications in a scoping review of EMS scheduling and work-schedule tolerance. Fatigue, poor sleep and stress recurred across the literature, but exposure definitions and work settings varied. Night work, consecutive duties, overtime, total shift length and protected recovery should be treated as related but distinct scheduling dimensions.

Sleep Loss, Fatigue, and Clinical Function

Clinical performance is multidimensional. Fatigue may influence sustained attention, short-term memory, reaction time, medication preparation, assessment accuracy, teamwork, and communication. Yet many studies use psychomotor vigilance tests or self-reported concentration rather than adjudicated clinical errors. In a prospective study of 112 air-medical clinicians, Patterson et al. (2019) did not detect an overall psychomotor-vigilance difference between shifts under 24 hours and those lasting 24 hours; selected performance measures were worse on night shifts, and performance soon after waking from a nap could be affected by sleep inertia.

More recently, Patterson et al. (2025) used repeated real-time assessments across 4,573 shifts worked by 388 EMS/fire clinicians from 35 agencies. Fatigue, sleepiness, and difficulty concentrating were most pronounced during 24-hour shifts at approximately 03:00–04:00. The study strengthens the argument for timing interventions around circadian vulnerability; however, its outcomes were mostly fatigue and perceived concentration, rather than directly measured patient injury.

Safety Events and Occupational Harm

The relationship between fatigue and patient safety is supported mainly by observational and self-report evidence. Donnelly et al. (2019) observed elevated odds of injuries, safety-compromising behaviors, and reported errors among fatigued Canadian paramedics. Toyokuni et al. (2022) identified an association between high fatigue and near-miss incidents in 254 Japanese ambulance workers (adjusted odds ratio 3.19). Neither design proves that a specific schedule caused those events; nonetheless, the convergence of findings from different settings warrants prevention-oriented management.

Administrative records offer more objective support for occupational rather than patient outcomes. Weaver et al. (2015) analyzed 966,082 shifts across 14 US EMS agencies and reported a relative risk of 1.60 (95% CI 1.22–2.10) for occupational injury/illness during shifts longer than 16 and up to 24 hours, compared with shifts longer than 8 and up to 12 hours. This does not establish a parallel 60% increase in patient harm; occupational and patient outcomes must be reported separately.

Fatigue Mitigation Strategies

Fatigue countermeasures include safer roster design, sufficient between-shift recovery, opportunities for planned naps and protected breaks, monitoring of alertness, and education about sleep and circadian timing. The evidence-based EMS guidance of Patterson et al. (2018a) includes five recommendations: use validated fatigue measures, prefer shifts shorter than 24 hours, ensure access to caffeine, permit on-duty naps when feasible, and provide fatigue education. These measures should be adapted to staffing demands and should not be interpreted as guarantees of fewer patient adverse events.

Martin-Gill et al. (2018) summarized 13 experiments on scheduled napping among EMS or related shift workers. Pooled findings favored reduced sleepiness, whereas psychomotor reaction-time effects were less consistent. Barger et al. (2018) reviewed fatigue education interventions, and Booker et al. (2024) described how 27 nurses, midwives and paramedics relied on individual coping strategies despite organizational gaps. Evidence from non-EMS workers provides contextual support but is less directly applicable to ground-ambulance practice.

Methods

Review Design and Research Question

This article is a structured narrative review of a defined body of published evidence addressing whether extended working hours, night or rotating duties, and insufficient recovery are related to fatigue and safety-sensitive outcomes in prehospital emergency medical services (EMS). It distinguishes associations with sleep and occupational health from estimates of direct clinical harm to patients.

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The analytic framework was: population—paramedics, emergency medical technicians, air-medical clinicians and related EMS personnel; exposure—shift duration, overnight/rotating work, overtime and fatigue; comparators—different schedules or lower fatigue exposure where available; outcomes—sleep disruption, insomnia, alertness, psychomotor performance, reported clinical errors, near misses, and occupational injury.

Information Sources and Search Strategy

The literature-identification framework identifies five bibliographic databases relevant to this review: PubMed/MEDLINE, Scopus, Web of Science, PsycINFO, and CINAHL (Cumulative Index to Nursing and Allied Health Literature). The topic-specific publication window is January 2010–December 2025, which encompasses the 2025 study discussed in this review. English-language peer-reviewed publications addressing prehospital EMS personnel, occupational schedules, fatigue, clinical performance, or safety are the principal focus. These information-source and time-window specifications describe the scope of the structured narrative evidence review.

Search concepts were organized into three groups: (1) population—paramedic*, "emergency medical services", "emergency medical technician*", ambulance, and prehospital; (2) exposure—"shift work", "shift length", "working hours", "extended shifts", "night shift*", "rotating shift*", fatigue, sleep deprivation, and insomnia; and (3) outcomes—"clinical performance", "patient safety", "occupational injur*", "near miss*", "medical error*", alertness, and "psychomotor vigilance". Terms within each group are joined with OR, and the groups are combined with AND. The search expression below documents the thematic keyword framework; platform field codes and controlled vocabulary would differ across databases.

Illustrative Boolean formulation: (paramedic* OR "emergency medical services" OR "emergency medical technician*" OR ambulance OR prehospital) AND ("shift work" OR "shift length" OR "working hours" OR "extended shifts" OR "night shift*" OR "rotating shift*" OR fatigue OR "sleep deprivation" OR insomnia) AND ("clinical performance" OR "patient safety" OR "occupational injur*" OR "near miss*" OR "medical error*" OR alertness OR "psychomotor vigilance").

Eligibility and Literature Selection

The review prioritizes original quantitative, qualitative, and mixed-methods studies examining paramedics, emergency medical technicians, or ambulance clinicians. Relevant exposures include extended duty hours, night or rotating schedules, inadequate rest, and occupational fatigue. Relevant outcomes include sleep disturbance, alertness, cognitive or clinical-performance indicators, near misses, incident reports, and occupational injury. Studies of other shift-working professions are used only as contextual evidence when findings cannot be isolated for prehospital clinicians.

Editorials and opinion articles without empirical findings do not contribute to the principal study table. Published systematic and scoping reviews inform interpretation and countermeasure recommendations, but are classified separately from original research to avoid double counting. Relevance to the review question, study type, EMS applicability, outcome specificity, and interpretive limitations determined placement in the evidence table. The 12 entries constitute the defined narrative evidence corpus (nine empirical studies and three reviews), and its findings are presented as a thematic synthesis rather than a numerical systematic-review flow.

Evidence Extraction and Classification

The evidence table records the author and setting, research design, relevant population or exposure, principal reported result, and limitations affecting interpretation. Numerators, denominators, percentages and effect estimates reflect the cited publication rather than re-analysis of individual-participant data. Reports were categorized as cross-sectional survey, administrative-record analysis, prospective cohort/service evaluation, repeated within-shift assessment, qualitative study, or secondary review.

Avoiding Double Counting

Primary studies and secondary reviews are identified separately. Donnelly et al. (2019) and Donnelly et al. (2020) both analyze the same Ontario paramedic survey involving 717 usable respondents; the latter is discussed as a complementary analysis, not as an independent additional sample. Published systematic reviews may also include some of the original studies summarized here, and their participant totals are therefore not combined with primary-study totals.

Methodological Appraisal

Study credibility was assessed descriptively with reference to design, participant recruitment, outcome ascertainment, exposure measurement, potential confounding, comparators, sample size, and transferability to EMS practice. Administrative injury records provide a different evidential basis from self-reported error inventories, while psychomotor tests assess alertness proxies rather than confirmed patient adverse events. These study-specific limitations are stated in Table 1 and used in the interpretation; no numeric risk-of-bias scores are assigned.

Narrative Synthesis

Findings were grouped into four domains: (1) work schedules, sleep and fatigue; (2) vigilance and clinical-performance indicators; (3) occupational harm, near misses and reported safety outcomes; and (4) organizational prevention strategies. A pooled effect size was not calculated because the reports differ in scheduling comparisons, study designs, outcome definitions and populations. Observational associations are distinguished from causal claims, and worker injury is not equated with patient injury.

Results

Profile of the Evidence

Table 1 summarizes nine empirical publications and three secondary evidence syntheses. The original studies span 2012–2025 and comprise surveys, linked shift/incident records, prospective alertness tests, repeated within-shift assessments, a service evaluation and a qualitative investigation. The secondary syntheses cover shift-length comparisons, EMS work-schedule tolerance and scheduled napping. Their study counts are not additional independent EMS samples.

Table 1. Published evidence concerning EMS shift work, fatigue and safety (2012–2025)

Study / setting	Design / sample and exposure	Principal reported result	Key interpretive limitation
Weaver et al. (2015) / USA	Linked administrative records; 966,082 EMS shifts; shift length	>16–24 h vs >8–12 h: worker injury/illness RR 1.60 (95% CI 1.22–2.10)	Occupational injury, not direct patient harm
Patterson et al. (2012) / USA	Cross-sectional; 547 EMS respondents; fatigue and sleep quality	Fatigue associated with reported injuries, errors and unsafe behavior	Self-report; convenience recruitment
Donnelly et al. (2019) / Canada	Cross-sectional; 717 paramedics; fatigue and safety reports	55% reported fatigue; fatigued respondents reported more safety issues	Shared cohort with Donnelly et al. (2020); self-report
Patterson et al. (2019) / USA	Prospective air-medical cohort; 112 clinicians; shift timing	No overall PVT difference by <24 vs 24 h; night effects on some measures	Small specialized cohort; alertness proxy

Study / setting	Design / sample and exposure	Principal reported result	Key interpretive limitation
Toyokuni et al. (2022) / Japan	Cross-sectional; 254 ambulance personnel; fatigue and near misses	Higher fatigue associated with near misses (aOR 3.19)	Reported incidents; observational association
Barth et al. (2022) / multiple	Scoping review; 12 articles on EMS shift patterns	Recurring fatigue, poor sleep and stress concerns	Secondary evidence; heterogeneous exposures
Rose et al. (2023) / UK	Prospective HEMS evaluation; shift cycle and vigilance	Trend to reduced vigilance and increased fatigue during shift cycle	Single specialist service
Alruwaili & Alanazy (2024) / Saudi Arabia	Cross-sectional; 1,076 paramedics; shift patterns and insomnia	513/1,076 (47.67%) met insomnia threshold	Convenience recruitment; self-report
Booker et al. (2024) / Australia	Qualitative; 27 mixed healthcare workers; coping strategies	Roster changes, sleep education and workplace support proposed	Not paramedic-only; qualitative sample
Patterson et al. (2025) / USA	Repeated assessments; 388 EMS/fire clinicians; 4,573 shifts	Highest fatigue at 03:00–04:00 during 24-h shifts	Mixed workforce; perceived fatigue
Patterson et al. (2018b) / multiple	Systematic review; 100 shift-comparison studies	<24-h shifts generally more favorable than ≥24 h	Low or very low certainty; largely indirect populations
Martin-Gill et al. (2018) / multiple	Systematic review/meta-analysis; 13 experiments	Naps reduced sleepiness; PVT findings mixed	Many non-EMS shift-worker studies

Abbreviations: EMS, emergency medical services; HEMS, helicopter emergency medical services; PVT, psychomotor vigilance test; RR, relative risk; aOR, adjusted odds ratio. Reviews provide contextual synthesis and are not independent primary participant samples.

Extended Working Hours, Shift Timing, and Sleep Disturbance

In a Saudi cross-sectional survey, Alruwaili and Alanazy (2024) identified insomnia using the Athens Insomnia Scale in 513 of 1,076 paramedics (47.67%). Working hours, shift schedule, and rest-related characteristics were associated with insomnia; work setting, occupational stress, sleep patterns, and caffeine use were also relevant. Convenience recruitment and self-reported exposures limit causal interpretation and national generalizability.

The 2025 real-time assessment study analyzed 4,573 shifts from 388 EMS/fire clinicians at 35 US agencies. Fatigue, sleepiness, and concentration difficulties were highest during 24-hour shifts near 03:00–04:00 (Patterson et al., 2025). These results identify a vulnerable time of day but do not quantify direct patient harm.

The shift-duration synthesis of Patterson et al. (2018b) generally favored duty periods shorter than 24 hours over those of at least 24 hours; nevertheless, the authors rated the evidence low or very low. Findings for 8 versus 12 hours were mixed. Work intensity, circadian phase, and rest availability likely modify the effect of scheduled duration.

Fatigue and Clinical Performance

Fatigue has plausible effects on sustained attention, reaction time, recall, communication, and decision-making. In 112 air-medical clinicians, however, Patterson et al. (2019) did not find an overall difference in PVT performance between shifts below 24 hours and those of 24 hours. Selected nighttime measures were worse, and shorter intervals after waking from a nap were associated with poorer performance, consistent with transient sleep inertia.

Momentary reports from the 2025 study likewise found a concentration of fatigue during early-morning hours. Both studies concern vigilance or perceived difficulty concentrating rather than independently adjudicated treatment errors; the distinction matters when translating their results into patient-safety policy (Patterson et al., 2019, 2025).

Occupational Injury, Near Misses, and Safety Indicators

A US survey of 547 EMS providers identified associations between fatigue and self-reported injuries, errors/adverse events, and safety-compromising behavior (Patterson et al., 2012). In 717 Canadian paramedics, 55% reported workplace fatigue, and fatigued respondents more often reported injuries, adverse events and unsafe behaviors (Donnelly et al., 2019). A complementary analysis of the same Canadian survey examined occupational stress alongside fatigue (Donnelly et al., 2020); it does not represent an additional independent group of respondents.

In a Japanese cross-sectional study of 254 ambulance personnel, higher fatigue was associated with an increased likelihood of reported near-miss incidents (aOR 3.19; Toyokuni et al., 2022). Recall bias, workplace conditions, irregular sleep, and dispatch intensity limit causal interpretation. Because near misses and reported errors are not identical to adjudicated patient injury, they should not be combined into a patient-harm rate.

Weaver et al. (2015) matched 966,082 EMS shifts to occupational incident reports in 14 US agencies. Shifts >16–24 hours were associated with higher worker injury/illness risk than shifts >8–12 hours (RR 1.60, 95% CI 1.22–2.10). This is important objective occupational evidence, but the estimate does not describe a corresponding increase in patient medication errors, triage failures or mortality.

Protective Strategies and Operational Implementation

EMS fatigue guidance favors a coordinated risk-management approach rather than a single educational measure (Patterson et al., 2018a). Practical components include limiting high-risk rosters, ensuring recovery, monitoring sleepiness, planning naps where operationally feasible, teaching early recognition of impairment, and maintaining access to relief staff. Evidence for naps primarily concerns sleepiness and selected performance indicators, rather than confirmed reductions in patient adverse events (Martin-Gill et al., 2018).

Service demand affects how much rest is possible during a nominally similar shift: an active urban station and a lower-volume rural post may have different fatigue profiles. Booker et al. (2024) identified fatigue-management gaps through interviews with mixed healthcare shift workers. Such findings support locally adapted implementation with attention to ambulance response coverage and the potential for sleep inertia immediately after a nap.

Summary of Findings

Across the core literature, extended and irregular duty schedules are associated with disturbed sleep and fatigue; fatigue is associated with self-reported safety problems and some occupational outcomes. The strongest directly observed safety estimate in this evidence set concerns worker injury/illness; patient-level clinical harm attributable to a specific roster remains less directly measured. This pattern supports risk-informed preventive practice without assigning a single universally safe shift length.

Discussion

The evidence supports a multifactorial model of EMS fatigue. Duty length, overnight timing, workload, consecutive shifts and recovery opportunities act together, while fatigue is more immediately related to alertness and safety-sensitive functioning. Findings favor prudent scheduling and recovery policies, but heterogeneity prevents treating a single shift threshold as an established causal safeguard.

Interpretation of Occupational Risk Factors

Reviews of shift duration found a general advantage for shifts below 24 hours relative to longer duties, but the underlying evidence was mostly of low or very low certainty (Patterson et al., 2018b). The air-medical prospective study identified selected nighttime effects without an overall difference by the 24-hour duration cut point (Patterson et al., 2019). These results are compatible once circadian exposure and intensity of work are considered alongside roster length.

Differences in outcome ascertainment are equally important. Survey studies in Canada, the United States and Japan link fatigue with self-reported injuries, errors or near misses; the administrative US cohort uses incident reports to estimate occupational injury risk. The Saudi cross-sectional survey contributes locally relevant insomnia data, not an estimate of clinical error rates. The Donnelly 2019 and 2020 papers share the same Canadian respondent cohort and should not be treated as independent replications.

Sleep and Fatigue as Proximal Safety Risks

Scheduling characteristics are organizational exposures, while accumulated sleep loss and fatigue are potential proximate pathways to impaired vigilance. A causal pathway remains plausible but cannot be established from cross-sectional associations alone. Work intensity, task complexity, commuting, clinician experience and habitual sleep may confound reported relationships.

Patient and workforce safety should be measured and interpreted separately. An occupational injury report, a PVT lapse, a self-reported near miss and an independently reviewed clinical error have distinct definitions and ascertainment methods. Their convergence suggests a prevention priority, but converting these proxies into claims about avoidable patient injury would overstate the evidence.

Implications for Saudi Emergency Medical Services

In Saudi prehospital services, long travel distances, urban congestion, service demand peaks, seasonal pilgrimage activity and differential station call volume may influence fatigue exposure and recovery opportunities. These are operational considerations rather than proven effect modifiers in the available Saudi survey. Local program evaluation can relate roster data to dispatch intensity, sleep, near misses and audited care indicators to determine which safeguards are most useful.

For the Saudi Red Crescent Authority and similar providers, fatigue monitoring could be embedded in operational quality improvement, coupled with nonpunitive reporting and safe relief procedures. Comparative evaluation of roster patterns should adjust for shift start time, number of calls, actual hours awake, availability of rest, clinician role, and journey length instead of comparing nominal shift duration in isolation.

Organizational and Clinical Implications

At the roster level, services can review duty length, consecutive night shifts, overtime and protected inter-shift recovery. During duty, supervisors can support meal breaks, brief planned naps where appropriate and reassignment when safety-critical performance is compromised. At the system level, fatigue-related near misses can be reviewed against workload patterns with an emphasis on learning rather than individual blame.

Fatigue interventions that improve sleep or subjective alertness should not automatically be credited with preventing patient injury. Education and judicious caffeine use may complement, but cannot replace, adequate sleep and staffing. Measures should be evaluated for workforce outcomes, clinical safety indicators and continuity of emergency response.

Strengths and Limitations of the Evidence

The review brings together EMS-focused observational, administrative and prospective evidence with relevant qualitative and secondary research. Distinguishing primary studies, shared respondent cohorts and secondary reviews limits double counting, while preserving the contrast between objective injuries, alertness proxies and reported safety events.

Its principal limitations arise from the focused narrative source selection and the underlying literature: no exhaustive systematic database sampling is claimed, risk-of-bias judgments are descriptive rather than formal instrument scores, and study designs and outcomes are heterogeneous. Much of the evidence relies on self-report or specialized EMS settings, with limited direct adjudication of patient-level outcomes. These constraints limit causal inference and transferability across EMS systems.

Future Research Directions

1. Conduct prospective multisite Saudi EMS studies linking routinely collected rosters to dispatch activity, objective alertness, and adjudicated patient-safety indicators.

2. Evaluate matched 8-, 12-, and 24-hour rosters while accounting for night work, actual workload, recovery intervals, and unplanned overtime; avoid comparing shift length without these covariates.

3. Test pragmatic interventions, including protected rest, targeted naps, fatigue training, and early-morning workload support, using pre-specified measures of effectiveness and implementation feasibility.

4. Investigate driving performance, medication and documentation errors, and high-acuity decision-making using confidential and standardized reporting methods.

5. Assess fatigue management during seasonal periods of increased EMS demand and within geographically diverse Saudi stations.

Conclusion

Extended working hours and irregular shift schedules can contribute to sleep disturbance and fatigue among EMS personnel. Published evidence links fatigue to reduced vigilance, self-reported near misses and safety-compromising behaviors, while large administrative records demonstrate an association between longer duties and occupational injury. A layered approach combining safer roster design, opportunities for sleep and recovery, fatigue monitoring, and operational support is warranted. Direct patient-safety benefits should be evaluated with objective clinical indicators rather than inferred from proxy measures.

Recommendations

1. Use routine, validated fatigue or sleepiness checks, with a confidential escalation pathway for clinicians who cannot safely perform critical duties.
2. Review 24-hour and longer duty patterns, consecutive nights, overtime accumulation and minimum recovery intervals in light of local workload and staffing.
3. Provide protected breaks and planned nap opportunities where compatible with coverage, with attention to short-term sleep inertia after waking.
4. Train staff and supervisors in circadian fatigue, signs of reduced alertness, sleep planning and appropriate use of caffeine as an adjunct.
5. Track staff injury, driving-related near misses, errors in clinical documentation and independently reviewed patient-safety indicators alongside duty duration and dispatch burden.

Ethics and Source Data

This article synthesizes information from published research and does not report new participant recruitment or identifiable patient-level data. Numerical results and study-level characteristics are attributable to the cited publications; no pooled individual-level dataset is presented.

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