

Safety and Risk Management in Malaysian Prehospital Emergency Services: A Sequential Explanatory Mixed-Methods Study.

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Abstract

Prehospital responders in low- and middle-income countries face substantial but under-studied safety risks. This study examined safety climate, work engagement, occupational hazards, physical injury, and safety incidents among Malaysian prehospital responders and explored expert perspectives on determinants of patient and responder safety. This sequential explanatory mixed-methods study combined a cross-sectional survey of 230 frontline responders from government hospitals and clinics in Klang Valley and Putrajaya, Malaysia, with nine purposively sampled expert interviews. Validated instruments assessed psychosocial safety climate, work engagement, safety attitudes, workplace accidents, physical injury, and EMS safety incidents. Descriptive statistics and partial least squares structural equation modelling were used for quantitative analysis; interviews were analysed using reflexive thematic analysis. Responders reported a moderate psychosocial safety climate, low staffing adequacy, high work engagement, and frequent exposure to unsafe scenes and high-stress shifts. Psychosocial safety climate was inversely associated with workplace accidents ($\beta = -0.181$, $p = 0.011$) and physical injury ($\beta = -0.222$, $p < 0.001$). Poorer safety attitudes were associated with more safety incidents ($\beta = -0.192$, $p = 0.021$). Work-engagement pathways were not significant. Qualitative themes identified patient-safety hazards, responder-safety risks, safety-culture problems, and training deficiencies. Safety deficits in Malaysian prehospital care reflect interacting organizational, cultural, training, equipment, and infrastructure factors. Psychosocial safety climate was a modifiable protective factor against occupational harm, whereas individual work engagement did not offset system-level risk. Strengthening governance, standardized protocols, safety-focused training, equipment auditing, and reporting culture may improve patient and responder safety in Malaysian and comparable EMS systems....

Keywords: Emergency Medical Services; Patient Safety; Risk Management; Occupational Health; Malaysia; human health

INTRODUCTION

Prehospital care is the critical first phase of the emergency medical services (EMS) continuum, encompassing the assessment, stabilization, and transport of acutely ill or injured patients before hospital admission, and timely high-quality intervention is well established to improve survival (Mohd Said et al., 2014). Yet responders work in uncontrolled, dynamic settings marked by time pressure, limited resources, and substantial clinical and physical demands, making safety a core dimension of service quality rather than an incidental concern (Maguire et al., 2002). Safety here has two interdependent dimensions: patient safety, the prevention of avoidable harm to those receiving care, and responder safety, the protection of personnel from occupational injury, illness, and

psychological harm. Because weaknesses in one domain propagate into the other, any comprehensive account of prehospital safety must address both simultaneously.

International research documents consistent challenges across EMS systems, including inadequate training, equipment failures, high workload, communication breakdowns, and the absence of incident-reporting cultures (Maguire et al., 2002). A 2024 integrative review confirms role uncertainty, resource insufficiency, and communication failure as core impediments to patient safety (Strandås et al., 2024), while validated prehospital safety performance indicators remain scarce (O'Connor et al., 2021), and infrastructure adequacy, personnel competence, and environmental conditions have been identified as the principal determinants of perceived safety (Pécule-Carrasco et al., 2023). However, most published evidence originates from high-income countries, leaving low- and middle-income countries (LMICs) substantially underrepresented.

Safety climate, the shared perceptions of how safety is valued within an organization, is among the most robust upstream predictors of safety behaviour in health care (Dollard & Bakker, 2010); within EMS it has been operationalized through instruments such as the EMS Safety Attitudes Questionnaire, and climate can change measurably in response to organizational intervention (Bitan et al., 2019), with a nine-country study identifying management perceptions and working conditions as the dimensions most clearly differentiating high- and low-performing systems (Kosydar-Bochenek et al., 2023). EMS is among the most hazardous health-care occupations, with transport-related events, manual patient handling, and exposure to violence and infection as the dominant injury mechanisms (Maguire et al., 2002); musculoskeletal injury from lifting is a persistent, largely preventable burden (Donnelly & Siebert, 2009), stretcher and equipment adverse events an enduring patient-safety concern (Wang et al., 2009), and fatigue, burnout, and chronic stress among the strongest risk factors for adverse events (Tikkanen et al., 2025). Governance also matters — systems under unified national frameworks achieve better protocol standardization and outcome monitoring than those with fragmented oversight (McLinton et al., 2018), fleet standardization and unified protocols underpin improved resuscitation outcomes in Asia (Ong et al., 2011), and fragmented regulation persists as a barrier to safe practice (Martin-Gill et al., 2025). Finally, brief initial training without continuous professional development leaves personnel ill-equipped for the unpredictability of real-world emergencies (Reid et al., 2018).

This study is anchored in three complementary theoretical frameworks. Human Factors Theory attributes adverse events in high-risk environments to interactions between human capabilities and the systems within which people work rather than to individual fallibility alone (Price et al., 2013; Rowland & Adefuye, 2022). Systems Theory frames prehospital care as an interconnected sociotechnical system in which safety is an emergent property, situating hazards such as stretcher-incompatible infrastructure as systemic conditions beyond the individual operator (Donnelly & Siebert, 2009). The Psychosocial Safety Climate (PSC) framework operationalizes the organizational conditions that protect worker psychological well-being, encompassing senior-management commitment to safety, the priority of worker welfare over productivity, and openness of safety communication, and longitudinal evidence from Malaysian hospital workers shows that PSC predicts hazard reporting and reduced occupational stress (Dollard & Bakker, 2010); its protective role in the prehospital setting remains untested.

LMIC and Southeast Asian EMS systems remain markedly underrepresented in the global prehospital-safety literature. In Malaysia, where demand has intensified alongside urbanization and rising trauma (Rahman & Holliman, 2005), empirical safety evidence is sparse, and recent survey work confirms that inadequate clinical information transfer between prehospital services and emergency departments persists as a system-level problem (Tokita et al., 2024). Existing evidence also relies largely on single-method designs, rarely testing hypothesized relationships between safety-climate antecedents and occupational-safety outcomes or triangulating such modelling against frontline expertise.

Against this background, this study used a sequential explanatory mixed methods design to investigate multilevel determinants of safety and risk management in Malaysian prehospital care. It was guided by three research questions: (1) What are prehospital responders' perceptions of safety across Klang Valley and Putrajaya? (2) Which psychosocial safety climate factors are associated with occupational hazards and physical injury? (3) How do expert stakeholders interpret and contextualize the observed quantitative patterns? The objectives were to measure occupational safety climate, work engagement, and injury burden using validated instruments; test hypothesized relationships among psychosocial safety climate, occupational hazards, physical injury, safety attitudes, work engagement, and safety incidents; and identify, through expert inquiry, the principal thematic determinants of prehospital safety, offering a replicable framework for comparable LMIC EMS systems.

METHODS

Study Design

This study employed a sequential explanatory mixed-methods design (Creswell & Plano Clark, 2018), in which quantitative data (Phase 1) were collected and analysed first, and the results then informed the sampling strategy and interview guide for qualitative Phase 2; integration occurred at the interpretive stage. Reporting followed the Good Reporting of a Mixed Methods Study (GRAMMS) guideline, and the qualitative component was reported

according to the Consolidated Criteria for Reporting Qualitative Research (COREQ), whose checklist is provided as a supplementary file.

Phase 1: Cross-Sectional Survey

Phase 1 was conducted from May 2019 to May 2020 across 10 government hospitals and five government clinics in Klang Valley and Putrajaya, Malaysia. Participants were active prehospital care responders, comprising assistant medical officers (AMOs) and ambulance drivers engaged in patient-facing emergency transport; sites spanned Ministry of Health hospitals, teaching hospitals, and health clinics serving urban and semi-urban settings. A total of 230 respondents completed self-administered bilingual (English and Malay) questionnaires voluntarily after providing written informed consent, distributed during non-duty periods over five working days.

Six instruments were administered. The PSC-12 measured organizational policies protecting psychological health on a five-point Likert scale (Dollard & Bakker, 2010); the UWES-17 assessed vigour, dedication, and absorption on a seven-point frequency scale (Schaufeli & Bakker, 2004); and the EMS Safety Attitudes Questionnaire (SAQ) measured safety culture, including teamwork, job satisfaction, and staffing adequacy (Patterson et al., 2010). The Accident in Workplace (AW) scale, adapted for the Malaysian prehospital context from established occupational hazard-exposure items, quantified hazard exposure on a four-point scale; the Physical Injury at Workplace (PIW) scale recorded self-reported injuries; and the study-specific EMS Safety Incidents (EMSSI) inventory captured exposure to unsafe scenes, high-stress shifts, and procedural error on a seven-point scale. The bilingual instrument was reviewed for cultural and linguistic equivalence before administration.

Instrument performance was established in two stages. Content validity was confirmed by expert review and a pilot among 30 prehospital trainees not in the main sample (overall Cronbach's $\alpha = 0.93$). Within the main sample ($n = 230$), a reflective measurement model was assessed following established PLS-SEM criteria (Hair et al., 2017): internal consistency by Cronbach's α and composite reliability (CR; threshold >0.70), convergent validity by average variance extracted (AVE; >0.50), and indicator reliability by outer loadings (>0.70), with discriminant validity examined using the Fornell–Larcker criterion and cross-loadings (Fornell & Larcker, 1981). Items with low or negative loadings that compromised convergent validity were excluded from the structural model where appropriate.

Descriptive statistics (means, standard deviations, frequencies) were computed in IBM SPSS version 25.0. Inferential analysis used partial least squares structural equation modelling (PLS-SEM) in SmartPLS, selected for its suitability with complex models and data that do not require multivariate normality (Hair et al., 2017). Following the two-step approach, the measurement model was evaluated first, after which the structural model was assessed through path coefficients, the coefficient of determination (R^2), predictive relevance (Q^2 via blindfolding), and effect size (f^2) interpreted against Cohen's thresholds (Cohen, 1988). The statistical significance of path coefficients was determined by bootstrapping with 5,000 subsamples, generating t-statistics, 90% confidence intervals (CIs), and p-values; because the hypotheses were directional, paths with $p < 0.05$ and a CI excluding zero were considered statistically significant. Drawing on Human Factors, Systems, and PSC theory, eight directional hypotheses were specified to model the pathways linking psychosocial safety climate, occupational hazards, physical injury, safety attitudes, work engagement, and safety incidents (Table 4).

Phase 2: Expert Qualitative Interviews

Purposive sampling recruited nine experts who combined substantial prehospital experience with involvement in service administration or policy: four emergency physicians, one senior lecturer, and four senior AMOs concurrently serving as prehospital administrators, drawn from seven hospitals across the Klang Valley, all with more than five years of relevant experience. Sampling adequacy was judged by information power, given the narrow aim, dense expertise, and theory-informed analysis, rather than by a fixed count; thematic sufficiency was reached by the seventh interview and confirmed by two subsequent interviews (Malterud et al., 2016).

Semi-structured interview guides, developed from the literature and the Phase 1 findings, covered safety risks, governance, training, collaboration, and resource adequacy, and were reviewed by the supervisory research team before data collection. Interviews were conducted from 15 to 30 December 2021, during the COVID-19 pandemic; in keeping with the public-health restrictions then in force, all were conducted via Zoom videoconferencing (45–60 minutes each) and audio-recorded with consent, in Malay and/or English according to participant preference. Malay excerpts were translated into English and checked for fidelity by a bilingual researcher, and all quotations were anonymized. Interviews were conducted by the first author (AKM), a male EMS researcher and practitioner with postgraduate training in disaster and risk management and prior qualitative experience, who had no supervisory or employment-evaluation relationship with participants. Transcription was verbatim; transcripts were not returned to participants, and member checking was not performed. Coding was conducted manually using word-processing and spreadsheet matrices, developed iteratively from initial codes into four final themes. Transcripts were analysed using Braun and Clarke's six-phase reflexive thematic analysis: data familiarization, code generation, theme construction, theme review, theme definition, and report writing (Braun & Clarke, 2006). Consistent with the reflexive orientation, coding was treated as an interpretative, theory-informed practice rather than a procedure for establishing a single correct account (Braun & Clarke, 2021). Two researchers coded

independently and then met to compare, interrogate, and reconcile their interpretations through structured dialogue, using discussion to deepen the analysis rather than to compute inter-rater agreement. Analytic decisions were documented in reflective memos, and trustworthiness was further supported by methodological triangulation with the Phase 1 strand and an audit trail of coding decisions.

RESULTS

Phase 1: Survey Findings

The 230 prehospital responders are summarized in Table 1. The workforce was predominantly male (85.7%) and Malay (90.4%), with 88.7% aged 40 years or below. Most (75.7%) held the designation of AMO, the remainder being ambulance drivers; educational attainment was comparatively high (70.9% diploma), and more than half (56.1%) had accumulated more than five years of prehospital experience. Notably, 91.3% worked 24-hour rotating shifts and 80.4% reported working 41 or more hours per week, indicating a substantial occupational load.

Descriptive findings are summarized in Table 2. PSC scores indicated moderate organizational commitment to psychological safety (overall mean 3.34/5.00), lowest for management responsiveness (3.25/5.00). Manual handling and patient lifting were the most prevalent hazard (1.96/4.00), while tension/stress was the most frequently reported injury complaint (PIW1 mean 1.59/4.00), followed by back pain (PIW11 mean 1.51/4.00); acute trauma was rare. Work engagement was high for vigour and dedication (5.01/6.00) but lower for absorption (2.95/6.00). SAQ findings revealed low scores for staffing adequacy (2.05/5.00) and openness in reporting safety concerns (SAQ29 mean 2.46/5.00) despite high ratings for teamwork and job satisfaction (4.21/5.00). Exposure to unsafe scenes and high-stress shifts was highly prevalent (EMSSI 4.32/7.00), while critical procedural errors were rarely reported (1.64/7.00), a discrepancy that may reflect underreporting rather than genuine infrequency.

The measurement model confirmed that all six instruments achieved good-to-excellent internal consistency (Cronbach's alpha 0.881–0.966; CR 0.847–0.969), all exceeding the 0.70 threshold (Table 3). Convergent validity was adequate for AW (AVE = 0.578), PIW (0.518), and PSC (0.664), with PSC the strongest construct (all 12 indicators loading above 0.70). The SAQ, UWES, and EMSSI constructs returned AVE values below 0.50, attributable to a subset of weak or reverse-keyed items; these were flagged for refinement, and the better-performing indicators were retained for the structural model. PLS-SEM with 5,000 bootstrap subsamples was used to test the eight hypothesized paths (Table 4). Four hypotheses were supported. Higher psychosocial safety climate was significantly and inversely associated with workplace accidents (H5: $\beta = -0.181$, $t = 2.296$, $p = 0.011$) and physical injury (H6: $\beta = -0.222$, $t = 3.423$, $p < 0.001$), identifying PSC as a protective factor against occupational harm. Greater occupational hazard exposure predicted poorer safety attitudes (H1: $\beta = -0.176$, $t = 1.69$, $p = 0.046$), and poorer safety attitudes predicted more safety events (H7: $\beta = -0.192$, $t = 2.030$, $p = 0.021$); for each supported path the 90% CI excluded zero. The four work-engagement pathways were not statistically significant (H2, H3, H4, H8; all $p > 0.05$), indicating that work engagement did not buffer the relationship between hazards or injury and downstream safety outcomes. Explained variance and effect sizes were modest ($R^2 = 0.020$ – 0.077 ; positive but small Q^2 ; largest f^2 for $PSC \rightarrow PIW = 0.052$), identifying statistically robust but modest protective associations, with PSC exerting the most consistent influence.

Phase 2: Thematic Analysis Findings

The expert panel is summarized in Table 5. Nine experts, all with more than five years of prehospital or emergency-care experience (four emergency physicians, one senior lecturer, and four AMOs), were drawn from institutions including Hospital Kuala Lumpur, Hospital Canselor Tuanku Muhriz, Hospital Ampang, Hospital Tengku Ampuan Rahimah, Hospital Sungai Buloh, the Universiti Sains Malaysia Specialist Hospital, and Hospital Banting, with qualifications ranging from diploma to doctoral level.

Reflexive thematic analysis of the nine interviews generated four interrelated themes (Table 6). Theme 1 (Patient Safety) identified infrastructure and equipment gaps, particularly inaccessible elevators, unsecured patient harnesses, and outdated stretchers, as direct threats to patients, compounded by rural terrain and narrow roads. Theme 2 (Responder Safety) located personnel hazards, including manual-handling strain, outdated two-pin restraint systems, environmental threats, and inadequate infectious-disease protection, as structurally embedded in current operations rather than isolated lapses. Theme 3 (Attitudes and Safety Culture) revealed a pervasive speed-over-safety mentality in which improvisation in response to systemic inadequacy had become normalized and required cultural, not merely procedural, intervention. Theme 4 (Training Deficiencies) documented critically brief initial training and an almost complete absence of continuous professional development. These accounts did not merely coexist with the survey results; they explained them, giving experiential meaning to the structural finding that psychosocial safety climate protects against injury whereas work engagement alone does not.

Table 1. Demographic characteristics of Phase 1 survey respondents (n = 230).

Variable	Category	n (%)
Sex	Male	197 (85.7)
	Female	33 (14.3)
Ethnicity	Malay	208 (90.4)
	Indian	7 (3.0)
	Chinese	2 (0.9)
	Other	13 (5.7)
Age group (years)	21–30	105 (45.7)
	31–40	99 (43.0)
	>40	26 (11.3)
Marital status	Married	153 (66.5)
	Single	74 (32.2)
Education	Standard 6	6 (2.6)
	Certificate	47 (20.4)
	Diploma	163 (70.9)
	Degree	14 (6.1)
Designation	Assistant Medical Officer	174 (75.7)
	Ambulance Driver	56 (24.3)
Monthly income (MYR)	<1,500	4 (1.7)
	1,501–2,500	84 (36.5)
	2,501–3,500	89 (38.7)
	3,501–4,500	49 (21.3)
	>4,500	4 (1.7)
Work experience	1–2 years	37 (16.1)
	2–5 years	64 (27.8)
	>5 years	129 (56.1)
Weekly working hours	21–40 h	45 (19.6)
	41–60 h	155 (67.4)
	>60 h	30 (13.0)
Shift pattern	24-hour rotating shift	210 (91.3)

Note: AMO = assistant medical officer; MYR = Malaysian ringgit. Percentages may not total 100 because of rounding or missing responses.

Table 2. Summary of descriptive scale scores among Phase 1 respondents (n = 230).

Scale Item	Mean	SD	Interpretation
Psychosocial Safety Climate (PSC; 1–5 scale)			
Overall PSC (mean of 12 items)	3.34	–	Moderate
Organizational commitment to well-being	3.52	0.68	Moderate

Scale Item	Mean	SD	Interpretation
Management responsiveness	3.25	0.74	Moderate (lowest sub-score)
Accident in Workplace (AW; 1–4 frequency scale)			
Manual handling patient lifting	1.96	0.89	Most frequent hazard
Overall hazard exposure range	0.64–1.96	–	Low to moderate
Physical Injury at Workplace (PIW; 1–4 scale)			
Tension/stress (PIW1)	1.59	1.23	Most prevalent (highest item)
Back pain (PIW11)	1.51	1.25	Second most prevalent
Fractures severe lacerations	0.15	0.42	Rare
Utrecht Work Engagement Scale (UWES; 0–6 scale)			
Vigor and dedication	5.01	0.91	High
Absorption	2.95	1.12	Moderate-low
Safety Attitudes Questionnaire (SAQ; 1–5 scale)			
Job satisfaction teamwork	4.21	0.63	High
Staffing adequacy	2.05	0.97	Low; key gap
Difficulty speaking up about safety (SAQ29)	2.46	1.31	Below midpoint; openness concern
EMS Safety Incidents (EMSSI; 1–7 scale)			
Exposure to unsafe scenes high-stress shifts	4.32	0.77	Highly prevalent
Critical procedural errors	1.64	0.59	Rarely reported

Note: AW = Accident in Workplace; EMSSI = EMS Safety Incidents; PIW = Physical Injury at Workplace; PSC = Psychosocial Safety Climate; SAQ = Safety Attitudes Questionnaire; UWES = Utrecht Work Engagement Scale. Scores are item means within the scale range specified.

Table 3. Internal consistency and convergent validity of study instruments (n = 230).

Construct	Items	Cronbach's α	CR	AVE
Accident in Workplace (AW)	7	0.881	0.905	0.578
Physical Injury at Workplace (PIW)	11	0.933	0.921	0.518
Psychosocial Safety Climate (PSC)	12	0.954	0.959	0.664
Safety Attitudes Questionnaire (SAQ)	30	0.906	0.847	0.248*
Utrecht Work Engagement Scale (UWES)	17	0.915	0.902	0.404*
EMS Safety Incidents (EMSSI)	40	0.966	0.969	0.456*

*Note: CR = composite reliability; AVE = average variance extracted. *AVE below the 0.50 threshold because of a subset of weak or reverse-keyed items; affected items were flagged for refinement and excluded from the*

structural model where appropriate. A pilot study ($n = 30$) returned an overall Cronbach's alpha of 0.93. Acceptable thresholds: Cronbach's alpha and CR > 0.70; AVE > 0.50.

Table 4. Structural model path coefficients and hypothesis-testing results.

H	Path	β	t	90% CI	p	Decision
H1	AW $\rightarrow$ SAQ	-0.176	1.69	[-0.348, -0.023]	0.046	Supported
H2	AW $\rightarrow$ UWES	-0.092	0.968	[-0.269, 0.041]	0.167	Not supported
H3	PIW $\rightarrow$ SAQ	0.068	0.674	[-0.100, 0.231]	0.250	Not supported
H4	PIW $\rightarrow$ UWES	-0.134	1.338	[-0.283, 0.040]	0.091	Not supported
H5	PSC $\rightarrow$ AW	-0.181	2.296	[-0.309, -0.106]	0.011	Supported
H6	PSC $\rightarrow$ PIW	-0.222	3.423	[-0.330, -0.151]	<0.001	Supported
H7	SAQ $\rightarrow$ EMSSI	-0.192	2.030	[-0.349, -0.041]	0.021	Supported
H8	UWES $\rightarrow$ EMSSI	-0.117	1.380	[-0.257, 0.020]	0.084	Not supported

Note: β = standardized path coefficient; CI = bootstrap confidence interval; AW = Accident in Workplace; EMSSI = EMS Safety Incidents; PIW = Physical Injury at Workplace; PSC = Psychosocial Safety Climate; SAQ = Safety Attitudes Questionnaire; UWES = Utrecht Work Engagement Scale. Paths were tested using PLS-SEM with 5,000 bootstrap subsamples; $p < 0.05$ with a CI excluding zero indicated statistical significance.

Table 5. Characteristics of Phase 2 expert interview participants (n = 9).

ID	Role	Institution	Experience	Qualification
R1	Assistant Medical Officer	PHCAS, Emergency and Trauma Department, Hospital Banting, Selangor	>5 years	Master's degree
R2	Emergency Physician	Emergency and Trauma Department, Hospital Kuala Lumpur	>5 years	Master's degree
R3	Emergency Physician	Hospital Canselor Tuanku Muhriz, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur	>5 years	Master's degree
R4	Assistant Medical Officer	Emergency and Trauma Department, Hospital Ampang, Selangor	>5 years	Diploma
R5	Emergency Physician	Emergency and Trauma Department, Hospital Tengku Ampuan Rahimah, Klang, Selangor	>5 years	Master's degree
R6	Assistant Medical Officer	PHCAS, Emergency and Trauma Department, Hospital Kuala Lumpur	>5 years	Diploma
R7	Assistant Medical Officer	PHCAS, Emergency and Trauma Department, Hospital Tengku Ampuan Rahimah, Klang, Selangor	>5 years	Degree
R8	Emergency Physician	Emergency and Trauma Department, Hospital Sungai Buloh, Selangor	>5 years	Master's degree
R9	Senior Lecturer	Department of Emergency Medicine, Universiti Sains Malaysia Specialist Hospital, Kelantan	>5 years	PhD

Note: PHCAS = Prehospital Care and Ambulance Services. All interviews were conducted in December 2021.

Table 6. Themes, key issues, and representative participant quotes from Phase 2 thematic analysis.

Theme	Key Issues	Representative Participant Quotes (verbatim)
1. Patient Safety	Infrastructure inadequacies, particularly the absence of stretcher-compatible elevators in high-rise buildings, delay emergency access and heighten patient risk. Equipment-handling deficiencies and the lack of secure harness systems further compromise patient safety during transport. In rural areas, uneven terrain and narrow roads compound these delays.	“Elevators in new buildings are not designed for stretchers, making it challenging to move patients safely. It delays response times and adds unnecessary risk.” (R1) “There have been situations where patients fell inside the ambulance or during unloading, causing additional injuries. This reflects a clear gap in equipment design and handling practices.” (R3) “Ambulances often lack basic safety measures like secure harnesses for patients, making emergency transport risky.” (R6)
2. Responder Safety	Physical strain from carrying patients in multi-story buildings, outdated two-pin seatbelts, inadequate PPE during infectious-disease outbreaks, and environmental hazards (poor weather, narrow roads, and unstable buildings) collectively jeopardize responder well-being and operational effectiveness.	“Before ensuring patient safety, we must ensure responder safety, particularly in unsuitable buildings with narrow staircases or non-functional lifts.” (R4) “Two-pin seatbelts are still widely used in many ambulances, increasing the risk of injuries during sudden stops.” (R5) “The pandemic revealed gaps in our preparedness, particularly in providing responders with adequate protective measures.” (R2)
3. Attitudes and Safety Culture	Complacency, overconfidence, and a pervasive speed-over-safety mentality, exemplified by drivers routinely disregarding traffic signals, reflect systemic cultural problems. Responders frequently view improvisation as a necessity born of systemic inadequacy, normalizing unsafe practice.	“Ambulance drivers often run red lights, assuming they have absolute right-of-way. This not only endangers them and their patients but also creates negative perceptions among the public.” (R7) “We need to shift from a speed-first mentality to a safety-first culture in pre-hospital care. Improvisation should not be the norm.” (R3)
4. Training Deficiencies	Initial training is restricted to brief rotations inadequate for building comprehensive prehospital competence, and continuous professional development is largely absent, leaving personnel ill-prepared for the complexity of real-world emergencies.	“The training provided is limited to two weeks within a three-year program, which is insufficient to build comprehensive skills.” (R2) “Continuous professional development is essential, yet many responders go years without updated training.” (R2)

Note: PPE = personal protective equipment. Quotations are presented verbatim; participant identifiers (R1–R9) correspond to Table 5

DISCUSSION

To the authors' knowledge, this is among the first mixed-methods investigations of safety and risk management within the Malaysian prehospital care system, and the integration of its data strands is mutually reinforcing. The

structural model provides statistical confirmation of relationships the qualitative themes describe experientially: the inverse associations of psychosocial safety climate with accidents ($\beta = -0.181$) and physical injury ($\beta = -0.222$) give quantitative form to expert accounts of unsupported responders operating in environments structurally incapable of protecting them, while the supported pathway from poorer safety attitudes to more safety events ($\beta = -0.192$) corresponds to the speed-over-safety culture described in Theme 3. This convergence aligns with Reason's organizational accident model, in which latent conditions, inadequate training, deficient equipment, and an unsafe culture create the preconditions for active failures at the point of care (Reason, 2000). The low error-reporting score set against high hazard exposure is therefore best read not as evidence of genuine safety but as the underreporting the qualitative data render visible.

The most consequential finding is that psychosocial safety climate functions as a measurable, modifiable protective factor against occupational harm, whereas individual work engagement does not. High engagement (UWES vigour/dedication mean 5.01/6.00) coexisted with low climate and staffing scores, and none of the engagement-mediated paths reached significance, indicating that the protective signal is organizational rather than dispositional. High engagement does not protect against error when systemic conditions are inadequate (Olds et al., 2017), and fatigue, burnout, and chronic stress dominate risk independent of motivation (Tikkanen et al., 2025). Extending Dollard and Bakker's longitudinal PSC evidence (Dollard & Bakker, 2010) to the prehospital setting, this study demonstrates, among the first in an LMIC EMS context, that PSC is inversely and significantly associated with accidents and injuries; the modest effect sizes locate the most reliable point of leverage at management commitment and communication rather than individual exhortation.

Themes 1 and 2 establish that hazards operate at multiple levels simultaneously. The absence of stretcher-compatible elevators and inadequate in-vehicle harness systems directly compromise patient safety (Wang et al., 2009), while exclusive use of two-pin seatbelts and the physical demands of carrying patients in multi-story buildings heighten musculoskeletal risk, converging with the PIW finding that tension/stress and strain were most prevalent (PIW1 mean 1.59/4.00); the COVID-19 pandemic further exposed shortfalls in protective-equipment provision. The salience of attitudes, cognitive load, and cultural norms aligns with established EMS literature (Bitan et al., 2019), and the identification of negative safety attitudes as predominant precursors of prehospital error directly mirrors Theme 3 (Rowland & Adefuye, 2022). The workforce profile compounds these risks: 13.0% worked more than 60 hours weekly and 91.3% operated on 24-hour rotating shifts that exceed evidence-based fatigue thresholds (Patterson et al., 2018). Moderate PSC (3.34/5.00) with a low management-responsiveness subscore (3.25/5.00) indicates structures that nominally recognize well-being but fail to operationalize it, consistent with German EMS data in which communication failures and legal insecurity were the most prevalent stressors (Elsässer et al., 2024) and with the nine-country finding that management perceptions most strongly differentiate performance (Kosydar-Bochenek et al., 2023).

Governance fragmentation underpins the challenges documented across the themes: ambulance designs incompatible with urban infrastructure and the dual driving-plus-clinical role of ambulance drivers reflect the absence of a unified regulatory authority. The Occupational Safety and Health Act 1994 was not designed for mobile prehospital operations, and hospital accreditation does not extend systematically to prehospital services (Occupational Safety and Health Act 1994, 1994). Unified frameworks deliver better compliance and outcome monitoring (Rahman et al., 2015), and fleet standardization underpins improved outcomes in Asia (Ong et al., 2011); the persistent policy–practice gap (Mahmudi, 2018) and fragmented oversight (Martin-Gill et al., 2025) reinforce the case for a dedicated national prehospital governing body as a central recommendation of this study. Theme 4's training deficits, an initial two-week program within a three-year service period and virtually no continuous professional development, are compounded by musculoskeletal injury attributable to inadequate ergonomic training; embedding safety and life-support competencies as continuously reinforced core components is warranted (Reid et al., 2018), and the supported attitudes-to-incidents pathway implies that curricula targeting safety culture, not only technical skill, may yield measurable reductions in adverse events. Environmentally, high-rise access without stretcher-compatible elevators, poor roads, congestion, and rural terrain situate prehospital safety within a broader sociotechnical context requiring urban-planning and inter-agency frameworks (Maguire, 2015; Biesbroek & Teteris, 2012).

Limitations

Several limitations should be noted. Phase 1 relied on self-reported measures susceptible to social-desirability bias, which may have overestimated safety-climate scores or underestimated hazard exposure. The structural model, although robust for the supported paths, explained only a modest proportion of variance ($R^2 = 0.020$ – 0.077) with small effect sizes, indicating that important determinants lie beyond the modelled constructs; it should therefore be interpreted as identifying reliable directional associations rather than comprehensive causation. Three constructs (SAQ, UWES, and EMSSI) returned AVE values below 0.50 and require item-level refinement before further use. The purposive sample of nine experts, adequate for thematic saturation, is not fully representative of Malaysia's heterogeneous prehospital workforce, and the study was confined to urban Klang Valley and Putrajaya,

so findings may not transfer directly to rural settings. Member checking of final themes was not performed; future studies should incorporate respondent validation to strengthen credibility and transferability.

CONCLUSION

This sequential explanatory mixed-methods study provides one of the first comprehensive empirical accounts of safety and risk management in Malaysian prehospital care, integrating validated survey data from 230 frontline responders with qualitative insight from nine expert stakeholders. Four interconnected themes emerged: patient-safety hazards arising from inadequate infrastructure and ambulance design; occupational risks from physical strain and infectious-disease exposure; a pervasive speed-over-safety cultural norm; and critical deficiencies in initial and continuing training. The structural model demonstrated that psychosocial safety climate is a significant, modifiable protective factor against accidents and injuries, whereas individual work engagement is not. These findings converge on three priorities: equipping ambulances with secure patient-harness and updated restraint systems; embedding safety culture, risk management, and ergonomic patient handling as core training competencies; and establishing the governance conditions needed to enforce and sustain these standards. Beyond Malaysia, the study extends the Psychosocial Safety Climate framework to an LMIC prehospital context, offers a transferable six-instrument measurement template for benchmarking EMS safety, and shows, quantitatively and qualitatively, that individual commitment cannot compensate for systemic safety failures, providing an empirical foundation for validated prehospital safety performance indicators across Southeast Asia.

Declarations

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References

1. Biesbroek S, Teteris E. Human factors review of EMS ground ambulance design. *Proc Hum Factors Ergon Soc Health Care Symp.* 2012;1:95-101.
2. Bitan Y, Moran P, Harris J. Evaluating safety culture changes over time with the emergency medical services safety attitudes questionnaire. *Australas J Paramedicine.* 2019; 16:1-6.
3. Braun V, Clarke V. One size fits all? What counts as quality practice in reflexive thematic analysis? *Qual Res Psychol.* 2021;18(3):328-52.
4. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* 2006;3(2):77-101.
5. Cohen J. *Statistical power analysis for the behavioral sciences.* 2nd ed. Hillsdale (NJ): Lawrence Erlbaum Associates; 1988.
6. Creswell JW, Plano Clark VL. *Designing and conducting mixed methods research.* 3rd ed. Thousand Oaks (CA): Sage; 2018.
7. Dollard MF, Bakker AB. Psychosocial safety climate as a precursor to conducive work environments, psychological health problems, and employee engagement. *J Occup Organ Psychol.* 2010;83(3):579-99.
8. Donnelly E, Siebert D. Occupational risk factors in the emergency medical services. *Prehosp Disaster Med.* 2009;24(5):422-9.

9. Elsässer A, Dreher A, Pietrowsky R, Flake F, Loerbroks A. Psychosocial working conditions, perceived patient safety and their association in emergency medical services workers in Germany: a cross-sectional study. *BMC Emerg Med.* 2024;24:62.
10. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res.* 1981;18(1):39-50.
11. Hair JF Jr, Hult GTM, Ringle CM, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). 2nd ed. Thousand Oaks (CA): Sage; 2017.
12. Kosydar-Bochenek J, Religa D, Knap M, Czop M, Knap B, Mędrzycka-Dąbrowska W, et al. Safety climate perceived by pre-hospital emergency care personnel: an international cross-sectional study. *Front Public Health.* 2023; 11:1192315.
13. Maguire BJ, Hunting KL, Smith GS, Levick NR. Occupational fatalities in emergency medical services: a hidden crisis. *Ann Emerg Med.* 2002;40(6):625-32.
14. Maguire BJ. Ambulance safety. In: Cone DC, Brice JH, Delbridge TR, Myers JB, editors. *Emergency medical services: clinical practice and systems oversight.* 2nd ed. Chichester: Wiley-Blackwell; 2015. p. 222-30.
15. Mahmudi A. The gap between theory and practice: a qualitative study on medical assistant program in Malaysia. *Eur J Educ Stud.* 2018;4(11).
16. Malterud K, Siersma VD, Guassora AD. Sample size in qualitative interview studies: guided by information power. *Qual Health Res.* 2016;26(13):1753-60.
17. Martin-Gill C, Patterson PD, Richards CT, et al. 2024 systematic review of evidence-based guidelines for prehospital care. *Prehosp Emerg Care.* 2025;29(6):703-12.
18. McLinton SS, Loh MY, Dollard MF, Tuckey MMR, Idris MA, Morton S. Benchmarking working conditions for health and safety in the frontline healthcare industry: perspectives from Australia and Malaysia. *J Adv Nurs.* 2018;74(8):1851-62.
19. Mohd Said N, Sukonthasarn A, Wangsrikhun S, Chanpransit C. Assessing and exploring the competency of prehospital emergency medical service personnel in Klang Valley, Malaysia: a mixed method approach. *IJUM Med J Malays.* 2014;13(2):7-20.
20. O'Connor P, O'Malley R, Oglesby AM, Lambe K, Lydon S. Measurement and monitoring of patient safety in prehospital care: a systematic review. *Int J Qual Health Care.* 2021;33(1):mzab013.
21. Occupational Safety and Health Act 1994 (Act 514). Laws of Malaysia. Kuala Lumpur: Government of Malaysia; 1994.
22. Olds DM, Aiken LH, Cimiotti JP, Lake ET. Association of nurse work environment and safety climate on patient mortality: a cross-sectional study. *Int J Nurs Stud.* 2017;74:155-61.
23. Ong MEH, Shin SD, Tanaka H, Ma MHM, Khruengkarnchana P, Hisamuddin N, et al. Pan-Asian Resuscitation Outcomes Study (PAROS): rationale, methodology, and implementation. *Acad Emerg Med.* 2011;18(8):890-7.
24. Patterson PD, Higgins JS, Van Dongen HPA, Buysse DJ, Thackery RW, Kupas DF, et al. Evidence-based guidelines for fatigue risk management in emergency medical services. *Prehosp Emerg Care.* 2018;22(sup1):89-101.
25. Patterson PD, Huang DT, Fairbanks RJ, Wang HE. The emergency medical services safety attitudes questionnaire. *Am J Med Qual.* 2010;25(2):109-15.
26. Péculo-Carrasco JA, Luque-Hernández MJ, Rodríguez-Ruiz HJ, Chacón-Manzano C, Failde I. Factors influencing the perception of feeling safe in pre-hospital emergency care: a mixed-methods systematic review. *J Clin Nurs.* 2023;32(15-16):4473-91.
27. Price R, Bendall JC, Patterson JA, Middleton PM. What causes adverse events in prehospital care? A human-factors approach. *Emerg Med J.* 2013;30(7):583-8.
28. Rahman NH, Tanaka H, Shin SD, Ng YY, Piyasuwanikul T, Lin CH, et al. Emergency medical services key performance measurement in Asian cities. *Int J Emerg Med.* 2015;8:12.
29. Rahman NHNA, Holliman CJ. Emergency medicine in Malaysia. *Hong Kong J Emerg Med.* 2005;12(4):246-51.
30. Reason J. Human error: models and management. *West J Med.* 2000;172(6):393-6.
31. Reid D, Jones R, Sim M. Pre-hospital advanced life support education: core components for pre-hospital professionals. *Australas J Paramedicine.* 2018;15(1):1-11.
32. Rowland M, Adefuye A. Human errors and factors that influence patient safety in the pre-hospital emergency care setting: perspectives of South African emergency care practitioners. *Health SA Gesondheid.* 2022;27: a1798.
33. Schaufeli WB, Bakker AB. Utrecht Work Engagement Scale: preliminary manual. Version 1.1. Utrecht: Occupational Health Psychology Unit, Utrecht University; 2004.

34. Strandås M, Flores Vizcaya-Moreno M, Ingstad K, et al. An integrative systematic review of promoting patient safety within prehospital emergency medical services by paramedics: a role theory perspective. *J Multidiscip Healthc.* 2024;17:1385-400.
35. Tikkanen V, Kääriäinen M, Roivainen P. The effect of ambulance clinicians' well-being on occupational and patient safety in prehospital emergency medical services: a scoping review. *Emerg Crit Care Med.* 2025;5(1):20-39.
36. Tokita A, Nunokawa H, Liu K, Iwamoto Y, Sonoo T, Hara K, et al. Key challenges in prehospital and emergency care in Indonesia and Malaysia: a survey of frontline clinicians. *BMC Res Notes.* 2024;17:287.
37. Wang HE, Weaver MD, Abo BN, Kaliappan R, Fairbanks RJ. Ambulance stretcher adverse events. *Qual Saf Health Care.* 2009;18(3):213-6.
38. Yu, L. G., Hoo, W. C., Juan, H. L., & Wolor, C. W. (2026). Unpacking the Mediating Role of Doctor–Patient Trust in the Service Quality–Loyalty Link: Insights from a Large Public Hospital in Shandong, China. *International Review of Management and Marketing*, 16(3), 305–316..