Aus dem

Institut und Poliklinik für Arbeits-, Sozial- und Umweltmedizin

Klinikum der Ludwig-Maximilians-Universität München

Identification of key factors for sustainable working conditions – Results from an EUSEM-initiated, Europe-wide Delphi consensus initiative among emergency department (ED) providers

Dissertation
zum Erwerb des Doktorgrades der Medizin
an der Medizinischen Fakultät
der Ludwig-Maximilians-Universität München

vorgelegt von

Michael Lifschitz

aus

Kiew, Ukraine

Jahr

2024

Confirmation of congruency between printed and electronic version of the doctoral thesis

Doctoral candidate: Lifschitz, Michael

Address: Pettenkoferstraße 8a, 80336 München

I hereby declare that the electronic version of the submitted thesis, entitled

Identification of key factors for sustainable working conditions – Results from an EUSEM-initiated, Europe-wide Delphi consensus initiative among emergency department (ED) providers

is congruent with the printed version both in content and format.

Munich, 20.12.2024   Michael Lifschitz

_____   _____

Place, Date   Signature doctoral candidate

Table of Contents.................................... Page

1 Summary / Zusammenfassung

Introduction and objectives

Demands for hospital-based emergency care have significantly expanded while emergency department (ED) providers pursue to safeguard high-quality care. Thus, determination of strategies to ensure work system solutions for resilient delivery of care amid rising workloads and persistent constraints is necessary. Despite this, to date empirical evidence and synthesis from large-scale investigations into ED providers' work-life surveys across European countries are lacking. Hence, this study aimed to identify and compare relevant work factors affecting ED providers' well-being on the job and respective intervention practices within and across European ED settings. Additionally, the objective was to establish consensus on key indicators of working conditions, provider well-being, and associated health and performance outcomes across various ED settings in Europe.

Design and methods

Altogether, a cross-European panel of 18 ED providers from six European countries (Belgium (BEL), Finland (FIN), Germany (GER), Italy (ITA), Romania (ROM), and United Kingdom (UK)) was recruited using a purposive snowball sampling approach within the network of the European Society for Emergency Medicine (EUSEM). A two-round mixed-methods Delphi survey was conducted. The sample of 18 interviewees was stratified for hospital sizes or care levels, seniority levels, ED expertise, active professional practice, and proficiency in the English language. In the first round, panelists provided free-text and guided responses, along with ratings, to various literature-based and pre-defined categories of ED work-life. In round 2, panelists rated the relevance of consolidated round 1 items, ED work system factors, provider health outcomes, and ED work-life intervention approaches, as well as specific challenges and implications related to the coronavirus disease 2019 (COVID-19), respectively. Consensus was achieved through qualitative content analysis (round 1) and standardized approval metrics (round 2).

Main results

Collectively, all 18 panelists engaged in both Delphi rounds. There was a near-unanimous agreement across several dimensions of [1] ED work influences. Notably, within positive ED work influences, general (esp., 'Job challenge: variation and/or interdisciplinary interaction', 'Job control: participation in decision-making', 'Job intellectuality', and 'Task significance'), provider-related (esp., 'Personal work ethic

and/or motivation', 'Teamwork, social climate and extracurricular activities', 'Work experience and/or utilization of skills', and 'Resilience and coping strategies'), and patient-provider interaction ('Patient case complexity') aspects achieved consensus. Conversely, within negative ED work influences, general (esp., 'Overcrowding', 'Workflow interruptions and/or multitasking', and 'Time pressure and/or lack of breaks'), and provider-related ('Medical errors') facets also attained consensus. Regarding [2] adverse ED providers' health outcomes, consensus was observed on esp. 'Physical fatigue', 'Exhaustion and/or mental fatigue', 'Burnout', 'Compassion fatigue, pessimism, and/or cynicism', and 'Dropouts / opt-outs (= quitters)'. However, there was less agreement on [3] current intervention practices. Organizational strategies, esp. 'Emergency care as autonomous specialty', 'ED reorganization and/or modernization', 'Evidence-based standard operating procedures (SOPs) and/or training concepts', and 'Adaptable staff and duty rostering', garnered agreement, as did the team-level approaches '(Simulation-based) Skills trainings' and 'Debriefings after critical events with potential post-traumatic consequences'. Additionally, experiences of facilitators and barriers in improving ED work-life were documented. Moreover, consensus was reached on [4] factors mitigating (esp., 'Personal protective equipment (PPE)', 'Vaccination campaigns', 'Testing: polymerase chain reaction (PCR) and/or point-of-care (POC) antigen', 'Persistent information flow', 'Change of SOPs', and 'Separate isolation and cohort areas or units') and exacerbating (esp., 'Shortage of staff', 'Excessive workload: organizational and/or isolation-related', and 'Crowding: ED space limitations and/or exit blocks') the impacts of COVID-19. Regarding impacts of COVID-19 on ED providers' health, esp. 'Confirmed COVID-19 infections', 'Mental exhaustion and/or less resilience', 'Anxieties', 'Undertreatment of emergency medicine diagnoses', and 'Delay in patient diagnostic and therapeutic pathways', achieved consensus. In terms of not only item- but also the overall scale-level panel consensus and internal panel correlation, [1] and [4] exhibited nearly acceptable overall consensus with good to excellent inter-rater consistency, while [2] and [3] showed weaker overall consensus but excellent inter-rater consistency.

Discussion and conclusion

This survey represents the first cross-European investigation into key indicators of physicians' work conditions in ED care across Europe and provides guidance on respective intervention practices. While consensus on work system factors was high, agreement on effective practices to reduce work stress was substantially lower. These expert-based results emphasize the significance of improvement strategies focusing on system-induced external stressors and shed further lights on the current status of

European ED improvement measures. The findings may inform future surveys, intervention studies, and policy and practice recommendations aimed at ameliorating European ED provider work-life and, subsequently, quality and safety of patient care.

Keywords

Burnout, emergency department, Europe, work-life, stress, well-being, patient care, consensus, Delphi, expert-based, survey, COVID-19.

Hintergrund und Ziele

Die Anforderungen an die notfallmedizinische Versorgung in Krankenhäusern haben erheblich zugenommen, während Mitarbeitende in Notaufnahmen gleichzeitig bestrebt sind, eine qualitativ hochwertige Versorgung zu gewährleisten. Daher ist es notwendig, Strategien zur Sicherstellung von Arbeitsablaufsystemen zu entwickeln, um eine resiliente Versorgung trotz steigender Arbeitsbelastungen und anhaltender Einschränkungen zu gewährleisten. Dennoch fehlen bisher empirische Belege und Synthesen aus groß angelegten Untersuchungen zu Arbeitsumfragen von Notaufnahme-Mitarbeitenden in europäischen Ländern. Diese Studie zielte daher darauf ab, relevante Arbeitsfaktoren zu identifizieren und zu vergleichen, die das Wohlbefinden der Notaufnahme-Mitarbeitenden am Arbeitsplatz beeinflussen, sowie entsprechende Interventionspraktiken innerhalb und zwischen europäischen Notaufnahmen. Zusätzlich war das Ziel, einen Konsens über zentrale Indikatoren für Arbeitsbedingungen, das Wohlbefinden der Mitarbeitenden sowie damit verbundene Gesundheits- und Leistungsresultate in verschiedenen Notaufnahme-Settings in Europa zu etablieren.

Design und Methoden

Insgesamt wurde ein europäisches Gremium von 18 Notaufnahme-Mitarbeitenden aus sechs europäischen Ländern (Belgien (BEL), Finnland (FIN), Deutschland (GER), Italien (ITA), Rumänien (ROM) und Vereinigtes Königreich (UK)) durch ein gezieltes Schneeballsampling innerhalb des Netzwerks der European Society for Emergency Medicine (EUSEM) rekrutiert. Eine zweistufige Delphi-Umfrage im Mixed-Methods Verfahren wurde durchgeführt. Die Stichprobe von 18 Befragten wurde nach Krankenhausgrößen oder Versorgungsniveaus, Seniorität, Notfallmedizin-Expertise, aktiver Berufspraxis und Englischkenntnissen stratifiziert. In der ersten Runde gaben die Panelteilnehmerinnen und -teilnehmer Freitext- und geführte Antworten sowie Bewertungen zu verschiedenen literaturbasierten und vordefinierten Kategorien des

Arbeitslebens in der Notaufnahme ab. In Runde 2 bewerteten die Panelteilnehmerinnen und -teilnehmer die Relevanz der konsolidierten Statements aus Runde 1, Arbeitssystem-Faktoren der Notaufnahmetätigkeit, gesundheitliche Auswirkungen auf Mitarbeitende und Arbeitsplatz-bezogene Interventionsansätze sowie spezifische Herausforderungen und Auswirkungen im Zusammenhang mit der Coronavirus-Krankheit 2019 (COVID-19). Der Konsens wurde durch qualitative Inhaltsanalyse (Runde 1) und standardisierte Zustimmungsmetriken (Runde 2) ermittelt.

Hauptergebnisse

18 Panelteilnehmerinnen und -teilnehmer nahmen an beiden Delphi-Runden teil. Es gab nahezu einstimmige Übereinstimmung in mehreren Dimensionen der [1] Einflussfaktoren auf die Notaufnahmetätigkeit. Insbesondere bei den positiven Einflussfaktoren erreichten allgemeine (insb. „Arbeitsanforderungen: Variation und/oder interdisziplinäre Interaktion", „Arbeitskontrolle: Teilnahme an Entscheidungsprozessen", „Arbeitsintellektualität" und „Aufgabenbedeutung"), mitarbeiterbezogene (insb. „Persönliche Arbeitsmoral und/oder Motivation", „Teamarbeit, soziales Klima und außercurriculäre Aktivitäten", „Arbeitserfahrung und/oder Nutzung von Fähigkeiten" und „Resilienz- und Bewältigungsstrategien") und patientenbezogene („Komplexität der Patientenfälle") Aspekte einen Konsens. Andererseits erreichten bei den negativen Einflussfaktoren allgemeine (insb. „Überbelegung", „Arbeitsflussunterbrechungen und/oder Multitasking" und „Zeitdruck und/oder Mangel an Pausen") und mitarbeiterbezogene Aspekte („Medizinische Fehler") ebenfalls Konsens. Hinsichtlich der [2] negativen gesundheitlichen Auswirkungen für Mitarbeitende wurde Konsens bei „Physische Ermüdung", „Erschöpfung und/oder geistige Ermüdung", „Burnout", „Mitgefühlsmüdigkeit, Pessimismus und/oder Zynismus" und „Aussteiger*innen / Abbrecher*innen" erzielt. Es gab jedoch weniger Übereinstimmung bei [3] Interventionsansätzen: Organisatorische Strategien, insb. „Notfallversorgung als autonome Fachrichtung", „Reorganisation und/oder Modernisierung von Notaufnahmen", „Evidenzbasierte Standardarbeitsanweisungen (SOPs) und/oder Trainingskonzepte" und „Flexible Personal- und Dienstplangestaltung" erzielten Übereinstimmung, ebenso wie die teambezogenen Ansätze „(simulationsbasierte) Kompetenztrainings" und „Nachbesprechungen nach kritischen Ereignissen mit potenziell posttraumatischen Konsequenzen". Darüber hinaus wurden Erfahrungen mit Erfolgsfaktoren und Barrieren bei der Verbesserung des Berufslebens an Notaufnahmen dokumentiert. Zudem wurde Konsens über [4] Faktoren erzielt, die die Auswirkungen von COVID-19 auf das Berufsleben mildern (insb. „Persönliche Schutzausrüstung", „Impfkampagnen", „Testungen: Polymerase-Kettenreaktion (PCR) und/oder Point-of-

Care (POC) Antigen", „Persistierender Informationsfluss", „Änderung von SOPs" und „Separate Isolations- und Kohortenbereiche oder -einheiten") und verschärfen (insb. „Personalmangel", „Übermäßige Arbeitsbelastung: organisatorisch und/oder isolationsbedingt" und „Überbelegung: Räumlichkeitsbeschränkungen und/oder Exit-Blockaden"). Hinsichtlich der gesundheitlichen Auswirkungen von COVID-19 auf die Mitarbeitenden erzielten „Bestätigte COVID-19-Infektionen", „Mentale Erschöpfung und/oder geringere Resilienz", „Ängste", „Unterversorgung von notfallmedizinischen Diagnosen" und „Verzögerungen bei diagnostischen und therapeutischen Patientenverläufen" einen Konsens. In Bezug auf den Gesamtkonsens des Panels (nicht nur auf Item- sondern auch auf Skalen-Niveau) und die interne Panelkorrelation, ergaben sich im Bereich [1] und [4] ein annähernd akzeptabler Gesamtkonsens mit guter bis exzellenter Interrater-Konsistenz, bei [2] und [3] ein jeweils schwächerer Gesamtkonsens bei gleichzeitig ausgezeichneter Interrater-Konsistenz.

Diskussion und Schlussfolgerung

Diese Umfrage stellt die erste europaweite Untersuchung zu Schlüsselindikatoren der Arbeitsbedingungen von Ärztinnen und Ärzten in der innerklinischen Notfallversorgung dar und bietet Orientierungshilfen zu entsprechenden Interventionspraktiken. Während der Konsens über Arbeitssystem-Faktoren hoch war, zeigte sich die Übereinstimmung über effektive Praktiken zur Reduktion von Arbeitsstress als deutlich geringer. Diese expertenbasierten Ergebnisse unterstreichen die Bedeutung von Optimierungsstrategien, die sich auf systeminduzierte externe Stressoren fokussieren, und werfen weiteres Licht auf den aktuellen Stand der Verbesserungsmaßnahmen innerhalb europäischer Notaufnahmen. Die Ergebnisse dieser Studie könnten zu zukünftigen Umfragen, Interventionsstudien sowie politischen und praktischen Empfehlungen zur Verbesserung des Berufslebens von Mitarbeitenden in europäischen Notaufnahmen, und letztlich zur Qualität und Sicherheit der Patientenversorgung beitragen.

2 Introduction

2.1 Challenges of ED care systems

Over the previous decades, ED care has evolved into a pivotal area for providing patient care, addressing the accelerating demands of acute cases with severe injuries and illnesses (1). ED visits and short-term observation stays are increasing across many European countries, while hospital admissions are on the decline (2, 3). Beyond high-

acuity care, challenges for EDs are further exacerbated by the progressive numbers of multimorbid patients and low-acuity visits due to non-urgent complaints (3). EDs have become the primary entry point for inpatient admissions for a substantial portion of patients (4). To ensure reliable and safe patient care, well-functioning EDs need to operate smoothly and effectively. Quality and timeliness of ED care play crucial roles in downstream patient outcomes, impacting factors such as in-hospital mortality (5) and the prevalence of adverse events (6). However, given the numerous fundamental and pertinent strains in ED care, continuous development is needed (1), particularly in response to:

Macro-level changes at the societal and public levels involving regulatory adjustments and EU work time regulations, alongside public expectations for round-the-clock availability and accurate care from ED providers;

Meso-level changes at the institutional and hospital-organization levels including challenges like overcrowding, manifested by growing patient numbers with grave illnesses and complex medical conditions, a shifting patient demographic towards more complex cases and elderly patients, and the ED's role as a vital resource for marginalized groups, such as derelicts (7). Balancing patient loads with minor injuries or potentially inappropriate demands, and complex cases requiring intense first-response care, also presents significant challenges. Moreover, coordinating various medical specialties in the initial assessment and early treatment under proficient and efficient utilization of hospital resources and unit facilities (8), allocation of financial and time resources for staff development and continuing professional development, as well as manpower shortages compounded by an expansion of responsibilities affecting patient waiting times pose additional strain factors to EDs.

Micro-level changes at the provider and patient levels encompassing the complex coordination of care delivery (such as primary care, social work, and community services, in order to select the appropriate response to emergency health and social needs), skill development and retention among ED providers amid staffing shortages and overcommitted schedules, and patient expectations for low accessibility and immediate care (9). High turnover rates among clinical staff are described, combined with demanding work environments and the increased risk of burnout and other adverse well-being and health consequences for ED providers (10, 11), with junior ED staff facing particular risks (12). Demands for a mix of technical and medical expertise combined with non-technical skills such as communication, team leadership, and building further compound these challenges (8). Additionally, high-stress ED work environments are

characterized by shift work, excessive workloads, challenges with work-life integration, inadequate skill mix, and inefficient work environments, coupled with dwindling levels of job autonomy and control (10). These conditions reduce the prospects for the sustained professional careers of ED staff and compromise their ability to maintain a healthy work-life balance.

Overall, in the pursuit of delivering the highest quality of care, ED providers are compelled to assess changes in the scope of the specialty. The challenge lies in establishing the delivery of reliable and safe ED care in the face of escalating workloads. Recognizing that the circumstances in ED practice, and notably the working conditions in hospital EDs, exert significant influence on both provider well-being and patient care, the present study aims to concentrate on the systemic features of the work environment (i.e., systemic and environmental flaws) that determine risks for both provider and patient outcomes.

General purpose of this survey

Systematic and thorough investigations to advance the currently confined knowledge on outcomes, costs and human resource issues to facilitate evidence-based policy formulation in ED work systems, provider well-being, and performance, as well as associated impacts on patient care are needed (1). This investigation is therefore guided by two overarching objectives:

Identifying key issues in ED work and care systems:

This entails uncovering the inherent challenges within current ED work and care systems that have discernible effects on ED provider well-being and patient care outcomes. The aim is to identify generic challenges present in EDs across Europe, as well as specific workplace issues unique to each surveyed country.

Outlining context or process conditions for successful improvement interventions:

This involves examining the contextual and process conditions conducive to the effective adoption and implementation of improvement interventions aimed at enhancing working conditions in European EDs. The focus is on assessing the effectiveness of implemented interventions, identifying factors contributing to their success or failure, and considering contextual factors at macro-, meso-, and micro-system levels within both EDs and hospitals.

The results of these evaluations will serve as a foundation for deriving recommendations on the most effective strategies to disseminate and implement interventions and improvement practices in ED care across European hospitals. Consequently, this investigation's findings aim to inform measures or interventions that enhance quality, efficacy, and safety of patient care while promoting favorable and healthy workplace environments in ED care delivery.

2.2 Conceptual framework: the SEIPS model

ED work and care systems

EDs represent highly dynamic and stressful care environments, characterized by specific demands on healthcare providers and ensuing effects on patient outcomes (13, 14). The health and performance of ED nurses and physicians are notably affected by the challenging and demanding working conditions inherent in the ED setting (15, 16). A heterogeneous spectrum of organizational, social, and patient-related factors collectively contributes to health outcomes of ED providers (13, 15, 16).

ED care, by its nature, frequently encompasses highly stressful and emotionally demanding patient care, exposing providers to various stressors related to both patients and occupational environment. Examples of such stressors include instances of child abuse, workplace violence, and high workloads, to name only few, most prominent aspects (17-19). In addition to the inherent ED care demands, such as time pressure and limited predictability, exist prevalent psychosocial work stressors that are often attributed to poor organizational or system design, i.e., limited autonomy, social conflicts, understaffing, information impediments (12, 16).

Conceptual framework

To comprehend the structures, processes, and outcomes in healthcare, as well as their intricate relationships in terms of human factors and ergonomics (HFE), it is essential to adopt robust and sound conceptual approaches (20-23). This investigation draws upon the 'Systems Engineering Initiative for Patient Safety' (SEIPS) work system model (24-26). The SEIPS model elucidates how sociotechnical systems within healthcare shape health-related work and, reciprocally, how work processes in patient care influence outcomes on patient, professional, and organizational levels. This model is characterized by several key features, enhancing its effectiveness as a framework for understanding and improving healthcare systems (26): [1] detailed healthcare work system description considering its complex interactions among various system components, [2] induction of

the widely-used and comprehensive quality-of-care assessment framework based on the structure-process-outcome (SPO) model of healthcare quality (20, 27), [3] identification of care processes influenced by the work system, emphasizing the impact of system elements on the execution of care procedures, [4] inclusion of patient outcomes with organizational and employee outcomes, and [5] feedback loops between care processes, outcomes, and the work system. They allow for a continuous improvement cycle, where insights from outcomes and processes inform adjustments to the work system, contributing to ongoing enhancements in healthcare delivery. This holistic approach acknowledges the interconnectedness of different outcomes, recognizing that changes in the work system can have ripple effects on both patient care and the well-being of healthcare professionals. It has proven effective in various healthcare contexts, serving as a foundation for studying and enhancing healthcare practices (25). Figure 1 illustrates the SEIPS 2.0 framework:
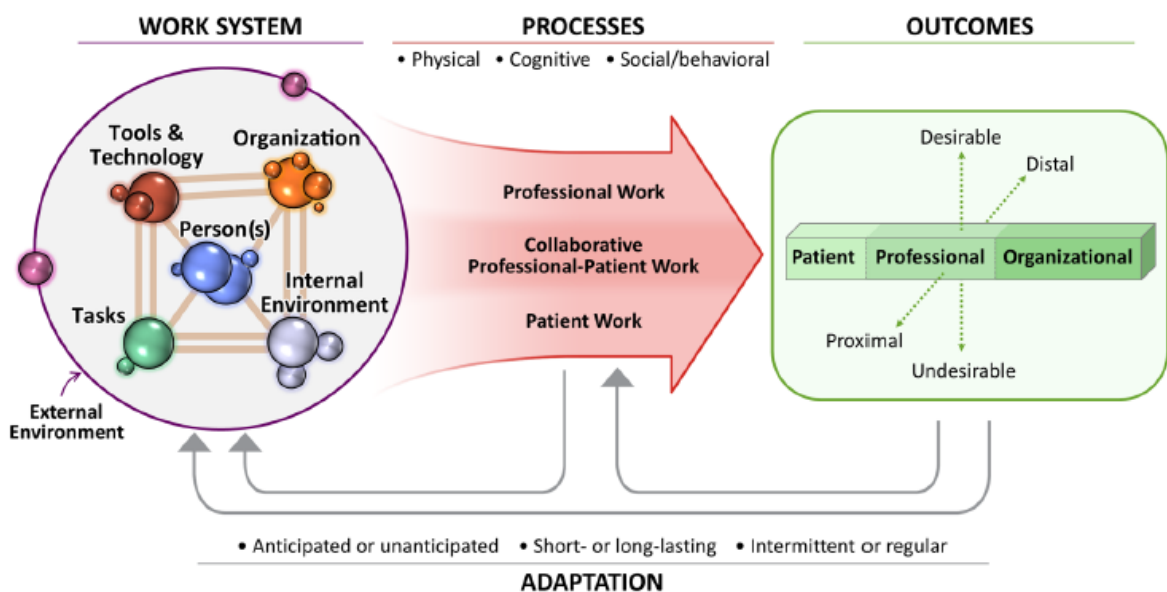
Figure 1: SEIPS 2.0 Model (from (25)).

The SEIPS 2.0 model retains fundamental aspects of its antecedent model while introducing several clarifications and expansions. Its overarching structure depicts a sociotechnical work system on the left, which generates work processes in the middle, ultimately influencing outcomes on the right. This format resonates with healthcare professionals due to its alignment with the widely recognized SPO model (27), and aligns

with systems theory's input-transformation-output framework (28). As a result, SEIPS 2.0 garners increased acceptance within the healthcare community.

The enhancements in SEIPS 2.0 are imperative to ensure the relevance of this human factors framework in light of the evolving landscape of healthcare work systems. These systems are now recognized as dynamic, collaborative, multilevel, and adaptive, with active involvement from patients and families. Recognizing that core healthcare issues and values evolve over time, it is crucial for human factors, along with its models and methodologies, to evolve as well to maintain their utility and pertinence.

The SEIPS 2.0 framework will serve as a system-based guidance tool throughout the study to elucidate the diverse determinants and contextual influences crucial for the conception of work conditions of ED professionals (25, 29). This conceptual framework is particularly suited for the investigation's comprehensive approach, as it facilitates the examination of multiple factors (tasks, technologies, individuals, environment, organization) that collectively contribute to stress loads and affect both provider and organizational outcomes, including provider health and patient safety (25, 26).

2.3 Contemporary ED work-life literature

2.3.1 ED work demands, resources, and provider well-being

An extensive body of literature, mainly derived from systematic reviews, validates the efficacy and significance of ED care as a specialized field, with educated ED providers delivering acute and urgent patient care (30, 31).

However, ED crowding emerges as a pivotal factor, impeding precise, timely, and efficient hospital care, resulting in heightened workloads, diminished performance, compromised self- and patient-perceived care, adverse events, and elevated morbidity and mortality rates (32-35). Contributors for overcrowding are multifactorial (e.g., encompassing boarding, access and exit blocks), and categorized within the Input-Throughput-Output (ITO) model (32-35).

Concurrently, a prevalent issue arises with staff shortages and consequently understaffing, often stemming from budgetary constraints (13). High job demands and cognitive workload, coupled with low job control/autonomy, insufficient workplace support, effort-reward imbalances, and organizational injustice, form recurring concerns (13, 18, 36, 37). Shift work and associated sleep deprivation, particularly prevalent among medical physicians-in-training (PIT) and in high-pressure ED environments, are

linked to circadian disorders, chronic fatigue, and burnout (38-42). Moreover, prior evidence underscores elevated blood pressure outcomes (43), an augmented susceptibility to coronary artery disease, and compromised reproductive health (44). In addition, multitasking, workflow interruptions, and suboptimal time allocation for ED providers are suggested to amplify cognitive workload, thus leading to reduced job satisfaction and fatigue, healthcare delays, as well as adverse events with diminished patient-perceived quality of care (45-48).

ED providers routinely encounter numerous occupational hazards, including exposure to transmissible infectious diseases, nitrous oxide, latex allergies, and needle stick injuries. Notably, preventive measures were deficient prior to the COVID-19 era (44). Amidst this hazardous landscape, instances of verbal, psychological, sexual, and physical workplace violence (WPV) against healthcare workers perpetrated by patients, their relatives, or advocates, have emerged as an alarming reality. This is particularly pronounced in high-pressure settings and is observed among both physicians and nursing staff (49-52). Adverse events, predominantly medical errors, are distressing consequences of clinical decision-making in malfunctioning ED care (38, 53, 54). Perfectionism, individual attributions of blame, legal actions, and the absence of both personal and administrative support contribute significantly to the exacerbation of detrimental mental health outcomes and emotional exhaustion among involved ED providers (38, 53). Frequently, this culminates in the manifestation of the 'second victim phenomenon' among ED providers, concomitant with diminished work performance, feelings of guilt and shame, heightened anxiety, post-traumatic stress disorder (PTSD), burnout, depression, and, in severe cases, even suicidal tendencies (38, 53).

Regarding provider-related outcomes, maladaptive coping strategies correlate with low self-realization, high workload, conflict, and nervousness, while active coping and positive thinking strategies are associated with a more positive work environment (55-57). Noteworthy, the type 'Distress' personality (type D) was identified in one survey as a predisposing factor for burnout among ED physicians (58).

Providers' mental well-being outcomes and affective symptoms, negative psychological functioning, and cognitive-behavioral outcomes, as well as psychosomatic health complaints, are influenced positively by factors such as high job control, autonomy, rewards, supervisor and peer support, teamwork, leadership, and positive patient interactions (16). Conversely, negative impacts arise from factors such as workload, time pressure, staffing issues, unfair compensation, work-life imbalance, critical incidents,

aggression, violence, and harassment, along with traumatic events. Those factors can subsequently lead to somatic complaints, sleep problems, fatigue, and PTSD (16, 57).

Objective biomarkers, such as blood pressure and heart rate variability, serve as indicators of psychosomatic distress, highlighting the widespread prevalence of adverse mental well-being and burnout outcomes among ED providers (43, 59). Profound evidence reinforces the prevalent phenomenon of burnout among ED physicians (57, 60, 61). This contributes to behavioral patterns, such as pre- or absenteeism (62), substance abuse (38), career disengagement and high turnover (63, 64), as well as depression and suicidal ideation (38).

In terms of patient-related outcomes, there is a notable impairment in the self- or employee-perceived quality of patient care (14, 65), particularly among PIT (11). Associations with high time pressure, imbalances in staff availability during peak flow times, boarding-related overcrowding, and perceived low support from supervisors and hospital management are reported (14, 65). Prospective associations reveal significant negative links between ED personnel's mental workload and patients' perceived quality of care (66).

Lastly, prior evidence primarily associates ED crowding with discernible clinical endpoints, including an elevated risk of in-hospital mortality, prolonged times-to-treatment for time-sensitive conditions (such as pneumonia or acute pain), and an increased likelihood of patients departing the ED against medical advice or without receiving necessary attention (5). Thus, a minimum of two components of quality of care, specifically safety and timeliness, as delineated by the Institute of Medicine (IOM), have been suggested as compromised (5, 67).

2.3.2 Interventions on ED work-life

As one delves into implemented interventions aimed at improving the work-life in ED settings, it's crucial to contextualize them within the broader challenges outlined in the preceding section. Building upon the multifaceted issues faced by ED providers, the following interventions span organizational (OLIs), team (TLIs), and individual (ILIs) levels, each targeting specific aspects of the complex ED environment.

ED work-life improvement measures at the organizational level

In the first place, the present narrative review explored OLIs, which encompass a range of strategies targeting systemic issues within the ED. These interventions focus on optimizing processes, enhancing resource allocation, and leveraging technological

advancements to streamline care delivery and improve overall efficiency. Notably, recent findings from systematic reviews focusing on overcrowding- and flow-centered interventions in healthcare settings have highlighted the efficacy of various multimodal macro- and microlevel measures. These implementations have demonstrated notable reductions in access and exit blocks, waiting time (WT), length of stay (LOS), left-without-being-seen (LWBS) rates, adverse events, and hospitalization rates, as well as mortality (34, 68-70). Particular attention has been directed towards adult frequent users, including those with chronic diseases, psychiatric comorbidities, low socioeconomic status, or the elderly (71).

OLIs have involved process improvements in ED care delivery utilizing mathematical algorithms, computer-simulation-based predictive modeling (72-74), and incorporating recent advancements in artificial intelligence and machine learning (AIML) approaches (75, 76).

Lean and Six Sigma principles have been applied to ED management, incorporating streamlined admission processes, standardized diagnostic pathways, integrated primary/ambulatory care, physician-led ED triage models, POC testing, overcapacity protocols, mental health team collocation models, and fast-track services (33, 34, 68, 70). These approaches have yielded tangible benefits, including decreased WT, reduced LOS, improved patient flow, and slim procedural and turnover time, and overall costs. Synchronously, these measures have demonstrated enhancements in provider efficiency, productivity, standardization, peer relationships, as well as advancements in safety and quality of care delivered (73, 77-79).

Specific ED reorganization measures incorporate fast-track and observational or short stay units (34, 68, 70), medical assessment units (MAU), acute medical units (AMU), rapid assessment zones (RAZ) (80-82), capacity command or patient flow management centers (34, 83), physician-assisted triage or triage liaison providers (33, 68, 70, 78, 80, 81, 84), AI-based clinical decision-support systems (85, 86), patient-focused shared decision-making support tools (87, 88), and natural language processing systems (89), as well as reverse triage (33, 34).

In the realm of health information technology (HIT), beneficial implementations encompass efficient and intuitive computerized provider order entry (CPOE) systems (68), electronic health records (EHR) (90, 91), and handheld devices (92). Workforce allocation schedules and staff calculation approaches have become increasingly crucial. AI-based resource allocation tools (86), such as real-time locating systems for local

personnel and equipment (93), assist in achieving appealing rostering, work-life balance, and employee retention (94, 95). This is particularly the case for PIT-related outcomes (96, 97). Additional support staff, including case management and social work services (98), clinical pharmacists (99), language interpretation services (100), and medical scribes (68, 101), contribute to facilitating ED work-life for all stakeholders.

Emphasis is also placed on error prevention and patient safety through critical incident reporting systems (CIRS) (102), continuous monitoring devices, SOPs for high-risk medication and triage (65), and AI-based applications for the prevention of diagnostic errors (86). Assessment and reporting systems for WPV are increasingly recognized as necessary components of ED operations (95, 103, 104).

In a broader organizational context, philanthropic role models, such as the 'Medicine in Motion' program, serve as examples by providing athletic workouts and competitions for professionals in medicine, dentistry, nursing, and physical therapy. This initiative aims to support provider wellness, foster interdisciplinary community building, and contribute to charitable work (105).

ED work-life improvement measures at the team level

Moving on to TLIs, the narrative review delves into strategies aimed at enhancing collaboration, leadership, and communication within the ED team. These interventions emphasize the importance of effective teamwork and supervision in optimizing patient care outcomes and provider well-being. In contemporary ED healthcare settings, the efficacy of team leadership and coordination skills, particularly within trauma and resuscitation teams, is acknowledged but still evolving (106). Remarkably, the use of humor by medical educators poses an integral role in the daily work-life of PIT. Positive humor is recognized for facilitating coping and communication, while negative humor appears to serve as an implicit outlet for expressing mockery and prejudgments (107).

The intensification of clinical supervision and mentorship is deemed essential for physicians' wellness, education, organizational efficiency, and patient-related outcomes (108, 109). This extends to feedback audits that promote educational value, team performance, and adherence to guidelines (110, 111). Well-established morbidity and mortality conferences (MMC) after critical incidents (112), along with (de)briefing tools (113-115) are crucial for enhancing well-being and minimizing errors in complex and critical patient cases.

Moreover, job crafting, peer networks, team building/-work, and intra-/interprofessional communication training play pivotal roles in achieving the aforementioned outcomes (95, 102, 116). Such training concepts are integrated into established approaches like 'Team Strategies and Tools to Enhance Performance and Patient Safety' (TeamSTEPPS), and crisis/crew resource management (CRM)-based trainings (117), as well as simulation-based education trainings in general (118, 119), which have recently also incorporated virtual reality (VR) applications (120).

Workplace-initiated multimodal and holistic resilience-promoting trainings, grounded in a combined theoretical foundation, are considered salutary. These encompass components on psychoeducation and emotional-supportive-coping regulation through cognitive behavioral psychotherapy, and mindfulness-meditation-relaxation interventions (121-124), with a particular focus on PTSD mitigation strategies (125).

Additional features promoting safe and reliable ED care include anti-fatigue trainings to foster provider- and patient-related outcomes (126), WPV prevention trainings focusing on de-escalation and self-defense skills (104), multitasking trainings (127, 128), and patient handoff trainings (129, 130).

ED work-life improvement measures at the individual level

Transitioning to ILIs, strategies targeted at enhancing the well-being and resilience of emergency department providers are explored. Such measures primarily focus on the promotion of personal wellness through mindfulness, meditation, and relaxation techniques. These encompass practices such as tactile massages, acupuncture, yoga, hypnosis, and engaging in happiness-promoting activities like gratitude journaling, choirs, and coaching (95, 115, 116, 131). Physical exercise, workouts, and fitness, as exemplified by initiatives like the 'Medicine in Motion' program (105), are also recognized as vital for mental liberation.

Additionally, both non-pharmacological measures such as sleep hygiene or napping (97, 132), and pharmacological interventions including melatonin, modafinil, and caffeinated energy drinks (132), are deemed approved booster measures to counteract fatigue and sleep deprivation, thus contributing to improved personal outcomes.

Ultimately, prior evidence underscores the significance of humor in the ED environment as a potent medium for exemplary patient-physician interaction, influencing the emotional and psychological aspects of patient care. Humor serves as both an individual coping mechanism and an uplifting tool in peer-to-peer interactions among medical

professionals (133-135). However, it is crucial to note that while humor can be a valuable asset, insensitive joking may be misinterpreted and perceived as indecent or appalling. Furthermore, the acceptance of humor varies among patients with acute life-threatening medical conditions, making it a high-risk balancing act in clinical settings.

In conclusion, contemporary literature provides insights from position papers outlining minimum benchmarks at organizational, team, and individual levels to ensure secure and reliable employment conditions in ED care (136). However, the field of implementation research appears to be in its infancy. Many investigations have exclusively identified evidence-practice gaps or employed inadequate study designs to evaluate the effectiveness of intervention implementation (137).

Common recommendations for the implementation of new evidence-based practices involve identifying evidence-practice gaps, evaluating references and applying relevant theoretical frameworks to address practice gaps, assessing barriers and prerequisites, designing and monitoring intervention strategies, providing feedback during the implementation process, enhancing reporting on intervention contents, and employing rigorous research designs to assess efficacy (137, 138).

2.3.3   COVID-19-related challenges and interventions for ED providers

COVID-19 pandemic-related ED work-life challenges

The COVID-19 pandemic posed significant challenges for ED care, disrupting patient referrals and causing delays in urgent care, thus posing substantial health risks (139). ED overcrowding, exacerbated by pre-pandemic hospital overcrowding (33), was further intensified due to access blocks and inadequate initial infection control measures coupled with a high viral transmissibility (35). Aggravated access blocks, in turn, resulted from an immediate mismatch between the heightened demand for intensive care unit (ICU) beds and the limited availability of such beds, based on both national and local historical needs (33, 34). Consequently, the scarcity of critical care resources led to ethically and morally challenging dilemmas related to triaging for treatment, involving life-and-death decisions, subsequently causing considerable mental distress for ED providers (140).

Additionally, collateral intricacies emerged, including the separation of patient flow, reduced productivity due to PPE, more frequent surveillance, and prolonged WT for inpatient admission (resulting from POC testing and ward assignments) (33). WPV and stigmatization, already present phenomena, escalated as ED staff had to implement

uncomfortable prophylactic infection control measures, such as quarantine or restrictions on family visits, both of which disrupted interactions between staff, patients, and their families (52). Confrontations were fueled by patients' skepticism and non-compliance with disease-related measures, the use of PPE, as well as the initial lack of scientific backing for vaccinations and antiviral medications (52).

Numerous reported pandemic-related factors were associated with a significant aggravation of distress, emotional exhaustion, anxiety, burnout, depersonalization, depression, PTSD symptoms, secondary trauma, and a low sense of personal accomplishment among ED healthcare workers, compared to the pre-pandemic era. These factors included resource shortages, concerns about COVID-19 infections, the use of PPE, cognitive workload, stigmatization, the separation of families due to quarantine, and WPV (141-144). Ultimately, the high risk of occupational mortality, especially in settings with inadequate PPE, raised ethical concerns regarding the duty of ED physicians to treat and employers' duty to protect their employees. However, the baseline pre-pandemic risk of occupational mortality for ED physicians remains unclear (145).

COVID-19 pandemic-related ED work-life organizational-level interventions

Amidst the COVID-19 pandemic, OLIs in EDs focused on mitigating challenges such as overcrowding, access blocks, and inadequate infection control measures. These interventions aimed to optimize resource allocation, improve patient flow, enhance infection control protocols, and support staff well-being. Additionally, measures were implemented to address ethical dilemmas related to triaging for treatment and ensure the safety of both patients and healthcare workers.

A conceptual framework and checklist aimed at enhancing ED preparedness for future infectious disease outbreaks has been proposed, acknowledging the continually evolving nature of the situation, especially in the early stages of the pandemic when new information was emerging (146, 147). Consideration of various elements from the ED ITO model is essential, categorized into the system (workflow, protocols, and communication), staff (human resources), space (infrastructure), and supply (logistics) (146).

In terms of infection control, strategies include decontamination methods such as mechanical ventilation or air purification (148, 149), along with practices like hand hygiene, patient and staff screening, surveillance, PPE use, cohorting and isolation, and enhanced cleaning (150). Additional measures involve restricting staff and patient

movement, establishing specific pathways for COVID-19 inpatients, operating theatres, and outpatient services, as well as ensuring fresh air in the absence of effective mechanical ventilation systems are unavailable (150).

Adapted ED triage algorithms, guided by the best available evidence and lessons from previous pandemics, adhere to Centers for Disease Control and Prevention (CDC) guidelines. These algorithms aim to streamline the evaluation of patients under investigation, optimizing patient triage, minimizing unnecessary clinician exposure, standardizing care, and maximizing appropriate resource and clinician PPE use in the context of an ongoing shortage (147). AIML applications have been extensively utilized since the onset of the COVID-19 pandemic, integrating into the entire ED patient journey, including domestic self-triage, tele-triage, ED registration and triage, diagnostics, consultations, and treatment, as well as hospitalization or discharge (151-154). Subsequently, the impact of these applications has resulted in improved ED care efficiency, reduced healthcare costs, and enhanced patient and provider outcomes (151-153).

During the pandemic, ED telehealth usage extended to pre-ED evaluation and screening, limiting staff and patient exposure within the ED, facilitating specialist consultations, post-ED discharge monitoring and treatment, educating PIT and healthcare workers, and coordinating resources and patient care (155). Telemedicine has proven effective in optimizing health resource utilization, as well as improving both patient and provider outcomes (156).

Notably, WPV prevention policies have become even more crucial than in the pre-pandemic era. Reports highlight intensified zero-tolerance management, robust reporting systems, psychological support offerings, staff protection systems with immediate police/security access, and effective public healthcare system communication through ED media communication by political entities (52).

COVID-19 pandemic-related ED work-life team-level interventions

Amidst the COVID-19 pandemic, intervention practices at the TL in EDs aimed to enhance collaboration, communication, and coordination among healthcare teams. These initiatives focused on improving team dynamics, implementing crisis management protocols, and fostering a supportive work environment to address the unique challenges posed by the pandemic. Additionally, training programs and debriefing sessions were conducted to enhance team resilience and facilitate effective response to the evolving healthcare crisis.

Pedagogical strategies for longitudinal competency- and portfolio-based interprofessional communication training (157), online mental health support through peer-to-peer or group platforms (158), and virtual peer-to-peer networks for real-time COVID-19-related clinical education information sharing have been outlined (159). These approaches are complemented by team mentoring programs, offering alternatives to traditional hierarchical dyadic approaches, including peer, near-peer, and collaborative mentorships (160).

In the era of social distancing, e-learning, distance-only, or mixed-distance simulation training, along with VR-based educational tools, have proven effective in enhancing technical and clinical performance, as well as extending global educational outreach (161-163). These tools and training methods concurrently contribute to increased confidence, comfort, physical activity, while reducing stress, anxiety, and depression (161, 162).

Additionally, WPV debriefing following critical incidents, coupled with fostering appropriate staff attitudes, strengthened self-awareness, communication skills, de-escalation techniques, and the ability to recognize warning signs have been emphasized (52).

COVID-19 pandemic-related ED work-life individual-level interventions

During the COVID-19 pandemic, intervention practices at the IL in EDs targeted the well-being and resilience of healthcare providers. These initiatives included mental health support services, stress management training, and resources for coping with pandemic-related challenges. Additionally, individualized coaching and peer support programs were implemented to address the unique stressors faced by ED staff, promoting self-care and emotional resilience in the face of adversity.

Mindfulness-based practices, particularly in the context of the COVID-19 pandemic, facilitated by modern information technologies like mobile applications, can serve as awareness-raising tools for physicians. These practices provide feasible and accessible interventions to effectively combat burnout (116, 164). Positive impacts have been observed on ED providers' empathy, compassion, self-awareness, stress responses, vigor, mood, mental health, and well-being, as well as effective leadership. Simultaneously, a decline in emotional exhaustion, depersonalization, and burnout has been reported (164, 165). Mindfulness-based practice is considered an essential component of positive psychology and is inherently linked to the enhancement of ED work-life (165).

2.4 Needs for further research

The significance of working conditions in the ED goes beyond just providing immediate care to patients; it also impacts the well-being of healthcare providers and the overall effectiveness of healthcare delivery systems. However, despite existing research efforts, several critical gaps persist, warranting comprehensive investigation to address these shortcomings.

Geographic disparities

The majority of studies and surveys on ED working conditions, associated outcomes on ED provider well-being as well as ED patient care, along with implemented intervention practices, have been conducted outside Europe, mainly in North America and Australia (55). Thus, such geographic disparities cause a scarcity of systematic international large-scale investigations within and across European countries. Comprehensive and reliable evaluations of the work situation of ED providers are needed to address current challenges in working conditions across Europe.

Cross-level comparisons

Societal and macro-level influences in Europe contributed to the establishment of different models of healthcare, i.e., Anglo-American vis-à-vis Franco-German model (1). However, respective implications for work stress and provider outcomes for professionals in different organizational and work systems are not sufficiently addressed yet. Eventually, systematic assessments are needed to establish empirical, data-based inferences enabling cross-level comparisons and identification of consistencies within and across different European healthcare levels and national ED systems (37, 46, 65). Identifying specific challenges and solutions holds the potential to highlight nuanced differences and commonalities within varying healthcare systems. Moreover, it enables insights into working conditions and ED provider outcomes that are genuine to ED care across a variety of settings and national contexts.

Context-targeted intervention practices

Presently, there is an inconsistent and incoherent literature base on effective and supportive intra- and inter-European-targeted solution strategies promoting healthy work environments (18, 29). In order to tackle work-related problems and develop effective interventions, there is a need to gather best practices and successful approaches to improve ED working conditions in and across European healthcare settings (29, 36).

Concurrent influences and rest-of-hospital processes

Previously, adaptive responses to both anticipated and unforeseen demands have been categorized as 'resilience strategies', with corresponding adjustments in performance and operations classified as 'matching, extending, sustaining, or transforming' (166). In this context, the interplay of four fundamental factors within the ED sociotechnical system – 'staff, supplies, space, and sequence' (four S's) – has been identified as pivotal in achieving successful performance adjustments (166). However, concurrent influences on ED providers' work situation, specific staffing requirements, patient acuity levels, and rest-of-hospital processes have been rarely explored (80).

Costs and policy recommendations

Collecting data on the prevailing conditions of ED workplaces throughout Europe, including the incurred costs for both providers and patients, is pivotal in informing policy and practice directives set forth by the EUSEM. This endeavor not only addresses the well-being of healthcare workers but also evaluates the effectiveness and safety of care delivery within ED settings. By amalgamating evidence and synthesizing knowledge, a robust foundation is laid for enhancing the standards of ED workplaces across Europe (167). Furthermore, the identification of effective strategies, leverage points, and requisite skills becomes imperative in ensuring the resilience and dependability of ED care, notwithstanding the persistent challenges posed by varying work environments, protocols, and resource limitations (166-168).

Pre- and post-COVID-19 pandemic-related considerations

In line with the aforementioned points, the detailed examination of challenges faced by ED providers and strategies to address them before and after the COVID-19 pandemic lacks clarity within European ED contexts. Moreover, it is crucial to derive insights from this analysis to enhance readiness for forthcoming pandemics, disasters, and mass casualty incidents across European ED settings, striving for continuous improvement in preparedness.

2.5   Objectives and research questions of this study

The imperative of delineating strategies and identifying pivotal leverage points becomes evident in the quest to fortify the resilience and reliability of ED care, notwithstanding the pervasive and enduring constraints imposed by work environments, procedures, and resources. Acknowledging the crucial role of working conditions within the ED milieu,

critical for both patient and provider well-being within the scope of different European healthcare models, underscores the necessity to address various deficiencies and unresolved concerns. To date, notably the absence or dearth of synthesized insights from large-scale investigations prompts the exigency for comprehensive systematic assessments to establish robust, data-driven inferences that compare the work-life of ED providers and prevailing intervention practices across European countries.

The current study thus endeavors to amass data through a systematic expert survey on ED work-life within the EUSEM network, spanning multiple European countries. The overarching objectives encompass three key facets:

(1) Research question one (RQ-1): identification and determination of pertinent factors influencing the work-life, well-being, and health of ED providers, as well as associated implications for patient care outcomes. Specifically, the following matters shall be explored:

   a. Work-life-related aspects of ED work within the respective ED.

   b. General, provider-, and patient-related work-life aspects influencing ED work.

   c. Investigation into adverse health outcomes experienced by ED providers.

(2) Research question two (RQ-2): results of the investigation are intended to derive future policy and practice recommendations for the effective design, dissemination, and implementation of contextual and procedural conditions conducive to the successful adoption of intervention and improvement measures in EDs across Europe. This study seeks to assess:

   a. Currently implemented improvement and intervention practices on organizational, team and individual levels (within the respective ED), aiming to enhance physicians' work-life, well-being on the job and employee-perceived quality and safety of patient care.

   b. The determinants of success and failure, including contextual factors at macro-, meso- and micro-system levels within respective EDs and hospitals.

   c. The identification of additional intervention approaches deemed effective for improvement.

(3) Research question three (RQ-3): evaluation and specification of potential COVID-19 pandemic-related challenges that subsequently impacted objectives (1) and (2). In detail, the following subjects shall be examined:

  a. Aspects and work system changes induced by the COVID-19 pandemic that either mitigate or exacerbate negative impacts on ED providers' working conditions.

  b. COVID-19-related effects on ED providers' health and the employee-perceived quality and safety of patient care.

  c. Impact of the pandemic on previously implemented or planned intervention approaches targeting the enhancement of ED physicians' work-life, well-being, and employee-perceived quality and safety of patient care.

In essence, this study aspires to furnish a comprehensive understanding of the multifaceted dimensions of ED work-life, thereby paving the way for informed policy recommendations and targeted intervention strategies that address the nuanced challenges faced by ED providers across diverse European settings.

3 Material and Methods

3.1 Study design and setting

3.1.1 Study protocol

The elucidation of the applied materials and methodologies in this investigation adhered to the Comprehensive Standards for Reporting Qualitative Research (COREQ) guidelines (169) as well as according to recommendations for good scientific practice and comprehensive guidance in the conduct of survey research, in particular with regard to the healthcare sector (170-172). The study coordination team (SCT) therefore devised a four-stage procedural framework encompassing distinct sequential phases:

In the inaugural phase, ethical clearance and data protection approval were obtained. An integral study component involved an unsystematic narrative literature search of peer-reviewed publications (in databases PubMed and Web of Science, refer to '7. Attachments' for the list of applied search terms), comprehensively investigating research pertaining to the assessment and comparative analysis of the work-life of ED

physicians and health risks germane to ED settings within and across the EUSEM National Society Member (NSM) states. Subsequently, a purposive snowball sampling was established (170, 171, 173). Subject matter experts (SMEs) meeting pre-defined criteria were identified and informed through communication facilitated by the EUSEM board.

The second phase comprised the selection and adaptation of research tools and methodologies by the SCT. Employing a mixed-methods approach, the study enclosed both qualitative and quantitative primary data (173).

The third phase incorporated the systematic implementation of the Delphi method approach. The total data acquisition ran between January 2021 and August 2022.

Ultimately, in the fourth phase, qualitative and descriptive statistical data analyses were conducted. Preliminary results were already presented at the European Emergency Medicine Day on May 27, 2022, and subsequently at the EUSEM Congress in Berlin, Germany, on October 19, 2022. Final results are anticipated to be disseminated via a peer-reviewed publication before or after the publication of this medical dissertation at the Medical Faculty, LMU Munich.

3.1.2 Delphi method

The Delphi approach is a commonly employed, systematic, iterative, interactive, and sequential interrogation method designed to achieve group consensus (174-177). Named after the ancient Greek oracle, the Delphi approach traces its origins back to the RAND Corporation in 1948 (Santa Monica, California), initially employed in military defense research (174, 178, 179). Over the past decades (180-182), the method has undergone refinement and expansion, evolving into heterogeneous forms and reflecting diverse application types, scoring methods, and approach implications (183, 184). Hence, its adaptability progressed to span across domains of socio-technological forecasting, decision-making, and policy formulation, with a prominent focus on applications in the business, education, and healthcare sectors (175-177, 185, 186). While its utility in healthcare and medical research has been recognized since the 1960s (187-193), it has also found application in graduate research endeavors (194-196).

The approach relies on the explicit and implicit collective wisdom and expertise of a group of 'experts' to achieve consensus on a specific topic by eliciting and refining group judgements (174). These experts are individual key informants with acquaintance of the scrutinized area of research. The approach involves a series of structured questionnaires

or 'rounds' that are administered to a 'panel' of experts, with the responses from each round informing subsequent iterations (175).

Key characteristics of the Delphi method include (174-177): (a) anonymity (b) multiple iterative rounds of data collection with structured questioning, (c) interspersed controlled feedback on the group's collective responses to stimulate cognitive reflection and convergence of informed opinions and insights over successive rounds, (d) expert panel composition, (e) consensus-building of opinions within an acceptable range with process continuation until a predetermined level of consensus is reached, (f) both quantitative and qualitative analysis, as well as (g) flexibility of use and area of application.

3.2 Ethical approval, data protection, and confidentiality measures

The investigation was initiated subsequent to the attainment of ethical approval from the Ethics Committee of the Medical Faculty at Munich University on the 14th of January 2020, under project number 19-729. Data protection clearance was obtained from the designated LMU data protection officer, as indicated by internal project number 1606.

Stringent adherence to the Declaration of Helsinki (2004) was followed throughout the study. Prescriptions mandated by the principle of medical confidentiality, coupled with relevant data protection statutes and regulations in Germany (harmonized with EU data protection directives), were upheld. The study adhered to all data protection regulations and obligations delineated in Article 13 of the General Data Protection Regulation (DSGVO). This research was conducted in accordance with prevailing norms of Good Scientific Practice, committing to objectivity and neutrality.

Written consent was procured prior to data acquisition. All interviews took part during participants' discretionary time. Apart from time investment, no detrimental consequences were anticipated for the participants. The SCT did not derive any financial benefit from the research, and conflicts of interest were absent throughout the duration of the study.

Prospective study participants were preliminarily required to furnish sensitive identification details. Those meeting inclusion criteria were subsequently apprised of the project's details, procedural aspects, consent requisites, the voluntary nature of participation, and the right to withdraw without adverse repercussions. Participants who opted to withdraw consent were informed, as specified in the 'Study Information' and 'Declaration of Informed Consent' form (refer to '7. Attachments'), that interview data

containing personalized information could not be expunged due to the absence of coding.

Acknowledgment was sought from participants regarding the potential lack of comprehensive data security and protection in the event of video-based interviews. However, all qualitative and semi-quantitative data derived from recorded and transcribed statements, reports, and responses during expert interviews were subjected to anonymization or pseudonymization upon data entry. These records were archived for subsequent scientific purposes. Notably, there was no exchange of individual data, whether anonymized or pseudonymized, between the employer and any third party, directly or indirectly, via the Institute for Occupational, Social, and Environmental Medicine, LMU Munich.

Access to the original data retained by the institute was confined to the SCT and stored in a segregated document, thereby precluding the disclosure of personal data. To safeguard against the inadvertent revelation of personal information, transcripts were curated to exclude contextually rich details. In the event of research result publication or feedback to collaborative partners, confidentiality pertaining to personal data would be upheld. Any reported data would be aggregated to preclude the identification of individual study participants, ensuring transparency in communication, including a report to the EUSEM board and members.

3.3 Study population

3.3.1 Panel selection

A purposive snowball sample comprising eighteen ED experts (197) in hospital-based emergency medicine (n=18) was deliberately chosen, ensuring equal representation from six EUSEM NSM (n=6) (cf., Figure 2). We tried to have a Europe-wide distribution of nations from the south-east (ROM), south (ITA), center (BEL, GER), west (UK) and north of Europe (FIN), as well as a coverage of large- (>600 beds), middle- (200 – 600) and small-sized hospitals (< 200 beds), for each of those countries, respectively.
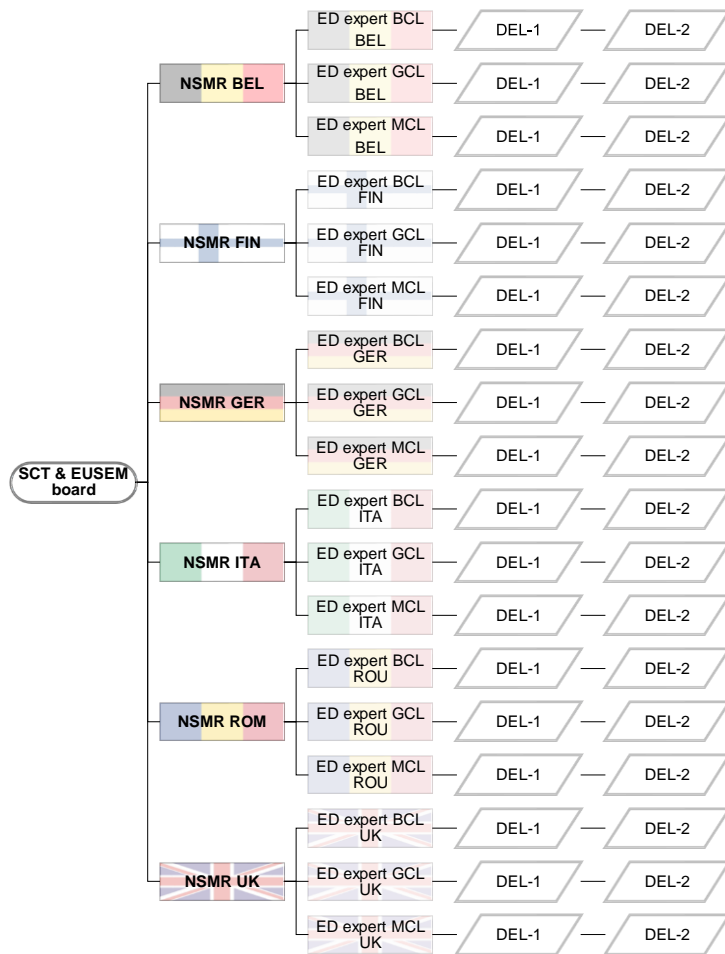
Figure 2: Overview of the panel selection. SCT = Study coordination team, EUSEM = European Society for Emergency Medicine, NSMR = National Society Member representative, BCL = Basic care level, GCL = General care level, MCL = Maximum care level, DEL-1/-2 = Delphi round one/two.

Table 1: Overview of the panel stratification scheme.

Features	Number of interviewees
Country of origin:	
- Belgium	3
- Finland	3
- Germany	3
- Italy	3
- Romania	3
- United Kingdom	3
Hospital care level:	
- Basic care level	6
- General care level	6
- Maximum care level	6
Hospital size:	
- Small-sized	6
- Medium-sized	6
- Large-sized	6
Total:	18

3.3.2 Inclusion and exclusion criteria

Table 2 describes criteria for panelist selection being applied (197):

Table 2: Inclusion and exclusion criteria for panel selection. DEL-1/-2 = Delphi round one / two.

Inclusion criteria	Exclusion criteria
(1) Currently engaged in providing ED care services. (2) Profound expertise, and both theoretical and practical knowledge in the field of ED care. (3) Occupying positions as senior physicians, consultants, assistant medical directors, or heads of department. (4) Proficient oral and written English language skills. (5) Completion and signature of the 'Declaration of Informed Consent'. (6) Full and active participation in both DEL-1 and DEL-2 phases of the study.	(1) Currently engaged in non-hospital-based ED care settings or presently inactive in the field. (2) Lack of adequate expertise, or both theoretical and/or practical knowledge in ED care. (3) Occupying positions as medical students, interns, trainees, junior physicians, specialists (beyond senior physicians or consultants), nursing, assistant, and/or technical staff. (4) Insufficient proficiency in either oral or written English language skills. (5) Submission of an incomplete and/or unsigned 'Declaration of Informed Consent'. (6) Deficient or fragmentary participation in DEL-1 and/or DEL-2 phases of the study.

3.3.3 Recruitment procedure

For the purpose of the addressed virtual snowball sampling procedure, an electronic mail outreach was executed. To facilitate this process, selection occurred through one of the study initiators who serves as EUSEM board representative, Christoph Dodt (CD), via the national representatives of the EUSEM council. The EUSEM board disseminated an information sheet created by the SCT (refer to '7. Attachments') and launched the project internally. All encompassed EUSEM National Society Member representatives (NSMRs) were formally solicited to nominate ED experts who met the defined inclusion criteria as potential interviewees. To streamline this procedure, the SCT furnished each NSMR with a blank Excel spreadsheet ('List of potential participants') for individual completion by interested participants. Subsequently, the filled-out spreadsheets were to be returned to the SCT. The requisite information sought included participants' country of origin,

hospital details (name, size, care level, and number of beds), personal particulars (surname, first name), professional role in the ED, tenure, and contact information (email, telephone). Each participant's individual list was amalgamated and incorporated into a comprehensive Excel spreadsheet ('List of steady participants'). Those study participants who consistently met all inclusion criteria were adjacently integrated into the study cohort.

3.4 Procedure: data acquisition process

Study participants were sent a comprehensive document package, denoted as 'Study participant package' (SPP), transmitted via electronic mail by the SCT. This package (outlined in '7. Attachments') contained project information, detailed interview guidelines, and consent requests ('Declaration of Informed Consent'). Panelists were required to complete, sign, and return the consent documentation to the SCT ahead of their scheduled initial interview appointments. Concurrently, the coordination and scheduling of video call appointments during the interim phase were managed through email correspondence.

The acquisition of panelist data transpired through a launched two-round Delphi approach, preceded by an initial pilot study (PS) conducted prior to Delphi round one (DEL-1). The PS involved pilot face-to-face video interviews with three arbitrarily selected ED experts who met at least four out of six inclusion criteria. These interviews served to test for feasibility and comprehensiveness by soliciting feedback regarding the clarity of the questions, potential ambiguities, and any perceived deficiencies in content. The interviewees' statements were transcribed verbatim and subsequently analyzed to identify areas requiring enhancement. Following a reflective and iterative process of agreement and adaptation on framing and wording within the SCT, the final version of the DEL-1 interview guideline was established and maintained in its written form thereafter (refer to '7. Attachments').

The DEL-1 was adjacently conducted, entailing audio recording, transcription, summarization, and preliminary analysis of content data obtained from the interviewee panel input by the SCT. Building upon the findings from DEL-1, an online survey for Delphi round two (DEL-2) was created and subjected to pretesting by the SCT. The DEL-1 panel was informed and invited to participate in DEL-2. Survey responses were analyzed for consensus, and descriptive statistics were compiled.
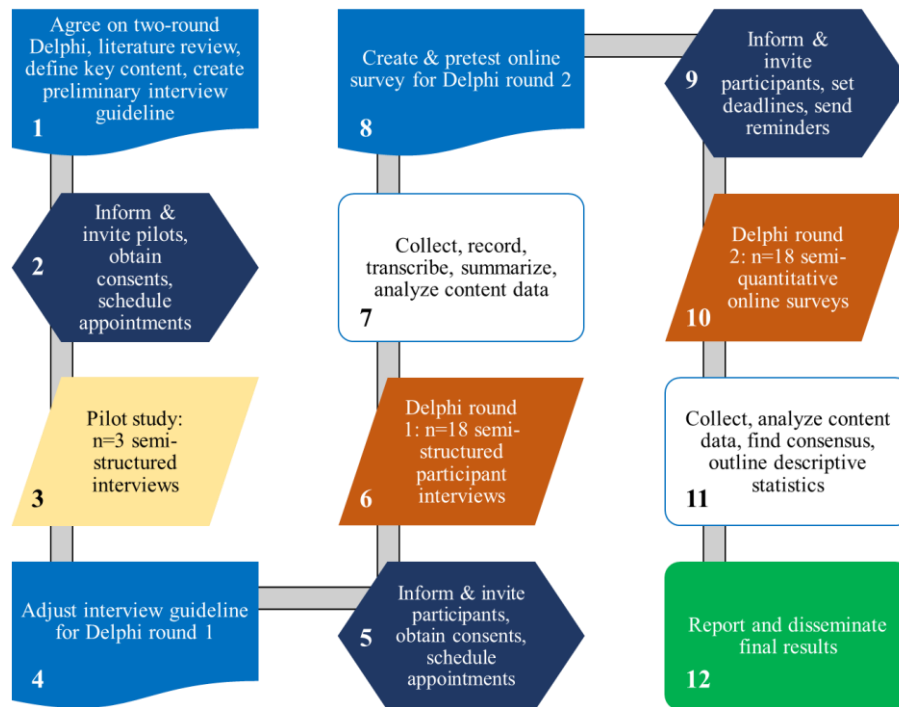
Figure 3: Overview of the data acquisition process within the pilot study and Delphi rounds one and two.

3.5 Variables and measures

3.5.1 First Delphi round

The interview guideline was methodically developed using the 'SPSS method' of guide creation (198). The conventional division into key questions, memos, specific questions, and maintenance and control questions was adopted and customized to facilitate a fluid conversation while ensuring the extraction of information pertinent to the research question.

After initial instructions, each section commenced with an introductory free-text key question functioning as a potential 'icebreaker'. Guided response sub-items included examples as prompts derived from the initial thematic literature review, providing the SMEs with potential additional ideas for consideration.

All face-to-face video-based interviews were conducted exclusively by Michael Lifschitz (ML) as part of his medical dissertation. Neutrality was ensured as the interviewer held no position in any ED and had no personal relationships with the participants. Only the interviewer and interviewees were present during the interviews, with a single exception involving language support provided by an in-house junior physician colleague to overcome potential language barriers. Zoom audio recording (Zoom version 5.7.7

(1105); Copyright ©2012-2021 Zoom Video Communications, Inc.) was employed to collect interviewee panel input data, stored as M4A files.

The transcription process was executed by a student assistant in 13 out of 17 cases (76.5 %), by a second student assistant, in one case (5.9 %), and by ML in three cases (17.6 %). One DEL-1 participation case exceptionally involved exclusively written responses, thus being exempted from transcription. To ensure inter-reader reliability, proof-listening/-reading of records and transcripts was performed by the second student assistant in three cases (17.6 %) and ML in 14 cases (82.4 %). Written transcription of verbal responses adhered to the simplified content-related and semantic transcription rules of Dresing and Pehl (199). The transcripts were not subjected to participant review or correction. Data acquisition for DEL-1 occurred between June 2021 and March 2022.

(1) • Sociodemographic and contextual hospital and ED variables

(2) • Influences and outcomes of ED work

(3) • Intervention approaches for ED work improvement

(4) • COVID-19 pandemic changes & adjustments
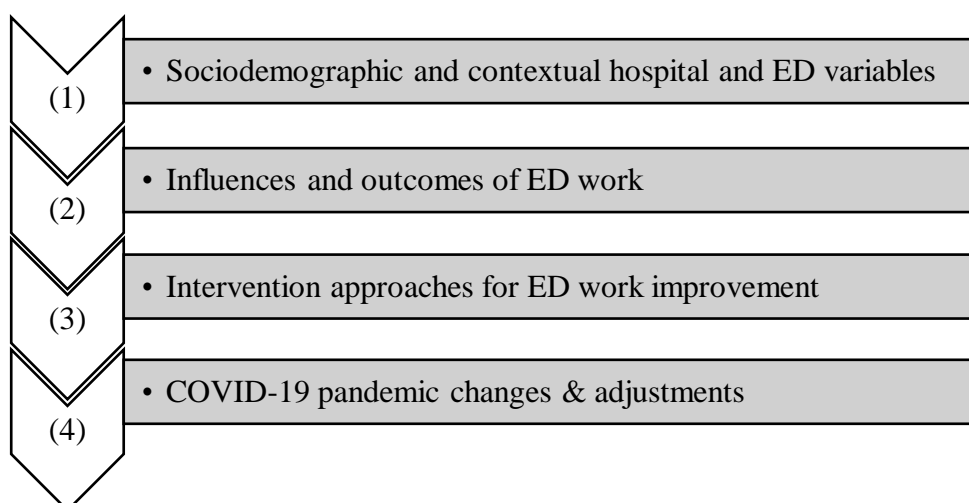
Figure 4: Overview of variables and measures within the DEL-1 interview guideline.

3.5.2 Second Delphi round

For DEL-2, the SCT synthesized the compiled DEL-1 interview data, consisting of 195 statements, into a consolidated list of a total of 102 items (consolidation ratio of 52.3 %). This list encompassed both the originally identified DEL-1 statements and additional items that were individually added by panelists but were not mentioned in the initial data collection (as detailed in '7. Attachments'). The objective was to reintroduce this condensed list to the expert panel and facilitate the establishment of relevance-ranked

consensus based on the SMEs' personal evaluations across various domains of ED work-life and ED provider issues.

The overarching goal included the determination of prevalence data on ED conditions for each EUSEM member state individually, as well as for the overall sample. Simultaneously, efforts were made to identify associations between ED context characteristics, provider reports of work conditions, and well-being outcomes. Therefore, a survey questionnaire was designed on a structured unipolar 5-point Likert-scale basis (200, 201), where respondents could indicate their level of agreement or relevance, ranging from '1 – Highly irrelevant' to '5 – Highly relevant'. Panelists received following instructions: 'Please rate the relevance for each of the following items'.

The online survey for DEL-2 was implemented and administered through the utilization of the established online-panel software 'Unipark' (www.unipark.com, Copyright © 1999-2021 Tivian XI GmbH, Hürth, Germany). Data collection for DEL-2 occurred during the period of July 2022 to August 2022.

In both rounds, panelists had the option to provide further comments (via verbal statements, in round 1, and free-text fields, round 2).

3.6 Data and statistical analyses

3.6.1 Qualitative content analysis (QCA)

The transcribed material, organized into 18 distinct cases, underwent analysis utilizing the guideline-based interview assessment method, incorporating the principles of structuring QCA (202-204). Our systematic approach to QCA entailed predefined sequences that aligned with the established methodological framework elucidated by Kuckartz (204). In this study it was executed using the 'MAXQDA Analytics Pro 2022 Student software' (MAXQDA, Software für qualitative Datenanalyse, 1989 – 2021, VERBI Software. Consult. Sozialforschung GmbH, Berlin, Deutschland).

The workflow encompassed multiple transcript reviews, highlighting of relevant and recurring text segments pertaining to the research question, and the creation of a hierarchical category system (referred to as a 'code system' or 'coding guide') with main categories and subcategories (refer to '7. Attachments'). The methodological and material-oriented development of main evaluation categories adhered to the viewpoints through which the material was analyzed. Corresponding subcategories captured all contents related to the main categories, displaying partial aspects of those.

Thematic main categories in our study were predominantly established through a deductive approach, initially informed by a comprehensive literature review. Subsequently, these main categories were expanded inductively based on insights gleaned from the text material. The resulting category system underwent quality control in an interim pilot phase, where a portion of the material (n=3 transcript samples) was re-coded by another experienced SCT member (MW).

Upon successful quality control, the main phase commenced, during which the coding team partitioned the transcript material relevant to the research question into sections (coding units) and coded them by assigning text passages to appropriate categories. This process resulted in the entire category system (202). Sections of the code system were then paraphrased, consolidated, and amalgamated into a set of preliminary main factors (or statement items), and organized based on their characteristics, serving as the foundational material for the subsequent DEL-2.

Within the framework of DEL-1, the following interview guide sections underwent QCA: 1 (Sociodemographic contextual factors), 2b (Outcomes of ED work on ED physicians' well-being on the job and self-perceived quality and safety of patient care), 3a (Intervention approaches to improve ED physicians' work-life, well-being and self-perceived quality and safety of patient care), 3b (Succession or failure factors and (in)effectiveness of implemented or planned/desired intervention practices), and 4 (ED physicians' work-life, working conditions, work-related key factors, well-being, self-perceived quality and safety of patient care and intervention approaches during the COVID-19 pandemic).

3.6.2 Quantitative descriptive metrics

In the context of DEL-1, the designated items within the interview guide section 2a (Influences of ED work on ED physicians' well-being on the job and self-perceived quality and safety of patient care) were subjected to ranking and filtering for DEL-2, utilizing medians (MDs), means (Ms), and standard deviations (SDs) as metrics.

In DEL-2, panelists' relevance ratings were primarily analyzed using metrics such as M and SD. Consensus among the panelists was measured with the 'content validity index' (CVI) for inter-rater agreement of relevance by percentage proportion within a restricted range at item- and scale-level (205-208). Hence, content validity (and consequently consensus) for each specific questionnaire item was predefined a priori as the percentage of panelists responding with '4 – Rather relevant' or '5 – Highly relevant', corresponding to the 'item-content validity index' (I-CVI) (208). Consensus on overall

scale-level was firstly assessed with the 'scale-content validity index' (S-CVI) by computing the I-CVI for each item on the scale, and then calculating the average I-CVI across items, referred to as the 'averaging scale-content validity index' (S-CVI/Ave) (208). Secondly, the 'universal agreement scale-content validity index' (S-CVI/UA) was measured by calculating the proportion of items rated 4 or 5 by all panel experts (208). Additionally, we introduced an adapted version (S-CVI/AUA), which considered the quotient of items with an I-CVI of ≥ .78against the total number of items.

Subsequently, we calculated the intraclass correlation coefficient (ICC) for inter-rater reliability and consistency within our metric interval scales (209, 210). As every item within every round was rated by every panelist, the two-way mixed effects model was chosen where people effects were random and measures effects were fixed. Moreover, as we could not entirely rule out systematic errors, we chose the rather conservative absolute agreement definition. The estimates were reported assuming the interaction effect was absent, because it could not be estimable otherwise.

M, SD, I-CVI, and S-CVI values were calculated for the overall panel, as well as for comparisons across hospital care levels and among nations, whereas ICC values were exclusively evaluated for the overall panel.

All quantitative descriptive metrics were computed using Excel (Microsoft Excel for Microsoft 365 MSO, Version 2312, Build 16.0.17126.20190, 64-bit) and SPSS (IBM Corp. Released 2023. IBM SPSS Statistics for Windows, Version 29.0.2.0. Armonk, NY: IBM Corp).

4 Results

4.1 Material and sample description

Altogether, a total of 18 panelists participated in both Delphi rounds, contributing evaluations from six European countries (BEL, FIN, GER, ITA, ROM, UK). Among 35 potential participants, six (17.1%) did not respond to the study inquiry, three (8.6%) declined participations, and eight (22.9%) did not meet all inclusion criteria (i.e., still undergoing specialty training, no leadership role in the ED, already one expert available for the respective country and ED size). Following the inclusion of 18 SMEs for DEL-1, there was a zero percent dropout rate for DEL-2, as depicted in Figure 5.

The total duration of the DEL-1 interview material was approximately 1,534 minutes, with each interview ranging from 61 to 120 minutes (M=90.2 minutes). The transcription of

the interviews resulted in a total of 222 pages in Microsoft Word ('Arial', font size 10, per transcription spanning 9 to 18 pages, M=13.1 pages). The duration of each survey participation varied from 5.7 to 34.8 minutes (M=15.7).

The panelists' hospitals included seven (38.9%) large-sized maximum care level hospitals, ranging from 650 to 2,395 hospital beds (M=1169.9 hospital beds); five (27.8%) medium-sized general care level hospitals, with 300 to 564 hospital beds (M=420); and six (33.3%) small-sized basic care level hospitals, containing 200 to 337 hospital beds (M=259). The medium annual patient volume ranged from 20.000 to 115.000 (M=60558.2) across all respondents.

Regarding professional status, there were 11 (61.1%) heads of department or assistant medical directors, and seven (38.9%) senior physicians or consultants. In terms of gender distribution, there were five (27,8%) female and 13 (72.2%) male panelists.
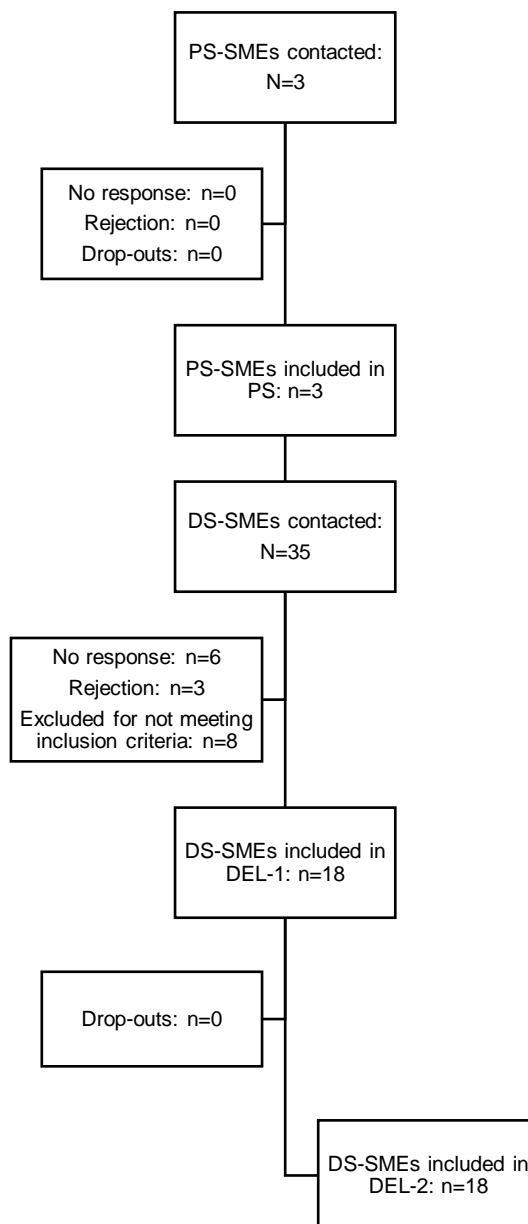
Figure 5: Overview of the recruitment procedure and sample description. SME=Subject matter experts, DEL-1/-2=Delphi round one / two, PS=Pilot study, DS=Delphi survey.

4.2 Sociodemographic context characteristics of included EDs

Professional, academic ED expert qualification and current ED role (DEL-1, RQ-1)

Of the 18 included panelists, nine (50%) were having a specialty degree in ED care; nine (50%) reported being involved in professional activities to develop ED care regionally or nationally (i.e., as champion or advocate); seven (38.9%) were involved with current academic affiliations (e.g., as full/adjunct professor, or faculty member); seven (38.9%) had obtained a PhD title; six (33.3%) held a MD title; six (33.3%) SMEs reported

professional roles in professional societies; three (16.7%) had an additional medical academic degree (i.e., M.Sc. disaster management or medical education); two (11.1%) respondents were involved in international activities related to ED care; whereas one (5.6%) had an additional non-medical academic degree (M.Sc.) (cf., Figure 6).
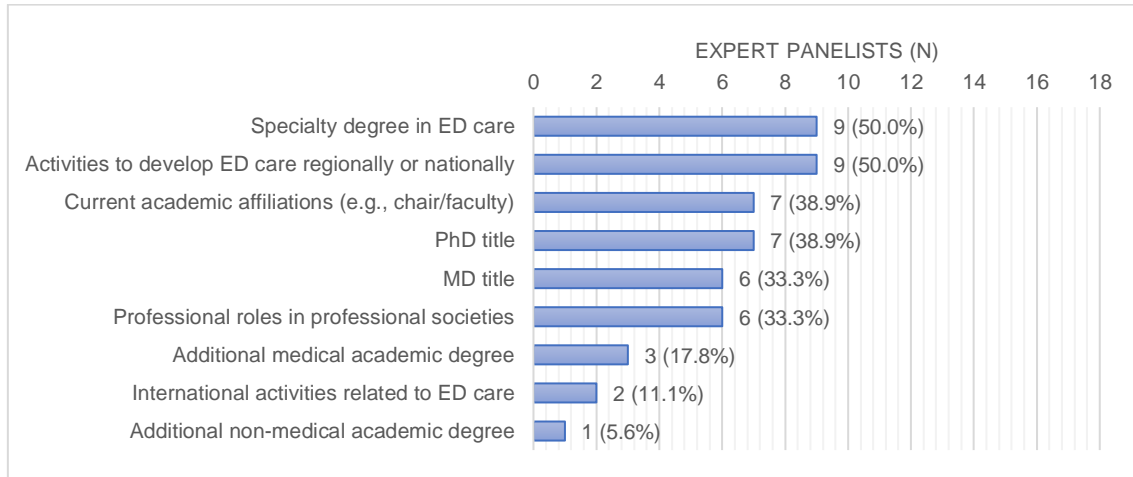
Figure 6: Professional, academic ED expert qualification and current ED role (DEL-1, RQ-1). MD=Doctor of Medicine; PhD=Doctor of Philosophy.

Own impact and influence of the ED experts on ED care (DEL-1, RQ-1)

Among the participants, three (16.7%) were speakers in or organizers of several congresses and society meetings; two (11.1%) expressed their hope of being role models to younger colleagues; one (5.6%) participant was noted as a champion and advocate for the National Health Service (NHS), while another (5.6%) served as a regional president of a national emergency medicine society, known for their great impact nationwide; one (5.6%) participant held the position of chairman of a leading group dedicated to developing and improving national ED care as an autonomous specialty; another (5.6%) participant supported the cause of the national emergency medicine society by being a member of a working group for quality and patient safety; additionally, one (5.6%) panelist served as the president of the commission of emergency medicine for the Ministry of Health, which initiated work on legislation to establish ED care in the country; one (5.6%) expert was member of a group responsible for creating the national ED curriculum, while another one (5.6%) was part of a recognition board; and finally, one (5.6%) participant was responsible for transforming

an ED into a specialists-led unit accredited for training, despite its initial limitations (cf., Figure 7).
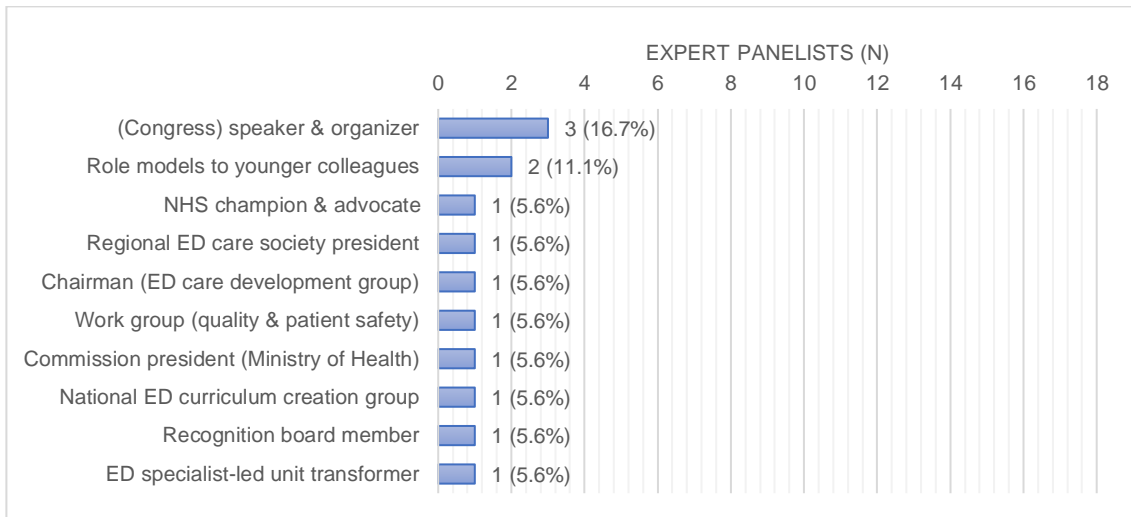
Figure 7: Own impact and influence of the ED experts on ED care (DEL-1, RQ-1). NHS=National Health Service, UK.

Local or nationwide ED expert perspectives and representation (DEL-1, RQ-1)

Among the interviewees, 13 (72.2%) provided perspectives that were mostly generalized and applicable nationwide, with the exception of local details; four (22.2%) represented hospitals of the same size in their respective countries, taking into account factors such as case mix; two (11.1%) panelists predominantly described a local setting, with only a few issues that were generalizable; additionally, two (11.1%) interviewees highlighted more geographical differences during the COVID-19 prime time, while another two (11.1%) emphasized settings or deficits that were more aggravated by the COVID-19 pandemic (cf., Figure 8).
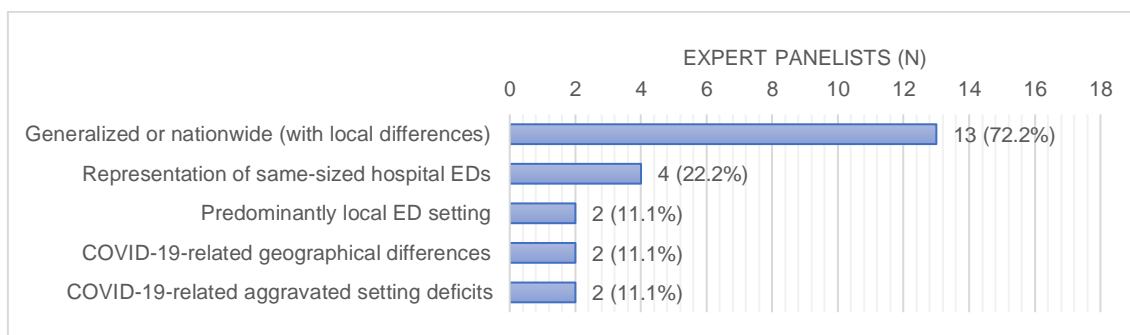
Figure 8: Local or nationwide ED expert perspectives and representation (DEL-1, RQ-1).

Social, economic/-logical and political influences on EDs (DEL-1, RQ-1)

Regarding positive aspects highlighted by the participants (cf., Figure 9), two (11.1%) SMEs noted that during COVID-19, all shortages were compensated by the government; two (11.1%) mentioned cooperation with politics and municipalities in planning new EDs & improving primary care; one (5.6%) respondent pointed out that having multinational employees leads to a better understanding of patients with different sociocultural backgrounds; Another one (5.6%) highlighted that ED care is in the focus of the public eye, especially since the COVID-19 pandemic; and ultimately, one (5.6%) informant expressed that the decentralization process leads to more competitive systems and a higher tempo of development.
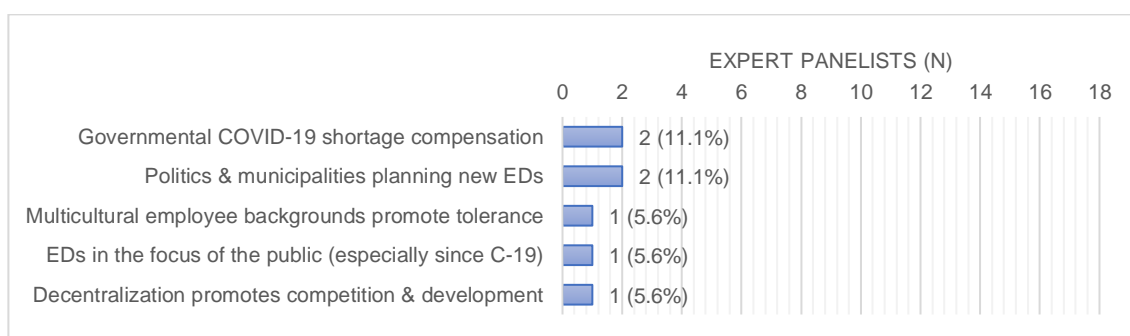
Figure 9: Positive social, economic/-logical and political influences on EDs (DEL-1, RQ-1).

Among the negative aspects reported by the panelists (cf., Figure 10), five (27.8%) mentioned challenges with regional government as the hospital organizer, including annoying decision-making processes, administrative issues, and budget cuts; two (11.1%) noted that general practitioners were distracted with vaccinations during COVID-

19, leading to dramatically increased low-acuity patient loads, especially during night and weekend shifts; two (11.1%) highlighted the lack of access to other care avenues, leading to uninsured individuals using EDs as their primary source of care; two (11.1%) pointed out challenges specific to rural area hospitals, including differences in social, cultural, religious status, and education compared to cities; two (11.1%) reported issues with verbal and physical violence in inner-city EDs; one (5.6%) expressed concerns about national rules and policies that may not necessarily be beneficial for patient care; one (5.6%) criticized the Ministry of Health for not economically sustaining hospitals and EDs adequately in terms of technical and human resources; one (5.6%) highlighted the pressure on EDs to prove their importance as cost centers, with admitted patients generating more revenue than ambulatory care; one (5.6%) raised concerns about the aging population and frail patients; one (5.6%) noted challenges for hospitals operating without networks or collaborations; one (5.6%) pointed out disparities between out-of-city and inner-city departments in terms of patient volume; one (5.6%) mentioned challenges related to urban planning, such as cities becoming greener, affecting transportation to the EDs; one (5.6%) raised concerns about the acute-on-chronic nursing shortages, leading to patients staying overnight in the ED; one (5.6%) highlighted the lack of uniformity due to decentralization; and lastly, one participant (5.6%) criticized the payment system, citing some services being poorly reimbursed under a fee-for-performance model.
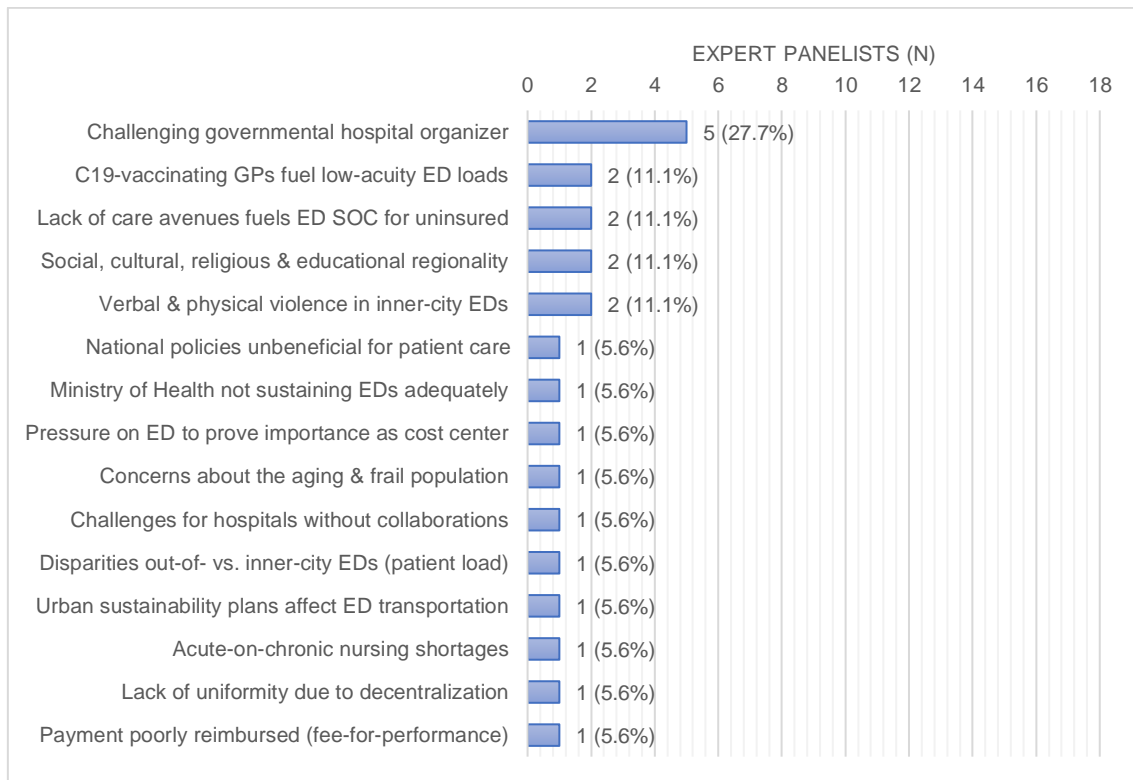
Figure 10: Negative social, economic/-logical and political influences on EDs (DEL-1, RQ-1). C19=COVID-19; GP=General practitioner; SOC=Source of care.

Physical ED work environment (DEL-1, RQ-1)

Regarding positive aspects delineated by the experts (cf., Figure 11), ten (55.6%) mentioned that the temperature and air quality were under control; six (33.3%) appreciated good lighting and ventilation; four (22.2%) noted the new or modern construction and design of their ED; three (16.7%) reported adequate noise levels; three (16.7%) pointed out that there was enough space; two (11.1%) mentioned a sufficient number of cubicles; two (11.1%) recognized having enough work- or computer stations; one (5.6%) noted having enough privacy; lastly, and lastly, one (5.6%) panelist appreciated having enough space in the break or pause room.
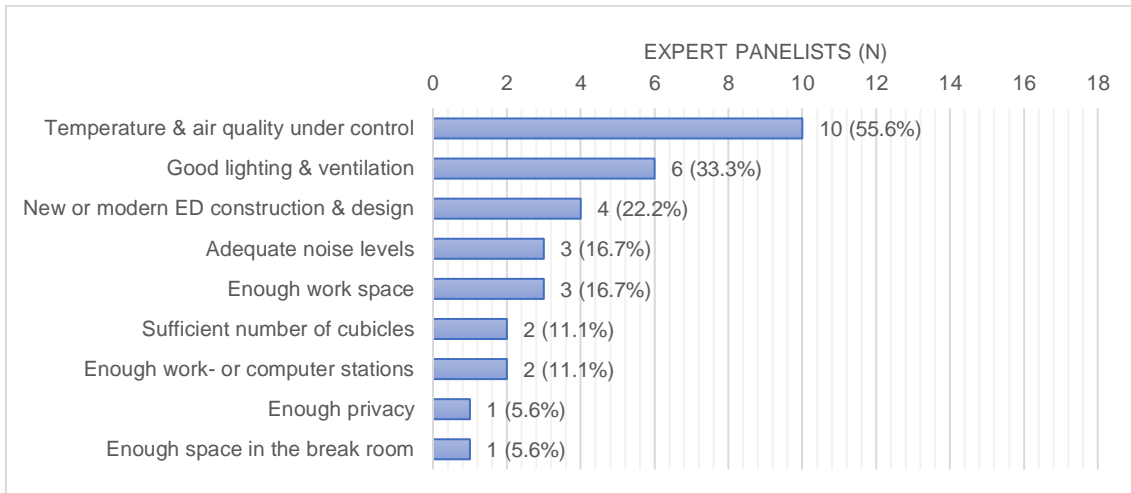
Figure 11: Positive aspects of the physical ED work environment (DEL-1, RQ-1).

Among the critical areas for improvement identified by the interviewees (cf., Figure 12), nine (50.0%) mentioned deficits in visual or acoustic privacy; eight (44.4%) noted that the physical space was too small; eight (44.4%) pointed out inadequate volume or noise levels; five (27.8%) highlighted issues with the aged ED construction or design; three (16.7%) reported inadequately high room temperatures or the lack of air conditioning; three (16.7%) referred to the lack of possibility for expansion; three (16.7%) mentioned too low room temperatures during winter; two (11.1%) complained about a lack of bright light or windows; two (11.1%) noted a small number of cubicles; two (11.1%) reported a shortage of work- or computer stations; two (11.1%) pointed out a pavilioned design with long distances; two (11.1%) highlighted issues with the renovation or restoration process; two (11.1%) mentioned overly bright lighting; and ultimately, one (5.6%) panelist reported the absence of a short-time observation unit.
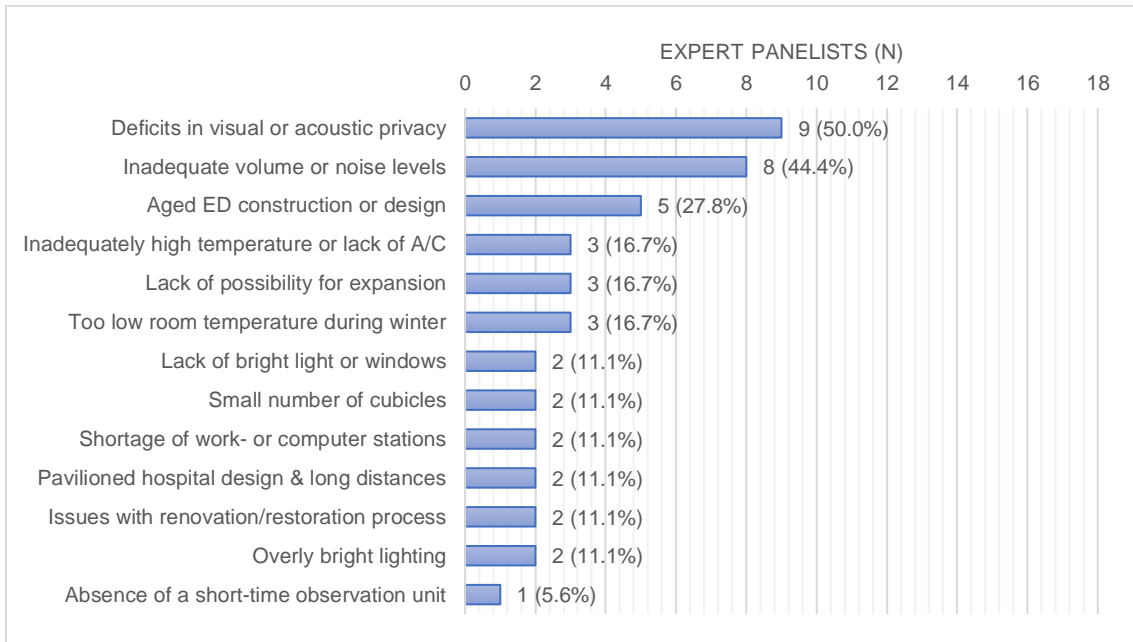
Figure 12: Negative aspects of the physical ED work environment (DEL-1, RQ-1). A/C=Air conditioning.

ED triage system (DEL-1, RQ-1)

Eight (44.4%) panelists reported an internally used (color-based) four- or five-point scale system; seven (38.9%) highlighted the use of the Manchester Triage System (MTS); and three (16.7%) mentioned the utilization of the Emergency Severity Index (ESI) (cf., Figure 13).
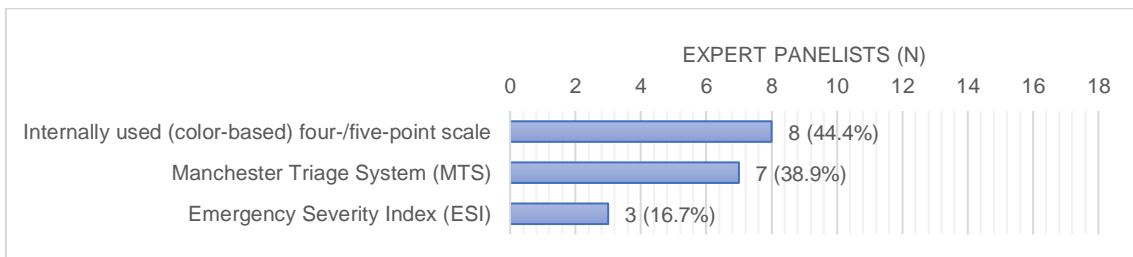
Figure 13: ED triage system (DEL-1, RQ-1).

Department responsibility for patient pathway (DEL-1, RQ-1)

Responsibility for patient pathways in the ED is distributed as follows (cf., Figure 14):

a. Triage: All 18 (100%) participants mentioned the ED as responsible.

b. Stabilization/resuscitation: Ten (55.6%) interviewees mentioned the ED; and eight (44.4%) pointed out interdisciplinary teams.

c. Bed management: Seven (38.9%) participants mentioned the ED; six (33.3%) stated the central case/bed management division; four (22.2%) highlighted interdisciplinary interactions (e.g., between the ED and a central bed management division); one (5.6%) pointed out other specialties (e.g., every department's daily coordinator during daytime, and respective on-call physician during night-time).

d. Diagnostic procedures: Ten (55.6%) interviewees named interdisciplinary teams; six (33.3%) mentioned the ED; and two (11.1%) pointed out other specialties (e.g., radiology).

e. Immediate therapy: Ten (55.6%) panelists stated the ED; seven (38.9%) pointed out interdisciplinary teams; and one (5.6%) mentioned other specialties (e.g., respective physician on-site).

f. Disposition: Nine (50.0%) participants mentioned the ED; six (33.3%) reported interdisciplinary teams (e.g., ED physicians/nursing with ward nursing); and lastly, one (5.6%) stated other specialties (e.g., the accepting department).
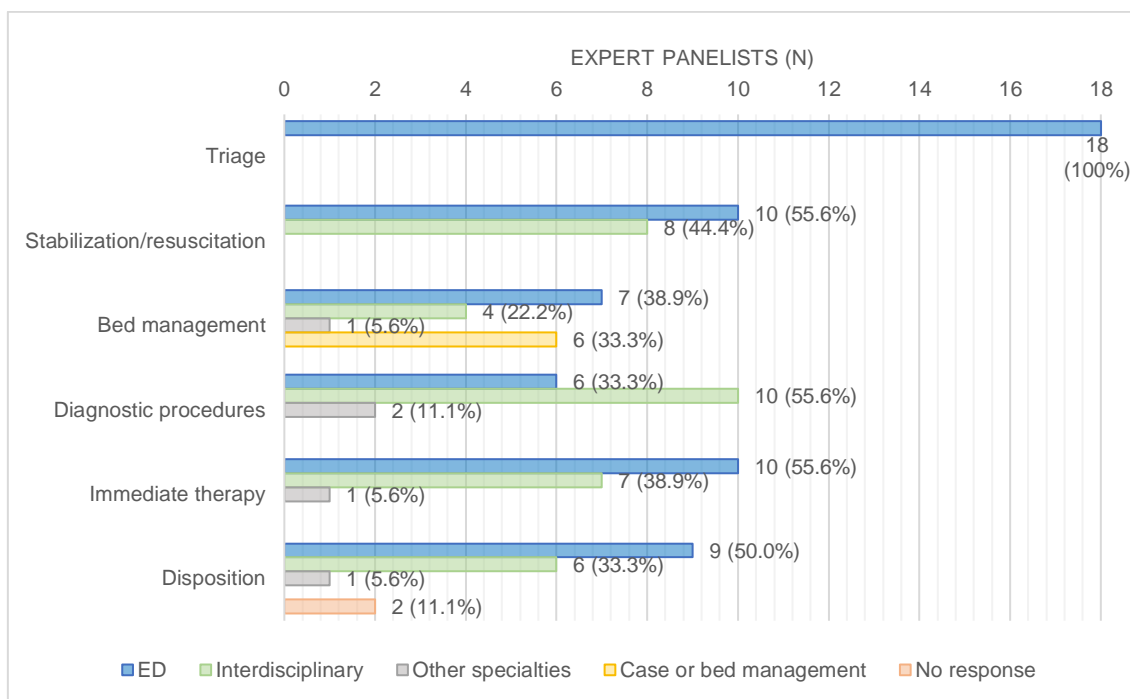
Figure 14: Department responsibility for patient pathway (DEL-1, RQ-1).

General ED work system factors (DEL-1, RQ-1)

In terms of general ED work system factors highlighted by the experts (cf., Figure 15), eight (44.4%) mentioned rostering shifts of less than 12 hours; seven (38.9%) reported limited teaching opportunities; six (33.3%) indicated little time for research; five (27.8%) reported that junior and senior residents have a minimum of 24-hour rostering shifts; five (27.8%) stated that there is no necessity of doing research; four (22.2%) mentioned that there is no dedicated ED staff, and it is shared with other specialties; four (22.2%) highlighted hospital-based emergency medicine as an autonomous specialty; two (11.1%) indicated that physicians working nighttime or on weekends also take care of wards; two (11.1%) mentioned that trainees are expected to have dedicated hours/days off for self-development; one (5.6%) reported a rotation to an out-of-hospital, brief observation unit, and emergency care ward; one (5.6%) stated that specialists are required to publish a minimum of one scientific paper (desirable); and finally, one (5.6%) mentioned that at a certain age there are fewer on-calls/nighttime shifts.
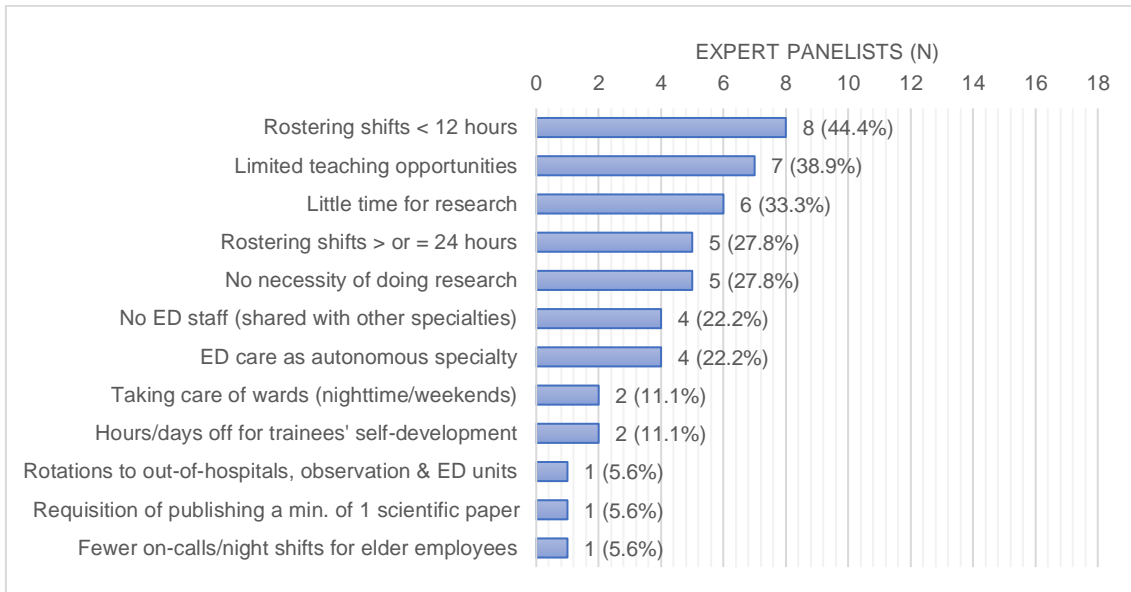
Figure 15: General ED work system factors (DEL-1, RQ-1).

ED qualification: ratios and definitions (DEL-1, RQ-1)

Out of all panelists, seven (38.9%) stated that there are more female than male physician staff members; seven (38.9%) described poor cultural diversity; six (33.3%) noted existent cultural diversity, with a multinational and diverse ED staff; four (22.2%) mentioned a very gender-diverse environment; four (22.2%) mentioned that there is generally an unidentified majority of junior compared to senior staff members; four (22.2%) complemented a specific senior-to-junior ratio of one to two; three (16.7%) indicated the presence of advanced clinical practitioners (ACPs) working independently or under the supervision of physicians, while serving as equivalents of junior residents. Moreover, nursing assistants, operative technical assistance, physician assistants, and paramedics also supplemented physician staff; two (11.1%) reported a senior-to-junior ratio of one to one; two (11.1%) reported more male than female physicians; one (5.6%) mentioned that there are more physicians than nurses; one (5.6%) reported the use of a 'see-one-do-one' teaching approach; one (5.6%) mentioned that more than half of the time is dedicated to university/teaching (60-70%), while less than half of the time is spent in the ED; one (5.6%) reported the absence of juniors/residents; one (5.6%) stated that the majority of doctors are seniors; one (5.6%) mentioned a physician-to-nurse ratio of one to three; and ultimately, one (5.6%) reported a physician-to-nurse ratio of one to one (cf., Figure 16).
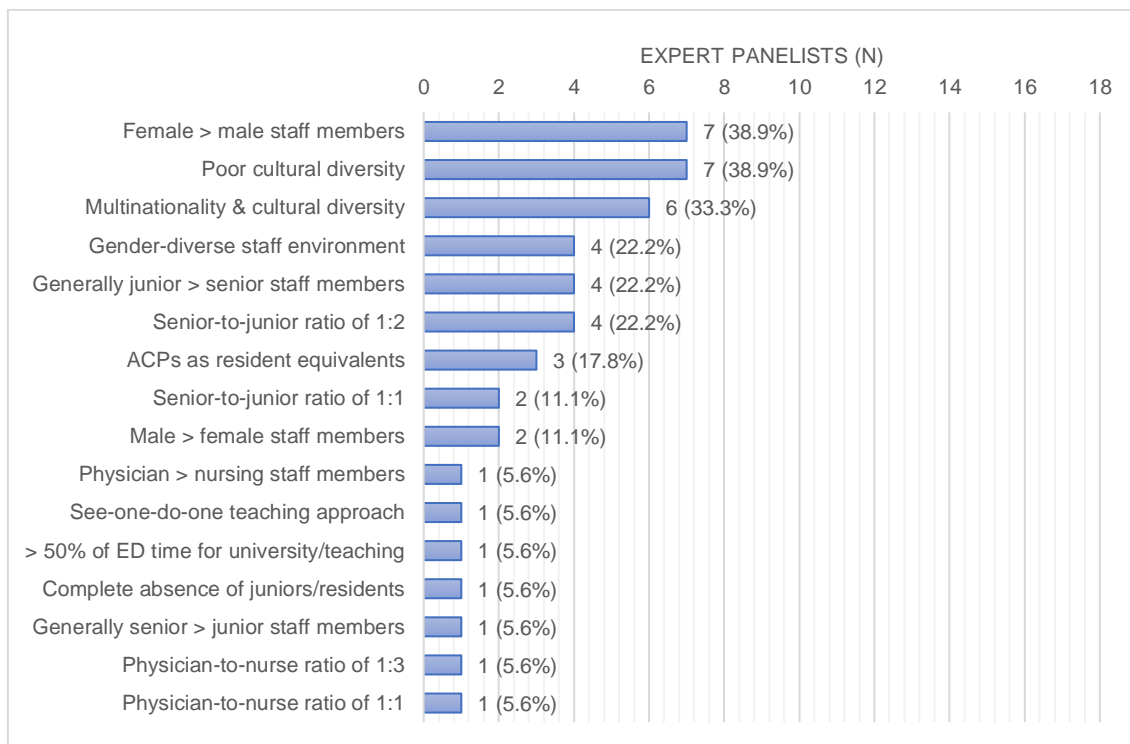
Figure 16: ED qualification: ratios and definitions (DEL-1, RQ-1). ACP=Advanced clinical practitioner.

ED staffing levels and determination approaches (DEL-1, RQ-1)

Five (27.8%) SMEs highlighted determining staffing levels based on the number of shifts, considering differences between weekday versus weekend and day versus night shifts; five (27.8%) stated determining staffing levels based on the mean physician-time-per-patient; five (27.8%) mentioned funding and staffing levels being determined for a certain annual patient volume, where acuity does not matter; five (27.8%) reported that staffing levels are negotiated and calculated with the company director or hospital management and that extra work and value needs to be proved for getting more staff; five (27.8%) pointed out that there are no minimum staffing level approaches, e.g., based on physician-time-per-patient or annual patient volume; two (11.1%) noted that there is usually a 20% reduction in staffing levels due to sickness, vacation, maternity leave, etcetera; two (11.1%) mentioned determining staffing levels based on the number of hours worked; one (5.6%) mentioned a standardized national calculation approach without providing further details; one (5.6%) mentioned the patients-per-physician approach and highlighted differences between surgical and medical patients; one (5.6%) mentioned calculation including "boarding of patients," with some hospitals having observation units or short-stay wards for that purpose, requiring additional staff; one (5.6%) reported minimal staffing levels, including at least one ED physician working

preclinically and one clinically. ED physicians in emergency medical service (EMS) shifts work in the ED while not having any preclinical emergency calls, ramping up ED staff, accordingly; and lastly, one (5.6%) panelist noted that work experience is not considered in work shift distribution, resulting in unequal shifts and work time (cf., Figure 17).
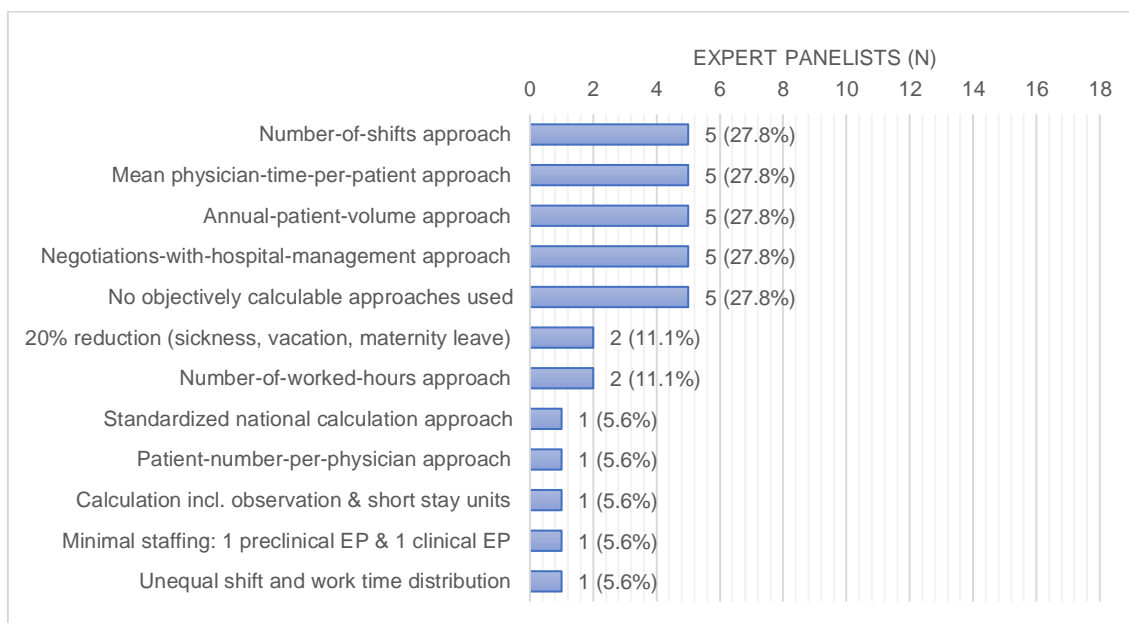
Figure 17: ED staffing levels and determination approaches (DEL-1, RQ-1). EP=Emergency physician.

Types of ED employee contracts (DEL-1, RQ-1)

12 (66.7%) panel experts reported mostly full-time equivalent (FTE) contracts; eight (44.4%) mentioned that juniors were on limited fixed-term contracts for ED rotation; five (27.8%) reported payment according to local employer associations; five (27.8%) reported that (almost) the complete staff is on permanent contracts; five (27.8%) have consultants and specialists on permanent contracts; five (27.8%) noted that part-time equivalent (PTE) contracts are very common and accepted; three (16.7%) mentioned no/little on-call payment; two (11.1%) noted that evening, night, and weekend shifts are better paid; two (11.1%) reported that ED rotation is minimum for six months; one (5.6%) mentioned an ED physician intensity bonus of +30% payment; one (5.6%) reported not being allowed to work more than 24 hours in a row anymore; one (5.6%) stated that juniors creating roster plans themselves; one (5.6%) mentioned special prehospital shifts (e.g., coming from other hospitals, mobile unit, air rescue service); one (5.6%) highlighted that salary was being paid by the department of origin during the temporary

ED rotations; one (5.6%) mentioned additional contracts for success-dependently more money (consultants); one (5.6%) participant noted that women with children under three years are not allowed to work nights/on-calls; one (5.6%) mentioned seven weeks of paid holiday/year; one (5.6%) mentioned relying on external locums to fill roster gaps; and ultimately, one (5.6%) mentioned a mixture of different types of employee contracts, contingent on professional grade (permanent, limited, legal benefits, full pensions and reimbursements in contrast to PIT being regulated by the government in terms of reimbursement) (cf., Figure 18).
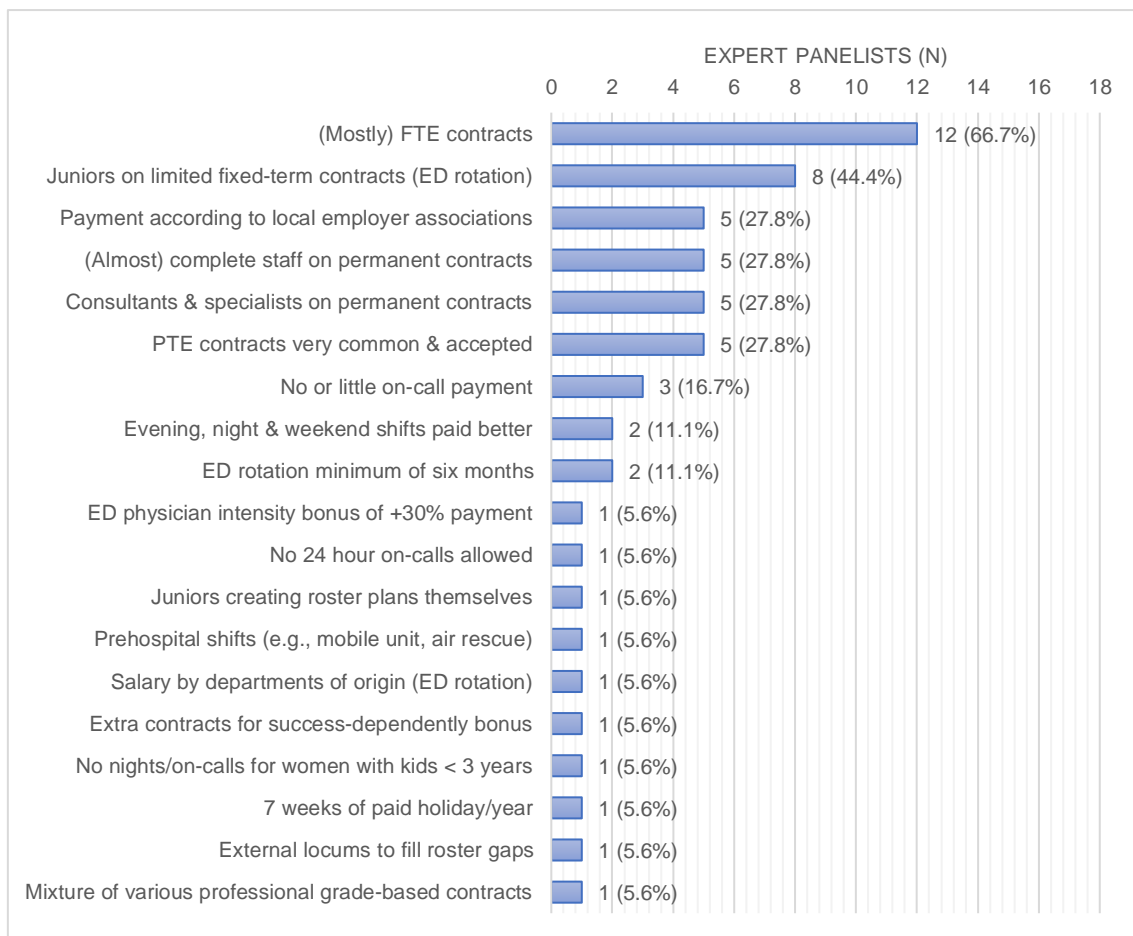
Figure 18: Types of ED employee contracts (DEL-1, RQ-1). FTE=Full-time equivalent; PTE=Part-time equivalent.

ED providers' overtime and compensation models (DEL-1, RQ-1)

12 (66.7%) participants reported overtime with extra payment; seven (38.9%) use an electronic check-in/-out system; seven (38.9%) use a manual check-in/-out system; six

(33.3%) mentioned additional on-call compensation payments in case of the need for more shifts to fill roster gaps (due to understaffing); five (27.8%) mentioned time off in lieu for overtime; five (27.8%) reported offered extra locum shifts on an hourly basis; four (22.2%) stated compensation models according to national legislation; two (11.1%) reported an average overtime of 12-15 hours per month; two (11.1%) mentioned contracts that limit overtime to no more than 48 hours per week; two (11.1%) pointed out extra remuneration for 120-140 hours/month, and even more if > 180/month; one (5.6%) reported an average overtime of 20-30 hours per month; one (5.6%) stated filling shift gaps with much overtime (up to 7-8 shifts per month); one (5.6%) reported overtime limited to 12-24 hours per week, and one (5.6%) overtime limited to < 5% of working hours; one (5.6%) pointed out that physicians were considered as medical hospital managers with no maximum overtime limits; and ultimately, one (5.6%) participant stated that overtime was worse during the COVID-19 pandemic (cf., Figure 19).
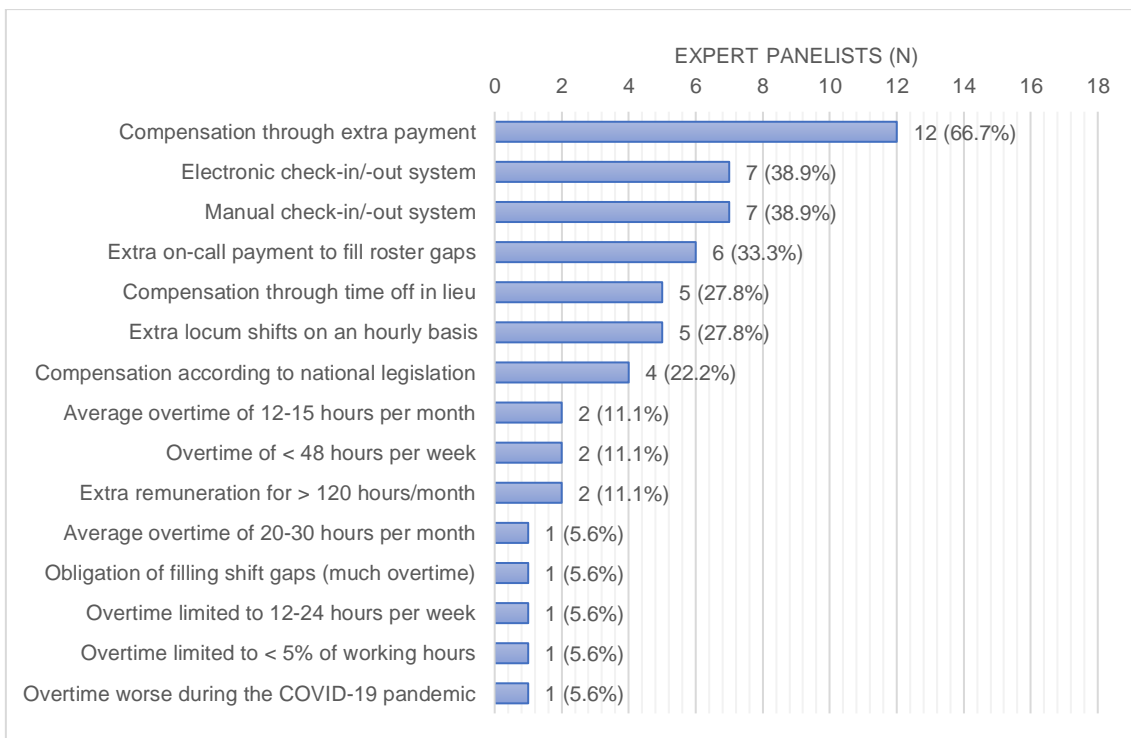
Figure 19: ED providers' overtime and compensation models (DEL-1, RQ-1).

ED health records and documentation systems (DEL-1, RQ-1)

13 (72.2%) participants reported having a complete or mostly full electronic record system, with dictating or writing capabilities; seven (38.9%) mentioned the planned

introduction of a complete digital process; six (33.3%) reported having no translation tools other than 'Google Translate'; seven (38.9%) noted the use of paper-based anamnesis and consultation protocols; five (27.8%) reported that ED registration files are computerized; five (27.8%) mentioned the absence of handheld devices; four (22.2%) described a patchwork of several different software tools used throughout the day, indicating room for improvement; five (27.8%) reported using one documentation system for everything, including radiography, electrocardiograms, vital signs, laboratories, medication, etcetera; four (22.2%) mentioned using a combination of both paper-based and paperless systems; three (16.7%) noted the availability of an external interpreter pool during working hours; two (11.1%) reported documentation times ranging from five to 30 minutes per patient on top of the consultation time; two (11.1%) reported having a good interface with general practitioners and other specialties; two (11.1%) mentioned the presence of interpreters within the staff; one (5.6%) mentioned plans to do everything bedside-wise; one (5.6%) mentioned the existence of an ED application with guidelines; one (5.6%) noted the absence of an interface for certain data, such as radiological images; one (5.6%) reported patient notes being imported into a national archive and accessible; one (5.6%) participant reported spending 40% of time with patients on documentation; one (5.6%) mentioned the absence of dictation tools; one (5.6%) reported using handhelds/mobiles directly transferred to patient record sheets; and finally, one (5.6%) mentioned telemedicine following patients home since the COVID-19 pandemic (cf., Figure 20).
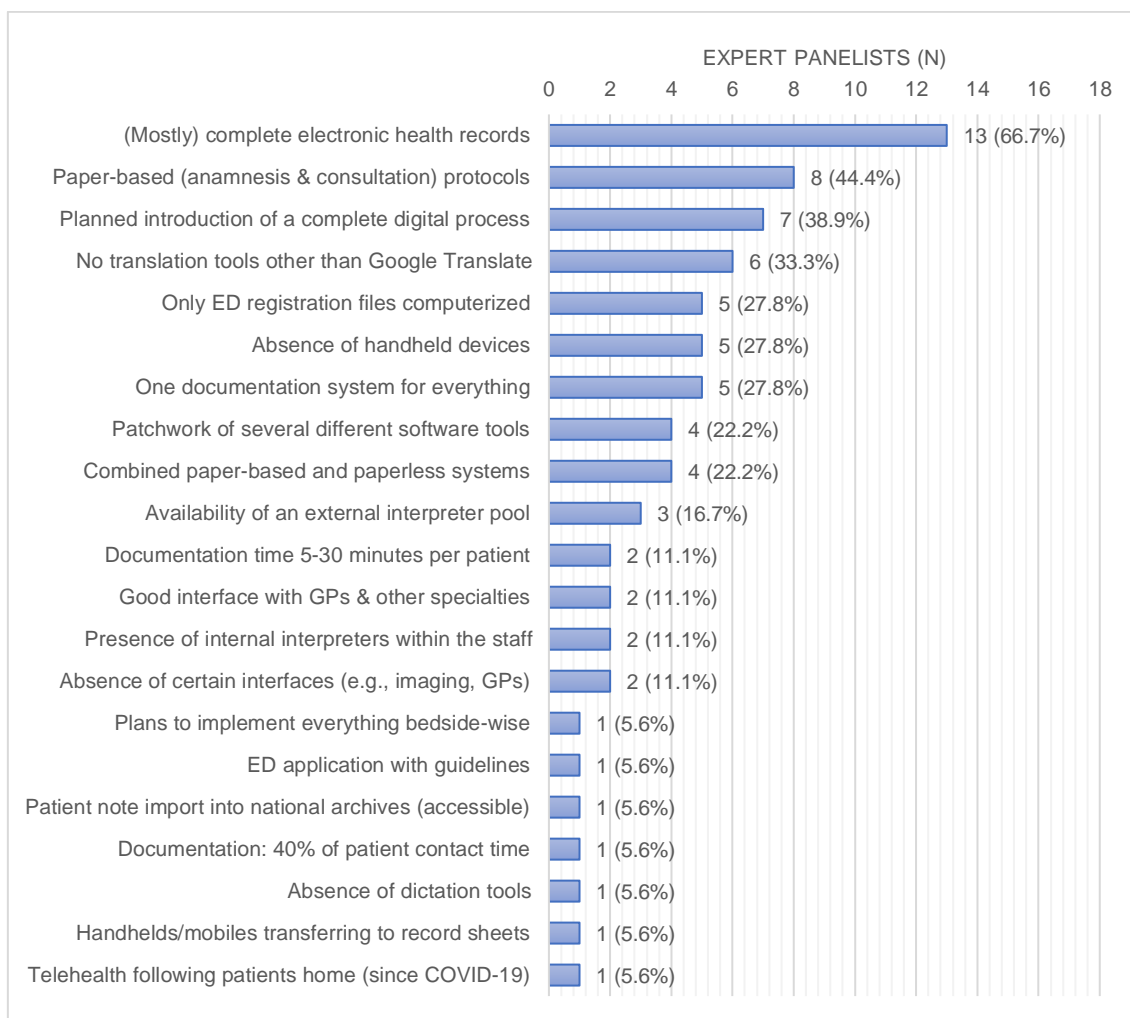
Figure 20: ED health records and documentation systems (DEL-1, RQ-1). GP=General practitioner.

Availability of diagnostic and interventional ED technology (DEL-1, RQ-1)

An ED preparedness 24/7 was reported in 13 (72.2%) cases; magnetic resonance imaging (MRI) not being available 24/7 in six (33.3%) cases; the absence of catheterization laboratories in two (11.1%) cases, of computer tomographies (CTs) in one (5.6%) case, stroke units in one (5.6%) case, interventional radiology during nighttime in one (5.6%) case, extracorporeal membrane oxygenation (ECMO) machines in one (5.6%) case, second level of surgery in one (5.6%) case; good communication with other hospitals was highlighted in one (5.6%) case, and electronic documentation in one (5.6%) case (cf., Figure 21).
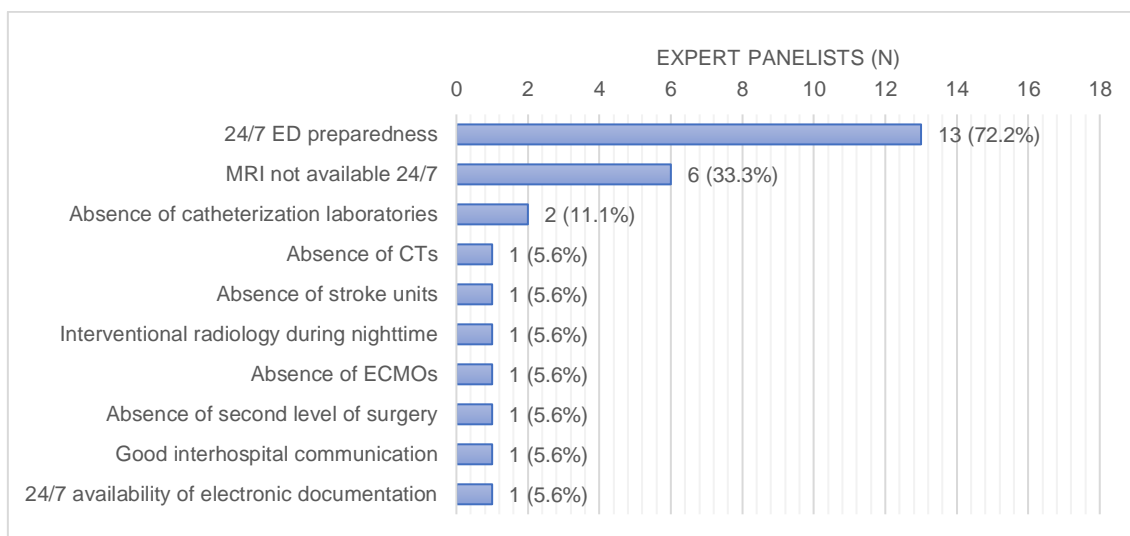
Figure 21: Availability of diagnostic and interventional ED technology (DEL-1, RQ-1). MRI=Magnetic resonance imaging; CT=Computer tomography; ECMO=Extracorporeal membrane oxygenation.

Introduction and access to ED health information technology (DEL-1, RQ-1)

Eight (44.4%) participants reported the implementation of HIT introduction, including protocols, guidelines, and information technology; seven (38.9%) stated the conduction of regular skill training sessions, which may be mandatory and cover various topics; seven (38.9%) mentioned learning-by-doing approaches on the job as a method of skill acquisition; four (22.2%) pointed out offers of free online resource access to materials such as handbooks and databases like 'Amboss', 'Thieme E-Ref', and 'Up-to-Date'; two (11.1%) provided trainees with access to technologies based on their skill level and relevant laws or legislation; two (11.1%) had a special roster system with rotations, as well as online, practical, and written exams; two (11.1%) expressed dissatisfaction with the briefness of the introduction and the limited nature of skill training; two (11.1%) consider the accessibility to the system to be good; one (5.6%) reported that decision-support tools and websites cannot be accessed; one (5.6%) mentioned consultants being trained to train juniors; one (5.6%) reported difficulty in accessing CT/MRI, with experienced radiologists seeking more experienced second opinions from ED senior physicians about indications; and lastly, one (5.6%) participant described bringing new technologies into the system with the assistance of external companies providing 24/7 on-site training to staff for up-skilling (cf., Figure 22).
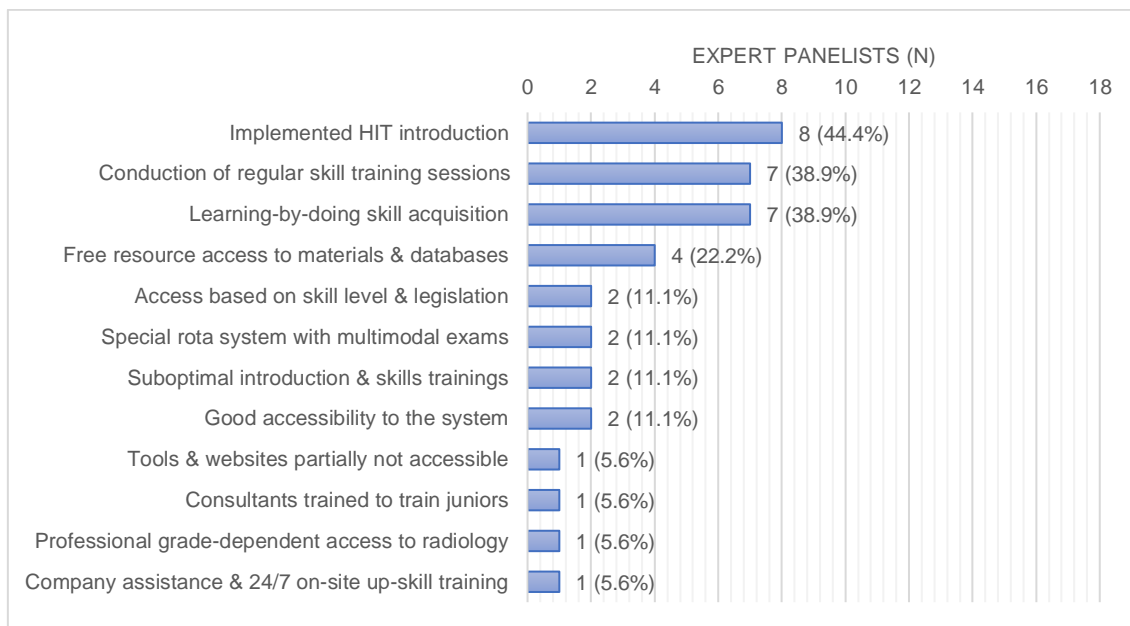
Figure 22: Introduction and access to ED health information technology (DEL-1, RQ-1). HIT=Health information technology.

Real-time maintenance and cleaning of health (information) technology (DEL-1, RQ-1)

Six (33.3%) interviewees reported real-time cleaning services available; five (27.8%) mentioned that reporting maintenance problems in real-time, especially for critical technology, is possible; five (27.8%) have a spectrum of different technologies to cope with technological or informational dropouts, including replacement machines in-between; four (22.2%) reported that real-time maintenance is not always available; four (22.2%) have contingency plans available in case of IT failures; four (22.2%) mentioned that a technical department, either on-site or on-call, usually comes to check and fix problems, often working together with external companies; three (16.7%) have external company devices, with companies sending teams for maintenance; two (11.1%) stated basic electronic maintenance carried out by their own nurses; one (5.6%) reported that maintenance is only available during daytime; one (5.6%) mentioned that maintenance within 24 hours is only possible with personal connections to medical technology companies; and ultimately, one (5.6%) participant pointed out that the ED always has priority for availability of imaging, and in worst-case scenarios, patients may be transferred to other hospitals for diagnostic procedures as temporary measures (cf., Figure 23).
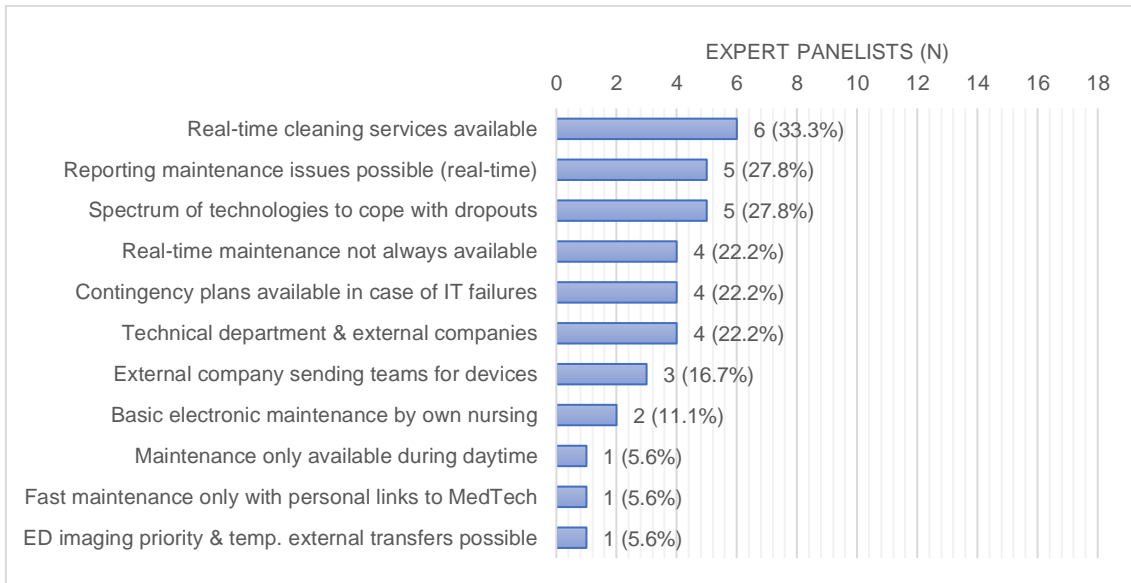
Figure 23: Real-time maintenance and cleaning of health (information) technology (DEL-1, RQ-1). MedTech=Medical technology company.

4.3 Consensus ratings for relevance across Europe (Delphi round 2)

In DEL-1, comprehensive interviews were conducted with each panelist, yielding transcribed records encompassing all 18 interactions. These transcripts were meticulously synthesized and scrutinized to distill salient assertions. Through rigorous examination, individual responses were methodically organized into a corpus comprising 195 distinct statements. Subsequently, 102 statements, inclusive of those independently proposed by panelists, were delineated into discrete items for evaluation regarding their pertinence during the subsequent round. In DEL-2, the entirety of the 18-member panel contributed their assessments concerning the significance of various factors within the ED operational framework. Hereinafter, the relevance statements and corresponding consensus metrics for each cluster delineating the ED work system are elucidated.

Ratings and consensus metrics on ED work-life factors and influences (DEL-2, RQ-1)

Regarding the study's primary inquiry, panelists underscored the significance of various positive overarching aspects within the ED work environment. Notably, they emphasized the stimulating nature of general ED-related attributes, such as 'job challenges' (i.e., 'variation and/or interdisciplinary interaction'; M=4.7, SD=0.4, I-CVI=1.00). Similarly, high levels of 'job control' (i.e., 'participation in decision-making'; 4.4, 0.5, 1.00), 'job intellectuality' (4.6, 0.6, .94), 'task significance' (4.3, 0.6, .94), and 'job autonomy' (4.0, 0.6, .83) were highlighted as vital components fostering favorable work experiences,

respectively. Furthermore, the panel identified 'personal work ethics and/or motivation' (4.4, 0.8, .94), 'teamwork, social climate and extracurricular activities' (4.3, 0.6, .94), 'work experience and/or utilization of skills' (4.4, 0.7, .89), and 'resilience and coping strategies' (4.4, 0.7, .89), alongside 'positive co-worker relationships' (4.2, 0.9, .83), as integral to cultivating positive provider-related facets of the ED work milieu. In the realm of patient-provider interaction, the factor of 'patient case complexity' (4.2, 0.6, .89) emerged prominently, garnering recognition for its positive impact (cf., Table 3).

Conversely, during the initial round of evaluations, a diverse array of negative factors was delineated. Subsequently, during the ensuing round, paramount importance and concerns were accorded surrounding general aspects such as 'overcrowding' (4.7, 0.6, .94), and 'workflow interruptions and/or multitasking' (4.6, 0.6, .94). Equally notable were apprehensions regarding 'time pressure and/or lack of breaks' (4.4, 0.7, .89), as well as challenges associated with 'employee turnover and understaffing' (4.4, 0.8, .83). Additionally, the prevalence of 'medical errors' (4.1, 0.9, .83) was underscored, garnering considerable attention regarding provider-related facets. Noteworthy negative aspects within patient-provider interactions were highlighted, particularly encompassing instances of workplace 'violence' (i.e., 'verbal and/or physical'; 4.0, 1.1, .72) towards healthcare workers (cf., Table 3).

In total, the S-CVI/Ave accounted for .77, the S-CVI/UA amounted to .06, and the S-CVI/AUA was .48. The ICC accounted for .72, with a 95% CI of .57 and .84 (cf., Table 4).

Table 3: Panel relevance ratings & consensus metrics (I/II): ED work-life influences (DEL-2, RQ-1).

Category and factors	Metrics		
	M	SD	I-CVI
Positive general aspects in ED work			
Job challenge: variation and/or interdisciplinary interaction	4.7	0.4	1.00
Job control: participation in decision-making	4.4	0.5	1.00
Job intellectuality	4.6	0.6	.94
Task significance	4.3	0.6	.94
Job autonomy	4.0	0.6	.83

Positive provider-related aspects in ED work

Personal work ethic and/or motivation	4.4	0.8	.94
Teamwork, social climate and extracurricular activities	4.3	0.6	.94
Work experience and/or utilization of skills	4.4	0.7	.89
Resilience and coping strategies	4.4	0.7	.89
Positive co-worker relationships	4.2	0.9	.83

Positive patient-provider interaction facets in ED work

Patient case complexity	4.2	0.6	.89
Therapy efficacy: seeing patients getting better	3.9	0.9	.67
Grateful patient feedback	3.6	1.0	.67
Communication: social interaction with patients and/or families	3.6	1.0	.56

Negative general aspects in ED work

Overcrowding	4.7	0.6	.94
Workflow interruptions and/or multitasking	4.6	0.6	.94
Time pressure and/or lack of breaks	4.4	0.7	.89
Employee turnover and understaffing	4.4	0.8	.83
Chronic cognitive workload	3.8	0.9	.67
Work-life imbalance	3.8	1.1	.67
Shift work	3.4	1.1	.50

Negative provider-related aspects in ED work

Medical errors	4.1	0.9	.83
Lack of communication and feedback culture	3.9	0.9	.72
Task overlap and interaction deficits with other specialties	3.8	0.9	.72
Tense atmosphere	3.7	1.1	.72
High pressure to take far-reaching decisions	3.8	1.1	.67
Lack of resilience and coping mechanisms	3.7	0.9	.61
Insufficient supervision	3.6	0.8	.56

Negative patient-provider interaction facets in ED work

Violence: verbal and/or physical	4.0	1.1	.72
Legal consequences of conflicts	3.7	1.2	.67
Minor complaints without the need of ED treatment	3.6	0.9	.67
Ungrateful feedback	3.6	1.2	.67
Excessive claims	3.4	1.3	.56
S-CVI/Ave			.77
S-CVI/UA			.06
S-CVI/AUA			.48

Note: N=18; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Table 4: Panel relevance ratings & consensus metrics (II/II): ED work-life influences (DEL-2, RQ-1).

	Intraclass Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	,13[a]	,07	,23	4,20	32	544	<,001
Average Measures	**,72[c]**	**,57**	**,84**	4,20	32	544	<,001

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Ratings and consensus metrics on ED providers' health outcomes (DEL-2, RQ-1)

Regarding the adverse health ramifications experienced by ED, profound significance was attributed to various mental health manifestations. Particularly, elevated pertinence was observed concerning 'exhaustion and/or mental fatigue' (4.5, 0.6, .94), 'burnout' (4.4, 0.8, .83), and 'compassion fatigue, pessimism, and/or cynicism' (3.9, 0.8, .78). Similarly, within the realm of physical health implications, 'physical fatigue' emerged as a primary concern, attaining the highest rating (4.1, 0.8, .83). Addressing psychosomatic and behavioral health dimensions, 'insomnia' (i.e., 'sleep deprivation and/or disturbance', 4.0, 0.9, .72) was notably highlighted, though rated lower. Reduced relevance was attributed to adverse behavioral health outcomes, yet, with highest for 'dropouts / opt-

outs (= quitters)' (3.8, 0.8, .78) and 'intentions to leave or reduce working hours' (3.9, 1.0, .72) (cf., Table 5).

In total, the S-CVI/Ave accounted for .57, the S-CVI/UA amounted to .00, and the S-CVI/AUA was .31. The ICC accounted for .82, with a 95% CI of .67 and .92 (cf., Table 6).

Table 5: Panel relevance ratings & consensus metrics (I/II): ED providers' health outcomes (DEL-2, RQ-1).

Category and factors	Metrics		
	M	SD	I-CVI
Adverse physical health outcomes of ED work			
Physical fatigue	4.1	0.8	.83
Musculoskeletal pain	3.2	1.1	.33
Injuries (e.g., needle stick, trauma, violence)	3.1	1.1	.33
Adverse mental health outcomes of ED work			
Exhaustion and/or mental fatigue	4.5	0.6	.94
Burnout	4.4	0.8	.83
Compassion fatigue, pessimism, and/or cynicism	3.9	0.8	.78
Anxiety	3.6	0.8	.56
Depression, sadness and/or low mood	3.3	0.9	.33
Adverse psychosomatic health outcomes of ED work			
Insomnia (sleep deprivation and/or disturbance)	4.0	0.9	.72
Cardiovascular consequences: hypertension and/or tachycardia	3.3	1.1	.44
Gastroesophageal reflux disease (GERD)	3.1	1.0	.33
Eating disorders	2.9	1.0	.28
Adverse behavioral health outcomes of ED work			
Dropouts / opt-outs (= quitters)	3.8	0.8	.78
Intentions to leave or reduce working hours	3.9	1.0	.72
Sick leaves	3.4	1.0	.61
Substance abuse	2.9	1.0	.28

			S-CVI/Ave	.57
			S-CVI/UA	.00
			S-CVI/AUA	.31

Note: N=18; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Table 6: Panel relevance ratings & consensus metrics (II/II): ED providers' health outcomes (DEL-2, RQ-1).

	Intraclass Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	,20[a]	,10	,41	7,81	15	255	<,001
Average Measures	,82[c]	,67	,92	7,81	15	255	<,001

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Ratings and consensus metrics on ED work-life intervention practices (DEL-2, RQ-2)

Regarding initiatives aimed at enhancing the quality of work-life and implementing interventions within the ED at an organizational level, an array of strategies surfaced during the initial round of evaluations. In the subsequent round, notable emphasis was placed on several key practices, as delineated in Table 7. Foremost among these were the establishment of 'emergency care as an autonomous specialty' within ED provision (4.4, 0.8, .94). Additionally, there was significant recognition for the 'ED reorganization and modernization' (4.1, 0.7, .89), along with initiatives targeting the development of 'evidence-based SOPs and/or training concepts' (4.3, 0.7, .83) and 'adaptable staff and duty rostering' (4.1, 1.0, .78).

Turning attention to improvement practices at the team level, prominent ratings were bestowed upon '(simulation-based) skills trainings' encompassing critical areas such as resuscitation and CRM techniques (4.3, 0.8, .89). Likewise, there was notable acclaim for facilitating 'debriefings after critical incidents with potential post-traumatic consequences' (4.2, 0.8, .89) (cf., Table 7).

While individual-level approaches garnered comparatively and considerably lower relevance, noteworthy recognition was afforded to the promotion of 'private sport activities: individual and/or group-based' (3.6, 1.3, .56) (cf., Table 7).

In total, the S-CVI/Ave accounted for .58, the S-CVI/UA amounted to .00, and the S-CVI/AUA was .25. The ICC accounted for .75, with a 95% CI of .59 and .87 (cf., Table 8).

Table 7: Panel relevance ratings & consensus metrics (I/II): ED intervention practices (DEL-2, RQ-2).

Category and factors	Metrics		
	M	SD	I-CVI
Improvement and intervention practices on organizational level			
Emergency care as autonomous specialty	4.4	0.8	.94
ED reorganization and/or modernization	4.1	0.7	.89
Evidence-based SOPs and/or training concepts	4.3	0.7	.83
Adaptable staff and duty rostering	4.1	1.0	.78
Critical Incident Reporting System (CIRS)	3.9	1.1	.72
Out-of-ED ambulatory care and/or medical assessment units	3.8	1.1	.72
Limited on-call duties, night or weekend shifts, overhours	3.7	1.0	.67
Quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))	3.5	1.5	.56
National emergency medicine society networking platforms	3.4	1.1	.50
Employee surveys	3.3	1.0	.44
Offer of mental health interventions	3.1	1.0	.39
Regular occupational health checks	2.8	1.0	.22
Improvement and intervention practices on team level			
(Simulation-based) Skills trainings (e.g., resuscitation, CRM)	4.3	0.8	.89
Debriefings after critical events with potential post-traumatic consequences	4.2	0.8	.89
Regular feedback from mentors	4.1	1.0	.72
Inter-professional educational initiatives for physicians and nursing	3.8	1.2	.61
Nurse practitioners (e.g., wound and/or pain care)	3.3	1.2	.50

Physician-assisted triage	3.2	1.3	.39
Improvement and intervention practices on individual level			
Private sport activities: individual and/or group-based	3.6	1.3	.56
Acute mental occupational health services (e.g., psychotherapy)	3.1	1.3	.44
Hospital-initiated mental health protection programs	3.1	1.2	.39
Private activities to prevent mental illness	3.1	1.4	.39
Acute physical occupational health services (e.g., physiotherapy)	2.8	1.3	.28
Hospital-initiated physical health protection programs	2.7	1.3	.28
S-CVI/Ave			.58
S-CVI/UA			.00
S-CVI/AUA			.25

Note: N=18; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Table 8: Panel relevance ratings & consensus metrics (II/II): ED intervention practices (DEL-2, RQ-2).

	Intraclass Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	,14[a]	,07	,28	5,10	23	391	<,001
Average Measures	**,75[c]**	**,59**	**,87**	5,10	23	391	<,001

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Barriers and Facilitators for ED work-life interventions (DEL-1, RQ-2)

Given the diverse and inconsistent responses from interviewees during the first round, the focus in DEL-2 remained solely on analyzing and reporting the statements provided, without subjecting them to further evaluation in subsequent rounds.

Regarding potential success factors, a comprehensive compilation encompassed various key contents and clusters. Noteworthy, among these were the efficacy of prompt actions post-incidents, identified as "hot debriefings" or, shortly thereafter, "cold

debriefings" coupled with MMCs. Additionally, interprofessional training initiatives involving physicians and nurses, alongside supportive measures from the hospital organization such as continuous modernization endeavors, sustained resource allocation, adequate provision of facilities, and enforcement of policies aimed at mitigating violence, were underscored. The cultivation of an open culture fostering psychological safety, facilitating discussions pertaining to stress or well-being issues in regular gatherings such as weekly meetings, as well as peer engagement activities outside the realm of work, were perceived as bolstering factors.

In contrast, various potential barriers were delineated, spanning diverse domains. These encompassed escalating workloads, organizational and logistical complexities, challenges in collaboration with non-ED specialties and functions, staff turnover attributable to rotation practices, understaffing, dilemmas encountered in decision-making processes pertaining to intended improvement initiatives, protracted or delayed timelines associated with intervention projects, and suboptimal integration of technological advancements like EHR due to deficiencies in staff and training resources.

Ratings and consensus metrics on COVID-19-related ED work (DEL-2, RQ-3)

Factors mitigating the adverse effects of COVID-19 on provider working conditions encompass several key elements. Notably, the utilization of 'PPE' (4.7, 0.5, 1.00), 'vaccination campaigns' (4.6, 0.6, .94), and 'testing: PCR and/or POC antigen' (4.6, 0.7, .89), were deemed highly effective. 'Persistent information flow' (4.4, 0.7, .89) and 'change of SOPs' (4.2, 0.8, .89) regarding the pandemic were also valued. Additionally, the 'separate isolation and cohort areas or units' (4.3, 1.1, .83) and 'intra- and interhospital networking' (4.0, 0.9, .78) to accommodate pandemic circumstances were acknowledged as effective strategies (cf., Table 9).

Conversely, factors exacerbating the negative impacts of COVID-19 on provider working conditions were prominent. Notably, issues such as 'staff shortage' (4.8, 0.4, 1.00) and 'excessive workload' (i.e., 'organizational and/or isolation-related'; 4.7, 0.5, 1.00), were identified as highly detrimental. Moreover, challenges related to 'crowding' (i.e., 'ED space limitations and/or exit blocks') were highlighted, albeit with a lower consensus rate (4.4, 1.1, .83) (cf., Table 9).

The pandemic also exerted significant impacts on providers' physical and mental health. 'Confirmed COVID-19 infections' among staff (4.2, 0.8, .83) underscored the physical health implications, while mental health repercussions were evidenced by increased

'mental exhaustion and/or less resilience' (4.2, 1.0, .83) and 'anxieties' (3.8, 0.8, .78) (cf., Table 9).

In addition, COVID-19-related disruptions extended to the employee-reported quality and safety of patient care. Instances of 'undertreatment of emergency medicine diagnoses' (4.2, 0.6, .89) and 'delays in patient diagnostic and therapeutic pathways (PDTP)' (4.2, 0.8, .83) were reported (cf., Table 9).

In total, the S-CVI/Ave accounted for .72, the S-CVI/UA amounted to .10, and the S-CVI/AUA was .52. The ICC accounted for .80, with a 95% CI of .68 and .89 (cf., Table 10).

Table 9: Panel relevance ratings & consensus metrics (I/II): COVID-19-related ED work (DEL-2, RQ-3).

Category and factors	Metrics		
	M	SD	I-CVI
Aspects reducing negative impacts of COVID-19 on provider working conditions			
Personal protective equipment (PPE)	4.7	0.5	1.00
Vaccination campaigns	4.6	0.6	.94
Testing: PCR and/or POC antigen	4.6	0.7	.89
Persistent information flow	4.4	0.7	.89
Change of SOPs	4.2	0.8	.89
Separate isolation and cohort areas or units	4.3	1.1	.83
Intra- and interhospital networking	4.0	0.9	.78
Employment of additional external staff	3.5	1.3	.72
Reorganization of staff and duty rostering	3.7	1.1	.56
Psychological support: employee surveys and/or well-being offers	3.5	1.0	.50
Contact tracing and quarantining	3.2	1.1	.50
Structural room ventilation systems	3.1	1.6	.50
Aspects inducing negative impacts of COVID-19 on provider working conditions			
Shortage of staff	4.8	0.4	1.00
Excessive workload: organizational and/or isolation-related	4.7	0.5	1.00

Crowding: ED space limitations and/or exit blocks	4.4	1.1	.83
Lack of PPE	2.9	1.6	.39

COVID-19-related impacts on providers' physical health

Confirmed COVID-19 infections	4.2	0.8	.83
PPE discomfort: overheating, skin and/or respiratory irritations	3.8	1.0	.67
Long-COVID syndrome	3.1	1.3	.44

COVID-19-related impacts on providers' mental health

Mental exhaustion and/or less resilience	4.2	1.0	.83
Anxieties	3.8	0.8	.78
Burnout	4.0	1.2	.72
Social isolation	3.7	1.0	.61
Depression	3.3	0.9	.44

COVID-19-related impacts on employee-reported quality and safety of patient care

Undertreatment of emergency medicine diagnoses	4.2	0.6	.89
Delay in patient diagnostic and therapeutic pathways (PDTP)	4.2	0.8	.83
Reduced emotional support for patients and/or their families	3.9	1.1	.72
CT scan overuse	3.2	1.2	.50
Diagnostic misperceptions and/or misdiagnoses	3.4	1.0	.44
S-CVI/Ave			**.72**
S-CVI/UA			**.10**
S-CVI/AUA			**.52**

Note: N=18; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Table 10: Panel relevance ratings & consensus metrics (II/II): COVID-19-related ED work (DEL-2, RQ-3).

	Intraclass Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	,18[a]	,11	,31	5,81	28	476	<,001
Average Measures	,80[c]	,68	,89	5,81	28	476	<,001

Two-way mixed effects model where people effects are random and measures effects are fixed.
   a. The estimator is the same, whether the interaction effect is present or not.
   b. Type A intraclass correlation coefficients using an absolute agreement definition.
   c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Comparisons among care levels and nations

For more detailed comparisons among care levels and participating nations refer to '7. Attachments'.

5 Discussion and conclusion

5.1 Discussion of the methods

5.1.1 Study protocol

Adherence to comprehensive guidelines, such as COREQ, for ensuring good scientific practice (169, 170, 172), has been established in Section 3, Material and Methods, specifically in the section '3.1.1 Study Protocol'. Moreover, the adoption of a mixed-methods approach, a well-established methodology that has garnered increasing recognition in recent decades, particularly within the fields of social sciences and healthcare research (211-213), including Delphi studies (214, 215), has been employed in this study.

5.1.2 Delphi technique application

The Delphi consensus procedure was opted for instead of conducting a systematic literature review due to the challenge of contextualizing international circumstances and recommendations within a process shaped by national and continental frameworks. This method is grounded on the premise that well-informed group opinion synthesis holds greater validity than individual perspectives in explorative and evaluative areas with tenuous or inconsistent evidence (216), which aligns well with the exploratory and evaluative nature of the subject area under study. Its underlying framework encourages unbiased, unconstrained, and independent opinions from the included study panelists. Thus, it eliminates significant shortcomings of conventional consensus approaches, such

as the influence of dominant opinion leadership, group dynamics, conformity pressure, status effects, or distorting public expectations (180, 217-219). Hence, this framework was selected by the SCT primarily for its ability to mitigate these shortcomings. Moreover, it offers notable advantages in terms of cost efficiency (175, 185, 191), particularly with the adoption of e-Delphis, given their feasibility and suitability for conducting interviews and surveys online and remote (220, 221). This approach thereby facilitated broader geographical outreach to a wide range of potential participants across Europe, particularly compared to other potentially eligible survey methods (180, 222-224), enhancing the study's inclusivity and representation.

Critics, however, contend that the anonymity afforded in Delphi surveys may absolve respondents of accountability for their viewpoints and result in a circular buck-passing phenomenon (179). Particularly in Delphi processes, anonymity is posited to potentially obscure participants who are less invested in the topic and may conform to the prevailing opinion to hasten the process, thereby fostering an artificial consensus (225). Additionally, critics have pointed out laborious time-consumption, panelist priming, as well as the lack of vivid live group discussions (226-228).

While multiple rounds are typically essential to achieve consensus, the number varies depending on the nature of the study (175, 229). A Delphi study may reach its conclusion upon achieving unanimity among participating experts or when the analysis manifests negligible deviation from previous rounds, indicating stability (230-233). Conducting two or three rounds might prove adequate to forestall escalating attrition, being the main rationale behind opting for a two-round design in this study. It is proposed to strive for a minimum response rate of 70% (229, 234). Attrition rates hinge significantly on the caliber of project design and accurately gauging and communicating the time and workload anticipated for respondents (225), which the SCT aimed to address. Indeed, attritions are prone to escalation with panel enlargement, whereas assemblies with around 20 members, as in this study design, tend to retain their constituents (229, 235). As evidenced in this study, no dropouts occurred as it progressed into the second round, indicating stability in panel participation.

Data from Delphi studies are predominantly subjective and tend to be qualitative in nature, although they may also incorporate quantitative approaches (236). Consequently, conventional criteria of quantitative research, such as validity, reliability, and objectivity (237), are not entirely suitable, as they can only be applied to qualitative research designs to a limited extent (238). However, critics argue that determining the reliability of the methodology is problematic because each round of a Delphi survey

involves creating a new measurement instrument (239), not least therefore raising concerns about reliability, validity and objectivity (239-242).

Throughout history, the identification of deficiencies and the assimilation of insights gleaned from the application of the Delphi methodology have been recurrently elucidated (227, 229, 243, 244). The quality of a Delphi study therefore hinges on systematic planning, recruitment of suitable experts, rigorous and appropriate data collection, as well as objective and critical presentation of the results (236, 245). Noteworthy, comprehensive literature on Delphi guidance is abundant and has long been available (191, 246-249). However, to ensure quality and transparency, this study particularly adhered to the Guidance on Conducting and REporting DElphi Studies (CREDES) guideline (250):

[1] *Justification:* The Delphi technique was chosen based on the need for an alternative perspective to evidence-based medicine, emphasizing the value of expert judgment, including implicit or tacit knowledge, particularly in areas such as clinical routines, which are not directly accessible through clinical trials. Much of the content of this study pertains to such knowledge domains. [2] *Planning and process:* The approach was tailored to the specific research objectives by employing a mixed-method e-Delphi, comprising a semi-structured semi-qualitative interview guideline followed by a quantitative online survey. [3] *Definition of consensus:* Given the exploratory nature of the first round, establishing an a priori criterion for consensus was deemed unnecessary. Instead, the SCT opted for internal discussion and clarification of DEL-1 items for inclusion in DEL-2. Nevertheless, the SCT aimed to transparently report on a priori DEL-2 item and overall thresholds. However, no predefined thresholds for terminating the Delphi process, such as a specified number of rounds or iteration stability, were employed. The predefined two-round procedure appeared promising for minimizing attrition rates, especially considering the broad scope of the area under investigation and the abundance of items. [4] *Informational input:* All materials presented to the expert panel at the project's commencement and during the Delphi process underwent thorough review and piloting beforehand. This was done to assess its impact on the experts' judgments and to mitigate potential biases. [5] *Prevention of bias:* The SCT implemented measures to prevent direct or indirect influence on the experts' judgments (such as offering open-ended questions in round one and a standardized Likert-scale survey in round two). Additionally, no conflicts of interest were identified. [6] *Interpretation and processing of results:* While stable disagreement or lack of consensus can offer valuable insights into differing perspectives on the topic, this study prioritized identifying the highest relevance agreement and consensus due to the abundance of items under

investigation and the relatively low number of panelists. [7] *External validation*: the chaperonage of this manuscript was limited to administrative oversight by the Munich Medical Research School (MMRS) mentoring committee before publication and dissemination. Furthermore, sections of the manuscript underwent publication trials in peer-reviewed journals. [8] *Purpose and rationale:* The purpose of this study was clearly defined and demonstrated the suitability of the use of the Delphi technique as a method to achieve the present research aim, which was clearly articulated. A rationale for the choice of the Delphi technique as the most appropriate method was provided. [9] *Expert panel:* The study provided clear criteria for selecting experts and transparent information on how the expert panel was recruited. Sociodemographic details, including expertise relevant to the topic, were disclosed. Additionally, (non)response and response rates were reported throughout the iterations of the study. [10] *Description of the methods*: The SCT aimed to employ comprehensible methods, including details on preparatory steps such as synthesizing available evidence, piloting of materials and survey instruments, survey instrument design, number and design of survey rounds, data analysis methods, processing and synthesis of expert responses, and methodological decisions made by the research team throughout the process. [11] *Procedure:* A flowchart depicting the stages of the Delphi process, encompassing a preparatory phase, the actual Delphi rounds, interim steps of data processing and analysis, and concluding steps, was provided. [12] *Definition and attainment of consensus*: The SCT endeavored to provide the reader with a comprehensive and transparent depiction of how consensus was attained throughout the entirety of the process. [13] *Results:* The reporting of results for each round separately, allowing for a transparent evolution of consensus, was partially provided. While sociodemographic context data were emphasized in round 1 and relevance ratings in round 2, modifications of the survey instrument based on previous rounds, such as deletion, addition, or modification of survey items, were indeed reported. [14] *Discussion of limitations:* The reporting within this study included a critical reflection on potential limitations and their impact on the reported results and respective implications. [15] *Adequacy of conclusions:* The study's conclusions adequately captured the outcomes of the Delphi study, addressing the scope and applicability of the reported results for further research, clinical practice, and policy recommendations. [16] *Publication and dissemination:* The manuscript clearly delineated the reported results and provided recommendations for their application in practice and implementation. Additionally, detailed methodological features of the applied Delphi technique were referenced in the attachments for further clarity.

5.1.3 Study population, panel selection, recruitment procedure

Experts are individuals possessing specialized knowledge in the subject under investigation (197, 218, 251). This expertise includes professional competence and a willingness to engage in reflective discourse on knowledge, attitudes, and beliefs.

Delphi surveys, including this study, typically prioritize accessible expertise over strict representativeness according to quantitative standards. This approach may result in panels with lower statistical power, reflecting available expertise rather than numerical samples from specific expert populations (197, 218, 251). However, reported sample sizes and recommendations for optimal panel sizes vary widely, from single- to four-digit numbers (229, 252, 253).

Moreover, while random sampling may be suitable for broad social and marketing Delphi studies, the in-depth expertise required for this study necessitated purposive sampling (173, 247). Similarly, panel heterogeneity is emphasized to prevent overlooking aspects of the research question (180), whereas homogeneity of expertise levels was deemed vital for this survey's validity (253). Yet, critics may contend that a broader expert base and a more heterogeneous sample on a national level could have been achieved either by sacrificing country stratification or by increasing the total number of panelists. In turn, the latter option would have considerably prolonged the recruitment and data acquisition process.

Additionally, the selection criteria for panel members vary based on the Delphi design, from screening procedures to assess expertise to using scales to gauge potential experts' level of dogmatism as an indicator of their ability and willingness to change opinions. While some advocate for these criteria, caution is advised against generalizing them (245). Hence, the SCT screened for expertise using the established inclusion and exclusion criteria. It is also suggested to maintain a balance between industry and academia, as well as regional representation (180, 245, 254). In this study, experts from industry were excluded, and regional representation was predefined.

However, a different composition of the expert panel under an otherwise similar Delphi survey design could yield different outputs, hence challenging the method's reliability (179, 187). Yet, previous references suggest that the response characteristics of a small expert panel in a well-defined area of expertise remain consistent even with augmented sampling (253, 255).

5.1.4 Variables, measures, and statistical analyses

Data acquisition via semi-structured interviews (DEL-1)

The guideline creation with SPSS method (198) for DEL-1 facilitated the formulation of a semi-structured interview guide incorporating open-ended questions on the subject matter. Conceptualized not merely as a questionnaire but as structural guidance for interview navigation, this guideline-based interview technique aimed to establish a free-text and guided consensus on major survey contents, grouped as specific themes and outlined as key factors.

The interview guide was designed to accommodate the individual setting of each SME, placing a heightened emphasis on heterogeneous sections, subitems, and factors. The flexibility in the order of key and additional questions allowed for dynamic exploration of new aspects without interrupting the flow of conversation. The deliberate choice of an open-exploratory approach using semi-structured interviews aimed to make subjective perspectives and experiences accessible. This qualitative study design permitted participants to articulate their views, experiences, and ideas in their own words, thereby allowing for the emergence of novel insights and hypotheses (256).

It is essential to emphasize that the objective was not solely focused on employing a representative sample for statistical analysis. Instead, it aimed to delve deeper into participants' perspectives, thus contributing to the discourse on working conditions for ED providers. The method's flexibility allowed for adaptation of research questions in response to participants (256).

In this research, it was opted to present items for assessment using a rating scale alongside open-ended questions for several reasons: Firstly, providing guidelines helps respondents understand the expected response formats, thereby reducing the analytical effort required by them. Secondly, rating questions are generally perceived as less daunting than open-ended ones, potentially preventing premature discontinuation of the process by respondents. Thirdly, the predefined items may stimulate additional mentions, leading to a more comprehensive identification of items overall. The strengths of this approach are in facilitating the exchange of novel ideas and perspectives, and in allowing respondents opportunities to propose additional items and influence in the iterative survey process.

Qualitative content analysis

The method of content analysis is frequently utilized in the German-speaking research contexts due to its structured and transparent approach. It is particularly suitable for describing homogeneous and unambiguous nuanced materials (202-204). Given the semi-structured nature of the interview guide and the similarity of responses in the present study, the material can be considered relatively homogeneous.

The QCA approach by Kuckartz et al. in particular was chosen for its detailed methodology and the level of computer support it offers (204). The category system facilitates traceability of the analysis and thus enables the intersubjectivity of the approach. The systematic nature of the procedure is ensured by a defined sequence of steps, while the various ways to implement these steps ensure appropriateness to the subject matter (202-204).

For a comprehensive and consistent assignment to categories, it was imperative not only to name the individual categories but also to precisely define each category through a definition, as well as specifying when it could be assigned to parts of the text material. Categorization was indispensable, as any content not attributed to a specific category would be excluded from the evaluation process (202).

A combined deductive-inductive approach was adopted to address both the deduction problem, where the theoretical framework may restrict unexpected insights, and the induction problem, where a single case may struggle to represent a general rule, introducing subjectivity (203, 204).

By carefully documenting all steps of the present work, ranging from the interview guide to the development of the category system, efforts were made to meet the criterion of procedure documentation. Any changes made during the iterative process were recorded in writing to ensure traceability. Moreover, it is emphasized that qualitative research aligns with the traditional criteria of reliability and validity used in quantitative research (202).

To assess the category system and ensure the reliability of the research, segments of the transcript material underwent proof-coding by a second coder during the pilot phase, thereby enhancing inter-coder reliability. The high consistency observed within the SCT demonstrated intersubjectivity, indicating a high reliability of the category system.

Data acquisition via rating scales (within DEL-2)

Scholarly literature indicates that various scales yield disparate levels of consensus and demonstrate varying degrees of test-retest reliability (257). However, Likert-scales are well-established and serve as widespread multistage rating scales. They are commonly used for detailed survey procedures in health, psychology, empirical market, social, as well as in election research (200, 201, 258, 259).

The differentiation degree of five levels used in this study is recommended to achieve high measurement quality without random response choices, while keeping the evaluations manageable for respondents (260). The applied middle category allows respondents the option of taking a neutral position and not having to resort to another category, which could lead to both decision-making pressure with higher dropout rates, and systematic bias (260). On the other hand, the middle position may encourage abstentions, potentially compromising the reliability of the results.

Overall, the SCT made use of the advantages of Likert-scales, encompassing high informative value and volume, great nuanced detail depth (variance), versatility, comprehensibility, time and cost savings, quantifiable response options (measurability and applicability), as well as boosts of morale and enhanced data quality (facilitated decision-making). Conversely, drawbacks include the absence of expressions of individual perspectives on items not explicitly listed (except for personal comments allowed at the end of each round). There is also concern about potential susceptibility to extreme statements versus tendencies towards the middle, resulting in distortions. Additionally, a decrease in motivation and attention may occur when confronted with large question volumes (200, 201, 258-260), as was the case in this study.

Moreover, it is crucial to recognize that the data obtained from individual item assessments on a Likert-scale provide ordinal-scaled rather than interval-scaled information (201, 259). This means that the categories per se cannot be assumed to be equidistant. Consequently, the results, reflecting respondents' assessments, should be regarded as preference judgments on an ordinal scale. The use of the mean is statistically acceptable only if it is ensured that the Likert-scale is symmetrically formulated and that the scale points are interpreted as equally spaced by all respondents (201, 259).

However, within this study a pivotal leveraging approach was adopted by employing a combination of verbal and numerical statements to label the unipolar scales, having a natural zero point (i.e., '1 – Highly irrelevant'). This procedure aimed to enhance the

analyzability and comprehensibility of the scales while ensuring approximately equal intervals between the response options. The point values of the individual item responses on the Likert-scale are then aggregated, yielding a total score for the overall scale, rendering it unequivocally metric, particularly interval-scaled. While this approach enables a wider range of statistical analysis methods, its validity may be subject to debate. Nonetheless, it aligns with the common modus operandi by a majority of scientific authors (201, 257-260).

Consensus measurements

Various analytical approaches have been identified and applied to represent consensus in Delphi surveys (225, 261-264). Commonly used descriptive metrics include MDs and arithmetic Ms for tendency, SDs for distribution of responses, chi-square, and quartiles or interquartile ranges, along with specific levels and percentages of agreement (229, 245, 261, 262, 264).

Regarding the latter, the CVI as an established parameter for proportion of percentage agreement (206-208) was employed. An I-CVI of ≥ .78is considered excellent (206, 208), while a minimum of .80 is required for an acceptable S-CVI/Ave approach, with a threshold of .90 and higher indicating excellent content validity (208). Also, two additional S-CVI approaches with similar thresholds were conducted, albeit with cautious interpretation due to their rigorous requirements (208). The S-CVI/AUA served for a more lenient evaluation compared to the S-CVI/UA.

Moreover, as a result of analyzing metric data, some authors advocate for the calculation of formal agreement measures (201, 257-259). As a well-established consistency estimate, the ICC serves as a complementary parameter to measure consensus (209, 210, 264). Values below .40 indicate poor correlation, between .40 and .59 fair correlation, between .60 and .74 good correlation, and between .75 and 1.00 excellent correlation (210). However, critics oppose the application of consistency or congruency estimates for content validity purposes, as they primarily reflect internal consistency rather than expert agreement (208). Furthermore, such calculations provide limited evaluative information about individual items or raters (208).

In terms of quality criteria, several shortcomings have been identified within the framework of consensus procedures, most notably post hoc instead of a priori definitions, lack of transparency in reporting, and the arbitrary use of round closure and descriptive metrics (263-266).

5.2 Discussion of the findings

5.2.1 Contextualization of results derived from the Delphi survey

In the area of emergency medicine, particularly within EDs, the nature of work is notably stressful. Despite the expanding body of scientific literature delving into various factors affecting the ED work environment and the health outcomes of providers, there remains a significant gap in studies offering guidance on the most pertinent and crucial factors within the ED work system. To address this shortcoming, in collaboration with the EUSEM network, a cross-European panel of ED physicians was convened to identify the most salient work-life factors through a structured and systematic approach. At this juncture, reported DEL-2 results (online survey via consolidated item list) will be discussed with regard to research questions 1 (work system factors influencing ED providers' work-life and associated health outcomes), 2 (implemented enhancement practices to ameliorate RQ1 and efficacy or failure of respective interventions), and 3 (COVID-19-related challenges and implications).

Contextualization of Delphi round 2 results addressing the research question 1

Initially, this study contributes an expert-derived overview and consensus regarding pertinent work system factors influencing ED providers' work-life and health. It augments prior research exploring the distinctive stressors and obstacles intrinsic to acute medical environments (15, 16, 36, 37). The panelists assessed various work-life elements, identified those of utmost impact, thus affirming their pivotal role in shaping the intricate and often contradictory work environment within the ED, characterized by both favorable and unfavorable contextual and occupational factors (14).

Notably, factors such as variability and interdisciplinary collaboration, job complexity or significance, and job control or autonomy garnered the highest ratings among positive aspects. Moreover, attributes like strong personal work ethics, motivation, positive co-worker relationships teamwork, social climate and extracurricular activities, along with resilience and coping strategies, as well as patient case complexity, were emphasized (65). These findings align well with existing literature emphasizing the demanding nature of ED work, which requires rapid decision-making, problem-solving skills, and, yet, offers ample opportunities for professional growth (16). Job control and autonomy emerged as a crucial resource, associated with increased engagement, self-efficacy, and a sense of mastery.

Conversely, the most prominent negative stressors included ED overcrowding (32-35, 267), workflow interruptions or multitasking (45-48), time constraints or inadequate breaks, staff turnover and shortages (13), as well as medical errors (38, 53, 54, 268), and workplace violence (49, 51, 52). This set of work stressors (18, 36, 37) is consistent with prior studies, which have linked them to aggravated job dissatisfaction, fatigue, and burnout among ED providers (16, 37, 49, 51, 52, 55, 65, 268). Particularly, the detrimental impact of overcrowding is well-documented, leading to care delays, prolonged waiting times, and diminished patient satisfaction (5, 65, 267). Frequent workflow interruptions and multitasking, inherent to ED work due to its nature and patient multiple simultaneous patient loads, pose risks to provider well-being and performance outcomes (47).

Overall, the identified work-life factors encompass a broad array of both positive and negative elements, endorsing an amalgamation and complex interplay of challenges encountered by ED professionals (13). In relation to the comprehensive consensus reached by the overall panel regarding content validity within this segment, the S-CVI/Ave of .77 reflects a level of consensus among experts that is approaching 'acceptable' (206, 208). Moreover, an ICC of .72, with a 95% CI of .57 and .84, complementarily indicates a 'good' level of correlation (210), thereby affirming relatively high inter-rater reliability and consistency among the panelists. Consequently, it appears that these results are uniformly considered both relevant and prevalent across participating European healthcare settings.

Secondly, another notable contribution of the present study refers to the comprehensive examination and synthesis of various work-related health outcomes experienced by ED providers. Extensive research has indicated that ED staff are subjected to elevated levels of job-related stress, predisposing them to a spectrum of physical and mental health issues such as burnout and depression (16, 55-58, 60, 61, 268-272)

Consistently, interviewees reported a range of adverse health outcomes prevalent among ED providers, encompassing physical, mental, psychosomatic, and behavioral health domains in response to the ED work environment. Of particular relevance were psychological health consequences, notably provider exhaustion, mental fatigue, and burnout, along with compassion fatigue, pessimism, and/or cynicism, reaffirming previous observations regarding a critical prevalence of fatigue and burnout within the ED workforce (16, 55-58, 60, 61, 268-272). Additionally, physical fatigue emerged as a prominent concern, along with sleep-related disturbances such as insomnia or restlessness (39-42). While consensus was less pronounced regarding behavioral

outcomes, turnover intentions were rated highest. This resonates with prior investigations indicating elevated turnover rates and job dissatisfaction among ED staff (38, 62-64), which can contribute to demoralization and adversely impact patient care (11, 14, 65, 66, 271, 272). Nonetheless, substantial disagreement regarding certain health outcomes, such as substance abuse (i.e., with 28% consensus and a medium rating), was observed. Despite being frequently discussed as a significant issue and a common coping mechanism among healthcare providers (including ED physicians) in high-strain work environments, reliable prevalence data and effective monitoring and mitigation measures remain scarce (273, 274).

In relation to the comprehensive consensus reached by the overall panel regarding content validity within this segment, the S-CVI/Ave of .57 indicates a level of consensus among experts that can be rather considered weak (206, 208). However, an ICC of .82, with a 95% CI of .67 and .92, suggests an 'excellent' level of correlation, affirming high inter-rater reliability among the panelists (15). Consequently, while these results achieve less overall relevance consensus, there remains a homogeneous level of consistency and congruency across all European nations participating in the study. Alternatively stated, panelists' overall ratings of relevance for various ED provider's outcomes were low to mediocre, yet showing agreement with each other at this lower level of consensus.

Taking into account all D-2/RQ-1 findings, particularly the negative ED work-life influences and adverse provider outcomes, it appears plausible to suggest that there exists a confluence of relatively uniform working environments within EDs, aligning with the introductory reference baseline of contemporary literature. However, there are divergent individual repercussions on health and satisfaction, thus not exclusively being consistent with the narrative literature review (16, 38, 55, 57, 60-64, 271). This juxtaposition could potentially stem from methodological nuances influencing the assessment of ED work influences and ED providers' health outcomes. It is conceivable that certain elements within ED work environments exhibit considerable consistency, while the individual ramifications on providers' well-being and contentment exhibit significant heterogeneity owing to personal determinants. A more exhaustive investigation would be warranted to elucidate the underlying causes of these disparities comprehensively and discern whether they are attributed to methodological discrepancies or genuine variances in working conditions and individual outcomes.

What should also be noted at this point is that the direct and immediate relationships between the insufficient safety and quality of patient care as adverse ED work-life drivers and the well-being of providers do not seem as evident and salient. However, a wealth

of literature describes negative impacts of provider health and well-being on the quality and safety of patient care (11, 14, 65, 270).

Contextualization of Delphi round 2 results addressing the research question 2

Thirdly, this study represents, to our knowledge, the first attempt to derive expert-based recommendations on intervention and improvement strategies deemed (in)effective to enhance the work-life balance within various local and variable ED settings. The survey yielded a heterogeneous array of potential practices, underscoring the necessity for multifaceted, systems-oriented approaches that address various influential factors and encompass a range of ILIs targeting different sources of work-related stress (15, 29, 36). At the organizational level, consensus was obtained regarding the effectiveness of regulatory measures such as establishing ED care as an independent specialty, formulation of standard operating procedures and training protocols, as well as initiatives targeting ED restructuring, modernization (68, 70, 81-86, 89), and flexible rostering arrangements (94, 95). These improvement efforts predominantly focus on work-life dynamics stemming from contextual factors situated at the organizational or institutional level (15). Regarding ED care as an autonomous specialty, careful consideration is necessary since the survey exclusively involved ED physicians; perspectives from other stakeholders, including those outside of ED care, may vary significantly (31). Post-hoc analysis suggests that ED physicians might view ED care as a distinct profession because specialty recognition and care provided by trained ED physicians are considered crucial for the efficacy, effectiveness, and value of acute care. This is particularly important given the increasing demand for EM and trauma care, as well as the ongoing need for the rapid and cost-effective utilization of limited healthcare resources (30).

Yet, interventions at the team level were also deemed effective, with simulation-based skills trainings (117-119), post-event debriefings (113-115), and regular mentor feedback (108, 110, 111) receiving the highest ratings. These intervention approaches address teamwork, communication (95, 102, 116), and leadership practices (106, 275) in everyday ED operations, all of which have the potential to alleviate work-related stress and enhance work-life.

Noteworthy, ILIs to mitigate work stress were rated as less relevant, which contrasts with the current literature that predominantly highlights educational or mindfulness-based interventions (122), highlighting the paramount importance of system-oriented interventions in improving the work-life experiences of ED professionals. To this end,

derived findings further suggest that a broader spectrum of improvement strategies may be warranted, to apply either in isolation or in combination, to ultimately ameliorate the work-life of ED providers (15, 29, 36). In relation to the comprehensive consensus reached by the overall panel regarding content validity within this segment, the S-CVI/Ave of .58 indicates a level of consensus among experts that can be considered weak (206, 208). However, an ICC of .75, with a 95% CI of .59 and .87, suggests an 'excellent' level of correlation, affirming high inter-rater reliability among the panelists (15).

Consequently, these results also achieve less overall relevance consensus, yet, with a high and homogeneous remaining level of consistency across all participants in the study. Alternatively stated, panelists' ratings of relevance for various implemented improvement practices were low to mediocre, yet they showed agreement with each other at this lower level of consensus. This could be interpreted in the context of uniformly insufficient implementation efforts of intervention practices at the organizational, team, and individual levels within the respective hospitals and EDs, consistent with existing literature (137, 138). The broad thematic range and variance in perceived relevance ratings indicate that no single solution is viewed as universally effective. Instead, a combination of measures across multiple levels is recommended (270, 276). However, caution is required, as there remains room for alternative interpretations. Intervention practices could be in place and regarded irrelevant, or they could not be implemented yet and regarded as relevant or irrelevant though.

Fourthly, this survey also sought to explore potential facilitators and barriers to effective improvement practices in ED work-life. Panelists' responses yielded a heterogeneous array of factors, indicating a varied landscape of supportive and obstructive elements in the context of enhancing ED provider work-life. It is important to note that these findings should be therefore considered preliminary and serve as a basis for more in-depth investigations. Nonetheless, the breadth of reported factors suggests the presence of multiple facilitators and barriers in efforts to modify work conditions and, eventually, to enhance ED providers' work-life. It is posited that insights gleaned from implementation science and organizational change practices may inform future research aimed at identifying effective and sustainable improvement endeavors within ED settings.

Contextualization of Delphi round 2 results addressing the research question 3

Fifthly, the present study delineated a comprehensive analysis of challenges encountered by ED providers and the corresponding strategies to mitigate them, both

pre-COVID-19 and during the specific context of the COVID-19 pandemic, across various European ED settings. The pandemic has significantly affected working conditions for ED providers, with both positive and negative impacts identified. Effective measures such as use of PPE, vaccination campaigns, and adjusted SOPs have helped mitigate adverse effects. However, challenges like staff shortages, excessive workload, and ED crowding not solely persisted but systemic deficiencies and vulnerabilities were accentuated and exacerbated, implicating a 'parallel pandemic' already before the COVID-19 one (277). The pandemic has also taken a toll on providers' physical and mental health, with increased infections, and heightened mental exhaustion and burnout reported. Disruptions in patient care quality and safety, including delays in diagnosis and treatment, further highlight the pandemic's impact. These findings align with existing literature (33-35, 139, 141-144) and underscore the need for ongoing efforts to support ED providers and enhance resource allocation and preparedness for future crises (277).

In relation to the comprehensive consensus reached by the overall panel regarding content validity within this segment, the S-CVI/Ave of .72 reflects a level of consensus among experts that is approaching 'acceptable' (206, 208). Moreover, an ICC of .80, with a 95% CI of .68 and .89, complementarily indicates an 'excellent' level of correlation (210), thereby affirming relatively high inter-rater reliability and consistency among the panelists. Consequently, it appears that these results are uniformly considered both relevant and prevalent across all European nations participating in the study.

5.2.2 Implications for research and clinical practice

Minimizing preventable harm to both patients and healthcare providers necessitates an understanding of the root causes, a shift in work practices and culture, and the promotion of staff engagement towards shared objectives and metrics (278). The survey reveals that emergency physicians are highly motivated in their field, yet stressors such as overcrowding and multitasking lead to significant health consequences, including burnout and exhaustion. These work-related factors are widespread and appear consistently across various healthcare systems throughout Europe.

A notable strength of the present study lies in the first-time Delphi-based recruitment of ED care experts from six European countries, encompassing a range of hospital sizes, allowing for a comprehensive and representative overview of key indicators pertinent to ED provider work-life. Notably, there was a striking alignment between the items identified in the initial Delphi round and those rated in the subsequent round. This concordance likely reflects the direct relevance of these indicators to panelists' daily

experiences, thereby providing valuable insights into avenues for improving ED working conditions.

The results derived from this EUSEM-initiated Delphi study may carry several implications for both research and clinical practice in the field of hospital-based emergency medicine.

Research implications

Focused investigation of pertinent work-life stressors and adverse provider outcomes

This study emphasizes and contributes to expert-derived insights into the most prominent, relevant and prioritized, both positive and negative key work-life system drivers influencing ED providers' work-life and well-being as well as, subsequently, respective adverse health outcomes. This research affirms their pivotal role in targeting and shaping the complex ED work environment. Researchers should delve deeper into understanding the nuanced impact of these identified factors on both ED provider health and satisfaction, to understand their underlying mechanisms and develop setting-tailored interventions.

Exploration and expansion of intervention strategies

This study represents the first attempt to derive expert-based recommendations on effective intervention strategies for enhancing work-life across European ED settings. The findings underscore the necessity for multifaceted, systems-oriented approaches targeting various influential factors to alleviate work-related stress among ED professionals. They offer a validated starting point for warranted further research in real-world ED settings addressing reported and consented both organizational- and team-level interventions identified in this study. Future studies may validate and expand upon the effectiveness of these interventions in real-world European ED settings and explore innovative approaches to tackle ED work-related stress. However, individual-level interventions were clearly low-ranked within panel ratings and thus ought to be another focus of future investigations.

Identification of facilitators and barriers

Panelists' responses were heterogeneous, resulting in a diverse array of potentially supportive or hindering influences during implementation. Therefore, these findings should be regarded as preliminary and serve as a basis for more in-depth investigations. Nonetheless, the collated statements highlight the complexities and multi-layered

intricacies involved in the sustainable implementation of interventions targeting the work-life of ED providers. These factors illuminate the various challenges associated with interventions in this domain, suggesting that comprehensive, system-oriented approaches are essential for successfully designing and securing these improvements in full partnership with all stakeholders (270, 276). The scope of reported factors identifies a varied landscape of facilitators and barriers in modifying work conditions within EDs that should be considered in the intervention design (122). These preliminary findings provide an essential basis and avenues for further investigations and highlight the importance of implementation science in enhancing ED provider work-life. Future studies should explore potentially underlying organizational and contextual factors contributing to the successful adoption and sustainability of these interventions in real-world ED settings and develop strategies to overcome implementation obstacles. In fact, insights from implementation science and organizational change are critical to the success of these ED work-life interventions.

Understanding COVID-19 pandemic-related ED work-life challenges

The comprehensive analysis of challenges faced by ED providers during the COVID-19 pandemic provides valuable insights for future research. Given the significant impact of the COVID-19 pandemic on ED providers, longitudinal studies are needed to assess the long-term effects and evolving challenges faced by ED professionals. Research should focus on tracking changes in workload, stress levels, and well-being over time, as well as identifying effective strategies for mitigating pandemic-related challenges and adverse effects.

Clinical practice implications

Tailored intervention implementation for the enhancement of ED work-life

By identifying and prioritizing key detrimental ED work environments and effective intervention strategies, this study provides actionable insights for clinical practitioners to enhance the work-life of ED providers.

The identified positive general (job challenge: variation and/or interdisciplinary interaction, job control: participation in decision-making, job intellectuality, task significance, and job autonomy), provider-related (personal work ethic and/or motivation, teamwork, social climate and extracurricular activities, work experience and/or utilization of skills, resilience and coping strategies, and positive co-worker relationships), and patient-provider interaction facets (patient case complexity) appear to be reasonable

drivers everyone may relate to, as providers' motivational drivers ought to be promoted by employers for employee retention and career choice gratitude.

The negative general (overcrowding, workflow interruptions and/or multitasking, time pressure and/or lack of breaks, and employee turnover and understaffing), provider-related (medical errors), and patient-provider interaction facets (violence: verbal and/or physical) are well-known and ubiquitous ED work-life stressors that should be controlled and contained. Consequently, familiar adverse physical (physical fatigue), mental (exhaustion and/or mental fatigue, burnout, and compassion fatigue, pessimism and/or cynicism), psychosomatic (insomnia: sleep deprivation and/or disturbance), and behavioral (dropouts / opt-outs, and intentions to leave or reduce working hours, or even career choice regrets) ED provider health outcomes could be omitted or at least mitigated.

Reported and common implemented organizational- (emergency care as autonomous specialty, ED reorganization and/or modernization, evidence-based SOPs and/or training concepts, adaptable staff and duty rostering, and critical incident reporting systems) and team-level ((Simulation-based) skills trainings, debriefings after critical events with potential post-traumatic consequences, and regular feedback from mentors) interventions, may proactively help alleviate work-related stress within clinical practice. A further focus should be put upon on complementarily establishing yet underrepresented individual-level interventions for a preferably multimodal and holistic implementation approach. Moreover, tailoring these practices in a targeted manner, based on the specific needs and challenges of the respective ED, may maximize their effectiveness to address expert-prioritized ED work-life stressors. Hence, this ensures ED professionals' well-being and, in the final instance, maintains and safeguards reliable and high-quality patient care.

Addressing and adapting to COVID-19 challenges

The study comprehensively analyzes the unique and publicly known challenges encountered by ED providers during the COVID-19 pandemic. Several reported aspects induced (shortage of staff, excessive workload: organizational and/or isolation-related, and crowding: ED space limitations and/or exit blocks) and reduced (PPE, vaccination campaigns, testing: PCR and/or POC antigen, persistent information flow, change of SOPs, separate isolation and cohort areas or units, and intra- or interhospital networking) negative impacts on ED work-life and, subsequently, employee-reported quality and safety of patient care. These impacts were namely confirmed COVID-19 infections,

exacerbated mental exhaustion and/or less resilience, anxieties and burnout, as well as undertreatment of emergency medicine diagnoses and delay in patient diagnostic and therapeutic pathways. Implementing effective measures for ensuring ED providers' safety and well-being should be prioritized and highlighted as essential, while also addressing the increased workload and stress associated with pandemic-related care demands. Clinical practitioners may use these insights to adapt practices and enhance preparedness for future crises.

5.2.3 Conclusion and outlook

In conclusion, the consolidation process and the identified list of relevant ED work-life drivers may serve as valuable groundwork to inform future investigations into ED providers' work-life, alongside subsequent, respective improvement and intervention practices to promote work-life and well-being in ED patient care. The reported findings offer valuable guidance for researchers and practitioners alike, providing insights into key factors to consider when examining ED work-life and provider health, as well as when designing respective intervention strategies. Moreover, these results may guide selection and definition of essential work-life factors to be scrutinized in international, cross-European research endeavors.

To this end, a deeper comprehension of effective improvement approaches for ED professionals contributes to the formulation of recommendations regarding their implementation in hospital-based emergency medicine settings across Europe. Ultimately, this contributes to the ongoing efforts to enhance the quality of care provided by EDs and to support the well-being of healthcare providers working within these demanding environments. Furthermore, it is essential to draw insights from this analysis to bolster preparedness for future pandemics, disasters, and mass casualty incidents within European ED settings, aiming for ongoing enhancement in readiness.

This survey employed a consensus-building process to elucidate pertinent aspects of ED work-life, provider health outcomes, strategies for intervention and improvement practices, as well as COVID-19-associated implications. Its results yielded a collection of drivers garnering medium to high consensus, which could serve as valuable inputs for future surveys. Furthermore, these findings may aid in the development of targeted methodologies to explore critical ED work system factors within diverse national contexts.

5.3 Limitations

The present discoveries necessitate nuanced interpretation in light of a myriad of constraints. The imposition of rather stringent inclusion criteria targeting the SMEs (i.e., specifically focusing on senior staff and ED leaders) led to the evaluation of a restricted cohort of panelists and key informants, thereby diminishing the statistical power and significance of metrics. It is imperative to recognize that their perspectives may profoundly differ from those of junior, resident physicians who may encounter disparate stressors in ED work (12), such as mistreatment or career choice regret (269) alongside elevated levels of burnout (272). Additionally, the omission of ED providers from other vital professional categories within ED care, including interns, nurses, physician assistants, nursing assistants, administrative staff, or technicians, deplorably results in a missed opportunity for garnering valuable insights from key informants. Future studies could benefit from enclosing various ED profession cohorts for provision of more diverse ED work-life perspectives. The exclusive inclusion of solely English-speaking panelists, coupled with a notable gender imbalance of five females to thirteen males, may additionally pose a potential bias, thus compromising the external validity of the study statements.

Noteworthy, no objective scales were used to assess the expertise of the included panelists, raising questions about the term "expertise" itself. Moreover, employing a purposive snowball sampling approach introduces the possibility of selection bias among EUSEM members. Furthermore, despite the efforts to encompass countries from diverse geographical regions, the representation of only six nations falls short of adequately encapsulating the entirety of the European continent. Similarly, the choice of three panelists per nation and one panelist per hospital size may fail to comprehend the full spectrum of national emergency medicine societies and care levels, respectively. Subsequent investigations could benefit from contemplating the adoption of more extensive sample sizes with the inclusion of either more countries or more participants per country according to the respective hospital care level.

While the endeavor aimed to address a broad array of potential work-life factors in ED care (such as ED physicians' working conditions, health outcomes, work-life intervention and improvement practices), the potentially omitted consideration of further crucial influential factors (e.g., specific regulatory or national health-system influences), that shape and determine ED providers' work-life, is acknowledged (37). The inherent advantages of Delphi processes in establishing consensus are tempered by and need to be weighed against their feasible drawback of diluting valuable insights and experiences of minority groups or individual evaluations. This is particularly pertinent in capturing nuanced perspectives within particular European countries. Moreover, the

consolidation process, characterized by a limited number of Delphi rounds and restricted panel re-confrontation compared to multi-round approaches, demands acknowledgment.

Additionally, a comprehensive questionnaire would have placed significant time and effort demands on the participants, potentially compromising the feasibility of the study. The solicitude cannot be discounted that the perspectives of the panelists may have undergone alterations during the interim between the two survey iterations, given the substantial temporal gap. This potential divergence in viewpoints could engender a diminished concordance in test-retest reliability when juxtaposed with antecedent evaluations, as the respondents may not have approached the second questionnaire with fidelity to their initial objectives. The listing of predefined competencies and content in the first round of the survey may also be subject to critical discussion. The compilation was based on a narrative rather than a systematic review, meaning that not all competency and content descriptions published in the literature at that time were considered. The respondents may have been biased by the selection. Hence, it is possible that a different preselection, as well as different questions, could have led to different results.

Furthermore, certain DEL-2 survey items potentially presented room for redundancy and lack of differentiation, where providing explanatory notes for better understanding of the specific concepts behind these items could have been recommendable. Notably, despite a-priori applied measurements and thresholds (265), the present consensus criteria (within the second round) and efforts to ensure consistency and reliability in the formulation of statements (within the first round) should be scrutinized cautiously. In addition to known factors influencing the outcomes of Delphi processes, such as participant selection and facilitation methods, the format of rating scales and the chosen consensus thresholds also significantly influence the level of agreement achieved (229, 261-266). Future studies could promptingly benefit from refining their criteria to attain more rigorous findings. Various metrics for defining consensus among panelists have been proposed and could be explored in subsequent investigations (261-264, 266, 279). Additionally, stable disagreement or lack of consensus, potentially offering further valuable insights into differing perspectives on the area under investigation, was not prioritized in this study.

Moreover, the absence of a comparative pre-COVID-19 study in this analysis raises the possibility of pandemic-related bias in panelists' statements. This caveat underscores the importance of contextualizing reported findings within the specific circumstances of the COVID-19 pandemic era.

Ultimately, as the content of this manuscript is partially simultaneously inspired by and used for the upcoming peer-reviewed publication within the EJEM, self-plagiarism cannot be ruled out at this juncture.

6 References

1.   Sakr M, Wardrope J. Casualty, accident and emergency, or emergency medicine, the evolution. Emergency Medicine Journal. 2000;17(5):314-9.

2.   Nuckols TK, Fingar KR, Barrett M, Steiner CA, Stocks C, Owens PL. The Shifting Landscape in Utilization of Inpatient, Observation, and Emergency Department Services Across Payers. Journal of Hospital Medicine. 2017;12(6):443-6.

3.   Berchet C. Emergency Care Services: Trends, Drivers and Interventions to Manage the Demand. OECD Health Working Papers: OECD Publishing, ed. Paris; 2015.

4.   Morganti KG, Bauhoff S, Blanchard JC, Abir M, Iyer N, Smith A, Vesely JV, Okeke EN, Kellermann AL. The Evolving Role of Emergency Departments in the United States. Rand Health Quarterly. 2013;3(2):3.

5.   Bernstein SL, Aronsky D, Duseja R, Epstein S, Handel D, Hwang U, McCarthy M, John McConnell K, Pines JM, Rathlev N, Schafermeyer R, Zwemer F, Schull M, Asplin BR. The effect of emergency department crowding on clinically oriented outcomes. Academic Emergency Medicine. 2009;16(1):1-10.

6.   Stang AS, Wingert AS, Hartling L, Plint AC. Adverse events related to emergency department care: a systematic review. PLOS One. 2013;8(9):e74214.

7.   Formosa EA, Kishimoto V, Orchanian-Cheff A, Hayman K. Emergency department interventions for homelessness: a systematic review. Canadian Journal of Emergency Medicine. 2021;23(1):111-22.

8.   Exadaktylos AK, Zimmermann H. [Interdisciplinary emergency response units: he who comes too late is punished by life and or by the hospital management!]. Deutsche Medizinische Wochenschrift. 2009;134(23):1236-7.

9.   Somasundaram R, Geissler A, Leidel BA, Wrede CE. [Reasons for Emergency Department Visits: Results of a Patient Survey]. Gesundheitswesen. 2018;80(7):621-7.

10.   Shanafelt TD, Boone S, Tan L, Dyrbye LN, Sotile W, Satele D, West CP, Sloan J, Oreskovich MR. Burnout and satisfaction with work-life balance among US physicians relative to the general US population. Archives of Internal Medicine. 2012;172(18):1377-85.

11. Lu DW, Dresden S, McCloskey C, Branzetti J, Gisondi MA. Impact of Burnout on Self-Reported Patient Care Among Emergency Physicians. Western Journal of Emergency Medicine. 2015;16(7):996-1001.

12. Kimo Takayesu J, Ramoska EA, Clark TR, Hansoti B, Dougherty J, Freeman W, Weaver KR, Chang Y, Gross E. Factors associated with burnout during emergency medicine residency. Academic Emergency Medicine. 2014;21(9):1031-5.

13. Johnston A, Abraham L, Greenslade J, Thom O, Carlstrom E, Wallis M, Crilly J. Staff perception of the emergency department working environment: Integrative review of the literature. Emergency Medicine Australasia. 2016;28(1):7-26.

14. Weigl M, Schneider A. Associations of work characteristics, employee strain and self-perceived quality of care in Emergency Departments: A cross-sectional study. International Emergency Nursing. 2017;30:20-4.

15. Basu S, Yap C, Mason S. Examining the sources of occupational stress in an emergency department. Occupational Medicine (London). 2016;66(9):737-42.

16. Schneider A, Weigl M. Associations between psychosocial work factors and provider mental well-being in emergency departments: A systematic review. PLOS One. 2018;13(6):e0197375.

17. Abraham LJ, Thom O, Greenslade JH, Wallis M, Johnston AN, Carlstrom E, Mills D, Crilly J. Morale, stress and coping strategies of staff working in the emergency department: A comparison of two different-sized departments. Emergency Medicine Australasia. 2018;30(3):375-81.

18. Elder E, Johnston ANB, Wallis M, Greenslade JH, Crilly J. Emergency clinician perceptions of occupational stressors and coping strategies: A multi-site study. International Emergency Nursing. 2019;45:17-24.

19. Kansagra SM, Rao SR, Sullivan AF, Gordon JA, Magid DJ, Kaushal R, Camargo CA, Jr., Blumenthal D. A survey of workplace violence across 65 U.S. emergency departments. Academic Emergency Medicine. 2008;15(12):1268-74.

20. Donabedian A. The Quality of Medical Care: Methods for assessing and monitoring the quality of care for research and for quality assurance programs. Science. 1978;200(4344):856-64.

21. Moray N. Culture, politics and ergonomics. Ergonomics. 2000;43(7):858-68.

22. Rasmussen J. Human factors in a dynamic information society: where are we heading? Ergonomics. 2000;43(7):869-79.

23. Kleiner BM. Macroergonomics: Analysis and design of work systems. Applied Ergonomics. 2006;37:81-9.

24. Carayon P, Schoofs Hundt A, Karsh BT, Gurses AP, Alvarado CJ, Smith M, Flatley Brennan P. Work system design for patient safety: the SEIPS model. Quality & Safety in Health Care. 2006;15 Suppl 1:i50-8.

25. Holden RJ, Carayon P, Gurses AP, Hoonakker P, Hundt AS, Ozok AA, Rivera-Rodriguez AJ. SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. Ergonomics. 2013;56(11):1669-86.

26. Carayon P, Wetterneck TB, Rivera-Rodriguez AJ, Hundt AS, Hoonakker P, Holden R, Gurses AP. Human factors systems approach to healthcare quality and patient safety. Applied Ergonomics. 2014;45(1):14-25.

27. Donabedian A. The Quality of Care: How Can It Be Assessed? Journal of American Medical Association. 1988;260(12):1743-8.

28. Karsh BT, Holden RJ, Alper SJ, Or CK. A human factors engineering paradigm for patient safety: designing to support the performance of the healthcare professional. BMJ Quality & Safety. 2006;15 Suppl 1(Suppl 1):i59-65.

29. Schneider A, Wehler M, Weigl M. Effects of work conditions on provider mental well-being and quality of care: a mixed-methods intervention study in the emergency department. BMC Emergency Medicine. 2019;19(1):1.

30. Holliman CJ, Mulligan TM, Suter RE, Cameron P, Wallis L, Anderson PD, Clem K. The efficacy and value of emergency medicine: a supportive literature review. International Journal of Emergency Medicine. 2011;4:44.

31. Sharp AL, Cobb EM, Dresden SM, Richardson DK, Sabbatini AK, Sauser K, Kocher KE. Understanding the value of emergency care: a framework incorporating stakeholder perspectives. Journal of Emergency Medicine. 2014;47(3):333-42.

32. Badr S, Nyce A, Awan T, Cortes D, Mowdawalla C, Rachoin JS. Measures of Emergency Department Crowding, a Systematic Review. How to Make Sense of a Long List. Open Access Emergency Medicine. 2022;14:5-14.

33. Sartini M, Carbone A, Demartini A, Giribone L, Oliva M, Spagnolo AM, Cremonesi P, Canale F, Cristina ML. Overcrowding in Emergency Department: Causes, Consequences, and Solutions-A Narrative Review. Healthcare (Basel, Switzerland). 2022;10(9):1625.

34. Savioli G, Ceresa IF, Gri N, Bavestrello Piccini G, Longhitano Y, Zanza C, Piccioni A, Esposito C, Ricevuti G, Bressan MA. Emergency Department Overcrowding: Understanding the Factors to Find Corresponding Solutions. Journal of Personalized Medicine. 2022;12(2):279.

35. Pearce S, Marchand T, Shannon T, Ganshorn H, Lang E. Emergency department crowding: an overview of reviews describing measures causes, and harms. Internal and Emergency Medicine. 2023;18(4):1137-58.

36. Basu S, Qayyum H, Mason S. Occupational stress in the ED: a systematic literature review. Emergency Medicine Journal. 2017;34(7):441-7.

37. Greenslade JH, Wallis M, Johnston AN, Carlstrom E, Wilhelms DB, Crilly J. Key occupational stressors in the ED: an international comparison. Emergency Medicine Journal. 2020;37(2):106-11.

38. Stehman CR, Testo Z, Gershaw RS, Kellogg AR. Burnout, Drop Out, Suicide: Physician Loss in Emergency Medicine, Part I. Western Journal of Emergency Medicine. 2019;20(3):485-94.

39. Stewart NH, Arora VM. The Impact of Sleep and Circadian Disorders on Physician Burnout. Chest. 2019;156(5):1022-30.

40. Ardizzone E, Lerchbaumer E, Heinzel JC, Winter N, Prahm C, Kolbenschlag J, Daigeler A, Lauer H. Insomnia-A Systematic Review and Comparison of Medical Resident's Average Off-Call Sleep Times. International Journal of Environmental Research and Public Health. 2023;20(5):4180.

41. Fowler LA, Hirsh EL, Klinefelter Z, Sulzbach M, Britt TW. Objective assessment of sleep and fatigue risk in emergency medicine physicians. Academic Emergency Medicine. 2023;30(3):166-71.

42. Morgenstern J, Heitz C, Milne WK. Hot off the press: Sleep and fatigue risk in emergency medicine physicians. Academic Emergency Medicine. 2023;30(8):877-9.

43. Patterson PD, Mountz KA, Budd CT, Bubb JL, Hsin AU, Weaver MD, Turner RL, Platt TE, Guyette FX, Martin-Gill C, Buysse DJ, Callaway CW. Impact of shift work on blood pressure among emergency medical services clinicians and related shift workers: A systematic review and meta-analysis. Sleep Health. 2020;6(3):387-98.

44. Dorevitch S, Forst L. The occupational hazards of emergency physicians. American Journal of Emergency Medicine. 2000;18(3):300-11.

45. Weigl M, Beck J, Wehler M, Schneider A. Workflow interruptions and stress atwork: a mixed-methods study among physicians and nurses of a multidisciplinary emergency department. BMJ Open. 2017;7(12):e019074.

46. Schneider A, Williams D, Kalynych C, Wehler M, Weigl M. Physicians' and nurses' work time allocation and workflow interruptions in emergency departments: a comparative time-motion study across two countries. Emergency Medicine Journal. 2020;38(4):263-8.

47. Augenstein T, Schneider A, Wehler M, Weigl M. Multitasking behaviors and provider outcomes in emergency department physicians: two consecutive, observational and multi-source studies. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 2021;29(1):14.

48. Danesh V, Sasangohar F, Kallberg AS, Kean EB, Brixey JJ, Johnson KD. Systematic review of interruptions in the emergency department work environment. International Emergency Nursing. 2022;63:101175.

49. Liu J, Gan Y, Jiang H, Li L, Dwyer R, Lu K, Yan S, Sampson O, Xu H, Wang C, Zhu Y, Chang Y, Yang Y, Yang T, Chen Y, Song F, Lu Z. Prevalence of workplace violence against healthcare workers: a systematic review and meta-analysis. Occupational and Environmental Medicine. 2019;76(12):927-37.

50. Timmins F, Timmins B. An integrative review of waiting time, queuing, and design as contributory factors to emergency department violence. Journal of Evidence-Based Medicine. 2021;14(2):139-51.

51. Chakraborty S, Mashreky SR, Dalal K. Violence against physicians and nurses: a systematic literature review. Journal of Public Health. 2022;30(8):1837-55.

52. Caruso R, Toffanin T, Folesani F, Biancosino B, Romagnolo F, Riba MB, McFarland D, Palagini L, Belvederi Murri M, Zerbinati L, Grassi L. Violence Against Physicians in the Workplace: Trends, Causes, Consequences, and Strategies for Intervention. Current Psychiatry Reports. 2022;24(12):911-24.

53. Robertson JJ, Long B. Suffering in Silence: Medical Error and its Impact on Health Care Providers. Journal of Emergency Medicine. 2018;54(4):402-9.

54. Zavala AM, Day GE, Plummer D, Bamford-Wade A. Decision-making under pressure: medical errors in uncertain and dynamic environments. Australian Health Review. 2018;42(4):395-402.

55. Crilly J, Greenslade JH, Johnston A, Carlstrom E, Thom O, Abraham L, Mills D, Wallis M. Staff perceptions of the emergency department working environment: An international cross-sectional survey. Emergency Medicine Australasia. 2019;31(6):1082-91.

56. Owen CP, Djukic M, Whisenant M, Lobiondo-Wood G. Factors of maladaptive coping in emergency healthcare professionals: A systematic review. Journal of Nursing Scholarship. 2023;55(2):536-48.

57. Somville F, Van Bogaert P, Wellens B, De Cauwer H, Franck E. Work stress and burnout among emergency physicians: a systematic review of last 10 years of research. Acta Clinica Belgica. 2024;79(1):52-61.

58. Somville F, Van der Mieren G, De Cauwer H, Van Bogaert P, Franck E. Burnout, stress and Type D personality amongst hospital/emergency physicians.

International Archives of Occupational and Environmental Health. 2022;95(2):389-98.

59. Thielmann B, Pohl R, Böckelmann I. Heart rate variability as a strain indicator for psychological stress for emergency physicians during work and alert intervention: a systematic review. Journal of Occupational Medicine and Toxicology (London, England). 2021;16(1):24.

60. Bragard I, Dupuis G, Fleet R. Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. European Journal of Emergency Medicine. 2015;22(4):227-34.

61. Boutou A, Pitsiou G, Sourla E, Kioumis I. Burnout syndrome among emergency medicine physicians: an update on its prevalence and risk factors. European Review for Medical and Pharmacological Sciences. 2019;23(20):9058-65.

62. Lui JNM, Andres EB, Johnston JM. Presenteeism exposures and outcomes amongst hospital doctors and nurses: a systematic review. BMC Health Services Research. 2018;18(1):985.

63. Darbyshire D, Brewster L, Isba R, Body R, Basit U, Goodwin D. Retention of doctors in emergency medicine: a scoping review of the academic literature. Emergency Medicine Journal. 2021;38(9):663-72.

64. Hodkinson A, Zhou A, Johnson J, Geraghty K, Riley R, Zhou A, Panagopoulou E, Chew-Graham CA, Peters D, Esmail A, Panagioti M. Associations of physician burnout with career engagement and quality of patient care: systematic review and meta-analysis. BMJ (Clinical Research Ed). 2022;378:e070442.

65. Petrino R, Tuunainen E, Bruzzone G, Garcia-Castrillo L. Patient safety in emergency departments: a problem for health care systems? An international survey. European Journal of Emergency Medicine. 2023;30(4):280-6.

66. Weigl M, Müller A, Holland S, Wedel S, Woloshynowych M. Work conditions, mental workload and patient care quality: a multisource study in the emergency department. BMJ Quality & Safety. 2016;25(7):499-508.

67. Wolfe A. Institute of Medicine report: Crossing the Quality Chasm: a New Health Care System for the 21st Century. Policy, Politics, & Nursing Practice. 2001;2(3):233-5.

68. De Freitas L, Goodacre S, O'Hara R, Thokala P, Hariharan S. Interventions to improve patient flow in emergency departments: an umbrella review. Emergency Medicine Journal. 2018;35(10):626-37.

69. Bittencourt RJ, Stevanato AM, Bragança C, Gottems LBD, O'Dwyer G. Interventions in overcrowding of emergency departments: an overview of systematic reviews. Revista de Saúde Pública. 2020;54:66.

70.   Grant KL, Bayley CJ, Premji Z, Lang E, Innes G. Throughput interventions to reduce emergency department crowding: A systematic review. Canadian Journal of Emergency Medicine. 2020;22(6):864-74.

71.   Moe J, Kirkland SW, Rawe E, Ospina MB, Vandermeer B, Campbell S, Rowe BH. Effectiveness of Interventions to Decrease Emergency Department Visits by Adult Frequent Users: A Systematic Review. Academic Emergency Medicine. 2017;24(1):40-52.

72.   Laker LF, Torabi E, France DJ, Froehle CM, Goldlust EJ, Hoot NR, Kasaie P, Lyons MS, Barg-Walkow LH, Ward MJ, Wears RL. Understanding Emergency Care Delivery Through Computer Simulation Modeling. Academic Emergency Medicine. 2018;25(2):116-27.

73.   Ortíz-Barrios MA, Alfaro-Saíz JJ. Methodological Approaches to Support Process Improvement in Emergency Departments: A Systematic Review. International Journal of Environmental Research and Public Health. 2020;17(8):2664.

74.   Maninchedda M, Proia AS, Bianco L, Aromatario M, Orsi GB, Napoli C. Main Features and Control Strategies to Reduce Overcrowding in Emergency Departments: A Systematic Review of the Literature. Risk Management and Healthcare Policy. 2023;16:255-66.

75.   Larburu N, Azkue L, Kerexeta J. Predicting Hospital Ward Admission from the Emergency Department: A Systematic Review. Journal of Personalized Medicine. 2023;13(5):849.

76.   Silva E, Pereira MF, Vieira JT, Ferreira-Coimbra J, Henriques M, Rodrigues NF. Predicting hospital emergency department visits accurately: A systematic review. International Journal of Health Planning and Management. 2023;38(4):904-17.

77.   Souza DL, Korzenowski AL, Alvarado MM, Sperafico JH, Ackermann AEF, Mareth T, Scavarda AJ. A Systematic Review on Lean Applications' in Emergency Departments. Healthcare (Basel, Switzerland). 2021;9(6):763.

78.   Clark J, Islam MS. Hospital Access Block: A Scoping Review. Journal of Emergency Nursing. 2022;48(4):430-54.

79.   Tlapa D, Tortorella G, Fogliatto F, Kumar M, Mac Cawley A, Vassolo R, Enberg L, Baez-Lopez Y. Effects of Lean Interventions Supported by Digital Technologies on Healthcare Services: A Systematic Review. International Journal of Environmental Research and Public Health. 2022;19(15):9018.

80.   Elder E, Johnston AN, Crilly J. Review article: systematic review of three key strategies designed to improve patient flow through the emergency department. Emergency Medicine Australasia. 2015;27(5):394-404.

81. Jarvis PR. Improving emergency department patient flow. Clinical and Experimental Emergency Medicine. 2016;3(2):63-8.

82. Reid LE, Dinesen LC, Jones MC, Morrison ZJ, Weir CJ, Lone NI. The effectiveness and variation of acute medical units: a systematic review. International Journal for Quality in Health Care. 2016;28(4):433-46.

83. Franklin BJ, Mueller SK, Bates DW, Gandhi TK, Morris CA, Goralnick E. Use of Hospital Capacity Command Centers to Improve Patient Flow and Safety: A Scoping Review. Journal of Patient Safety. 2022;18(6):e912-e21.

84. Benabbas R, Shah R, Zonnoor B, Mehta N, Sinert R. Impact of triage liaison provider on emergency department throughput: A systematic review and meta-analysis. American Journal of Emergency Medicine. 2020;38(8):1662-70.

85. Fernandes M, Vieira SM, Leite F, Palos C, Finkelstein S, Sousa JMC. Clinical Decision Support Systems for Triage in the Emergency Department using Intelligent Systems: a Review. Artificial Intelligence in Medicine. 2020;102:101762.

86. Boonstra A, Laven M. Influence of artificial intelligence on the work design of emergency department clinicians a systematic literature review. BMC Health Services Research. 2022;22(1):669.

87. Flynn D, Knoedler MA, Hess EP, Murad MH, Erwin PJ, Montori VM, Thomson RG. Engaging patients in health care decisions in the emergency department through shared decision-making: a systematic review. Academic Emergency Medicine. 2012;19(8):959-67.

88. Coronado-Vázquez V, Gómez-Salgado J, Cerezo-Espinosa de Los Monteros J, García-Colinas MA. Shared Decision-Support Tools in Hospital Emergency Departments: A Systematic Review. Journal of Emergency Nursing. 2019;45(4):386-93.

89. Stewart J, Lu J, Goudie A, Arendts G, Meka SA, Freeman S, Walker K, Sprivulis P, Sanfilippo F, Bennamoun M, Dwivedi G. Applications of natural language processing at emergency department triage: A narrative review. PLOS One. 2023;18(12):e0279953.

90. Hockstein MA, Pope SN, Donnawell K, Chavez SA, Bhat L. Emergency Medicine Residents on Electronic Medical Records: Perspectives and Advice. Cureus. 2019;11(2):e4027.

91. Mullins A, O'Donnell R, Mousa M, Rankin D, Ben-Meir M, Boyd-Skinner C, Skouteris H. Health Outcomes and Healthcare Efficiencies Associated with the Use of Electronic Health Records in Hospital Emergency Departments: a Systematic Review. Journal of Medical Systems. 2020;44(12):200.

92. Pourmand A, Roberson J, Gallugi A, Sabha Y, O'Connell F. Secure smartphone application-based text messaging in emergency department, a system implementation and review of literature. American Journal of Emergency Medicine. 2018;36(9):1680-5.

93. Overmann KM, Wu DTY, Xu CT, Bindhu SS, Barrick L. Real-time locating systems to improve healthcare delivery: A systematic review. Journal of American Medical Informatics Association. 2021;28(6):1308-17.

94. Behringer W, Dodt C. [Physician staffing and shift work schedules : Concepts for emergency and intensive care medicine]. Medizinische Klinik, Intensivmedizin und Notfallmedizin. 2020;115(6):449-57.

95. Elder EG, Johnston A, Wallis M, Crilly J. Work-based strategies/interventions to ameliorate stressors and foster coping for clinical staff working in emergency departments: a scoping review of the literature. Australasian Emergency Care. 2020;23(3):181-92.

96. Sephien A, Reljic T, Jordan J, Prida X, Kumar A. Resident duty hours and resident and patient outcomes: Systematic review and meta-analysis. Medical Education. 2023;57(3):221-32.

97. Redinger J, Kabil E, Forkin KT, Kleiman AM, Dunn LK. Resting and Recharging: A Narrative Review of Strategies to Improve Sleep During Residency Training. Journal of Graduate Medical Education. 2022;14(4):420-30.

98. Bristow DP, Herrick CA. Emergency department case management: the dyad team of nurse case manager and social worker improve discharge planning and patient and staff satisfaction while decreasing inappropriate admissions and costs: a literature review. Lippincott's Case Management. 2002;7(6):243-51.

99. Fairbanks RJ, Rueckmann EA, Kolstee KE, Hays DP, Cobaugh DJ, Wears RL, Dewar KH, Martin HA, Davis CO, Schneider SM, Shah MN. Clinical Pharmacists in Emergency Medicine. In: Henriksen K, Battles JB, Keyes MA, Grady ML, editors. Advances in Patient Safety: New Directions and Alternative Approaches (Vol 4: Technology and Medication Safety). Rockville (MD): Agency for Healthcare Research and Quality (US); 2008.

100. Ramirez D, Engel KG, Tang TS. Language interpreter utilization in the emergency department setting: a clinical review. Journal of Health Care for the Poor and Underserved. 2008;19(2):352-62.

101. Gottlieb M, Palter J, Westrick J, Peksa GD. Effect of Medical Scribes on Throughput, Revenue, and Patient and Provider Satisfaction: A Systematic Review and Meta-analysis. Annals of Emergency Medicine. 2021;77(2):180-9.

102. Amaniyan S, Faldaas BO, Logan PA, Vaismoradi M. Learning from Patient Safety Incidents in the Emergency Department: A Systematic Review. Journal of Emergency Medicine. 2020;58(2):234-44.

103. Kumari A, Kaur T, Ranjan P, Chopra S, Sarkar S, Baitha U. Workplace violence against doctors: Characteristics, risk factors, and mitigation strategies. Journal of Postgraduate Medicine. 2020;66(3):149-54.

104. Wirth T, Peters C, Nienhaus A, Schablon A. Interventions for Workplace Violence Prevention in Emergency Departments: A Systematic Review. International Journal of Environmental Research and Public Health. 2021;18(16):8459.

105. Seward MW, Marso CC, Soled DR, Briggs LG. Medicine in Motion: Addressing Physician Burnout Through Fitness, Philanthropy, and Interdisciplinary Community Building. American Journal of Lifestyle Medicine. 2022;16(4):462-8.

106. Wilson S, Rixon A, Hartanto S, White P, Judkins S. Systematic literature review of leadership in emergency departments. Emergency Medicine Australasia. 2020;32(6):935-52.

107. Garcia JT, DuBose L, Arunachalam P, Hairrell AS, Milman RM, Carpenter RO. The Effects of Humor in Clinical Settings on Medical Trainees and the Implications for Medical Educators: A Scoping Review. Medical Science Educator. 2023;33(2):611-22.

108. Farnan JM, Petty LA, Georgitis E, Martin S, Chiu E, Prochaska M, Arora VM. A systematic review: the effect of clinical supervision on patient and residency education outcomes. Academic Medicine. 2012;87(4):428-42.

109. Stassen P, Westerman D. Novice Doctors in the Emergency Department: A Scoping Review. Cureus. 2022;14(6):e26245.

110. Le Grand Rogers R, Narvaez Y, Venkatesh AK, Fleischman W, Hall MK, Taylor RA, Hersey D, Sette L, Melnick ER. Improving emergency physician performance using audit and feedback: a systematic review. American Journal of Emergency Medicine. 2015;33(10):1505-14.

111. Heesters V, Witlox R, van Zanten HA, Jansen SJ, Visser R, Heijstek V, Te Pas AB. Video recording emergency care and video-reflection to improve patient care; a narrative review and case-study of a neonatal intensive care unit. Frontiers in Pediatrics. 2022;10:931055.

112. Chathampally Y, Cooper B, Wood DB, Tudor G, Gottlieb M. Evolving from Morbidity and Mortality to a Case-based Error Reduction Conference: Evidence-based Best Practices from the Council of Emergency Medicine Residency Directors. Western Journal of Emergency Medicine. 2020;21(6):231-41.

113. Lorenzini G, Zamboni A, Gelati L, Di Martino A, Pellacani A, Barbieri N, Baraldi M. Emergency team competencies: scoping review for the development of a tool to support the briefing and debriefing activities of emergency healthcare providers. Journal of Anesthesia, Analgesia and Critical Care. 2023;3(1):24.

114. Phillips EC, Smith SE, Tallentire V, Blair S. Systematic review of clinical debriefing tools: attributes and evidence for use. BMJ Quality & Safety. 2023;33(3):187-98.

115. Gerrard KM, Shepherd J, Sehdev R, Gangathimmaiah V, Nagle C. Meeting the wellness needs of emergency department clinicians: A scoping review of interventions. Australasian Emergency Care. 2023;26(2):169-78.

116. Cohen C, Pignata S, Bezak E, Tie M, Childs J. Workplace interventions to improve well-being and reduce burnout for nurses, physicians and allied healthcare professionals: a systematic review. BMJ Open. 2023;13(6):e071203.

117. Alsabri M, Boudi Z, Lauque D, Dias RD, Whelan JS, Östlundh L, Alinier G, Onyeji C, Michel P, Liu SW, Jr Camargo CA, Lindner T, Slagman A, Bates DW, Tazarourte K, Singer SJ, Toussi A, Grossman S, Bellou A. Impact of Teamwork and Communication Training Interventions on Safety Culture and Patient Safety in Emergency Departments: A Systematic Review. Journal of Patient Safety. 2022;18(1):e351-e61.

118. Moslehi S, Masoumi G, Barghi-Shirazi F. Benefits of simulation-based education in hospital emergency departments: A systematic review. Journal of Education and Health Promotion. 2022;11:40.

119. Young C, Patey C, Norman P, Chan T, Hurley O, Swab M, Asghari S. Identifying relevant topics and training methods for emergency department flow training. Canadian Journal of Emergency Medicine. 2022;24(8):837-43.

120. Abbas JR, Chu MMH, Jeyarajah C, Isba R, Payton A, McGrath B, Tolley N, Bruce I. Virtual reality in simulation-based emergency skills training: A systematic review with a narrative synthesis. Resuscitation Plus. 2023;16:100484.

121. Kunzler AM, Helmreich I, Chmitorz A, König J, Binder H, Wessa M, Lieb K. Psychological interventions to foster resilience in healthcare professionals. Cochrane Database of Systematic Reviews. 2020;7(7):CD012527.

122. Xu HG, Kynoch K, Tuckett A, Eley R. Effectiveness of interventions to reduce emergency department staff occupational stress and/or burnout: a systematic review. JBI Evidence Synthesis. 2020;18(6):1156-88.

123. Angelopoulou P, Panagopoulou E. Resilience interventions in physicians: A systematic review and meta-analysis. Applied Psychology: Health and Well-Being. 2022;14(1):3-25.

124. Townsley AP, Li-Wang J, Katta R. Healthcare Workers' Well-Being: A Systematic Review of Positive Psychology Interventions. Cureus. 2023;15(1):e34102.

125. Di Nota PM, Bahji A, Groll D, Carleton RN, Anderson GS. Proactive psychological programs designed to mitigate posttraumatic stress injuries among at-risk workers: a systematic review and meta-analysis. Systematic Reviews. 2021;10(1):126.

126. Barger LK, Runyon MS, Renn ML, Moore CG, Weiss PM, Condle JP, Flickinger KL, Divecha AA, Coppler PJ, Sequeira DJ, Lang ES, Higgins JS, Patterson PD. Effect of Fatigue Training on Safety, Fatigue, and Sleep in Emergency Medical Services Personnel and Other Shift Workers: A Systematic Review and Meta-Analysis. Prehospital Emergency Care. 2018;22(sup1):58-68.

127. Heng KW. Teaching and evaluating multitasking ability in emergency medicine residents - what is the best practice? International Journal of Emergency Medicine. 2014;7:41.

128. Skaugset LM, Farrell S, Carney M, Wolff M, Santen SA, Perry M, Cico SJ. Can You Multitask? Evidence and Limitations of Task Switching and Multitasking in Emergency Medicine. Annals of Emergency Medicine. 2016;68(2):189-95.

129. Reimer AP, Alfes CM, Rowe AS, Rodriguez-Fox BM. Emergency Patient Handoffs: Identifying Essential Elements and Developing an Evidence-Based Training Tool. Journal of Continuing Education in Nursing. 2018;49(1):34-41.

130. Alimenti D, Buydos S, Cunliffe L, Hunt A. Improving perceptions of patient safety through standardizing handoffs from the emergency department to the inpatient setting: a systematic review. Journal of the American Association of Nurse Practitioners. 2019;31(6):354-63.

131. Fendel JC, Bürkle JJ, Göritz AS. Mindfulness-Based Interventions to Reduce Burnout and Stress in Physicians: A Systematic Review and Meta-Analysis. Academic Medicine. 2021;96(5):751-64.

132. Sholtes D, Kravitz HM, Deka A, Westrick J, Fogg LF, Gottlieb M. Optimising sleep and performance during night float: A systematic review of evidence and implications for graduate medical education trainees. Journal of Sleep Research. 2021;30(4):e13212.

133. van Wormer K, Boes M. Humor in the emergency room: a social work perspective. Health & Social Work. 1997;22(2):87-92.

134. Bennett HJ. Humor in Medicine. Southern Medical Journal. 2003;96(12):1257-61.

135. Penson RT, Partridge RA, Rudd P, Seiden MV, Nelson JE, Chabner BA, Lynch TJ, Jr. Laughter: the best medicine? Oncologist. 2005;10(8):651-60.

136. Petrino R, Castrillo LG, Yilmaz B, Dodt C, Tuunainen E, Khoury A. Policy statement on minimal standards for safe working conditions in Emergency Medicine. European Journal of Emergency Medicine. 2022;29(6):389-90.

137. Tavender EJ, Bosch M, Fiander M, Knott JC, Gruen RL, O'Connor D. Implementation research in emergency medicine: a systematic scoping review. Emergency Medicine Journal. 2016;33(9):652-9.

138. de Wit K, Curran J, Thoma B, Dowling S, Lang E, Kuljic N, Perry JJ, Morrison L. Review of implementation strategies to change healthcare provider behaviour in the emergency department. Canadian Journal of Emergency Medicine. 2018;20(3):453-60.

139. Mogharab V, Ostovar M, Ruszkowski J, Hussain SZM, Shrestha R, Yaqoob U, Aryanpoor P, Nikkhoo AM, Heidari P, Jahromi AR, Rayatdoost E, Ali A, Javdani F, Farzaneh R, Ghanaatpisheh A, Habibzadeh SR, Foroughian M, Ahmadi SR, Akhavan R, Abbasi B, Shahi B, Hakemi A, Bolvardi E, Bagherian F, Motamed M, Boroujeni ST, Jamalnia S, Mangouri A, Paydar M, Mehrasa N, Shirali D, Sanmarchi F, Saeed A, Jafari NA, Babou A, Kalani N, Hatami N. Global burden of the COVID-19 associated patient-related delay in emergency healthcare: a panel of systematic review and meta-analyses. Globalization and Health. 2022;18(1):58.

140. Chamsi-Pasha H, Chamsi-Pasha M, Albar MA. Ethical dilemmas in the era of COVID-19. Avicenna Journal of Medicine. 2020;10(3):102-5.

141. Gualano MR, Sinigaglia T, Lo Moro G, Rousset S, Cremona A, Bert F, Siliquini R. The Burden of Burnout among Healthcare Professionals of Intensive Care Units and Emergency Departments during the COVID-19 Pandemic: A Systematic Review. International Journal of Environmental Research and Public Health. 2021;18(15):8172.

142. Alanazi TNM, McKenna L, Buck M, Alharbi RJ. Reported effects of the COVID-19 pandemic on the psychological status of emergency healthcare workers: A scoping review. Australasian Emergency Care. 2022;25(3):197-212.

143. Claponea RM, Pop LM, Iorga M, Iurcov R. Symptoms of Burnout Syndrome among Physicians during the Outbreak of COVID-19 Pandemic-A Systematic Literature Review. Healthcare (Basel, Switzerland). 2022;10(6):979.

144. Alanazy ARM, Alruwaili A. The Global Prevalence and Associated Factors of Burnout among Emergency Department Healthcare Workers and the Impact of the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. Healthcare (Basel, Switzerland). 2023;11(15):2220.

145. Goolsby C, Lala V, Gebner R, Dacuyan-Faucher N, Charlton N, Schuler K. Emergency physician risk of occupational mortality: A scoping review. Journal of American College of Emergency Physicians Open. 2021;2(5):e12554.

146. Nadarajan GD, Omar E, Abella BS, Hoe PS, Do Shin S, Ma MH, Ong MEH. A conceptual framework for Emergency department design in a pandemic. Scandinavian Journal of Trauma, Resuscitation and Emergency medicine. 2020;28(1):118.

147. Wallace DW, Burleson SL, Heimann MA, Crosby JC, Swanson J, Gibson CB, Greene C. An adapted emergency department triage algorithm for the COVID-19 pandemic. Journal of American College of Emergency Physicians Open. 2020;1(6):1374-9.

148. Gola M, Caggiano G, De Giglio O, Napoli C, Diella G, Carlucci M, Carpagnano LF, D'Alessandro D, Joppolo CM, Capolongo S, Montagna MT. SARS-CoV-2 indoor contamination: considerations on anti-COVID-19 management of ventilation systems, and finishing materials in healthcare facilities. Annali di Igiene: Medicina Preventiva e di Comunità. 2021;33(4):381-92.

149. Piscitelli P, Miani A, Setti L, De Gennaro G, Rodo X, Artinano B, Vara E, Rancan L, Arias J, Passarini F, Barbieri P, Pallavicini A, Parente A, D'Oro EC, De Maio C, Saladino F, Borelli M, Colicino E, Gonçalves LMG, Di Tanna G, Colao A, Leonardi GS, Baccarelli A, Dominici F, Ioannidis JPA, Domingo JL. The role of outdoor and indoor air quality in the spread of SARS-CoV-2: Overview and recommendations by the research group on COVID-19 and particulate matter (RESCOP commission). Environmental Research. 2022;211:113038.

150. Dancer SJ. Reducing the risk of COVID-19 transmission in hospitals: focus on additional infection control strategies. Surgery (Oxford, Oxfordshire). 2021;39(11):752-8.

151. Hamilton AJ, Strauss AT, Martinez DA, Hinson JS, Levin S, Lin G, Klein EY. Machine learning and artificial intelligence: applications in healthcare epidemiology. Antimicrobial Stewardship & Healthcare Epidemiology. 2021;1(1):e28.

152. Chenais G, Lagarde E, Gil-Jardiné C. Artificial Intelligence in Emergency Medicine: Viewpoint of Current Applications and Foreseeable Opportunities and Challenges. Journal of Medical Internet Research. 2023;25:e40031.

153. Farzandipour M, Nabovati E, Sharif R. The effectiveness of tele-triage during the COVID-19 pandemic: A systematic review and narrative synthesis. Journal of Telemedicine and Telecare. 2023:1357633x221150278.

154. Ziebart C, Kfrerer ML, Stanley M, Austin LC. A Digital-First Health Care Approach to Managing Pandemics: Scoping Review of Pandemic Self-triage Tools. Journal of Medical Internet Research. 2023;25:e40983.

155. Jaffe TA, Hayden E, Uscher-Pines L, Sousa J, Schwamm LH, Mehrotra A, Zachrison KS. Telehealth use in emergency care during coronavirus disease 2019: a systematic review. Journal of American College of Emergency Physicians Open. 2021;2(3):e12443.

156. Ganjali R, Jajroudi M, Kheirdoust A, Darroudi A, Alnattah A. Telemedicine solutions for clinical care delivery during COVID-19 pandemic: A scoping review. Frontiers in Public Health. 2022;10:937207.

157. Ong ZH, Tan LHE, Ghazali HZB, Ong YT, Koh JWH, Ang RZE, Bok C, Chiam M, Lee ASI, Chin AMC, Zhou JX, Chan GWH, Nadarajan GD, Krishna LKR. A Systematic Scoping Review on Pedagogical Strategies of Interprofessional Communication for Physicians in Emergency Medicine. Journal of Medical Education and Curricular Development. 2021;8:23821205211041794.

158. Carbone R, Ferrari S, Callegarin S, Casotti F, Turina L, Artioli G, Bonacaro A. Peer support between healthcare workers in hospital and out-of-hospital settings: a scoping review. Acta Biomedica. 2022;93(5):e2022308.

159. Hunt RC, Struminger BB, Redd JT, Herrmann J, Jolly BT, Arora S, Armistad AJ, Dezan AM, Bennett CA, Krohmer JR, Brown LH. Virtual Peer-to-Peer Learning to Enhance and Accelerate the Health System Response to COVID-19: The HHS ASPR Project ECHO COVID-19 Clinical Rounds Initiative. Annals of Emergency Medicine. 2021;78(2):223-8.

160. Sobel J, Hayden SR, Wardi G. The Knowledge Gap: Mentorship in Emergency Medicine Residency. Annals of Emergency Medicine. 2023;82(1):47-54.

161. Pallavicini F, Pepe A, Clerici M, Mantovani F. Virtual Reality Applications in Medicine During the COVID-19 Pandemic: Systematic Review. JMIR Serious Games. 2022;10(4):e35000.

162. Boutros P, Kassem N, Nieder J, Jaramillo C, von Petersdorff J, Walsh FJ, Bärnighausen T, Barteit S. Education and Training Adaptations for Health Workers during the COVID-19 Pandemic: A Scoping Review of Lessons Learned and Innovations. Healthcare (Basel, Switzerland). 2023;11(21):2902.

163. Charnetski MD, Wawersik D, Palaganas JC, Duff JP, Bailey SKT, Ramachandra G, Birido N, Elkin R, Nair B, Thurber P, Gross IT. Understanding the Effects of Health Care Distance Simulation: A Systematic Review. Simulation in Healthcare. 2024;19(1s):57-64.

164. Tement S, Ketiš ZK, Miroševič Š, Selič-Zupančič P. The Impact of Psychological Interventions with Elements of Mindfulness (PIM) on Empathy, Well-Being, and Reduction of Burnout in Physicians: A Systematic Review. International Journal of Environmental Research and Public Health. 2021;18(21):11181.

165. Malik H, Annabi CA. The impact of mindfulness practice on physician burnout: A scoping review. Frontiers in Psychology. 2022;13:956651.

166. Son C, Sasangohar F, Rao AH, Larsen EP, Neville T. Resilient performance of emergency department: Patterns, models and strategies. Safety Science. 2019;120:362-73.

167. Katari R. Regarding Wellness and Burnout Initiatives in Emergency Medicine. Academic Emergency Medicine. 2018;25(5):607-8.

168. Wachs P, Saurin TA, Righi AW, Wears RL. Resilience skills as emergent phenomena: A study of emergency departments in Brazil and the United States. Applied Ergonomics. 2016;56:227-37.

169. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007;19(6):349-57.

170. Kelley K, Clark B, Brown V, Sitzia J. Good practice in the conduct and reporting of survey research. International Journal for Quality in Health Care. 2003;15(3):261-6.

171. Burns KE, Duffett M, Kho ME, Meade MO, Adhikari NK, Sinuff T, Cook DJ. A guide for the design and conduct of self-administered surveys of clinicians. Canadian Medical Association Journal. 2008;179(3):245-52.

172. O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. Standards for reporting qualitative research: a synthesis of recommendations. Academic Medicine. 2014;89(9):1245-51.

173. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. Administration and Policy in Mental Health and Mental Health Services Research. 2015;42:533-44.

174. Dalkey N, Helmer O. An experimental application of the Delphi method to the use of experts. Management Science. 1963;9(3):458-67.

175. Linstone HA, Turoff ME. The Delphi Method-Techniques and Applications: Reading, MA: Addison-Wesley.; 1975.

176. Rowe G, Wright G. Expert Opinions in Forecasting: The Role of the Delphi Technique. In: Armstrong JS, editor. Principles of Forecasting: A Handbook for Researchers and Practitioners. Boston, MA: Springer US; 2001. p. 125-44.

177. Hsu C-C, Sandford BA. The Delphi Technique: Making Sense of Consensus. Practical Assessment, Research and Evaluation. 2007;12:10.

178. Helmer O. Analysis of the future: The Delphi method. Rand Corporation Santa Monica; 1967.

179. Sackman H. Delphi assessment: Expert opinion, forecasting, and group process. Santa Monica, CA: R-1283-PR; 1974.

180. Pill J. The Delphi method: substance, context, a critique and an annotated bibliography. Socio-Economic Planning Sciences. 1971;5(1):57-71.

181. Gupta UG, Clarke RE. Theory and applications of the Delphi technique: A bibliography (1975–1994). Technological Forecasting and Social Change. 1996;53(2):185-211.

182. Flostrand A, Pitt L, Bridson S. The Delphi technique in forecasting–A 42-year bibliographic analysis (1975–2017). Technological Forecasting and Social Change. 2020;150:119773.

183. Beiderbeck D, Frevel N, von der Gracht HA, Schmidt SL, Schweitzer VM. Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements. MethodsX. 2021;8:101401.

184. Niederberger M, Deckert S. Das Delphi-Verfahren: Methodik, Varianten und Anwendungsbeispiele. Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen. 2022;174:11-9.

185. Adler M, Ziglio E. Gazing into the oracle: The Delphi method and its application to social policy and public health: Jessica Kingsley Publishers; 1996.

186. Clayton MJ. Delphi: a technique to harness expert opinion for critical decision-making tasks in education. Educational Psychology. 1997;17(4):373-86.

187. Goodman CM. The Delphi technique: a critique. Journal of Advanced Nursing. 1987;12(6):729-34.

188. McKenna HP. The Delphi technique: a worthwhile research approach for nursing? Journal of Advanced Nursing. 1994;19(6):1221-5.

189. Jones J, Hunter D. Consensus methods for medical and health services research. BMJ: British Medical Journal. 1995;311(7001):376-80.

190. Murphy M, Black N, Lamping D, McKee C, Sanderson C, Askham J, Marteau T. Consensus development methods, and their use in clinical guideline development. Health Technology Assessment. 1998;2(3):i-88.

191. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. Journal of Advanced Nursing. 2000;32(4):1008-15.

192. Keeney S, Hasson F, McKenna HP. A critical review of the Delphi technique as a research methodology for nursing. International Journal of Nursing Studies. 2001;38(2):195-200.

193. Powell C. The Delphi technique: myths and realities. Journal of Advanced Nursing. 2003;41(4):376-82.

194. Rieger WG. Directions in Delphi developments: Dissertations and their quality. Technological Forecasting and Social Change. 1986;29(2):195-204.

195. Skulmoski GJ, Hartman FT, Krahn J. The Delphi method for graduate research. Journal of Information Technology Education: Research. 2007;6(1):1-21.

196. Avella JR. Delphi panels: Research design, procedures, advantages, and challenges. International Journal of Doctoral Studies. 2016;11:305.

197. Häder M. Die Expertenauswahl bei Delphi-Befragungen. (GESIS-How-to, 5) Mannheim: Zentrum für Umfragen, Methoden und Analysen -ZUMA-. 2000.

198. Helfferich C. Die Qualität qualitativer Daten: Manual für die Durchführung qualitativer Interviews. Wiesbaden: VS Verlag für Sozialwissenschaften 2011.

199. Dresing T, Pehl T. Praxisbuch Interview, Transkription & Analyse: Anleitungen und Regelsysteme für qualitativ Forschende. 2018;8:56.

200. Likert R. A technique for the measurement of attitudes. Archives of Psychology. 1932;22(140):1-55.

201. Jamieson S. Likert scales: how to (ab)use them. Medical Education. 2004;38(12):1217-8.

202. Schreier M. Qualitative Content Analysis in Practice. Los Angeles: SAGE Publications; 2012.

203. Mayring P, Fenzl T. Qualitative Inhaltsanalyse. In: Baur N, Blasius J, editors. Handbuch Methoden der empirischen Sozialforschung. Wiesbaden: Springer Fachmedien Wiesbaden; 2019. p. 633-48.

204. Kuckartz U, Rädiker S. Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung. 5 ed: Beltz Juventa; 2022.

205. Klemp GO, Martuza VR. Applying norm-referenced and criterion-referenced measurement in education. Journal of Education. 1978;160(1):78-81.

206. Lynn MR. Determination and quantification of content validity. Nursing Research. 1986;35(6):382-6.

207. Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. Research in Nursing and Health. 2006;29(5):489-97.

208. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Research in Nursing and Health. 2007;30(4):459-67.

209. Bravo G, Potvin L. Estimating the reliability of continuous measures with Cronbach's alpha or the intraclass correlation coefficient: toward the integration of two traditions. Journal of Clinical Epidemiology. 1991;44(4-5):381-90.

210. Cicchetti DV. Guidelines, Criteria, and Rules of Thumb for Evaluating Normed and Standardized Assessment Instruments in Psychology. Psychological Assessment. 1994;6(4):284-90.

211. O'Cathain A, Murphy E, Nicholl J. The quality of mixed methods studies in health services research. Journal of Health Services Research & Policy. 2008;13(2):92-8.

212. Doyle L, Brady A-M, Byrne G. An overview of mixed methods research. Journal of Research in Nursing. 2009;14(2):175-85.

213. Halcomb E, Hickman L. Mixed methods research. Nursing Standard. 2015;29(32):41-7.

214. Tapio P, Paloniemi R, Varho V, Vinnari M. The unholy marriage? Integrating qualitative and quantitative information in Delphi processes. Technological Forecasting and Social Change. 2011;78(9):1616-28.

215. Brady SR. Utilizing and adapting the Delphi method for use in qualitative research. International Journal of Qualitative Methods. 2015;14(5):1609406915621381.

216. Keeney S, McKenna HA, Hasson F. The Delphi technique in nursing and health research: John Wiley & Sons; 2011.

217. Rowe G, Wright G. The Delphi technique as a forecasting tool: issues and analysis. International Journal of Forecasting. 1999;15(4):353-75.

218. Okoli C, Pawlowski SD. The Delphi method as a research tool: an example, design considerations and applications. Information & Management. 2004;42(1):15-29.

219. Rowe G, Wright G, McColl A. Judgment change during Delphi-like procedures: The role of majority influence, expertise, and confidence. Technological Forecasting and Social Change. 2005;72(4):377-99.

220. Donohoe H, Stellefson M, Tennant B. Advantages and limitations of the e-Delphi technique: Implications for health education researchers. American Journal of Health Education. 2012;43(1):38-46.

221. Linstone HA, Turoff M. Delphi: A brief look backward and forward. Technological Forecasting and Social Change. 2010;78(9):1712-9.

222. Riggs WE. The Delphi technique: An experimental evaluation. Technological Forecasting and Social Change. 1983;23(1):89-94.

223. Cantrill J, Sibbald B, Buetow S. The Delphi and nominal group techniques in health services research. International Journal of Pharmacy Practice. 1996;4(2):67-74.

224. McMillan SS, King M, Tully MPJIjocp. How to use the nominal group and Delphi techniques. International Journal of Clinical Pharmacy. 2016;38:655-62.

225. de Meyrick J. The Delphi method and health research. Health Education. 2003;103(1):7-16.

226. Scheibe M, Skutsch M, Schofer J. IV. C. Experiments in Delphi methodology. In: The Delphi method: techniques and applications. 2002:257-81.

227. Yousuf MI. Using Experts' Opinions Through Delphi Technique. Practical Assessment, Research and Evaluation. 2007;12:4.

228. Fink-Hafner D, Dagen T, Doušak M, Novak M, Hafner-Fink M. Delphi Method: Strengths and Weaknesses. Advances in Methodology and Statistics. 2019;2:1-19.

229. Mullen PM. Delphi: myths and reality. Journal of Health Organization and Management. 2003;17(1):37-52.

230. Dajani JS, Sincoff MZ, Talley WK. Stability and agreement criteria for the termination of Delphi studies. Technological Forecasting and Social Change. 1979;13(1):83-90.

231. Erffmeyer RC, Erffmeyer ES, Lane IM. The Delphi technique: An empirical evaluation of the optimal number of rounds. Group & Organization Studies. 1986;11(1-2):120-8.

232. Holey EA, Feeley JL, Dixon J, Whittaker VJ. An exploration of the use of simple statistics to measure consensus and stability in Delphi studies. BMC Medical Research Methodology. 2007;7:1-10.

233. Kalaian SA, Kasim RM. Terminating sequential Delphi survey data collection. Practical Assessment, Research and Evaluation. 2012;17(5):5.

234. Walker A, Selfe J. The Delphi method: a useful tool for the allied health researcher. British Journal of Therapy and Rehabilitation. 1996;3(12):677-81.

235. Reid N. The Delphi technique: its contribution to the evaluation of professional practice. Professional competence and quality assurance in the caring professions. 1988;230:262.

236. Häder M. Methodenforschung zu Delphi-Befragungen. In: Häder M, editor. Delphi-Befragungen: Ein Arbeitsbuch. Wiesbaden: Springer Fachmedien Wiesbaden; 2014. p. 219-21.

237. Mayer MA. Objektivität, Reliabilität und Validität in der empirischen Sozialforschung: GRIN Verlag; 2008.

238. Steinke I. Kriterien qualitativer Forschung. Ansätze zur Bewertung qualitativ-empirischer Sozialforschung. München; Weinheim: Juventa; 1999. 288 S. p.

239. Rowe G, Wright G, Bolger F. Delphi: a reevaluation of research and theory. Technological Forecasting and Social Change. 1991;39(3):235-51.

240. Hill KQ, Fowles J. The methodological worth of the Delphi forecasting technique. Technological Forecasting and Social Change. 1975;7(2):179-92.

241. Landeta J. Current validity of the Delphi method in social sciences. Technological Forecasting and Social Change. 2006;73(5):467-82.

242. Hasson F, Keeney S. Enhancing rigour in the Delphi technique research. Technological Forecasting and Social Change. 2011;78(9):1695-704.

243. Keeney S, Hasson F, McKenna H. Consulting the oracle: ten lessons from using the Delphi technique in nursing research. Journal of Advanced Nursing. 2006;53(2):205-12.

244. Rowe G, Wright G. The Delphi technique: Past, present, and future prospects—Introduction to the special issue. Technological Forecasting and Social Change. 2011;78(9):1487-90.

245. Häder M. Delphi-Befragungen: Ein Arbeitsbuch: Springer Fachmedien Wiesbaden GmbH; 2009.

246. Kennedy HP. Enhancing Delphi research: methods and results. Journal of Advanced Nursing. 2004;45(5):504-11.

247. Day J, Bobeva M. A generic toolkit for the successful management of Delphi studies. Electronic Journal of Business Research Methods. 2005;3(2):103-16.

248. Boulkedid R, Abdoul H, Loustau M, Sibony O, Alberti C. Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. PLOS One. 2011;6(6):e20476.

249. Trevelyan EG, Robinson N. Delphi methodology in health research: how to do it? European Journal of Integrative Medicine. 2015;7(4):423-8.

250. Jünger S, Payne SA, Brine J, Radbruch L, Brearley SG. Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. Palliative Medicine. 2017;31(8):684-706.

251. Baker J, Lovell K, Harris N. How expert are the experts? An exploration of the concept of 'expert' within Delphi panel techniques. Nurse Researcher. 2006;14(1):59-70.

252. Turoff M. The design of a policy Delphi. Technological Forecasting and Social Change. 1970;2(2):149-71.

253. Akins RB, Tolson H, Cole BR. Stability of response characteristics of a Delphi panel: application of bootstrap data expansion. BMC Medical Research Methodology. 2005;5:37.

254. Häder M, Häder S. Die Delphi-Technik in den Sozialwissenschaften. Methodische Forschungen und innovative Anwendungen. Forum Qualitative Sozialforschung: Springer; 2000.

255. Duffield C. The Delphi technique: a comparison of results obtained using two expert panels. International Journal of Nursing Studies. 1993;30(3):227-37.

256. Malterud K. Qualitative research: standards, challenges, and guidelines. The Lancet. 2001;358(9280):483-8.

257. Lange T, Kopkow C, Lützner J, Günther K-P, Gravius S, Scharf H-P, Stöve J, Wagner R, Schmitt J. Comparison of different rating scales for the use in Delphi studies: different scales lead to different consensus and show different test-retest reliability. BMC Medical Research Methodology. 2020;20(1):1-11.

258. Norman G. Likert scales, levels of measurement and the "laws" of statistics. Advances in Health Sciences Education: Theory and Practice. 2010;15(5):625-32.

259. Sullivan GM, Artino AR, Jr. Analyzing and interpreting data from likert-type scales. Journal of Graduate Medical Education. 2013;5(4):541-2.

260. Menold N, Bogner K. Gestaltung von Ratingskalen in Fragebögen (Version 1.1). (GESIS Survey Guidelines). Mannheim, GESIS – Leibniz-Institut für Sozialwissenschaften. 2015;10.

261. Fink A, Kosecoff J, Chassin M, Brook RH. Consensus methods: characteristics and guidelines for use. American Journal of Public Health. 1984;74(9):979-83.

262. Vernon W. The Delphi technique: a review. International Journal of Therapy & Rehabilitation. 2009;16(2):69-76.

263. Von Der Gracht HA. Consensus measurement in Delphi studies: review and implications for future quality assurance. Technological Forecasting and Social Change. 2012;79(8):1525-36.

264. Diamond IR, Grant RC, Feldman BM, Pencharz PB, Ling SC, Moore AM, Wales PW. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. Journal of Clinical Epidemiology. 2014;67(4):401-9.

265. Williams PL, Webb C. The Delphi technique: a methodological discussion. Journal of Advanced Nursing. 1994;19(1):180-6.

266. Grant S, Booth M, Khodyakov D. Lack of preregistered analysis plans allows unacceptable data mining for and selective reporting of consensus in Delphi studies. Journal of Clinical Epidemiology. 2018;99:96-105.

267. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: A systematic review of causes, consequences and solutions. PLOS One. 2018;13(8):e0203316.

268. Yan S, Wang J, Yin X, Lv C, Wu J, Jiang N, Chen Z, Mu K, Zhang G, Gong Y. Rates of perceived medical errors and its correlation with work-related factors and personal distress among emergency physicians in China: a national cross-sectional study. Emergency Medicine Journal. 2023;40(5):320-5.

269. Lu DW, Zhan T, Bilimoria KY, Reisdorff EJ, Barton MA, Nelson LS, Beeson MS, Lall MD. Workplace Mistreatment, Career Choice Regret, and Burnout in Emergency Medicine Residency Training in the United States. Annals of Emergency Medicine. 2023;81(6):706-14.

270. Weigl M. Physician burnout undermines safe healthcare. BMJ (Clinical Research Ed). 2022;378:o2157.

271. Elder E, Johnston ANB, Wallis M, Crilly J. The demoralisation of nurses and medical doctors working in the emergency department: A qualitative descriptive study. International Emergency Nursing. 2020;52:100841.

272. Petrino R, Riesgo LG-C, Yilmaz B. Burnout in emergency medicine professionals after 2 years of the COVID-19 pandemic: a threat to the healthcare system? European Journal of Emergency Medicine. 2022;29(4):279-84.

273. Lala AI, Sturzu LM, Picard JP, Druot F, Grama F, Bobirnac G. Coping behavior and risk and resilience stress factors in French regional emergency medicine unit workers: a cross-sectional survey. Journal of Medicine and Life. 2016;9(4):363-8.

274. Rose JS, Campbell M, Skipper G. Prognosis for Emergency Physician with substance abuse recovery: 5-year outcome study. The Western Journal of Emergency Medicine. 2014;15(1):20-5.

275. Rosenman ED, Branzetti JB, Fernandez R. Assessing Team Leadership in Emergency Medicine: The Milestones and Beyond. Journal of Graduate Medical Education. 2016;8(3):332-40.

276. Carayon P, Cassel C, Dzau VJ. Improving the System to Support Clinician Well-being and Provide Better Patient Care. Journal of the American Medical Association. 2019;322(22):2165-6.

277. Weigl M, Schreyer J. Die parallele Pandemie? Der Internist. 2021;62(9):928-36.

278. Pronovost PJ, Cleeman JI, Wright D, Srinivasan A. Fifteen years after To Err is Human: a success story to learn from. BMJ Quality & Safety. 2016;25(6):396-9.

279. Kottner J, Audigé L, Brorson S, Donner A, Gajewski BJ, Hróbjartsson A, Roberts C, Shoukri M, Streiner DL. Guidelines for Reporting Reliability and Agreement Studies (GRRAS) were proposed. International Journal of Nursing Studies. 2011;48(6):661-71.

7 Attachments

7.1 Comparisons among care levels and participating nations

This section aims to streamline and focus exclusively on feasible rating dissensus regarding mean and consensus metrics across the participating care levels and nations. Detailed consensus specifics for each individual DEL-2 item can be found in Tables 11 to 14.

Hospital care level-based relevance ratings and consensus metrics

In terms of general aspects, 'job autonomy' exhibited slightly less relevance for MCL hospitals (4.0, 0.8, .71), compared to BCL (4.0, 0.6, .83), and GCL (4.0, 0.0, 1.00). Provider-related factors such as 'positive co-worker relationships' displayed lower relevance for BCL hospitals (4.2, 1.2, .67) compared to MCL (4.1, 0.6, .86) and GCL (4.4, 0.5, 1.00). Positive aspects of patient-provider interaction, specifically 'therapy efficacy: seeing patients getting better' and 'communication: social interaction with patients and/or families' garnered greater relevance for GCL compared to BCL and MCL (cf., Table 11).

Concerning negative general aspects in ED work, 'time pressure and/or lack of breaks' demonstrated less relevance for MCL (4.1, 0.8, .71) compared to GCL (4.4, 0.5, 1.00) and BCL (4.7, 0.5, 1.00). Conversely, 'chronic cognitive workload' was specifically more relevant to BCL (4.3, 0.7, .83) compared to MCL (3.3, 1.0, .43). Moreover, 'work-life imbalance' appears to be a predominant straining factor to GCL (4.0, 0.6, .80) compared to MCL (3.9, 1.0, .71) and BCL (3.7, 1.4, .50). Regarding negative provider-related aspects, GCL scored highest in various areas comprising 'medical errors', 'lack of communication and feedback culture', 'task overlap and interaction deficits with other specialties', as well as 'tense atmosphere'. However, it was outperformed in 'high

pressure to take far-reaching decisions' by BCL and 'lack of resilience and coping mechanisms' by MCL (cf., Table 11). Concerning negative patient-provider interaction, GCL hospitals significantly surpass others, particularly in items such as 'violence: verbal and/or physical', 'legal consequences of actions', 'minor complaints without the need of ED treatment', and 'ungrateful feedback' (cf., Table 11).

In total, the CVI values demonstrate significant disparities among care levels. Particularly, the CVI is notably highest for GCL (i.e., S-CVI/Ave .90, S-CVI/UA .58, S-CVI/AUA .91). In contrast, lower values are observed for BCL (i.e., .73, .24, .55) respectively. Similarly, for MCL, the CVI values are even lower (i.e., .73, .15, .45).

Table 11: Level-based relevance ratings & consensus metrics: ED work-life influences (DEL-2, RQ-1).

Category and factors	Metrics (M/SD/I-CVI)		
	MCL	GCL	BCL
Positive general aspects in ED work			
Job challenge: variation and/or interdisciplinary interaction	4.7/0.5/1.00	4.8/0.4/1.00	4.7/0.5/1.00
Job control: participation in decision-making	4.3/0.5/1.00	4.4/0.5/1.00	4.7/0.5/1.00
Job intellectuality	4.4/0.5/1.00	4.8/0.4/1.00	4.5/0.8/.83
Task significance	4.3/0.7/.86	4.4/0.5/1.00	4.3/0.5/1.00
Job autonomy	4.0/0.8/.71	4.0/0.0/1.00	4.0/0.6/.83
Positive provider-related aspects in ED work			
Personal work ethic and/or motivation	4.3/0.5/1.00	4.8/0.4/1.00	4.3/1.1/.83
Teamwork, social climate and extracurricular activities	4.4/0.5/1.00	4.4/0.5/1.00	4.0/0.6/.83
Work experience and/or utilization of skills	4.3/0.7/.86	4.8/0.4/1.00	4.3/0.7/.83
Resilience and coping strategies	4.3/0.7/.86	4.6/0.5/1.00	4.5/0.8/.83
Positive co-worker relationships	4.1/0.6/.86	4.4/0.5/1.00	4.2/1.2/.67
Positive patient-provider interaction facets in ED work			
Patient case complexity	4.0/0.5/.86	4.4/0.8/.80	4.3/0.5/1.00
Therapy efficacy: seeing patients getting better	3.7/1.0/.57	4.2/0.7/.80	4.0/0.8/.67
Grateful patient feedback	4.0/0.8/.71	3.4/0.8/.60	3.2/1.2/.67
Communication: social interaction with patients and/or families	3.4/0.5/.43	4.0/1.1/.80	3.3/1.1/.50

Negative general aspects in ED work

Overcrowding	4.4/0.7/.86	5.0/0.0/1.00	4.7/0.5/1.00
Workflow interruptions and/or multitasking	4.4/0.7/.86	4.6/0.5/1.00	4.7/0.5/1.00
Time pressure and/or lack of breaks	4.1/0.8/.71	4.4/0.5/1.00	4.7/0.5/1.00
Employee turnover and understaffing	4.4/0.7/.86	4.4/0.8/.80	4.3/0.7/1.00
Chronic cognitive workload	3.3/1.0/.43	3.8/0.4/.80	4.3/0.7/.83
Work-life imbalance	3.9/1.0/.71	4.0/0.6/.80	3.7/1.4/.50
Shift work	3.1/1.0/.43	4.0/0.9/.60	3.3/1.1/.50

Negative provider-related aspects in ED work

Medical errors	3.9/1.0/.71	4.6/0.5/1.00	4.0/1.0/.83
Lack of communication and feedback culture	4.3/0.7/.86	4.2/0.4/1.00	3.2/1.1/.33
Task overlap and interaction deficits with other specialties	4.0/0.8/.71	4.2/0.4/1.00	3.3/1.1/.50
Tense atmosphere	3.3/1.3/.57	4.4/0.8/.80	3.7/0.7/.83
High pressure to take far-reaching decisions	3.3/1.4/.43	4.0/0.6/.80	4.2/0.7/.83
Lack of resilience and coping mechanisms	4.1/0.6/.86	4.2/0.7/.80	2.8/0.7/.17
Insufficient supervision	3.6/0.7/.43	4.0/0.6/.80	3.3/0.7/.50

Negative patient-provider interaction facets in ED work

Violence: verbal and/or physical	4.1/0.8/.71	4.6/0.5/1.00	3.3/1.4/.50
Legal consequences of conflicts	3.7/1.5/.57	3.8/0.4/.80	3.5/1.3/.67
Minor complaints without the need of ED treatment	3.3/0.7/.43	4.0/0.0/1.00	3.5/1.3/.67
Ungrateful feedback	3.6/0.9/.57	4.2/0.4/1.00	3.2/1.6/.50
Excessive claims	3.7/1.3/.57	3.6/0.5/.60	3.0/1.7/.50
S-CVI/Ave	**.73**	**.90**	**.73**
S-CVI/UA	**.15**	**.58**	**.24**
S-CVI/AUA	**.45**	**.91**	**.55**

Note: n=6 for each column; MCL=maximum care level; GCL=general care level; BCL=basic care level; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

In terms of providers' health outcomes associated with ED work, various trends are observed across different care levels. Adverse physical health outcomes such as 'physical fatigue' are considered less relevant for BCL hospitals (4.0, 1.2, .67) compared to MCL (4.1, 0.6, .86) and GCL hospitals (4.2, 0.4, 1.00).

Concerning adverse mental health outcomes, 'burnout' is less prominent as a topic for discussion in GCL clinics (4.2, 1.0, .60) compared to BCL (4.7, 0.7, .83) and MCL hospitals (4.4, 0.5, 1.00). Similarly, 'compassion fatigue, pessimism, and/or cynicism' are considered less relevant for MCL panelists (3.7, 0.9, .71) compared to GCL (4.0, 0.6, .80) and BCL (4.2, 0.7, .83). Increased 'anxiety' was highest for BCL (3.8, 0.9, .83).

In terms of adverse psychosomatic health outcomes, 'insomnia (sleep deprivation and/or disturbance)', is more prominently acknowledged by MCL experts (4.1, 0.6, .86) compared to BCL (3.8, 1.1, .67) and GCL (4.0, 0.9, .60).

Ultimately, regarding specific adverse behavioral health outcomes, namely 'dropouts/opt-outs (= quitters)' and 'intentions to leave or reduce working hours', these issues are highlighted more by GCL hospitals (cf., Table 12).

Overall, the CVI values do not indicate significant disparities among care levels. The CVI is consistently low across MCL (S-CVI/Ave .58, S-CVI/UA .06, and S-CVI/AUA .25), GCL (.58, .19, 31), and BCL (.57, .06, .25), respectively.

Table 12: Level-based relevance ratings & consensus metrics: ED providers' health outcomes (DEL-2, RQ-1).

Category and factors	Metrics (M/SD/I-CVI)		
	MCL	GCL	BCL
Adverse physical health outcomes of ED work			
Physical fatigue	4.1/0.6/.86	4.2/0.4/1.00	4.0/1.2/.67
Musculoskeletal pain	3.0/1.1/.43	3.2/1.3/.40	3.5/1.0/.50
Injuries (e.g., needle stick, trauma, violence)	3.1/1.1/.43	3.4/1.5/.40	2.8/0.7/.17
Adverse mental health outcomes of ED work			
Exhaustion and/or mental fatigue	4.3/0.7/.86	4.6/0.5/1.00	4.7/0.5/1.00
Burnout	4.4/0.5/1.00	4.2/1.0/.60	4.7/0.7/.83
Compassion fatigue, pessimism, and/or cynicism	3.7/0.9/.71	4.0/0.6/.80	4.2/0.7/.83

	MCL	GCL	BCL
Anxiety	3.4/0.9/.43	3.4/0.5/.40	3.8/0.9/.83
Depression, sadness and/or low mood	3.0/0.9/.14	3.6/0.5/.60	3.5/1.1/.33
Adverse psychosomatic health outcomes of ED work			
Insomnia (sleep deprivation and/or disturbance)	4.1/0.6/.86	4.0/0.9/.60	3.8/1.1/.67
Cardiovascular consequences: hypertension and/or tachycardia	3.4/1.2/.43	3.4/0.5/.40	3.0/1.4/.50
Gastroesophageal reflux disease (GERD)	3.0/1.3/.43	3.2/0.4/.20	3.0/0.8/.33
Eating disorders	2.9/1.1/.29	3.0/0.6/.20	3.0/1.2/.33
Adverse behavioral health outcomes of ED work			
Dropouts/opt-outs (= quitters)	3.9/1.0/.71	4.0/0.0/1.00	3.7/0.9/.67
Intentions to leave or reduce working hours	4.0/1.1/.71	4.0/0.6/.80	3.8/1.1/.67
Sick leaves	3.7/0.9/.71	3.2/1.0/.60	3.2/1.1/.50
Substance abuse	3.0/1.1/.29	3.0/0.6/.20	2.7/1.1/.33
S-CVI/Ave	**.58**	**.58**	**.57**
S-CVI/UA	**.06**	**.19**	**.06**
S-CVI/AUA	**.25**	**.31**	**.25**

Note: n=6 for each column; MCL=maximum care level; GCL=general care level; BCL=basic care level; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

In the realm of improvement and intervention practices at the organizational level, distinct patterns emerge across different care levels. For instance, initiatives such as 'ED reorganization and/or modernization' and the establishment of 'Out-of-ED ambulatory care and/or medical assessment units' are considered less pertinent for MCL settings. Conversely, 'adaptable staff and duty rostering', 'critical incident reporting system (CIRS)' and the implementation of 'quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))' receive higher ratings among GCL establishments (cf., Table 13). Similarly, that is the case for 'national emergency medicine society networking platforms' and 'employee surveys'. Meanwhile, the emphasis on 'evidence-based SOPs and/or training concepts' appears to be less prevalent or relevant for BCL facilities (4.0, 0.8, .67) compared to MCL (4.1, 0.6, .86) and GCL settings (4.8, 0.4, 1.00).

At the team level, practices such as '(Simulation-based) skills trainings' are ranked lower for GCL hospitals (4.0, 1.3, .60; versus BCL (4.3, 0.5, 1.00) and MCL 4.4/0.5/1.00)). In turn, 'regular feedback from mentors' holds by far the highest importance for MCL establishments (4.6, 0.5, 1.00; versus GCL (4.0, 1.3, .60) and BCL (3.7, 1.1, .50)). Additionally, 'inter-professional educational initiatives for physicians and nursing' and 'nurse practitioners (e.g., wound and/or pain care)' are deemed most crucial by GCL hospitals (cf., Table 13).

Lastly, individual-level interventions, particularly 'private sport activities: individual and/or group-based', are deemed of highest relevance for GCL settings (4.2, 0.7, .80; versus MCL (3.6, 1.3, .57) and BCL (3.0, 1.3, .33)).

Overall, the CVI values do not indicate significant disparities. The CVI is consistently low across care levels, yet, with highest values for GCL (S-CVI/Ave .67, S-CVI/UA .17, and S-CVI/AUA .54).

Table 13: Level-based relevance ratings & consensus metrics: ED intervention practices (DEL-2, RQ-2).

Category and factors	Metrics (M/SD/I-CVI)		
	MCL	GCL	BCL
Improvement and intervention practices on organizational level			
Emergency care as autonomous specialty	4.7/0.5/1.00	4.4/0.5/1.00	4.0/1.0/.83
ED reorganization and/or modernization	3.7/0.9/.71	4.6/0.5/1.00	4.2/0.4/1.00
Evidence-based SOPs and/or training concepts	4.1/0.6/.86	4.8/0.4/1.00	4.0/0.8/.67
Adaptable staff and duty rostering	3.9/1.4/.71	4.8/0.4/1.00	3.8/0.7/.67
Critical Incident Reporting System (CIRS)	3.9/1.0/.71	3.8/1.5/.80	4.0/0.8/.67
Out-of-ED ambulatory care and/or medical assessment units	3.4/1.2/.57	4.0/1.1/.80	4.2/0.7/.83
Limited on-call duties, night or weekend shifts, overhours	3.6/1.2/.71	4.0/0.9/.60	3.7/0.9/.67
Quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))	3.6/1.2/.57	4.0/1.5/.80	3.0/1.5/.33
National emergency medicine society networking platforms	3.7/0.7/.57	3.6/1.4/.80	2.8/1.1/.17
Employee surveys	3.0/0.5/.14	3.6/1.4/.80	3.3/1.1/.50
Offer of mental health interventions	3.1/0.6/.29	3.4/1.4/.60	2.8/0.9/.33
Regular occupational health checks	2.1/0.8/.00	3.4/0.5/.60	3.2/1.1/.33

Improvement and intervention practices on team level

	MCL	GCL	BCL
(Simulation-based) Skills trainings (e.g., resuscitation, CRM)	4.4/0.5/1.00	4.0/1.3/.60	4.3/0.5/1.00
Debriefings after critical events with potential post-traumatic consequences	4.4/0.7/.86	3.8/1.0/.80	4.3/0.5/1.00
Regular feedback from mentors	4.6/0.5/1.00	4.0/1.3/.60	3.7/1.1/.50
Inter-professional educational initiatives for physicians and nursing	4.0/1.1/.71	4.2/1.2/.80	3.2/1.1/.33
Nurse practitioners (e.g., wound and/or pain care)	3.3/1.2/.43	3.8/1.0/.80	3.0/1.3/.33
Physician-assisted triage	2.7/1.4/.29	3.4/1.0/.40	3.5/1.3/.50
Improvement and intervention practices on individual level			
Private sport activities: individual and/or group-based	3.6/1.3/.57	4.2/0.7/.80	3.0/1.3/.33
Acute mental occupational health services (e.g., psychotherapy)	3.4/0.9/.43	2.6/1.6/.40	3.0/1.2/.50
Hospital-initiated mental health protection programs	3.6/0.5/.57	2.6/1.5/.20	2.8/1.3/.33
Private activities to prevent mental illness	3.6/1.3/.57	2.6/1.5/.20	3.0/1.3/.33
Acute physical occupational health services (e.g., physiotherapy)	3.4/1.3/.43	2.8/1.3/.20	2.2/1.1/.17
Hospital-initiated physical health protection programs	2.7/0.9/.14	2.8/1.6/.40	2.7/1.4/.33
S-CVI/Ave	**.58**	**.67**	**.53**
S-CVI/UA	**.13**	**.17**	**.13**
S-CVI/AUA	**.21**	**.54**	**.21**

Note: n=6 for each column; MCL=maximum care level; GCL=general care level; BCL=basic care level; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Regarding challenges related to COVID-19 in ED work, distinct trends are observed across different care levels. Aspects reducing negative impacts of COVID-19 on provider working conditions such as 'intra- and interhospital networking' are significantly more relevant to BCL facilities (4.3, 0.5, 1.00) compared to MCL (3.7, 1.2, .71) and GCL (4.0, 0.9, .60) establishments. Conversely, the 'employment of additional external staff' is notably higher among GCL hospitals (4.2, 0.4, 1.00; versus BCL (3.3, 1.4, .67) and MCL (3.1, 1.5, .57)).

In contrast, aspects inducing negative impacts such as 'crowding: ED space limitations and/or exit blocks' exhibit lucidly less relevance for BCL (4.0, 1.4, .67), compared with MCL (4.4, 1.0, .86) and GCL (4.8, 0.4, 1.00).

Concerning COVID-19-related impacts on providers' health, issues like 'confirmed COVID-19 infections', 'mental exhaustion and/or less resilience', and 'burnout' are considerably less discussed topics for MCL hospitals (cf., Table 14). 'Anxieties', however, was rated lower for BCL (3.7, 0.9, .67; versus GCL: 3.8, 0.4, .80), MCL: 3.9, 0.8, .86). Moreover, 'PPE discomfort: overheating, skin and/or respiratory irritations' are more prevalent among BCL hospitals (4.0, 1.0, .83) compared to GCL (3.8, 0.7, .60) and MCL facilities (3.7, 1.0, .57).

Ultimately, impacts on the employee-reported quality and safety of patient care demonstrate nuanced differences. For instance, 'reduced emotional support for patients and/or their families' is significantly higher rated by BCL hospitals (4.3, 0.5, 1.00; versus GCL (4.0, 0.9, .60) and MCL (3.4, 1.4, .57)), while 'CT scan overuse' is overwhelmingly relevant for GCL establishments (4.2, 0.4, 1.00); versus BCL (3.0, 0.8, .33) and MCL (2.7, 1.4, .29).

Overall, the CVI values do not suggest significant disparities. The CVI remains consistently low across care levels, albeit with nearly marginal significant values for GCL (S-CVI/Ave .75, S-CVI/UA .34, S-CVI/AUA .59) and BCL (.75, .24, .55).

Table 14: Level-based relevance ratings & consensus metrics: COVID-19-related ED work (DEL-2, RQ-3).

Category and factors	Metrics (M/SD/I-CVI)		
	MCL	GCL	BCL
Aspects reducing negative impacts of COVID-19 on provider working conditions			
Personal protective equipment (PPE)	4.6/0.5/1.00	5.0/0.0/1.00	4.5/0.5/1.00
Vaccination campaigns	4.3/0.5/1.00	4.8/0.4/1.00	4.7/0.7/.83
Testing: PCR and/or POC antigen	4.3/0.7/.86	4.6/0.6/.80	4.8/0.4/1.00
Persistent information flow	4.6/0.5/1.00	4.4/0.8/.80	4.2/0.7/.83
Change of SOPs	4.1/1.0/.86	4.2/0.7/.80	4.3/0.5/1.00
Separate isolation and cohort areas or units	4.0/1.3/.86	4.2/1.2/.80	4.7/0.7/.83

Intra- and interhospital networking	3.7/1.2/.71	4.0/0.9/.60	4.3/0.5/1.00
Employment of additional external staff	3.1/1.5/.57	4.2/0.4/1.00	3.3/1.4/.67
Reorganization of staff and duty rostering	3.6/1.3/.57	3.8/1.2/.60	3.8/0.9/.50
Psychological support: employee surveys and/or well-being offers	3.7/0.7/.57	3.4/1.0/.40	3.3/1.2/.50
Contact tracing and quarantining	2.7/1.2/.29	3.6/1.0/.60	3.5/0.8/.67
Structural room ventilation systems	2.7/1.4/.29	3.4/1.6/.60	3.3/1.7/.67

Aspects inducing negative impacts of COVID-19 on provider working conditions

Shortage of staff	4.7/0.5/1.00	4.8/0.4/1.00	4.8/0.4/1.00
Excessive workload: organizational and/or isolation-related	4.6/0.5/1.00	4.4/0.5/1.00	5.0/0.0/1.00
Crowding: ED space limitations and/or exit blocks	4.4/1.0/.86	4.8/0.4/1.00	4.0/1.4/.67
Lack of PPE	3.0/1.6/.43	1.8/0.7/.00	3.7/1.6/.67

COVID-19-related impacts on providers' physical health

Confirmed COVID-19 infections	3.9/0.6/.71	4.6/0.5/1.00	4.2/1.1/.83
PPE discomfort: overheating, skin and/or respiratory irritations	3.7/1.0/.57	3.8/0.7/.60	4.0/1.0/.83
Long-COVID syndrome	3.0/1.3/.43	3.6/0.5/.60	2.7/1.5/.33

COVID-19-related impacts on providers' mental health

Mental exhaustion and/or less resilience	4.0/1.1/.71	4.6/0.5/1.00	4.0/1.0/.83
Anxieties	3.9/0.8/.86	3.8/0.4/.80	3.7/0.9/.67
Burnout	3.9/1.1/.57	4.2/0.7/.80	4.0/1.4/.83
Social isolation	3.7/1.0/.57	3.6/1.0/.60	3.8/1.1/.67
Depression	3.1/1.0/.29	3.2/0.7/.40	3.7/0.9/.67

COVID-19-related impacts on employee-reported quality and safety of patient care

Undertreatment of emergency medicine diagnoses	4.0/0.5/.86	4.4/0.5/1.00	4.3/0.7/.83
Delay in patient diagnostic and therapeutic pathways (PDTP)	4.4/0.7/.86	4.0/0.6/.80	4.0/1.0/.83
Reduced emotional support for patients and/or their families	3.4/1.4/.57	4.0/0.9/.60	4.3/0.5/1.00
CT scan overuse	2.7/1.4/.29	4.2/0.4/1.00	3.0/0.8/.33
Diagnostic misperceptions and/or misdiagnoses	3.7/0.9/.43	3.8/0.7/.60	2.8/0.9/.33
S-CVI/Ave	**.68**	**.75**	**.75**

		S-CVI/UA	.17	.34	.24
		S-CVI/AUA	.41	.59	.55

Note: n=6 for each column; MCL=maximum care level; GCL=general care level; BCL=basic care level; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Nation-based relevance ratings and consensus metrics

As further restriction and for the purpose of feasibility and conciseness, this subsection will exclusively address major differences among the included EUSEM NSM states. This procedure seems especially appropriate considering the limited power of 3 panelists per nation. Detailed con-/dissensus specifics for each individual DEL-2 item can be found in Tables 15 to 18.

Positive ED work-life factors and influences, specifically patient-provider interaction facets, exhibit noteworthy variations among different NSMs. For instance, 'therapy efficacy: seeing patients getting better' is rated highest in relevance for GER hospitals (4.7, 0.5, 1.00), while receiving the lowest ratings for BEL (3.7, 0.9, .33) and FIN (3.3, 0.9, .67).

Concerning negative general aspects in ED work, 'work-life imbalance' and 'shift work' are rated highest for ITA (both 4.7, 0.5, 1.00). Conversely, the UK demonstrates the lowest ratings for 'work-life imbalance' (2.7, 0.9, .33) and 'shift work' (2.0, 0.8, .00), the latter along with FIN (3.0, 0.8, .33) and BEL (3.3, 0.5, .33).

Negative provider-related aspects in ED work additionally exhibit significant variations. For instance, 'medical errors' are significantly lower in relevance for FIN (3.3, 1.2, .33) in comparison to any other NSM state. 'Lack of communication and feedback culture' is least relevant for ITA panelists (3.3, 0.5, .33), while being highest for BEL (4.7, 0.5, 1.00) and ROM (4.3, 0.5, 1.00) experts. 'Task overlap and interaction deficits with other specialties' is reported lowest for FIN (3.0, 0.8, .33) and UK (3.7, 0.9, .33). Ultimately, 'high pressure to take far-reaching decisions' is lowest for UK (2.7, 1.2, .33) and FIN (3.3, 0.5, .33), while being highly relevant for GER (4.7, 0.5, 1.00) and ROM (4.3, 0.5, 1.00).

Negative patient-provider interaction facets, such as 'violence: verbal and/or physical' and 'legal consequences of conflicts', are significantly lower for FIN and UK, while being a prevalent issue in ITA, GER, and ROM (cf., Table 15). 'Minor complaints without the

need of ED treatment' scored lowest for BEL (2.7, 1.2, .33), compared to FIN and ROM (both 4.0, 0.0, 1.00) in particular. Moreover, 'ungrateful feedback' reached highest relevance for ROM (4.3, 0.5, 1.00) and lowest for the UK (2.7, 0.9, .33). Similarly, 'excessive claims' are highest for ITA (4.7, 0.5, 1.00) and ROM (4.0, 0.0, 1.00), while considerably lower for the UK (2.0, 0.8, .00), FIN (2.7, 0.9, .33), and GER (3.7, 0.9, .33).

Overall, the CVI values indicate significant disparities among different nations. Particularly, the CVI is notably highest for ROM, GER, and ITA. In contrast, lower values are predominantly observed for UK, respectively (cf., Table 15).

Table 15: Nation-based relevance ratings & consensus metrics: ED work-life influences (RQ-1, DEL-2).

Category and factors	Metrics (M/SD/I-CVI)					
	BEL	FIN	GER	ITA	ROM	UK
Positive general aspects in ED work						
Job challenge: variation and/or interdisciplinary interaction	5.0/0.0/1.00	5.0/0.0/1.00	4.7/0.5/1.00	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00
Job control: participation in decision-making	4.3/0.5/1.00	4.3/0.5/1.00	5.0/0.0/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00
Job intellectuality	4.3/0.9/.67	4.7/0.5/1.00	4.7/0.5/1.00	5.0/0.0/1.00	4.7/0.5/1.00	4.0/0.0/1.00
Task significance	4.7/0.5/1.00	4.7/0.5/1.00	3.7/0.5/.67	4.3/0.5/1.00	4.7/0.5/1.00	4.0/0.0/1.00
Job autonomy	4.7/0.5/1.00	3.7/0.5/.67	3.7/0.5/.67	4.0/0.8/.67	4.0/0.0/1.00	4.0/0.0/1.00
Positive provider-related aspects in ED work						
Personal work ethic and/or motivation	3.7/1.2/.67	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00
Teamwork, social climate and extracurricular activities	4.7/0.5/1.00	4.0/0.0/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.0/0.8/.67
Work experience and/or utilization of skills	4.0/0.8/.67	4.0/0.0/1.00	5.0/0.0/1.00	4.7/0.5/1.00	5.0/0.0/1.00	4.0/0.8/.67

Resilience and coping strategies	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.9/.67	4.0/0.8/.67	4.7/0.5/1.00
Positive co-worker relationships	4.0/1.4/.67	4.7/0.5/1.00	4.3/0.5/1.00	4.0/0.8/.67	4.3/0.5/1.00	4.0/0.8/.67
Positive patient-provider interaction facets in ED work						
Patient case complexity	3.7/0.5/.67	4.3/0.5/1.00	4.3/0.5/1.00	4.7/0.5/1.00	4.3/0.9/.67	4.0/0.0/1.00
Therapy efficacy: seeing patients getting better	3.7/0.9/.33	3.3/0.9/.67	4.7/0.5/1.00	4.0/0.8/.67	4.0/0.8/.67	4.0/0.8/.67
Grateful patient feedback	3.3/1.7/.67	3.7/0.5/.67	4.0/0.8/.67	3.3/0.9/.67	3.3/0.9/.67	3.7/0.5/.67
Communication: social interaction with patients and/or families	3.3/0.9/.67	3.7/0.9/.33	3.7/0.5/.67	3.3/1.2/.33	3.7/1.2/.67	3.7/0.5/.67
Negative general aspects in ED work						
Overcrowding	4.3/0.9/.67	4.7/0.5/1.00	5.0/0.0/1.00	5.0/0.0/1.00	4.3/0.5/1.00	4.7/0.5/1.00
Workflow interruptions and/or multitasking	5.0/0.0/1.00	5.0/0.0/1.00	5.0/0.0/1.00	4.0/0.0/1.00	4.3/0.5/1.00	4.0/0.8/.67
Time pressure and/or lack of breaks	5.0/0.0/1.00	4.0/0.0/1.00	4.3/0.5/1.00	4.0/0.8/.67	4.7/0.5/1.00	4.3/0.9/.67
Employee turnover and understaffing	4.3/0.5/1.00	4.3/0.5/1.00	4.0/0.8/.67	5.0/0.0/1.00	4.3/0.9/.67	4.3/0.9/.67
Chronic cognitive workload	4.0/1.4/.67	3.7/0.5/.67	4.0/0.8/.67	3.7/0.5/.67	4.0/0.8/.67	3.3/0.9/.67
Work-life imbalance	4.3/0.9/.67	3.3/0.9/.67	4.0/0.8/.67	4.7/0.5/1.00	4.0/0.8/.67	2.7/0.9/.33
Shift work	3.3/0.5/.33	3.0/0.8/.33	3.7/0.5/.67	4.7/0.5/1.00	4.0/0.8/.67	2.0/0.8/.00
Negative provider-related aspects in ED work						
Medical errors	4.3/0.5/1.00	3.3/1.2/.33	4.3/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	3.7/1.2/.67
Lack of communication	4.7/0.5/1.00	3.7/1.2/.67	3.7/1.2/.67	3.3/0.5/.33	4.3/0.5/1.00	3.7/0.5/.67

	BEL	FIN	GER	ITA	ROM	UK
and feedback culture						
Task overlap and interaction deficits with other specialties	4.7/0.5/1.00	3.0/0.8/.33	4.3/0.5/1.00	4.0/0.0/1.00	3.3/0.9/.67	3.7/0.9/.33
Tense atmosphere	3.3/1.7/.67	4.3/0.5/1.00	3.7/0.5/.67	4.0/0.8/.67	3.3/0.9/.67	3.7/1.2/.67
High pressure to take far-reaching decisions	3.7/1.2/.67	3.3/0.5/.33	4.7/0.5/1.00	4.0/0.8/.67	4.3/0.5/1.00	2.7/1.2/.33
Lack of resilience and coping mechanisms	3.7/1.2/.67	4.0/0.8/.67	4.0/0.8/.67	3.7/0.9/.33	3.7/0.5/.67	3.3/0.9/.33
Insufficient supervision	3.3/0.5/.33	3.3/0.5/.33	3.7/1.2/.67	3.7/0.5/.67	3.7/0.5/.67	4.0/0.8/.67
Negative patient-provider interaction facets in ED work						
Violence: verbal and/or physical	4.0/1.4/.67	3.3/1.2/.33	4.3/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	3.3/1.2/.33
Legal consequences of conflicts	3.7/1.2/.67	2.3/1.2/.33	4.3/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	2.7/0.5/.00
Minor complaints without the need of ED treatment	2.7/1.2/.33	4.0/0.0/1.00	4.0/0.8/.67	3.7/0.5/.67	4.0/0.0/1.00	3.3/0.9/.67
Ungrateful feedback	3.3/1.7/.67	3.3/0.9/.67	4.0/0.8/.67	4.0/0.8/.67	4.3/0.5/1.00	2.7/0.9/.33
Excessive claims	3.7/1.9/.67	2.7/0.9/.33	3.7/0.9/.33	4.7/0.5/1.00	4.0/0.0/1.00	2.0/0.8/.00
S-CVI/Ave	**.75**	**.74**	**.84**	**.82**	**.87**	**.64**
S-CVI/UA	**.36**	**.48**	**.55**	**.55**	**.61**	**.27**
S-CVI/AUA	**.36**	**.48**	**.55**	**.55**	**.61**	**.27**

Note: n=3 for each column; BEL=Belgium; FIN=Finland; GER=Germany; ITA=Italy; ROM=Romania; UK=United Kingdom; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

In terms of adverse provider health outcomes stemming from ED work, significant disparities exist among different countries. Notably, 'physical fatigue' is considerably lowest in the UK (3.0, 0.8, .33). Conversely, 'compassion fatigue, pessimism, and/or cynicism' are comparably lowest for ROM (3.3, 0.5, .33). Interestingly, 'anxiety' appears to be less prevalent for FIN, with minimal relevance reported (2.7, 0.5, .00), as well as for GER and ROM (both 3.3, 0.5, .33), while more pronounced in ITA and the UK (both 4.0, 0.0, 1.00).

'Insomnia (sleep deprivation and/or disturbance)' is by far less discussed in the UK (3.7, 0.9, .33) compared to ITA (4.7, 0.5, 1.00) and FIN (4.0, 0.0, 1.00). 'Dropouts / opt-outs (= quitters)' were lowest for FIN and the UK (both 3.0, 0.8, .33). Similarly, 'intentions to leave or reduce working hours' are least prevalent for FIN, while highest for BEL and ITA (both 4.3, 0.5, 1.00). Conversely, 'sick leaves' were rarely reported by FIN panelists (2.3, 0.5, .00), whereas straining GER EDs (4.0, 0.0, 1.00).

Overall, the CVI values do not indicate significant disparities. The CVI is consistently low across care levels, yet, with nearly significant values for BEL and ITA (cf., Table 16).

Table 16: Nation-based relevance ratings & consensus metrics: ED providers' health outcomes (RQ-1, DEL-2).

Category and factors	Metrics (M/SD/I-CVI)					
	BEL	FIN	GER	ITA	ROM	UK
Adverse physical health outcomes of ED work						
Physical fatigue	4.7/0.5/1.00	3.7/0.5/.67	4.3/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	3.0/0.8/.33
Musculoskeletal pain	3.7/0.9/.33	3.0/0.8/.33	3.3/0.5/.33	3.3/1.2/.33	3.0/1.6/.33	3.0/0.8/.33
Injuries (e.g., needle stick, trauma, violence)	4.0/0.8/.67	3.0/1.4/.33	2.7/0.5/.00	3.7/0.9/.33	3.0/1.4/.67	2.3/0.5/.00
Adverse mental health outcomes of ED work						
Exhaustion and/or mental fatigue	5.0/0.0/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.0/0.0/1.00
Burnout	4.7/0.5/1.00	4.3/0.9/.67	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.9/.67	4.0/0.8/.67

	BEL	FIN	GER	ITA	ROM	UK
Compassion fatigue, pessimism, and/or cynicism	4.7/0.5/1.00	3.3/0.9/.67	4.0/0.0/1.00	4.0/0.8/.67	3.3/0.5/.33	4.3/0.5/1.00
Anxiety	4.0/1.4/.67	2.7/0.5/.00	3.3/0.5/.33	4.0/0.0/1.00	3.3/0.5/.33	4.0/0.0/1.00
Depression, sadness and/or low mood	4.3/0.9/.67	3.0/0.8/.33	3.0/0.0/.00	3.3/0.5/.33	3.7/0.9/.33	2.7/0.9/.33
Adverse psychosomatic health outcomes of ED work						
Insomnia (sleep deprivation and/or disturbance)	4.0/1.4/.67	4.0/0.0/1.00	3.7/0.5/.67	4.7/0.5/1.00	4.0/0.8/.67	3.7/0.9/.33
Cardiovascular consequences: hypertension and/or tachycardia	3.3/1.7/.67	2.3/0.5/.00	4.0/0.8/.67	3.7/0.5/.67	3.7/0.9/.33	2.7/0.9/.33
Gastroesophageal reflux disease (GERD)	3.0/1.4/.67	2.7/0.9/.33	2.7/0.5/.00	3.3/0.5/.33	3.3/0.5/.33	3.3/1.2/.33
Eating disorders	3.7/1.2/.67	2.3/0.5/.00	2.3/0.5/.00	3.7/0.5/.67	3.7/0.9/.33	2.0/0.0/.00
Adverse behavioral health outcomes of ED work						
Dropouts / opt-outs (= quitters)	4.7/0.5/1.00	3.0/0.8/.33	4.0/0.0/1.00	4.0/0.0/1.00	4.3/0.5/1.00	3.0/0.8/.33
Intentions to leave or reduce working hours	4.3/0.5/1.00	3.0/0.8/.33	4.0/0.8/.67	4.3/0.5/1.00	4.0/0.8/.67	4.0/1.4/.67
Sick leaves	4.0/0.8/.67	2.3/0.5/.00	4.0/0.0/1.00	3.7/0.5/.67	3.3/0.9/.67	3.0/1.4/.67
Substance abuse	3.0/1.4/.33	2.0/0.0/.00	3.3/0.5/.33	2.7/0.5/.00	3.3/0.5/.33	3.0/1.4/.67
S-CVI/Ave	**.75**	**.37**	**.56**	**.69**	**.56**	**.50**
S-CVI/UA	**.38**	**.13**	**.38**	**.44**	**.19**	**.19**
S-CVI/AUA	**.38**	**.13**	**.38**	**.44**	**.19**	**.19**

Note: n=3 for each column; BEL=Belgium; FIN=Finland; GER=Germany; ITA=Italy; ROM=Romania; UK=United Kingdom; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Regarding implemented ED intervention practices, specifically at organizational level, notable differences emerge among various countries. For instance, 'evidence-based SOPs and/or training concepts' receive the lowest ratings from FIN hospitals (3.3, 0.5, .33), while 'Critical Incident Reporting System (CIRS)' is least prevalent for both FIN (3.3, 1.2, .33) and the UK (3.3, 0.5, .33), Similarly, 'Out-of-ED ambulatory care and/or medical assessment units' are least emphasized in GER (3.3, 1.2, .33).

Conversely, 'limited on-call duties, night or weekend shifts, overhours' are deemed highly relevant by ITA (4.7, 0.5, 1.00) and ROM (4.3, 0.5, 1.00) hospitals, while being considered irrelevant by BEL (2.7, 1.2, .33) and FIN (3.0, 0.8, .33) counterparts. Moreover, the establishment of 'quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))' as well as 'employee surveys' is predominantly favored by GER panelists in comparison to all other participants (cf., Table 17).

At the team level: 'nurse practitioners (e.g., wound and/or pain care)' receive highest relevance ratings from the UK (4.7, 0.5, 1.00) and ROM (4.3, 0.5, 1.00), while scored low by all other nations. Ultimately, 'physician-assisted triage' is exclusively highlighted by ROM experts (4.7, 0.5, 1.00).

Overall, the CVI values do not indicate significant disparities. The CVI is consistently low across care levels, albeit with highest values for ITA, ROM, and GER (cf., Table 17).

Table 17: Nation-based relevance ratings & consensus metrics: ED intervention practices (RQ-2, DEL-2).

Category and factors	Metrics (M/SD/I-CVI)					
	BEL	**FIN**	**GER**	**ITA**	**ROM**	**UK**
Improvement and intervention practices on organizational level						
Emergency care as autonomous specialty	5.0/0.0/1.00	3.7/1.2/.67	4.7/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00
ED reorganization and/or modernization	4.3/0.5/1.00	4.0/0.8/.67	4.0/0.0/1.00	4.3/0.5/1.00	4.3/0.5/1.00	3.7/1.2/.67
Evidence-based SOPs and/or training concepts	4.0/0.8/.67	3.3/0.5/.33	4.7/0.5/1.00	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00
Adaptable staff and duty rostering	3.0/1.4/.67	4.3/0.9/.67	4.0/0.8/.67	4.3/0.5/1.00	4.3/0.9/.67	4.7/0.5/1.00

Critical Incident Reporting System (CIRS)	4.7/0.5/1.00	3.3/1.2/.33	4.7/0.5/1.00	4.3/0.5/1.00	3.0/1.4/.67	3.3/0.5/.33
Out-of-ED ambulatory care and/or medical assessment units	3.0/1.4/.67	4.0/0.8/.67	3.3/1.2/.33	3.7/0.5/.67	4.3/0.5/1.00	4.7/0.5/1.00
Limited on-call duties, night or weekend shifts, overhours	2.7/1.2/.33	3.0/0.8/.33	4.0/0.8/.67	4.7/0.5/1.00	4.3/0.5/1.00	3.7/0.5//.67
Quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))	3.7/1.9/.67	3.0/1.4/.33	4.3/0.5/1.00	4.0/0.8/.67	3.0/1.6/.33	3.0/1.4/.33
National emergency medicine society networking platforms	3.3/1.2/.33	3.7/1.2/.67	3.7/0.5/.67	3.0/0.8/.33	3.0/1.6/.33	3.7/0.5/.67
Employee surveys	2.7/0.5/.00	3.0/0.8/.33	4.0/0.0/1.00	3.3/0.5/.33	3.0/1.6/.33	3.7/1.2/.67
Offer of mental health interventions	3.7/0.5/.67	3.0/0.8/.33	3.3/0.5/.33	3.3/1.2/.33	2.7/1.2/.33	2.7/0.9/.33
Regular occupational health checks	2.3/1.2/.33	2.7/0.9/.33	3.0/0.0/.00	3.3/0.5/.33	3.7/0.9/.33	2.0/0.8/.00

Improvement and intervention practices on team level

(Simulation-based) Skills trainings (e.g., resuscitation, CRM)	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	4.0/1.4/.67	3.7/0.5/.67
Debriefings after critical events with potential post-traumatic consequences	4.3/0.5/1.00	3.7/0.5/.67	4.7/0.5/1.00	4.7/0.5/1.00	3.7/1.2/.67	4.3/0.5/1.00
Regular feedback from mentors	4.0/0.8/.67	4.3/0.9/.67	4.0/0.8/.67	4.7/0.5/1.00	3.7/1.2/.67	4.0/1.4/.67
Inter-professional educational initiatives for physicians and nursing	3.7/1.2/.67	3.3/1.2/.33	3.7/0.5/.67	4.0/0.8/.67	4.0/1.4/.67	4.0/1.4/.67
Nurse practitioners (e.g., wound and/or pain care)	2.3/0.9/.00	3.0/0.8/.33	2.3/1.2/.33	3.3/0.5/.33	4.3/0.5/1.00	4.7/0.5/1.00

	BEL	FIN	GER	ITA	ROM	UK
Physician-assisted triage	2.3/1.9/.33	3.0/1.4/.33	2.7/0.5/.00	2.7/0.5/.00	4.7/0.5/1.00	3.7/0.5/.67
Improvement and intervention practices on individual level						
Private sport activities: individual and/or group-based	2.3/1.9/.33	3.3/0.9/.67	4.0/0.8/.67	4.0/0.8/.67	4.0/0.8/.67	3.7/0.9/.33
Acute mental occupational health services (e.g., psychotherapy)	4.0/0.8/.67	3.0/0.8/.33	2.7/1.2/.33	4.0/0.8/.67	3.0/1.4/.67	1.7/0.5/.00
Hospital-initiated mental health protection programs	3.7/0.5/.67	2.7/0.5/.00	2.7/1.2/.33	3.3/1.2/.33	3.3/1.7/.67	2.7/1.2/.33
Private activities to prevent mental illness	3.3/1.7/.67	3.0/0.8/.33	3.0/1.6/.33	4.0/0.8/.67	3.0/1.6/.33	2.3/0.9/.00
Acute physical occupational health services (e.g., physiotherapy)	2.3/1.9/.33	3.0/0.8/.33	3.0/1.6/.33	3.3/1.2/.33	3.3/0.5/.33	2.0/0.8/.00
Hospital-initiated physical health protection programs	2.0/0.8/.00	3.0/0.8/.33	3.0/1.4/.67	3.3/12/.33	3.0/1.6/.33	2.0/0.8/.00
S-CVI/Ave	.57	.46	.63	.65	.65	.54
S-CVI/UA	.21	.04	.33	.38	.29	.25
S-CVI/AUA	.21	.04	.33	.38	.29	.25

Note: n=3 for each column; BEL=Belgium; FIN=Finland; GER=Germany; ITA=Italy; ROM=Romania; UK=United Kingdom; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

Concerning challenges posed by COVID-19 within ED settings, particularly aspects aimed at mitigating negative impacts on provider working conditions, the significance of interventions varies across nations. Notably, the 'change of SOPs' was deemed irrelevant solely by UK panelists (3.3, 1.2, .33). Similarly, 'intra- and interhospital networking' and the 'employment of additional external staff' were least prioritized by the UK compared to other nations (cf., Table 18). In turn, the latter received relevant ratings by ITA and ROM (both 4.3, 0.5, 1.00). Additionally, ROM facilities (4.7, 0.5, 1.00)

recognized the value in 'reorganization of staff and duty rostering', while the UK (2.7, 0.5, .00) and BEL (3.0, 1.6, .33) reported the lowest relevance.

Regarding aspects inducing negative impacts, 'crowding: ED space limitations and/or exit blocks' scored lowest by FIN (3.3, 1.2, .33). Similarly, impacts on providers' health, such as 'confirmed COVID-19 infections', were lowest for FIN (3.3, 1.2, .33). Induction of increased prevalence of 'anxieties' appears not to be a concern for FIN (2.7, 0.9, .33) and GER (3.3, 0.5, .33), compared to significant consensus ratings among all other participants. Noteworthy, 'burnout' was less relevant for the UK (3.0, 1.6, .33) and FIN (3.0, 0.8, .33), while being prevalent and relevant to nearly all other countries.

In terms of impacts on employee-reported quality and safety of patient care, 'reduced emotional support for patients and/or their families' was highest for ITA (4.7, 0.5, 1.00) and GER (4.3, 0.5, 1.00), while lowest for FIN (3.0, 0.8, .33). 'CT scan overuse' was a significant concern for ROM (4.3, 0.5, 1.00), while not a topic for BEL (2.0, 0.8, 0), GER (2.3, 1.2, .33), and the UK (3.3, 0.5, .33). Lastly, 'diagnostic misperceptions and/or misdiagnoses' were significantly relevant for the UK (4.7, 0.5, 1.00) and ROM (4.0, 0.0, 1.00), while by far less reported by any other participating nation.

In total, the CVI values indicate significant disparities among different nations. Particularly, the CVI is highly significant and considerably highest for ITA and ROM. In contrast, the lowest values are predominantly scored by the UK and FIN, respectively (cf., Table 18).

Table 18: Nation-based relevance ratings & consensus metrics: COVID-19-related ED work (RQ-3, DEL-2).

Category and factors	Metrics (M/SD/I-CVI)					
	BEL	FIN	GER	ITA	ROM	UK
Aspects reducing negative impacts of COVID-19 on provider working conditions						
Personal protective equipment (PPE)	5.0/0.0/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00
Vaccination campaigns	4.7/0.5/1.00	4.7/0.5/1.00	4.0/0.8/.67	4.7/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00
Testing: PCR and/or POC antigen	5.0/0.0/1.00	4.7/0.5/1.00	5.0/0.0/1.00	4.3/0.5/1.00	4.3/0.9/.67	4.0/0.8/.67

Persistent information flow	4.3/0.9/.67	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	3.7/0.5/.67
Change of SOPs	4.7/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	4.3/0.5/1.00	3.3/1.2/.33
Separate isolation and cohort areas or units	3.7/1.9/.67	4.7/0.5/1.00	4.0/0.8/.67	4.7/0.5/1.00	5.0/0.0/1.00	3.7/1.2/.67
Intra- and interhospital networking	4.3/0.5/1.00	3.7/1.2/.67	4.0/0.0/1.00	4.3/0.5/1.00	4.3/0.9/.67	3.3/1.2/.33
Employment of additional external staff	3.0/1.4/.67	4.0/0.8/.67	3.0/1.4/.67	4.3/0.5/1.00	4.3/0.5/1.00	2.3/1.2/.33
Reorganization of staff and duty rostering	3.0/1.6/.33	4.0/0.8/.67	3.7/0.5/.67	4.7/0.5/1.00	4.3/0.9/.67	2.7/0.5/.00
Psychological support: employee surveys and/or well-being offers	3.3/1.7/.67	3.3/0.5/.33	3.7/0.5/.67	3.7/0.9/.33	3.7/1.2/.67	3.3/0.5/.33
Contact tracing and quarantining	3.0/1.4/.67	3.7/0.5/.67	3.0/0.8/.33	4.0/0.8/.67	3.0/0.8/.33	2.7/1.2/.33
Structural room ventilation systems	3.3/1.7/.67	4.3/0.9/.67	2.3/1.2/.33	4.0/0.8/.67	3.3/1.7/.67	1.3/0.5/.00

Aspects inducing negative impacts of COVID-19 on provider working conditions

Shortage of staff	5.0/0.0/1.00	5.0/0.0/1.00	4.3/0.5/1.00	4.7/0.5/1.00	5.0/0.0/1.00	4.7/0.5/1.00
Excessive workload: organizational and/or isolation-related	4.7/0.5/1.00	5.0/0.0/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	4.3/0.5/1.00
Crowding: ED space limitations and/or exit blocks	4.0/1.4/.67	3.3/1.2/.33	4.0/0.0/1.00	5.0/0.0/1.00	4.7/0.5/1.00	4.0/1.4/.67
Lack of PPE	2.3/1.9/.33	2.0/0.0/.00	2.3/1.9/.33	3.7/0.9/.33	3.7/1.2/.67	3.3/1.7/.67

COVID-19-related impacts on providers' physical health

Confirmed COVID-19 infections	4.7/0.5/1.00	3.3/1.2/.33	4.0/0.0/1.00	4.7/0.5/1.00	4.0/0.0/1.00	4.3/0.9/.67
PPE discomfort: overheating, skin and/or respiratory irritations	4.3/0.9/.67	3.7/1.2/.67	3.7/0.5/.67	3.7/1.2/.67	3.7/0.5/.67	4.0/0.8/.67
Long-COVID syndrome	2.0/0.8/.00	2.0/0.8/.00	3.7/1.2/.67	3.7/0.5/.67	4.0/0.8/.67	3.0/1.4/.67

COVID-19-related impacts on providers' mental health						
Mental exhaustion and/or less resilience	4.7/0.5/1.00	3.7/1.2/.67	4.3/0.5/1.00	4.7/0.5/1.00	4.0/0.8/.67	3.7/1.2/.67
Anxieties	4.3/0.5/1.00	2.7/0.9/.33	3.3/0.5/.33	4.0/0.0/1.00	4.3/0.5/1.00	4.0/0.0/1.00
Burnout	4.3/0.9/.67	3.0/0.8/.33	4.3/0.5/1.00	4.7/0.5/1.00	4.7/0.5/1.00	3.0/1.6/.33
Social isolation	4.0/0.8/.67	3.7/1.2/.67	3.3/0.9/.67	4.3/0.9/.67	3.3/0.5/.33	3.7/1.2/.67
Depression	3.7/1.2/.67	3.3/0.9/.67	3.0/0.0/.00	3.7/0.5/.67	3.7/0.9/.33	2.7/0.9/.33
COVID-19-related impacts on employee-reported quality and safety of patient care						
Undertreatment of emergency medicine diagnoses	4.0/0.8/.67	4.0/0.5/1.00	3.7/0.5/.67	4.7/0.5/1.00	4.3/0.5/1.00	4.7/0.5/1.00
Delay in patient diagnostic and therapeutic pathways (PDTP)	3.7/1.2/.67	4.3/0.5/1.00	3.7/0.5/.67	4.7/0.5/1.00	4.3/0.9/.67	4.3/0.5/1.00
Reduced emotional support for patients and/or their families	4.0/0.8/.67	3.0/0.8/.33	4.3/0.5/1.00	4.7/0.5/1.00	3.7/0.5/.67	3.7/1.9/.67
CT scan overuse	2.0/0.8/.00	3.3/0.9/.67	2.3/1.2/.33	4.0/0.8/.67	4.3/0.5/1.00	3.3/0.5/.33
Diagnostic misperceptions and/or misdiagnoses	3.3/1.2/.33	2.7/0.5/.00	2.7/0.5/.00	3.3/0.5/.33	4.0/0.0/1.00	4.7/0.5/1.00
S-CVI/Ave	**.70**	**.64**	**.70**	**.85**	**.81**	**.62**
S-CVI/UA	**.34**	**.34**	**.41**	**.66**	**.52**	**.28**
S-CVI/AUA	**.34**	**.34**	**.41**	**.66**	**.52**	**.28**

Note: n=3 for each column; BEL=Belgium; FIN=Finland; GER=Germany; ITA=Italy; ROM=Romania; UK=United Kingdom; scale range '1 – Highly irrelevant' to '5 – Highly relevant'; M=Mean; SD=Standard deviation; I-CVI=item-content validity index: ratio of panelists rating with '4 – Rather relevant' or '5 – Highly relevant' against the total number of panelists for each item; S-CVI/Ave=averaging scale-content validity index: averaged I-CVI values across all items; S-CVI/UA=universal agreement scale-content validity index: proportion of items achieving a rating of 4 or 5 by all panelists; S-CVI/AUA=adapted universal agreement scale-content validity index: ratio of items with an I-CVI of ≥ .78 and the overall item list; GREEN: I-CVI ≥ .78 | S-CVI ≥ .90, YELLOW: S-CVI .80 - .89, RED: I-CVI < .78 | S-CVI < .80.

7.2 List of search terms (narrative literature review)

1) delphi[Title/Abstract] AND emergency[Title/Abstract]

2) interview[Title/Abstract] AND emergency[Title/Abstract]

3) work conditions[Title/Abstract] AND emergency[Title/Abstract]

4) work stress[Title/Abstract] AND emergency[Title/Abstract]

5) job stress[Title/Abstract] AND emergency[Title/Abstract]

6) job strain[Title/Abstract] AND emergency[Title/Abstract]

7) work characteristics[Title/Abstract] AND emergency[Title/Abstract]

8) employee strain[Title/Abstract] AND emergency[Title/Abstract]

9) employee[Title/Abstract] AND emergency[Title/Abstract]

10) psychosocial work factors[Title/Abstract] AND emergency[Title/Abstract]

11) provider mental well-being[Title/Abstract] AND emergency[Title/Abstract]

12) work factors[Title/Abstract] AND emergency[Title/Abstract]

13) psychosocial[Title/Abstract] AND emergency[Title/Abstract]

14) provider[Title/Abstract] AND emergency[Title/Abstract]

15) providers[Title/Abstract] AND emergency[Title/Abstract]

16) conditions[Title/Abstract] AND emergency[Title/Abstract]

17) well-being[Title/Abstract] AND emergency[Title/Abstract]

18) stress[Title/Abstract] AND emergency[Title/Abstract]

19) strain[Title/Abstract] AND emergency[Title/Abstract]

20) quality of care[Title/Abstract] AND emergency[Title/Abstract]

21) work-related strain[Title/Abstract] AND emergency[Title/Abstract]

22) job demands[Title/Abstract] AND emergency[Title/Abstract]

23) demands[Title/Abstract] AND emergency[Title/Abstract]

24) burnout[Title/Abstract] AND emergency[Title/Abstract]

25) job satisfaction[Title/Abstract] AND emergency[Title/Abstract]

26) work satisfaction[Title/Abstract] AND emergency[Title/Abstract]

27) satisfaction[Title/Abstract] AND emergency[Title/Abstract]

28) physician[Title/Abstract] AND emergency[Title/Abstract]

29) job condition AND emergency[Title/Abstract]

30) job characteristic AND emergency[Title/Abstract]

31) job factors AND emergency[Title/Abstract]

32) work-related AND emergency[Title/Abstract]

33) work AND emergency[Title/Abstract]

34) work stressors AND emergency[Title/Abstract]

35) work fatigue AND emergency[Title/Abstract]

36) job-related AND emergency[Title/Abstract]

37) job AND emergency[Title/Abstract]

38) wellness AND emergency[Title/Abstract]

39) workplace AND emergency[Title/Abstract]

40) health AND emergency[Title/Abstract]

41) environment AND emergency[Title/Abstract]

42) quality of life AND emergency[Title/Abstract]

43) occupation AND emergency[Title/Abstract]

44) mental stress AND emergency[Title/Abstract]

45) emotional distress AND emergency[Title/Abstract]

7.3 EUSEM board information bulletin

Information bulletin: Emergency Department experts for an EUSEM study wanted

Working title:
Identification of provider working conditions and well-being in Emergency Departments:
A cross-European interview study

Motivation of the study:
1) Necessity of implementing reforms within political agendas
2) Establishment of a validated scientific basis (by Delphi-consensus process)
3) Groundwork for a medical dissertation and consecutive peer-reviewed publications

Objectives of the study:
We are conducting a scientific survey among ED professionals in various European countries to obtain a systematic and thorough understanding on the issue of ED work conditions, provider well-being and performance as well as associated outcomes on patient care. Our investigation has two general objectives:

(1) To identify key stressors of current ED work and associated effects on ED provider well-being and patient care outcomes. To identify issues that are generic across European countries as well as specific workplace issues that are unique to the particular countries.

(2) Scrutiny of context and process conditions of successful adoption and implementation of improvement interventions in EDs. We seek to understand how effectively these interventions have been implemented and investigate the reasons behind success and failure.

Procedure / Methods:
Semi-structured expert video interviews with a total purposive convenience sample of around 12-18 subject matter experts, equally selected from prospectively following EUSEM member states (2-3 each): Netherlands, United Kingdom, Denmark (alternative: Sweden), Germany, Spain (alternative: Italy), Romania. Identification of main statements for structured Delphi-consensus process and key statements concerning major domains.

Inclusion criteria:
I. Hospital-based ED consultant doctors and heads of emergency departments
II. Profound experience, expertise, theoretical and practical knowledge of hospital-based emergency medicine
III. Sufficient oral and written English language skills
IV. Equal panel distribution between university, urban and rural hospitals

Steps of the investigation:
Ethical & data protection approval are obtained already. Since all interviews will be conducted in the spare time of the experts, an intra-hospital procedure of consents (e.g., through boards or department heads) is not necessary. Participants will adequately beforehand receive a document package providing project information, interview guidelines and consent requests from the scientific team.

Next steps:
Recruitment procedure:
a. Internal mail or direct approach via EUSEM association (e.g., membership information, newsletters, EUSEM board)
b. Snowball sampling procedure: EUSEM councils asked to provide potential experts of interests as study participants

Scientific team in charge:
❖ Project coordinator & EUSEM contact:
Prof. Dr. med. Christoph Dodt, +49(0)89 9270 3269, Christoph.Dodt@muenchen-klinik.de
(Head of A&E Department, München Klinik Bogenhausen; Vice President of EUSEM)
❖ MD candidate & study contact:
Michael Lifschitz, +49 176 317 991 00, Michael.Lifschitz@muenchen-klinik.de
(Assistant physician, Department of Anesthesiology, Operative Intensive Care & Pain Therapy, München Klinik Bogenhausen)
❖ Scientific investigator:
PD Dr. phil. Matthias Weigl, +49 (0)89 4400 55311, Matthias.Weigl@med.uni-muenchen.de
(Senior Researcher AG AMPA, Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, LMU Munich)

7.4 Study participant package (Delphi round 1)

Study Information

Identification of provider working conditions and well-being indicators in Emergency Departments: An EUSEM-initiated, cross-European, Delphi consensus initiative

Dear Sir or Madam,

We – Michael Lifschitz, Christoph Dodt and Matthias Weigl – are cooperating with the European Society for Emergency Medicine (EUSEM) for the purpose of a scientific investigation into working conditions in Emergency Departments (EDs). Moreover, we are interested in structural and work-related influences on ED providers' health and ED quality and safety of patient care.

This document informs you about the purpose, steps, methods, and data protection measures of our study.

Furthermore, in case of your willingness, we ask you to sign the *Declaration of Informed Consent* attached to this letter and return it to us.

Background and purpose of this survey

We are conducting a scientific survey among ED professionals in various European countries to obtain a systematic and thorough understanding on the issue of ED work conditions, provider well-being and performance as well as associated self-perceived outcomes on self-perceived quality and safety of patient care. Our investigation has two general objectives:

(1)   To identify key stressors of current ED work and associated effects on ED provider well-being and patient care outcomes. To identify issues that are generic across European countries as well as specific workplace issues that are unique to particular countries.

(2)   Identification of context and process conditions of successful adoption and implementation of improvement interventions in EDs. We seek to understand how effectively these interventions have been implemented and investigate the reasons behind success and failure.

Procedure of the survey

This is a two-step design that combines qualitative and semi-quantitative methods. The following steps will be applied:

Step 1: First round of semi-structured European ED expert interviews (Delphi-consensus process round 1)

During the first part of the study, interviews (via phone or video call) will be conducted with participating key informants (= subject matter experts). A purposive sample of ED physicians from each participating country will be surveyed with semi-structured interviews concerning their perspective on prevalent ED work stressors, provider well-being issues at work, and

associated indicators for self-perceived quality and safety of patient care. Drawing upon a first round of Delphi-consensus process, we seek to establish a free-text response consensus concerning major survey contents and grouped as specific themes (see step 2). Expert panel input will be collected individually, anonymized, summarized, and analyzed preliminarily.

Within this step 1 of the study, we ask to interview you on your experience of ED work conditions, provider well-being at work and associated factors. The duration is approximately between 60-90 min.

Step 2: Second round of semi-structured European ED expert interviews
(Delphi-consensus process round 2)

During the second part of the study, an online survey will be conducted with participating key informants (= subject matter experts) from round 1. Drawing upon a second round of Delphi-consensus process, we seek to establish an importance-ranked response consensus concerning the consolidated factors from round 1. We intend to identify a preliminary set of European ED director and ED provider survey contents for refinement, finalization, and application. We seek to determine prevalence data on ED conditions for each European country separately as well as for the overall sample. In the same vein, we further seek to identify associations between ED context characteristics, provider reports of work conditions, and well-being outcomes.

Within this step 2 of the study, we ask to survey you on above mentioned consolidated factors from round 1. The duration is approximately between 15-30 min.

Confidentiality and data protection measures

Neither of your reports and responses (in step 1 and 2) will be accessible to your employer or third parties outside of the study team. All interview and survey data will be only accessible to the study team (see below).

Please acknowledge that we cannot guarantee full data security and protection if interviews are conducted via video call.

To compare data across the participating EDs and countries, each ED will be assigned a study code (i.e., random three-digit number). We will use a pseudonymization procedure such that each interview transcript (step 1) will be coded with the respective study code. All study codes and respective EDs are stored within an encrypted, separate document
(that is only accessible to the study team). Therefore, disclosure of your personal data is not possible. In case of context-rich information we will reduce information in our transcripts to eliminate information that may disclose personal information.

Results to be generated from the study

The results of this study serve to examine how ED providers evaluate their level of working conditions in the ED, in their respective countries as well as across several European

countries. We seek to establish further evidence on the current state of ED work conditions in the EU as well as associated costs for providers and patients in terms of well-being at work as well as efficacy and safety of emergency care delivery. The finding shall provide base for policy and practice recommendation to foster the quality of workplaces in hospital-based emergency medicine.

Our responsibilities towards you as a study participant:

- Your participation in this study is voluntary! You can withdraw from the study at any time without providing any reasons (see also form *Declaration of Informed Consent – Study Participation*). However, please consider that we can only obtain scientifically solid results if as many ED experts as possible complete the survey.
- All collected data will be handled in a strictly confidential manner. It will not be possible to infer information about individual study participants from the reported results. All aspects of data protection will be fully maintained. Personal data will be handed on only in the manner described in these forms (*Study Information & Declaration of Informed Consent – Study Participation*).
- This study is guided by current standards of scientific practice and is committed to objectivity and neutrality.
- The results of the study will be reported back to all involved parties and stakeholders in a manner such that transparency is safeguarded (a report to EUSEM board and members).

Benefit of study participation

With your potential participation, you can contribute to the further examination of ED provider work conditions and work-related well-being in Europe. This may eventually inform future policy and practice recommendation to promote the quality of workplaces in emergency medicine.

Disadvantages of study participation

For step 1 and step 2, the duration will be around 60-90 (step 1) and 15-30 (step 2) minutes each. Besides this time investment, no disadvantages are to be expected.
Please acknowledge that a survey on your work conditions may trigger or foster negative feelings towards your actual work situation. Furthermore, the study results may reveal negative findings that may influence the reputation of hospital-based emergency care as a profession in the public.

Insurance coverage for study participants

There is no need for an insurance coverage since we do not foresee hazards associated with participation.

Compensation for study participation

Please acknowledge that a compensation for study participation is not provided.

Data protection

All prescriptions made by the principle of medical confidentiality, as well as those made by the pertinent data protection acts and regulations in Germany (which are in line with EU-data protection regulations), will be upheld.

All data will be pseudonymised immediately upon data entry and archived for further scientific use. The study code will identify your ED. Pseudonymisation means that all your interview data are encrypted with this code that will contain neither your name, nor your initials, nor your exact or any part of your birth date. It allows us to link the different data within each ED and country, respectively.

There will be no exchange of individual data, whether pseudonymised or anonymised, between your employer, and any other third party, neither directly nor indirectly via the Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, LMU University Hospital.

All study data will be stored at the Institute for 10 years following publication of the final study report. If you decide to revoke your consent to participation in the study, please be aware that we cannot delete your personal interview data since we do not code personalized information (neither for step 1 nor step 2). Your pseudonymised data will be used continuously in this form until the end of data collection. Please acknowledge that we cannot restore your individual data once irreversible anonymization has been conducted.

Access to original data received by the institute and to the encryption code is restricted to the following persons: MD cand. Michael Lifschitz, Prof. Dr. med. Christoph Dodt, PD Dr. phil. Matthias Weigl.

In case of publication of research results as well as feedback to cooperating partners, confidentiality of personal data will be maintained. The reported data will be aggregated such that it will not be possible to identify any individual study participant.

All data protection regulations and duties outlined in Art. 13 DSGVO will be adhered to.

Our local person in charge for our institution's data protection measures of the University Hospital, LMU Munich is Mister Gerhard Meyer.	The data protection agency of the State of Bavaria is the *Bayerisches Landesamt für Datenschutzaufsicht*.
Contact: Pettenkoferstraße 8 D-80336 Munich datenschutz@med.uni-muenchen.de Tel.: +49 (0)89 4400 58454 Fax: +49 (0)89 4400 55192	**Contact**: Bayerisches Landesamt für Datenschutzaufsicht (BayLDA) Promenade 18 D-91522 Ansbach www.lda.bayern.de

Information concerning the *Declaration of Informed Consent*

(1) Should you decide to participate in the study or parts of it, we kindly ask you to sign the sheet *Declaration of Informed Consent – Study Participation*.

(2) Please scan your signed forms and send them to us via e-mail to
Michael.Lifschitz@campus.lmu.de.

Thank you very much for your consideration.

Study team contact

The study is supervised by the following scientific team in charge, you may contact at any
time:

MD candidate & study contact:

Michael Lifschitz, +49 176 317 991 00, Michael.Lifschitz@campus.lmu.de (Work Group
Applied Medicine and Psychology at Work, Institute and Outpatient Clinic for Occupational,
Social and Environmental Medicine, University Hospital, Ludwig-Maximilians-University
Munich, Germany)

Project coordinator & EUSEM contact:

Prof. Dr. med. Christoph Dodt, +49 (0)89 9270 3269, Christoph.Dodt@muenchen-klinik.de
(Head of A&E Department, München Klinik Bogenhausen; Vice President of EUSEM)

Scientific investigator:

Prof. Dr. phil. Matthias Weigl, +49 (0)89 4400 55311, Matthias.Weigl@med.uni-
muenchen.de (Senior researcher at the Work Group *Applied Medicine and Psychology at
Work*, Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine,
University Hospital, Ludwig-Maximilians-University Munich, Germany

LMU KLINIKUM   EUSEM
                      EUROPEAN SOCIETY FOR EMERGENCY MEDICINE

(after completion, to be returned to study team)

Declaration of Informed Consent – Study Participation

I, the signatory, ………………………………………… (First name, Last name), herewith declare my consent to participate in the study ***Identification of provider working conditions and well-being in Emergency Departments: A cross-European interview study***.

I confirm that I have been sufficiently briefed about the study by the Study Information sheet. I have understood all information provided to me. I had adequate opportunity to inquire about any aspect of the study.

I can receive further information at any time from the persons conducting the study (principal contact: MD cand. Michael Lifschitz, +49 176 317 991 00, Michael.Lifschitz@campus.lmu.de).

I was informed that I can freely decide about participation in this study.

In this study, medical confidentiality and regulations concerning data protection will be adhered to. I agree to the storage of the data received by the responsible study team, as described in the Study Information sheet. None of my survey data will be made accessible to my employer. None of my individual survey data will be made accessible to any other persons besides the ones named in the Study Information sheet. All personal data received by the study team will be pseudonymised upon data entry. I agree that my data cannot be revoked after irreversible anonymization of the data. Data management, analysis, and reporting of results will be anonymous, i.e., my personal identity cannot be traced back as a result of these activities. No personal data will be handed on by the study team. In case of publication of study results, confidentiality of my personal data will be upheld at any time. For the purpose of scientific evaluation, all data will be stored at the Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine, LMU University Hospital.

I have been informed that I can revoke my participation in the study at any time without giving any reasons if I desire to do so. All data collected until the time of revocation will be irreversibly anonymised and will continue to be used for scientific evaluation in this form.

I agree to participate in the study and – in accordance with my declaration above – to the collection and use of my personal data as outlined in the Study Information sheet.

_____   _____   _____
Place / Date   Participant signature & stamp   Study team signature

EUSEM cross-European Emergency department (ED) expert-based interview guideline (Delphi method round 1) [1]

Dear Sir or Madam,

Thank you very much for your interest in our expert survey and your consent to participate.

In order to gain preliminary insights into the work situation of ED physicians in your country and hospital, it is important to obtain experts' statements.

We prepared a list of questions that address several aspects of ED physicians' work life, well-being at the job, and self-perceived quality and safety of patient care. Furthermore, we are interested in your knowledge and appraisal of intervention approaches on previously mentioned aspects and of potential changes due to the COVID-19 pandemic.

We ask you to report us your individual opinions on the following issues:

(1) ED physicians' work life, working conditions and work-related key factors

   a. For your Emergency Department, please briefly state **work-related factors** of physicians' work life.

   b. Please give a concise insight into the following **work life aspects** of your ED work:

   ⬩*Infrastructure & organization*

   ➢ Clinic scope (e.g., category; specialties; ward beds; ICU & IMC beds; ED staff; annual out- & in-patient volume) [2]
   ➢ Triage system (e.g., number & definition of categories) [3, 4]
   ➢ ED physical work environment (e.g., workstation layout; space; privacy; lightning; noise; vibration; temperature; humidity; air quality) [5]
   ➢ (Un-)beneficially influential societal, economic, ecological & political factors [5]

   ⬩*Personnel & employment conditions*

   ➢ Work system (e.g., schedules & shifts; rotation into inpatient wards & ICU/IMC; necessity of performing research & teaching) [5-7]
   ➢ Skills and qualification: ratio & definition (e.g., seniors vs juniors; physicians vs nurses; skill mix, gender & cultural diversity ratio; classification of different experience levels) [2, 5, 8]
   ➢ Staffing levels & determination (e.g., calculation approaches; *mean physician time per patient* vs *workplace method*; minimal staffing levels) [2, 8-10]
   ➢ Types of contracts (e.g., ratio of part- vs full-time; unlimited vs limited; permanent vs temporary rotation into the ED; average annual full-time salaries & on-call payments; additional compensation) [4, 7, 11]
   ➢ Overtime & compensation (e.g., average amount of monthly overtime; time off in lieu vs additional payment; electronical check-in/-out vs manual time diaries) [4, 7, 11]

   ⬩*(Information) Tools & technology*

   ➢ Health information technologies / health records (e.g., documentation: average time per patient, computerized vs paper-based records & provider order entries; hand-held systems; patchwork of software tools; translation tools) [5]
   ➢ Availability of diagnostic & intervention technologies
   ➢ Introduction, skills training & free resource access [5]
   ➢ Maintenance & cleaning (e.g., real-time action in case of malfunction & deficits) [5]

   ⬩*Intra- & inter-professional collaboration*

   ➢ Department responsibility for: (a) triage, (b) stabilization/resuscitation, (c) bed management, (d) diagnostic procedure, (e) immediate therapy, (f) disposition? [4]

LMU KLINIKUM

EUSEM
EUROPEAN SOCIETY FOR EMERGENCY MEDICINE

(2) Influences (2a) and outcomes (2b) of ED work on ED physicians' well-being on the job and self-perceived quality and safety of patient care

   a. For your Emergency Department, please briefly state **influences of ED work** on physicians' well-being on the job and on the self-perceived quality and safety of patient care (2a).

   b. Please offer a concise insight into the following **influences** of your ED work by (a) putting them in a personal order from relevance to irrelevance and (b) adding unconsidered factors (2a):

⁜ *Organizational influences*

   ❖ **Job satisfaction:**
     ① Job intellectuality/content ② Task significance ③ Work challenge, variation & interdisciplinary interaction ④ Job autonomy ⑤ Job control & participation in decision-making ⑥ Work-life balance ⑦ Job security ⑧ Prospects & promotion ⑨ Salary/payment ⑩ Social esteem & respectability [2, 5, 11, 12]

   ❖ **Job dissatisfaction:**
     ① Chronic cognitive workload ② Time pressure & lack of breaks ③ Workflow interruptions & multitasking ④ Shift work ⑤ Employee turnover, fluctuation, shortages & understaffing ⑥ Overcrowding ⑦ In-/outflow deficits & lack of patient information (transfer) ⑧ Limited trainee authority, autonomy & job control ⑨ Administrative & coordinative duties (e.g., interpreters/translators; bed management) ⑩ Work-life imbalance ⑪ Delay in triage, diagnostic & therapy ⑫ Profitability ⑬ (Information) technology & internal/external environment deficits ⑭ Insufficient medication, resource & isolation supply [2, 4, 5, 7, 11, 13-20]

⁜ *Provider influences*

   ❖ **Job satisfaction:**
     ① Resilience & coping strategies ② Personal strong work ethic & motivation ③ Work experience & utilization of skills ④ Teamwork & social climate ⑤ Peer credibility & reputation ⑥ Positive co-workers' relationships ⑦ Conscientiousness & adequate risk-taking ⑧ Persistent presence of senior doctors, positive leader behaviour, sufficient supervisor support & teaching ⑨ Strong communication & feedback culture ⑩ Flat hierarchies [2, 4, 5, 11-13, 21-23]

   ❖ **Job dissatisfaction:**
     ① Lack of resilience & coping mechanisms ② Negative leader behaviour, lack of supervisor support & teaching ③ Problematic co-workers' relationships ④ Tense atmosphere ⑤ Low presence of senior doctors ⑥ Lack of communication & feedback culture ⑦ Steep hierarchies ⑧ Non-compliance with guidelines & algorithms ⑨ Under-/overconscientiousness ⑩ Inadequate risk-taking/averseness ⑪ Medical errors & adverse effects ⑫ Task overlap & interaction deficits (e.g., physicians vs nursing; ED vs other specialties; resuscitation room) ⑬ Lack of organizational skills ⑭ Lack of introduction into new procedures & structures [2, 4, 5, 11-13, 21-23]

⁜ *Patient influences*

   ❖ **Job satisfaction:**
     ① Grateful feedback ② Patient case complexity ③ Participation in patients' private life

   ❖ **Job dissatisfaction:**
     ① Primary care complaints ② Patient case complexity ③ Family & social concerns ④ Non-compliance ⑤ Breaking bad news & death ⑥ Excessive claims & self-diagnostics ⑦ Ungrateful feedback ⑧ Verbal & physical violence ⑨ Litigations [2, 4, 5, 7, 11, 14, 21]

LMU KLINIKUM

EUSEM
EUROPEAN SOCIETY FOR EMERGENCY MEDICINE

c. For your Emergency Department, please briefly state **outcomes of negative ED work** on physicians' well-being on the job and on the self-perceived quality and safety of patient care (2b).

d. Please provide a concise insight into the following **outcomes** of your ED work (2b):

⚜ *Outcomes on physical health* (e.g., musculoskeletal pain; (needlestick) injuries; infections; radiation, fatigue) [12, 24-28]

⚜ *Outcomes on mental health* (e.g., internal tension; anxiety; sadness; despair; compassion fatigue; exhaustion; burnout; depression; isolation; PTSD; psychoses; personality disorders) [2, 5, 11, 12, 23]

⚜ *Outcomes on psychosomatic complaints* (e.g., hypertension; tachycardia; sleep disturbances; skin problems; gastroesophageal reflux; diabetes; eating disorders) [29-32]

⚜ *Outcomes on behavioural patterns* (e.g., substance abuse; intentions to leave; drop-outs; sick leaves; self-harm; suicidal ideation & rates) [2, 5, 33-36]

⚜ *Outcomes on the self-perceived quality & safety of patient care* (e.g., feedback loop: patient -> management -> physician -> patient; challenges of patient handovers)

(3) Intervention approaches to improve ED physicians' work life, well-being and self-perceived quality and safety of patient care (3a); success/failure and effectiveness/ineffectiveness (3b)

a. For your Emergency Department, please briefly state **intervention strategies** to improve physicians' work life, well-being on the job and self-perceived quality & safety of patient care (3a).

b. Please give a concise insight into the following **intervention approaches** of your ED work and add unconsidered existing intervention approaches (3a):

⚜ *Interventions on organizational level*

➢ ED expansion & modernization (e.g., improvement of internal environment concepts & information technology; non-health professionals for call centers & secretaries)
➢ Standardized & evidence-based training concepts (e.g., Emergency care as autonomous specialty with official job descriptions) [37, 38]
➢ Roster redesign (e.g., throughout collective agreements by trade unions; compressed work weeks & less on-calls) [37, 38]
➢ Regular health checks & mental health interventions (e.g., assistance/consultation by mental health experts & occupational physicians / company medical officers) [30, 39]
➢ Measurement instruments & feedback platforms (e.g., employee surveys; CIRS) [40-46]
➢ Networking opportunities (e.g., platforms for exchange of experiences, opinions & criticism) [6]

⚜ *Interventions on team level*

➢ Skill training (e.g., (simulation-based) resuscitation room; team building; communication; violence management; leadership) [38, 47-57]
➢ Feedback & performance evaluations (e.g., junior doctors' representatives; quality circles; counselling; debriefings; mentor talks; peer reviews; incentive systems) [5, 38, 58-64]
➢ Collaborations between nursing & physician staff (e.g., physician-assisted triage; medical assessment units; nurse practitioners & clinical initiative nurses) [65, 66]

⚜ *Interventions on individual level*

➢ Physical fitness programs (e.g., lifestyle interventions; physiotherapy; pharmacological & herbal interventions) [12, 23, 38, 67-71]

> ➤ Mental fitness programs (e.g., resilience & coping mechanism training; task-oriented vs emotion-oriented; mindfulness & relaxation techniques; hypnosis) [12, 23, 38, 67-71]

c. According to you, (why) are the already implemented interventions within your ED likely to be successful or non-successful (3b)?

d. What kind of **additional intervention approaches** would you personally deem effective to address ED physicians' working conditions, well-being on the job and self-perceived quality and safety of patient care (3b)?

(4) ED physicians' work life, working conditions, work-related key factors, well-being, self-perceived quality and safety of patient care and intervention approaches during the COVID-19 pandemic

a. For your Emergency Department, please briefly state **changes and adjustments** for physicians caused **by the COVID-19 pandemic.**

b. Please give a concise insight into the following **COVID-19 pandemic aspects** of your ED work:

⁂ What *major precautions* have been taken *to prevent exposure* to infection hazards (a) pre-COVID-19 and (b) specifically due to COVID-19 (e.g., quarantining; PPE; testing; vaccinations)? *Which prevention aspects have not been considered enough yet?* [5, 72-76]

⁂ *Work system* changes (e.g., separate ED units; excessive workload; short-time allowance; rerostering & reallocation of staff for compensation of staff shortages & sick leaves; shortage in resources; leadership behaviour & communication strategies) [77, 78]

⁂ *Impacts on physical health* (e.g., infections; violence; PPE overheating; skin & respiratory irritations; Long-COVID-syndrome) [79-81]

⁂ *Impacts on mental health* (e.g., anxiety of infections; neglect of individual coping & resilience mechanisms; increased confrontation with patients' panic attacks; social isolation & domestic violence; aggravated work-life imbalance; exhaustion; burnout; depression) [79-81]

⁂ *Impacts on self-perceived quality and safety of patient care* (e.g., reduced direct physical diagnostics & treatment; CT scanning overuse; misdiagnoses & misperceptions; aggravated untreated preconditions)

⁂ *Impacts on already implemented or planned intervention approaches* to improve ED physicians' work life, well-being and self-perceived quality and safety of patient care

(5) Finally, a few questions concerning your professional background:

+ What is your highest professional and academic qualification?

+ What is your current role in emergency medicine?

+ Please, rate your own impact & influence on emergency medicine as an ED expert?

+ According to you, does your opinion only represent your specific local or also the generalized nationwide emergency care situation?

Thank you very much for your time and responses.

We very much appreciate your participation.

References

1. Iqbal, S. and L. Pipon-Young, *The Delphi method.* Psychologist, 2009. **22**: p. 598-601.
2. Schneider, A. and M. Weigl, *Associations between psychosocial work factors and provider mental well-being in emergency departments: A systematic review.* PLoS One, 2018. **13**(6): p. e0197375.
3. Sakr, M. and J. Wardrope, *Casualty, accident and emergency, or emergency medicine, the evolution.* J Accid Emerg Med, 2000. **17**(5): p. 314-9.
4. Exadaktylos, A.K. and H. Zimmermann, *[Interdisciplinary emergency response units: he who comes too late is punished by life and or by the hospital management!].* Dtsch Med Wochenschr, 2009. **134**(23): p. 1236-7.
5. Carayon, P., et al., *Work system design for patient safety: the SEIPS model.* Qual Saf Health Care, 2006. **15 Suppl 1**: p. i50-8.
6. Arora, M., et al., *Review article: burnout in emergency medicine physicians.* Emerg Med Australas, 2013. **25**(6): p. 491-5.
7. Johnston, A., et al., *Review article: Staff perception of the emergency department working environment: Integrative review of the literature.* Emerg Med Australas, 2016. **28**(1): p. 7-26.
8. Weigl, M., et al., *Work stress, burnout, and perceived quality of care: a cross-sectional study among hospital pediatricians.* Eur J Pediatr, 2015. **174**(9): p. 1237-46.
9. Behringer, W. and C. Dodt, *[Physician staffing and shift work schedules : Concepts for emergency and intensive care medicine].* Med Klin Intensivmed Notfmed, 2020. **115**(6): p. 449-457.
10. Wrede, J., H. Wrede, and W. Behringer, *Emergency Department Mean Physician Time per Patient and Workload Predictors ED-MPTPP.* J Clin Med, 2020. **9**(11).
11. Weigl, M. and A. Schneider, *Associations of work characteristics, employee strain and self-perceived quality of care in Emergency Departments: A cross-sectional study.* Int Emerg Nurs, 2017. **30**: p. 20-24.
12. Boutou, A., et al., *Burnout syndrome among emergency medicine physicians: an update on its prevalence and risk factors.* Eur Rev Med Pharmacol Sci, 2019. **23**(20): p. 9058-9065.
13. Holden, R.J., et al., *SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients.* Ergonomics, 2013. **56**(11): p. 1669-86.
14. Carayon, P., et al., *Human factors systems approach to healthcare quality and patient safety.* Appl Ergon, 2014. **45**(1): p. 14-25.
15. Carayon, P., et al., *SEIPS 3.0: Human-centered design of the patient journey for patient safety.* Appl Ergon, 2020. **84**: p. 103033.
16. Weigl, M., et al., *Workflow interruptions and stress atwork: a mixed-methods study among physicians and nurses of a multidisciplinary emergency department.* BMJ Open, 2017. **7**(12): p. e019074.
17. Schneider, A., et al., *Physicians' and nurses' work time allocation and workflow interruptions in emergency departments: a comparative time-motion study across two countries.* Emerg Med J, 2020.
18. Weigl, M., et al., *Workflow disruptions and provider situation awareness in acute care: An observational study with emergency department physicians and nurses.* Appl Ergon, 2020. **88**: p. 103155.
19. Schneider, A., M. Wehler, and M. Weigl, *Provider interruptions and patient perceptions of care: an observational study in the emergency department.* BMJ Qual Saf, 2019. **28**(4): p. 296-304.
20. Weigl, M., et al., *[Time-allocation study of nurse and physician activities in the emergency department].* Med Klin Intensivmed Notfmed, 2020.
21. Ting, J.Y.S., *Emergency department presentations of patients with primary care complaints might engender negative staff attitudes that impact on quality of care.* Emergency Medicine Australasia, 2008. **20**(1): p. 91-92.
22. Basu, S., C. Yap, and S. Mason, *Examining the sources of occupational stress in an emergency department.* Occup Med (Lond), 2016. **66**(9): p. 737-742.
23. Xu, H.G., et al., *Effectiveness of interventions to reduce emergency department staff occupational stress and/or burnout: a systematic review.* JBI Evid Synth, 2020. **18**(6): p. 1156-1188.
24. Kansagra, S.M., et al., *A survey of workplace violence across 65 U.S. emergency departments.* Acad Emerg Med, 2008. **15**(12): p. 1268-74.
25. Carter, E.J., S.M. Pouch, and E.L. Larson, *Common infection control practices in the emergency department: a literature review.* Am J Infect Control, 2014. **42**(9): p. 957-62.
26. Liang, S.Y., et al., *Infection prevention in the emergency department.* Ann Emerg Med, 2014. **64**(3): p. 299-313.

27. Abraham, L.J., et al., *Morale, stress and coping strategies of staff working in the emergency department: A comparison of two different-sized departments.* Emerg Med Australas, 2018. **30**(3): p. 375-381.

28. Berlanda, S., et al., *Addressing Risks of Violence against Healthcare Staff in Emergency Departments: The Effects of Job Satisfaction and Attachment Style.* Biomed Res Int, 2019. **2019**: p. 5430870.

29. Baig, A., et al., *Correlation of serum cortisol levels and stress among medical doctors working in emergency departments.* J Coll Physicians Surg Pak, 2006. **16**(9): p. 576-80.

30. Komissarova, E.M. and M.A. Ermakova, *[Characteristics of arterial hypertension in psychoemotional burnout of emergency medical staffers].* Med Tr Prom Ekol, 2011(10): p. 19-23.

31. Kotov, A.V. and N.E. Revina, *Heart rate variability during "alarm stage" of burnout syndrome in emergency doctors.* Bull Exp Biol Med, 2012. **153**(5): p. 598-600.

32. Dutheil, F., et al., *Maximal tachycardia and high cardiac strain during night shifts of emergency physicians.* Int Arch Occup Environ Health, 2017. **90**(6): p. 467-480.

33. Rugless, M.J. and D.M. Taylor, *Sick leave in the emergency department: staff attitudes and the impact of job designation and psychosocial work conditions.* Emerg Med Australas, 2011. **23**(1): p. 39-45.

34. Lin, B.Y., et al., *Relationships of hospital-based emergency department culture to work satisfaction and intent to leave of emergency physicians and nurses.* Health Serv Manage Res, 2012. **25**(2): p. 68-77.

35. Stehman, C.R., et al., *Burnout, Drop Out, Suicide: Physician Loss in Emergency Medicine, Part I.* West J Emerg Med, 2019. **20**(3): p. 485-494.

36. Stehman, C.R., et al., *Erratum: This Article Corrects: "Burnout, Drop Out, Suicide: Physician Loss in Emergency Medicine, Part 1".* West J Emerg Med, 2019. **20**(5): p. 840-841.

37. Nicks, B.A. and D. Nelson, *Emergency department operations and management education in emergency medicine training.* World J Emerg Med, 2012. **3**(2): p. 98-101.

38. Elder, E.G., et al., *Work-based strategies/interventions to ameliorate stressors and foster coping for clinical staff working in emergency departments: a scoping review of the literature.* Australas Emerg Care, 2020.

39. Gulen, B., et al., *Serum S100B as a Surrogate Biomarker in the Diagnoses of Burnout and Depression in Emergency Medicine Residents.* Acad Emerg Med, 2016. **23**(7): p. 786-9.

40. Maas, M. and T. Güß, *[Patient safety -- mission for the future: The importance of Critical Incident Reporting Systems (CIRS) in clinical practice].* Anasthesiol Intensivmed Notfallmed Schmerzther, 2014. **49**(7-8): p. 466-72; quiz 473.

41. Beyer, M., et al., *[jeder-fehler-zaehlt.de: Content of and prospective benefits from a critical incident reporting and learning system (CIRS) for primary care].* Z Evid Fortbild Qual Gesundhwes, 2015. **109**(1): p. 62-8.

42. Babitsch, B., et al., *The relevance of cultural diversity on safety culture: a CIRS data analysis to identify problem areas and competency requirements of professionals in healthcare institutions.* GMS J Med Educ, 2020. **37**(2): p. Doc14.

43. Neuhaus, C., et al., *[Findings from 10 years of CIRS-AINS : An analysis of usepatterns and insights into new challenges].* Anaesthesist, 2020. **69**(11): p. 793-802.

44. Caponnetto, P., et al., *Quality of life, work motivation, burn-out and stress perceptions benefits of a stress management program by autogenic training for emergency room staff: A pilot study.* Ment Illn, 2018. **10**(2): p. 7913.

45. Dunne, P.J., et al., *Burnout in the emergency department: Randomized controlled trial of an attention-based training program.* J Integr Med, 2019. **17**(3): p. 173-180.

46. Schneider, A., M. Wehler, and M. Weigl, *Effects of work conditions on provider mental well-being and quality of care: a mixed-methods intervention study in the emergency department.* BMC Emerg Med, 2019. **19**(1): p. 1.

47. Morey, J.C., et al., *Error reduction and performance improvement in the emergency department through formal teamwork training: evaluation results of the MedTeams project.* Health Serv Res, 2002. **37**(6): p. 1553-81.

48. Goldman, E.F., et al., *Learning clinical versus leadership competencies in the emergency department: strategies, challenges, and supports of emergency medicine residents.* J Grad Med Educ, 2011. **3**(3): p. 320-5.

49. Jones, F., P. Podila, and C. Powers, *Creating a culture of safety in the emergency department: the value of teamwork training.* J Nurs Adm, 2013. **43**(4): p. 194-200.

50. Doby, V., *Leadership's role in eliminating workplace violence and changing perceptions in the emergency department.* J Emerg Nurs, 2015. **41**(1): p. 7.

51. Husebø, S.E. and E. Olsen Ø, *Impact of clinical leadership in teams' course on quality, efficiency, responsiveness and trust in the emergency department: study protocol of a trailing research study.* BMJ Open, 2016. **6**(8): p. e011899.
52. Rixon, A., et al., *Communication and Influencing for ED Professionals: A training programme developed in the emergency department for the emergency department.* Emerg Med Australas, 2016. **28**(4): p. 404-11.
53. Aaronson, E.L., et al., *Training to Improve Communication Quality: An Efficient Interdisciplinary Experience for Emergency Department Clinicians.* Am J Med Qual, 2019. **34**(3): p. 260-265.
54. Lien, W.C., et al., *A leadership-based program can reduce boarding time of emergency department admissions.* Am J Emerg Med, 2019. **37**(4): p. 783-788.
55. Patterson, M.D., et al., *In situ simulation: detection of safety threats and teamwork training in a high risk emergency department.* BMJ Qual Saf, 2013. **22**(6): p. 468-77.
56. Patterson, M.D., et al., *Impact of multidisciplinary simulation-based training on patient safety in a paediatric emergency department.* BMJ Qual Saf, 2013. **22**(5): p. 383-93.
57. Sweeney, L.A., et al., *A simulation-based training program improves emergency department staff communication.* Am J Med Qual, 2014. **29**(2): p. 115-23.
58. Zun, L.S. and D. Moss, *Bonus/incentive programs to increase physician productivity in academic emergency medicine.* Am J Emerg Med, 1996. **14**(3): p. 334-6.
59. Etherington, J., et al., *Development, implementation and reliability assessment of an emergency physician performance evaluation tool.* Cjem, 2000. **2**(4): p. 237-45.
60. Magyar, J. and T. Theophilos, *Review article: debriefing critical incidents in the emergency department.* Emerg Med Australas, 2010. **22**(6): p. 499-506.
61. Kessler, D.O., A. Cheng, and P.C. Mullan, *Debriefing in the emergency department after clinical events: a practical guide.* Ann Emerg Med, 2015. **65**(6): p. 690-8.
62. Nadir, N.A., et al., *Characteristics of Real-Time, Non-Critical Incident Debriefing Practices in the Emergency Department.* West J Emerg Med, 2017. **18**(1): p. 146-151.
63. Cantu, L. and L. Thomas, *Baseline well-being, perceptions of critical incidents, and openness to debriefing in community hospital emergency department clinical staff before COVID-19, a cross-sectional study.* BMC Emerg Med, 2020. **20**(1): p. 82.
64. Coggins, A., et al., *Interdisciplinary clinical debriefing in the emergency department: an observational study of learning topics and outcomes.* BMC Emerg Med, 2020. **20**(1): p. 79.
65. Elder, E., A.N. Johnston, and J. Crilly, *Review article: systematic review of three key strategies designed to improve patient flow through the emergency department.* Emerg Med Australas, 2015. **27**(5): p. 394-404.
66. Chang, B.P. and K. Cato, *Tackling Burnout With Team Science: Nursing and Physician Collaborations on Improving Psychological Well-Being Among Emergency Clinicians.* Journal of Emergency Nursing, 2020. **46**(5): p. 557-559.
67. Howlett, M., et al., *Burnout in emergency department healthcare professionals is associated with coping style: a cross-sectional survey.* Emerg Med J, 2015. **32**(9): p. 722-7.
68. Wachs, P., et al., *Resilience skills as emergent phenomena: A study of emergency departments in Brazil and the United States.* Appl Ergon, 2016. **56**: p. 227-37.
69. Katari, R., *Regarding Wellness and Burnout Initiatives in Emergency Medicine.* Acad Emerg Med, 2018. **25**(5): p. 607-608.
70. Son, C., et al., *Resilient performance of emergency department: Patterns, models and strategies.* Safety Science, 2019. **120**: p. 362-373.
71. Watson, A.G., et al., *Self-reported modifying effects of resilience factors on perceptions of workload, patient outcomes, and burnout in physician-attendees of an international emergency medicine conference.* Psychol Health Med, 2019. **24**(10): p. 1220-1234.
72. Siddle, J., S. Tolleson-Rinehart, and J. Brice, *Survey of Emergency Department staff on disaster preparedness and training for Ebola virus disease.* Am J Disaster Med, 2016. **11**(1): p. 5-18.
73. Chen, S.C., K. Chang, and C.H. Kuo, *Emergency department infection control strategies in response to COVID-19.* Kaohsiung J Med Sci, 2020. **36**(7): p. 568-569.
74. Kung, C.T., et al., *Effective strategies to prevent in-hospital infection in the emergency department during the novel coronavirus disease 2019 pandemic.* J Microbiol Immunol Infect, 2020.
75. Schmitz, D., et al., *Association between personal protective equipment and SARS-CoV-2 infection risk in emergency department healthcare workers.* Eur J Emerg Med, 2020.
76. Walker, A.D., et al., *Development of an interactive curriculum and trainee-specific preparedness plan for emergency medicine residents.* Int J Emerg Med, 2020. **13**(1): p. 37.

LMUKLINIKUM   EUSEM
EUROPEAN SOCIETY FOR EMERGENCY MEDICINE

77.   Lang, E., et al., *Authentic emergency department leadership during a pandemic.* Cjem, 2020. **22**(4): p. 400-403.

78.   Pothiawala, S., H.K. Lau, and A. Annathurai, *Regular versus extended shift outbreak roster in the emergency department and its impact on staff well-being.* Emerg Med J, 2020. **37**(8): p. 468.

79.   de Wit, K., et al., *Canadian emergency physician psychological distress and burnout during the first 10 weeks of COVID-19: A mixed-methods study.* J Am Coll Emerg Physicians Open, 2020.

80.   Dorsett, M., *Point of no return: COVID-19 and the U.S. healthcare system: An emergency physician's perspective.* Sci Adv, 2020. **6**(26): p. eabc5354.

81.   Rodriguez, R.M., et al., *Academic Emergency Medicine Physicians' Anxiety Levels, Stressors, and Potential Stress Mitigation Measures During the Acceleration Phase of the COVID-19 Pandemic.* Acad Emerg Med, 2020.

7.5 'MAXQDA' Code system (Delphi round 1)

List of codes	Memo	Frequency
Code system		968
1. SCF - Sociodemographic & contextual ED factors		
1.1 PPG - Personal professional background		
1.1.1 HPAQ - Highest professional & academic qualification	Code definition: Text material and sections associated with panelists' respective highest professional and academic qualification Anchor example: 'So, university degree and, a doctor.' ((1) DEL-1_KMS_SW, Pos. 147) Code production: Deductive	19
1.1.2 CR - Current role in EM	Code definition: Text material and sections associated with panelists' respective current role in ED care Anchor example: 'Current role is department leader.' ((1) DEL-1_KMS_SW, Pos. 147) Code production: Deductive	20
1.1.3 OII - Own impact & influence on EM	Code definition: Text material and sections associated with panelists' own impact and influence on ED care Anchor example: 'So, I suppose I am relatively influential in that leadership role, so I am the champion and advocate for emergency medicine with NHS England for London. Whether I'm successful in that impact, I'm not sure. But that's what my job is.' ((2) DEL-1_ICH_RB, Pos. 171)	15

	Code production: Deductive	
1.1.4 LNR - Local or nationwide representation	Code definition: Text material and sections associated with panelists' perspective of representing local or nationwide ED care settings Anchor example: 'I mean, we have some very, very special points here in the hospital I mentioned before, but otherwise, I worked at other ED's. And that was the same, I mean, so therefore, I think it's more generalized nationwide.' ((1) DEL-1_KMS_SW, Pos. 149) Code production: Deductive	18
1.2 GPOI - General physical & organizational infrastructure		
1.2.1 CES - Clinic & ED scope	Code definition: Text material and sections associated with panelists' hospital and ED scope Anchor example: 'So, it's, well, it's a very small hospital, it's a rural hospital. In the level three of the three B******* levels, or level one are the University Hospitals and so on, two are the bigger hospitals and three are the regular hospitals. So, we are level three.' ((1) DEL-1_KMS_SW, Pos. 19) Code production: Deductive	24
1.2.2 SEEPI - Social, economic/-logical & political influences	Code definition: Text material and sections associated with panelists' perspectives of local social, economic/-logical and political influences on respective EDs Anchor example: 'When I started, as I told we started 2007, but we had in part of our area, our area is about 171 000 people, we can count in as peoples. And it is our catchment area. So,	19

many people, normally may use our services, are living in this area and half of this, a little bit more than half of those municipalities in Finland. The hospitals are, so far, run by municipalities, not by state or they are not private or not state-owned, they are run from, by municipalities or group of municipalities. And we had to project how to do better primary care, together with some of those municipalities and so-, Ministry of Social Affairs and Health. And one factor was, how do we get better emergency services? And because of this cooperation of the politicians and people in municipalities, we decided to plan a new emergency department. And so, the politicians that time, from 2002 till 2007, they were totally with us, that we need a good place for emergency patients. So, it was very favorable for us. But of course, people have changed, and politics, policy ha-, policies have changed. So, it is not the same group of politicians, who are nowadays working, we don't have much special pressure from there. So, I think it is quite neutral or positive. And directors, now it is 4th director of the whole hospital. And every one of them, they have been in favor of this ED, so, that they see, that it is better for our hospital to stay alive. For hospital to stay alive, when we have a good ED, and the patients are staying alive.' ((4) DEL-1_KHCH_AP, Pos. 17)

Code production: Deductive

1.2.3 PWED - ED physical work environment deficits	Code definition: Text material and sections associated with panelists' perspectives of physical work environment deficits within the respective EDs	21
	Anchor example: 'Our hospital is quite old, it's, the construction of the building was, I think it's something like 50 years old or so. And that means the structures are very, very unmodern and we lack natural light at the workstations, they are inside and there are no windows	

	because it's something like an inbox and all the, no, not all, except one, cabins have direct lightning, that means windows and so on. And noise, well, I reduced a lot of the noise with blocking multiple entrance points and so on.' ((1) DEL-1_KMS_SW, Pos. 27) Code production: Deductive	
1.2.4 TS - Triage system	Code definition: Text material and sections associated with panelists' local ED triage system Anchor example: 'We use Manchester. We, our department, our ED started in 2017. And we introduced Manchester Triage System right immediately at the beginning and we are still working with that and are, yeah, that, are very happy with the triage system, so, and it's more, because we are a rural hospital, it's the best thing for us because the ESI is more resources-oriented and the Manchester is working better for us.' ((1) DEL-1_KMS_SW, Pos. 23) Code production: Deductive	19
1.2.5 DR - Department responsibility for patient pathway	Code definition: Text material and sections associated with panelists' perspectives on department responsibility for defined steps within the in-hospital patient pathway Anchor example: 'So, for the triage, ED. Stabilization, resuscitation, that's interdisciplinary, bed management, that's the case management in our hospital. Diagnostic procedures, depends on the procedure, because you decide for the procedure. So, if it's a procedure of the internal medicine, then they are responsible. Immediate therapy, the physician on site. And disposition, that's always checking with the senior physician, and then with the department. [Okay.] The accepting department.' ((1) DEL-1_KMS_SW, Pos. 63)	19

	Code production: Deductive	
1.3 PEC - Personnel & employment conditions		
1.3.1 WS - Work system	Code definition: Text material and sections associated with panelists' general perspectives on their respective ED work system	29
	Anchor example: 'R: Yeah. So, we organize our ED, right now. For the doctors, that we have the normal working days, Monday to Friday, usually, we have from 07:30 till 09:00 in the evening, from 07:30 in the morning till nine in the evening we have at least one doctor of internal medicine and one doctor of surgery in the ED, neurology only joins the department when a neurologic patient is noted. So, these are only 10% of all patient contacts in our ED, and during the weekend it's a special system because the doctors have to take responsibility for all the patients in the wards as well. So, ICU is extra. And for the nurses, we have usually a 3-3-2 system, usually. I: Which means? R: Three during morning, three in the afternoon, two in the night. I: And do the employees, the assistant doctors, assistant physicians, do they need to perform research and teaching, or anything like that? R: No, usually not. So, no research. We are an academic hospital for the University of W*******. But usually, we don't have to do research here. We have to do teaching but in the ED it's quite limited because the, yeah, the most students join the normal wards.' ((1) DEL-1_KMS_SW, Pos. 31-35)	
	Code production: Deductive	
1.3.2 SQ - Skills & qualification: ratio & definition	Code definition: Text material and sections associated with panelists' perspectives on skills and qualification ratios and definitions within their respective EDs	21

Anchor example: 'R: We have about 80, 85 nurses. And I have here, I have to count, we have, seniors, 6, 8, 20, we have 23 posts for seniors, 23, and nine for juniors. I: That´s [But as I told …] only concerning the emergency department, right? R: Emergency Department and emergency medicine. So, it means that, your, so that, but now because this is a young specialty, as I told, we don't have those specialists in Finland yet, but in two years, it seems that our posts will be filled. So, I count it again, because they are older and newer. 6, 8, 14, no, 14, 15, no, it is 17 seniors and 9 juniors and about 80 nurses or a little bit more. That is our emergency department. And then we get, from internal medicine and from surgery or orthopedics we get juniors, so that maybe 60% of the shifts are run by emergency physicians in training or emergency specialists. I: And what is the gender and cultural diversity ratio? Is there a certain ratio? R: Generous, so that maybe 1/4 or 1/5 are ladies, women in our doctor group. And in Finland we are quite monotonic [Monotonic.], we don't have many Africans or Americans here. So, they are all Caucasians, who are working in emergency department. But in radiology, which is easier to do, we have from India and some from Greece, also.' ((4) DEL-1_KHCH_AP, Pos. 27-31)

Code production: Deductive

1.3.3 SLD - Staffing levels & determination	Code definition: Text material and sections associated with panelists' perspectives on determination of staffing levels within their respective EDs	21

Anchor example: 'Yeah, for the nurses, definitely. So, that's established and for the physicians I planned the staffing for the new hospital. And I calculated that by the usual formulas, something like, you need the number of shifts, you need the number of hours, then

you have the netto working time and then you have to, you have to calculate the usual 20% off due to sickness, vacation and so on. So yeah, so we do that. I: Is it also including the time, for example? R: Ah, okay, so I see, you mean, so the contact time per patient. Yeah, I use that as well, for just for calculation purposes, to get a feeling, how many doctors do we need for calculating, how many people we need per shift. Yeah, I did that.' ((1) DEL-1_KMS_SW, Pos. 39-41)

Code production: Deductive

	1.3.4 TC - Types of contracts	Code definition: Text material and sections associated with panelists' perspectives on types of employee contracts within their respective EDs	21
		Anchor example: 'Usually, without a specialty, it's limited. When you have your specialty or you have to sign your third contract, then it's unlimited. And the most physicians are full-time. With the nurses, it's very, well, there are many, many types of part-time. And we don't have on-call, on-call payments. That means, outside, physicians from the outside or contracted, something like that, we don't use that in the ED. I: Okay, and the average annual full-time salaries are within the "Tarifvertrag", so that's... R: Yeah, that's VKA, yeah.' ((1) DEL-1_KMS_SW, Pos. 43-45) Code production: Deductive	
	1.3.5 OC - Overtime & compensation	Code definition: Text material and sections associated with panelists' perspectives on overtime and compensation within their respective EDs	19
		Anchor example: 'Usually, with the physicians, we have the agreement with, we have the agreement that every hour over 60 overhours, you get paid for. You have to get paid for, and	

	all other hours, you can try to take time off. Yeah. I: Okay. And how many, what, let's say, what's the average amount of monthly overtime, for the employees? R: Depends. I would say 20 to 30 hours for the physicians, for the nursing staff less. I: And is there an electronic, electronical, check-in/check-out system? R: Yeah, yeah, definitely.' ((1) DEL-1_KMS_SW, Pos. 47-51) Code production: Deductive	
1.4 TT- Tools & technology		
1.4.1 HITR - Health information technologies & records	Code definition: Text material and sections associated with panelists' perspectives on health information technologies and health records within their respective EDs Anchor example: 'So, we're completely paperless. So, we have a complete electronic record in a system called SRNA, it's an American product. I think it takes the average doctor, probably, another 10 minutes on top of their consultation time to write it up and work stuff out. We also have to use three or four other programs that are not interfaced. So, the ambulance service uses another electronic thing that doesn't interface with SRNA. So, you have to go into their system, if you want to look at it, as does the urgent treatment center, as does the GP record, etcetera. So, we end up using, maybe, five or six different systems in a day. So, it takes a long time. I: Okay, and any handheld systems available? R: No, no. I: Or like, translation tools for other languages or something like that. R: We just use Google, Google Translate. Yeah. I mean, we have, we have apps. So, we all use a range of apps. We've got an ED department app, that's all our guidelines are on, so that we can look at it close to the patient. And we just are stopping using a tool that gives us some of the results from the patient on an app, but that's a	25

		Microsoft, no, in fact, it's not. It's Google supported, and they've stopped supporting it because they want to focus on other things that we're just (00:27:37?).' ((2) DEL-1_ICH_RB, Pos. 63-67) Code production: Deductive	
	1.4.2 ADIT - Availability of diagnostic/intervention technology	Code definition: Text material and sections associated with panelists' perspectives on the availability of diagnostic and intervention technologies within their respective EDs Anchor example: 'They are available all the time. Everything we do here is 24/7, and all the documentation is, everything is electronically.' ((1) DEL-1_KMS_SW, Pos. 55) Code production: Deductive	17
	1.4.3 IFRA - Introduction & free resource access	Code definition: Text material and sections associated with panelists' perspectives on the introduction and free resource access of health information technologies within their respective EDs Anchor example: 'So, the introduction, yes. So, we have that. The skills training, so that's not with the regular schedule, but we have to, I check with the, all the assist staff to get the level. So, that means I evaluate which procedures they have to do, which procedures they haven't done before. And we try to train them.' ((1) DEL-1_KMS_SW, Pos. 59) Code production: Deductive	18
	1.4.4 RTMC - Real-time maintenance & cleaning	Code definition: Text material and sections associated with panelists' perspectives on real-time maintenance and cleaning of health (information) technology within their respective EDs	18

	Anchor example: 'Yeah. Real-time not always, but cleaning and so on, yes.' ((1) DEL-1_KMS_SW, Pos. 61) Code production: Deductive	
2.2 ONEW - Outcomes of negative ED work		
2.2.1 OPH - Physical health	Code definition: Text material and sections associated with panelists' perspectives on physicians' physical health outcomes within their respective EDs Anchor example: 'So, the musculoskeletal pain, that's a big issue. Needle stick, we don't have that very often. Infections and radiation issues not, but fatigue is definitely a factor. It's, I think, mostly because the patients get bigger all the time. So, the musculoskeletal pain, that's a big issue.' ((1) DEL-1_KMS_SW, Pos. 91) Code production: Deductive	18
2.2.2 OMH - Mental health	Code definition: Text material and sections associated with panelists' perspectives on physicians' mental health outcomes within their respective EDs Anchor example: 'For the mental health it's, yeah, more fatigue, less burnout and anxiety, no. Yeah, more fatigue, less burnout and otherwise no, no strange things like psychoses or personality disorders. Yeah. Fatigue and burnout. Yeah. I: Any depressions [Not that I'm aware of.] registered? Okay. [No.] Or PTSD's? Because you were talking about, for example, verbal and physical violence, any PTSDs resulting? R: No, not diagnosed.' ((1) DEL-1_KMS_SW, Pos. 91-93) Code production: Deductive	23

	2.2.3 OPC - Psychosomatic complaints	Code definition: Text material and sections associated with panelists' perspectives on physicians' psychosomatic health outcomes within their respective EDs	25
		Anchor example: 'Sleep disturbances, definitely. Skin problems, and I know nothing about eating disorders. No. We don't have that in the department, but sleep disturbances and skin problems, yes. Especially now during the pandemic with all the hygiene protocols and so on. Yeah. I: Any hypertension, tachycardia...? R: Hypertension, we have some people, some overweight people. Yeah. But nothing severe.' ((1) DEL-1_KMS_SW, Pos. 95-97)	
		Code production: Deductive	
	2.2.4 OBP - Behavioral patterns	Code definition: Text material and sections associated with panelists' perspectives on physicians' behavioral health pattern outcomes within their respective EDs	25
		Anchor example: 'Yeah, that's, that was a very big improvement. Because we have a team right now, especially with the nurses. They are, they stick together, and there are no planned dropouts. No long sick leaves, and no self-harm. No substance abuse that I'm aware of, nothing, and no intentions to leave. On the contrary, so we get every year new people. So, if people leave, that's something like retirement or, so, they move, so nothing, that they are not content anymore, something like that. No, that's not the case.' ((1) DEL-1_KMS_SW, Pos. 99)	
		Code production: Deductive	
	2.2.5 OEQSC - Employee-reported quality & safety of care	Code definition: Text material and sections associated with panelists' perspectives on physician-reported quality and safety of patient care within their respective EDs	19
		Anchor example: 'Yeah, that means they have	

		to reflect themselves. Depends on the people. So, I would say, so there are some people who think about the patient care they give, and they think about the results, and they try to rethink the procedures they did, and so on. But there are also people, they do just the same every time. I: And is there like a feedback loop from patients that gets back? R: Yeah, we have, we have a sheet they can provide, but the, I think only 10% of the patients or so, they answer the questions. There's a questionnaire, so but it's not, well, the most just don't fill out the questionnaire.' ((1) DEL-1_KMS_SW, Pos. 101-103) Code production: Deductive	
3. IA - Intervention approaches			
3.1 IIA - Implemented intervention approaches			
3.1.1 OL - Organizational level			
	3.1.1.1 EEM - ED expansion & modernization	Code definition: Text material and sections associated with panelists' perspectives on implemented expansion and modernization practices within their respective EDs Anchor example: 'Yeah, so we modernized the structure. So, we changed the working stations, and we reorganized the working stations. And that was worse before. And secretaries, that's something I'd like to have. But right now, we get at least the speech system, so that we can dictate all the time electronically. That's, that's good.' ((1) DEL-1_KMS_SW, Pos. 107) Code production: Deductive	25
	3.1.1.2 SERC - Standardized &	Code definition: Text material and sections associated with panelists' perspectives on	22

| | evidence-based residency concepts | implemented standardized and evidence-based residency concepts within their respective EDs

Anchor example: 'Training concepts, well, that's the plan to do that in the new hospital, but right now it's not autonomous. Trade Union, that's, yeah, they are important.' ((1) DEL-1_KMS_SW, Pos. 107)

Code production: Deductive | |
| | 3.1.1.3 RRC - Roster redesign concepts | Code definition: Text material and sections associated with panelists' perspectives on implemented roster redesign concepts within their respective EDs

Anchor example: 'So, we don't have something like longer days and therefore less working days, because the most people want to do the usual, if they work 100%, they just want to do the usual 40 hours week with the usual times and the regular shifting. So that, like in other countries, that you can do double shifting and so on. No, there's not the wish for, so definitely not.' ((1) DEL-1_KMS_SW, Pos. 107)

Code production: Deductive | 18 |
| | 3.1.1.4 RM - Regular health checks & mental health intervention | Code definition: Text material and sections associated with panelists' perspectives on implemented regular health checks and mental health interventions within their respective EDs

Anchor example: 'Regular health checks. Yeah, that's, I mean, health check, that's, I think, every, every other year, if you don't work with radiation, otherwise, it's every year. And mental health interventions. We don't have something like supervision or something like that. But we provide, if they want, something like Balint interventions, if there's the wish for, so, yeah.' ((1) DEL-1_KMS_SW, Pos. 109) | 18 |

		Code production: Deductive	
	3.1.1.5 MFNI - Measurement, feedback & networking instruments	Code definition: Text material and sections associated with panelists' perspectives on implemented measurements, feedback and networking instruments within their respective EDs Anchor example: 'Yeah, measurement instruments, feedback platforms. Yeah, CIRS. We have employee surveys we just did this year. And networking opportunities in our hospital, not that I know of, no.' ((1) DEL-1_KMS_SW, Pos. 109) Code production: Deductive	25
3.1.2 TL - Team level			
	3.1.2.1 ST - Skills trainings	Code definition: Text material and sections associated with panelists' perspectives on implemented skills trainings within their respective EDs Anchor example: 'Skills training, we have. We have that for critical patients. So, that's a team training. We have some staff trained with de-escalation methods. We had some leadership training. So, well, I had that before. But we have that.' ((1) DEL-1_KMS_SW, Pos. 111) Code production: Deductive	25
	3.1.2.2 PE - Performance evaluations	Code definition: Text material and sections associated with panelists' perspectives on implemented performance evaluations within their respective EDs Anchor example: 'And feedback performance evaluations, we do that regularly with the junior doctors.' ((1) DEL-1_KMS_SW, Pos. 111)	26

		Code production: Deductive	
	3.1.2.3 NPC - Nursing & physician staff collaborations	Code definition: Text material and sections associated with panelists' perspectives on implemented nursing and physician staff collaborations within their respective EDs Anchor example: 'And collaborations, physician-assisted triage. We don't do that with a fixed workflow. That's more, so if you need a physician at the triage, then you get them. So, but it's not the regular way. And nurse practitioners, we don't have here. And medical assessment units. What's the meaning? I: It's, yeah, it's basically something very similar to, like, a combination of physicians and nurses within one unit. R: Yeah, social services, we have also available in the emergency department. That's possible.' ((1) DEL-1_KMS_SW, Pos. 115-117) Code production: Deductive	22
3.1.3 IL - Individual level			
	3.1.3.1 PFP - Physical fitness programs	Code definition: Text material and sections associated with panelists' perspectives on implemented physical fitness programs within their respective EDs Anchor example: 'For intervention on individual level, we have no physical fitness programs, one of my physicians would like to, but we haven't anything structured right now.' ((3) DEL-1_SMdS_RF, Pos. 88) Code production: Deductive	22
	3.1.3.2 MFP - Mental fitness programs	Code definition: Text material and sections associated with panelists' perspectives on implemented mental fitness programs within their respective EDs	18

	Anchor example: 'The mental fitness programs, that's scarce. So, that's not that often. So, mindfulness and relaxation techniques. Sometimes, we have something like one minute, one minute training in the escalator or at stations where you can read facts about something like that, but not on a very regular basis.' ((1) DEL-1_KMS_SW, Pos. 119) Code production: Deductive	
3.2 PAPB - Personal acceptance & perceived benefit	Code definition: Text material and sections associated with panelists' perspectives on personal acceptance and perceived benefits of implemented enhancement practices on work-life within their respective EDs Anchor example: 'Well, for, you implement the interventions only if you need them on a regular basis. So, if you need a regular debriefing, I mean, a hot debriefing right after the accident, then it's very useful. But also, the cold debriefing, something like "MMI", are very, very important, because after a certain time, you just have another view on the case, and you can discuss everything with a bit more relaxed viewpoint. So, that means, the structures we implemented, we asked the staff if they want to do that, so, and that's the reason why they work because they accept the interventions. And if you try to implement something the staff doesn't like, then they don't use it.' ((1) DEL-1_KMS_SW, Pos. 121) Code production: Deductive	22
3.3 AFAC - Additional future approach concepts	Code definition: Text material and sections associated with panelists' perspectives on wished or planned future concepts for implementing enhancement practices on work-life within their respective EDs Anchor example: 'I think, the biggest, the	31

	biggest thing that would help us is to stop the patients coming for whom we don't think we add any value. I: Okay. R: Because then you would have a manageable number of patients on your shift in a reasonably sized department for the number of patients there are, you would be able to give them the care that they need. And then I think that would give everybody a sense of well-being. But I think as long as we're looking after patients for whom emergency departments are not the right place, because their condition doesn't need us, and we don't know what to do with them. And there's, they've crowded and there's pressure and you, know, you can't get the care you'd want to give to the people who are really sick. I think well-being is really difficult to promote.' ((2) DEL-1_ICH_RB, Pos. 145-147) Code production: Deductive	
4. CCA - COVID-19 changes & adjustments		
4.1 PPE - Exposure precautions & system changes		
4.1.1 PRCP - Pre-COVID-19 precautions	Code definition: Text material and sections associated with panelists' perspectives on Pre-COVID-19 precautions within their respective EDs Anchor example: 'So, I think, pre-COVID, we were very lax about infection. Depending on who first saw the patient and thought about potential for infection, we may or may not have controlled it properly.' ((2) DEL-1_ICH_RB, Pos. 149) Code production: Deductive	18

4.1.2 CWSA - COVID-19 WS adjustments		
4.1.2.1 CCWSA - Constructive C19 WS adjustments	Code definition: Text material and sections associated with panelists' perspectives on constructive COVID-19 work system adjustments within their respective EDs Anchor example: 'I think that's very different now. So, you know, all the patients have masks, we all wear masks, gloves, aprons all the time. Everyone's been vaccinated, we all have lateral flow, we have point-of-care testing twice a week, if we want it. So, I think we're very different now to pre-COVID.' ((2) DEL-1_ICH_RB, Pos. 149) Code production: Inductive	60
4.1.2.2 NICWSA - Negative or insufficient C19 WS adjustments	Code definition: Text material and sections associated with panelists' perspectives on negative or insufficient COVID-19 work system adjustments within their respective EDs Anchor example: 'In that, I think, "which prevention aspects have not been considered enough yet?" I think that logistic and structural. So, we have worked a lot in organization for very clear, how can I say, very clear, I'm looking for the word, wait a minute…routes, ways, diagnostic and therapeutic ways. We have worked a lot about that. But I think that, for example, negative pressure rooms, all the systems when you are non-invasively ventilating a patient, I think that structural changes is something we have to work. We are doing this, I think that it can make a difference, even if our perception is not so strong.' ((3) DEL-1_SMdS_RF, Pos. 94) Code production: Inductive	24

	4.2 NIEWL - Negative impacts on ED work life aspects		
	4.2.1 IPH - Physical health	Code definition: Text material and sections associated with panelists' perspectives on COVID-19-associated ED physicians' physical health outcomes within their respective EDs Anchor example: 'No infections, no violence, overheating, yeah, well, that's normal, and some skin irritations. We don't have somebody with Long-COVID.' ((1) DEL-1_KMS_SW, Pos. 133) Code production: Deductive	31
	4.2.2 IMH - Mental health	Code definition: Text material and sections associated with panelists' perspectives on COVID-19-associated ED physicians' mental health outcomes within their respective EDs Anchor example: 'Well, I think, the people are a bit more anxious. And I think one very big point is that you have to change your workflow. So, if you, with an isolated patient, it's a different work. So, you can't go in and out all the time, you have to think, you have to rethink, and you have to organize everything quite well. And you have to, and that's one very important thing, if you need something quite fast, you always have to wait for that. So, and this waiting time, even, if it's less than a minute, that's very stressful, because you think, "oh, my God, so the patient is disorienting". And then you have to do that, but you don't have the necessary materials and so on. And this waiting time, even if it's only 30 seconds, or 40-45 seconds, it's still stressful. Yeah, and this stress is, I think, that's something that the people feel, so, but otherwise, no panic. We don't, well, in our region, it's not that very often that patients with domestic violence problems present. And we didn't see that more often. And with the workers and co-workers, I'm not aware of any	23

	problems.' ((1) DEL-1_KMS_SW, Pos. 135) Code production: Deductive	
4.2.3 IPCBP - Psychosomatic complaints & behavioral patterns	Code definition: Text material and sections associated with panelists' perspectives on COVID-19-associated ED physicians' psychosomatic complaints and behavioral health outcomes within their respective EDs Anchor example: 'Some of our physicians have had, maybe one at least, had lots of anxiety and stopped working in the ED because of this. Maybe also some nurses, they have, they are anxious, but it's only 1 or 2 percent, so…I: Pardon. You said, also, like, doctors that…? R: Yeah, one doctor who stopped working in the ED, because she was so anxious of COVID.' ((7) DEL-1_SSCH_HH, Pos. 173-175) Code production: Inductive	9
4.2.4 IEQSC - Employee-reported quality & safety of care	Code definition: Text material and sections associated with panelists' perspectives on COVID-19-associated ED physician-reported quality and safety of patient care within their respective EDs Anchor example: 'Definitely. So, I think that's something that's the same point I mentioned before. So, you have to wait, and you have to do your normal procedures, you do different. We have, we had different SOP's for every special patient, let's say, something like CPR or so. You have different SOP's. That's something, also the diagnostics with the radiology department, you think and rethink if you have to do that right now. What's the effort and yeah, that's, that's definitely an issue. I: But was there, was there, like, as it's said here, like, for example, CT scanning overuse, [No.] because of...R: CT...No, no. Quite contrary, underuse. I: Underuse? Okay, [Yeah, yeah.] so no perceiving of "Okay, all of this could be	24

COVID, we need to...". R: Well, that was something, yeah, yeah, oh no, I know what you mean. Yeah. So that we, oh yeah. We saw that a lot. Every fever had to be COVID. Every cough had to be COVID, no. So yeah, that was an issue as well. I: And because of that, misdiagnoses and misperceptions happened, so that, that any other disease that could be, from their symptoms, similar to COVID, were like misdiagnosed? R: Misdiagnosed in the first moment, yes. But with nothing bad on the outcomes, so, because, after the first anxious isolation, the people got the time to rethink the diagnosis. I: And did you see any aggravated untreated preconditions of patients? Due to the fact that less people came to the emergency department and less people got treated? R: Yeah, yeah, stroke and heart problems. And some infections. Skin infections. Yeah. Definitely. And cancer, not that I'm aware of.' ((1) DEL-1_KMS_SW, Pos. 137-145)

Code production: Deductive

	4.2.5 IIPIA - Implemented or planned intervention approaches	Code definition: Text material and sections associated with panelists' perspectives on COVID-19-associated impacts on their respective ED work-life enhancement practices	32
		Anchor example: 'Yes, I mean, I think we had, we had a program of things lined up for both social interactions, and also some training together, and away-days to discuss strategy and things which have been delayed. And so, I think it did have an impact on some of the stuff we had planned. And has changed some of those plans forever, because we've realized we don't need to do it, or we could do it in a different way. So, I think it's not only bad. I: Not only bad. Okay. R: Yeah, yeah. ((2) DEL-1_ICH_RB, Pos. 167-169)	
		Code production: Deductive	

7.6 'Unipark' survey questionnaire (Delphi round 2)

Questionnaire

1 Introduction

Dear interviewee,

thank you very much for your further participation and welcome back to the second part of our two-round study:

Identification of key factors for sustainable working conditions – Results of an EUSEM-initiated, Europe-wide Delphi consensus initiative among emergency department (ED) providers.

In the previous interviews we collected your statements concerning influencing factors and aspects of emergency department (ED) work across 6 different EUSEM member states. We analyzed all interview data and condensed it to the list of items you will find in the following survey. In this second round, we now seek to establish a consensus concerning the relevance of the factors. We therefore ask you for your personal evaluation across various domains of ED work life as well as ED provider issues.

The duration of this survey will be approximately between 15-30 min. Good luck!

Yours sincerely,

MD cand. Michael Lifschitz | Prof. Dr. med. Christoph Dodt | Prof. Dr. phil. Matthias Weigl

2 1. Positive aspects in ED work

1.1 Positive general aspects in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Job challenge: variation and/or interdisciplinary interaction	○	○	○	○	○
Job control: participation in decision-making	○	○	○	○	○
Job intellectuality	○	○	○	○	○
Task significance	○	○	○	○	○
Job autonomy	○	○	○	○	○

1.2 Positive provider-related aspects in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Teamwork, social climate and extracurricular activities	○	○	○	○	○
Personal work ethic and/or motivation	○	○	○	○	○
Work experience and/or utilization of skills	○	○	○	○	○
Positive co-worker relationships	○	○	○	○	○
Resilience and coping strategies	○	○	○	○	○

1.3 Positive aspects of patient-provider interaction in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Patient case complexity	○	○	○	○	○
Grateful patient feedback	○	○	○	○	○
Therapy efficacy: seeing patients getting better	○	○	○	○	○
Communication: social interaction with patients and/or their families	○	○	○	○	○

3   2. Negative aspects in ED work

2.1 Negative general aspects in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Time pressure and/or lack of breaks	○	○	○	○	○
Workflow interruptions and/or multitasking	○	○	○	○	○
Overcrowding	○	○	○	○	○
Employee turnover and understaffing	○	○	○	○	○
Shift work	○	○	○	○	○
Chronic cognitive workload	○	○	○	○	○
Work-life imbalance	○	○	○	○	○

2.2 Negative provider-related aspects in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Lack of resilience and coping mechanisms	○	○	○	○	○
Medical errors	○	○	○	○	○
Task overlap and interaction deficits with other specialties	○	○	○	○	○
Lack of communication and feedback culture	○	○	○	○	○
Insufficient supervision	○	○	○	○	○
Tense atmosphere	○	○	○	○	○
High pressure to take far-reaching decisions	○	○	○	○	○

2.3 Negative aspects of patient-provider interaction in ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Violence: verbal and/or physical	○	○	○	○	○
Ungrateful feedback	○	○	○	○	○
Excessive claims	○	○	○	○	○
Minor complaints without the need of ED treatment	○	○	○	○	○
Legal consequences of conflicts	○	○	○	○	○

4   3. Adverse health outcomes of ED work

3.1 Adverse physical health outcomes of ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Physical fatigue	○	○	○	○	○
Musculoskeletal pain	○	○	○	○	○
Injuries (e.g., needlestick, trauma, violence)	○	○	○	○	○

3.2 Adverse _mental_ health outcomes of ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Burnout	○	○	○	○	○
Exhaustion and/or mental fatigue	○	○	○	○	○
Anxieties	○	○	○	○	○
Depression, sadness and/or low mood	○	○	○	○	○
Compassion fatigue, pessimism and/or cynism	○	○	○	○	○

3.3 Adverse _psychosomatic_ health outcomes of ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Insomnia (sleep deprivation and/or disturbance)	○	○	○	○	○
Cardiovascular consequences: hypertension and/or tachycardia	○	○	○	○	○
Eating disorders	○	○	○	○	○
Gastroesophageal reflux disease (GERD)	○	○	○	○	○

3.4 Adverse _behavioral_ health outcomes of ED work

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Dropouts / opt-outs (= quitters)	○	○	○	○	○
Intentions to leave or reduce	○	○	○	○	○
Substance abuse	○	○	○	○	○
Sick leaves	○	○	○	○	○

5   4. Currently implemented improvement and intervention practices in your ED

4.1 Currently implemented improvement and intervention practices in your ED on <u>organizational</u> level

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
ED reorganization and/or modernization	O	O	O	O	O
Out-of-ED ambulatory care and/or medical assessment units	O	O	O	O	O
Emergency care as autonomous specialty	O	O	O	O	O
Standardized / evidence-based SOPs and/or training concepts	O	O	O	O	O
Limited on-call duties, night or weekend shifts, overhours	O	O	O	O	O
Adaptable staff and duty rostering	O	O	O	O	O
Regular occupational health checks	O	O	O	O	O
Offer of mental health interventions	O	O	O	O	O
Employee surveys	O	O	O	O	O
Critical Incident Reporting System (CIRS)	O	O	O	O	O
Quality circles and tracking of key performances (e.g., Morbidity-Mortality-Improvement conferences (MMI))	O	O	O	O	O
National emergency medicine society networking platforms	O	O	O	O	O

4.2 Currently implemented improvement and intervention practices in your ED on <u>team</u> level

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
(Simulation-based) Skills trainings (e.g., resuscitation, CRM)	O	O	O	O	O
Debriefings after critical events with potential posttraumatic consequences	O	O	O	O	O
Regular feedback from mentors	O	O	O	O	O
Physician-assisted triage	O	O	O	O	O
Interprofessional educational initiatives for physicians and nursing	O	O	O	O	O
Nurse practitioners (e.g., wound and/or pain care)	O	O	O	O	O

4.3 Currently implemented improvement and intervention practices in your ED on <u>individual</u> level

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Private sport activities: individual and/or group-based	○	○	○	○	○
Acute physical occupational health services (e.g., physiotherapy)	○	○	○	○	○
Hospital-initiated physical health protection programs	○	○	○	○	○
Hospital-initiated mental health protection programs	○	○	○	○	○
Private activities to prevent mental illness	○	○	○	○	○
Acute mental occupational health services (e.g., psychotherapy)	○	○	○	○	○

6   5.1-5.2 Aspects reducing/inducing negative impacts of COVID-19 on provider working conditions in your ED

5.1 Aspects <u>reducing</u> negative impacts of COVID-19 on provider working conditions in your ED

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Personal protective equipment (PPE)	○	○	○	○	○
Separate ED isolation and cohort areas or units	○	○	○	○	○
Vaccination campaigns	○	○	○	○	○
Persistent information flow	○	○	○	○	○
Intra- and interhospital networking	○	○	○	○	○
Change of standard operating procedures (SOP)	○	○	○	○	○
Testing: PCR and/or Point-of-Care antigen (PoC)	○	○	○	○	○
Psychological support: employee surveys and/or well-being offers	○	○	○	○	○
Reorganization of staff and duty rostering	○	○	○	○	○
Contact tracing and quarantining	○	○	○	○	○
Employment of additional external staff	○	○	○	○	○
Structural room ventilation systems	○	○	○	○	○

5.2 Aspects <u>inducing</u> negative impacts of COVID-19 on provider working conditions in your ED

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Excessive workload: organizational and/or isolation-related	○	○	○	○	○
Shortage of staff	○	○	○	○	○
Lack of personal protective equipment (PPE)	○	○	○	○	○
Crowding: ED space limitations and/or exit blocks	○	○	○	○	○

7   5.3-5.5 COVID-19-related impacts of ED work on health and patient care in ED work

5.3 COVID-19-related impacts of ED work on <u>physical health</u>

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Confirmed COVID-19 infections	○	○	○	○	○
PPE discomfort: overheating, skin and/or respiratory irritations	○	○	○	○	○
Long-COVID syndrome	○	○	○	○	○

5.4 COVID-19-related impacts of ED work on <u>mental health</u>

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Anxieties	○	○	○	○	○
Mental exhaustion and/or less resilience	○	○	○	○	○
Burnout	○	○	○	○	○
Social isolation	○	○	○	○	○
Depression	○	○	○	○	○

5.5 COVID-19-related impacts of ED work on employee-reported quality and safety of patient care

Please rate the relevance for each of the following items.

	1 - Highly irrelevant	2 - Rather irrelevant	3 - Neutral	4 - Rather relevant	5 - Highly relevant
Undertreatment of emergency medicine diagnoses (e.g., ACS/heart failure, stroke)	○	○	○	○	○
CT scan overuse	○	○	○	○	○
Diagnostic misperceptions and/or misdiagnoses	○	○	○	○	○
Delay in patient diagnostic and therapeutic pathways (PDTP)	○	○	○	○	○
Reduced emotional support for patients and/or their families	○	○	○	○	○

8 Further comments or notifications?

Further comments or notifications?

Please do not hesitate to give us any personal feedback on the conducted survey. Would you like to add any neglected factors or aspects that you personally consider as relevant?

9 Epilog

C O N G R A T U L A T I O N S - you successfully completed our survey! Thank you very much!

Hereby you contributed to the first study that provides a cross-European investigation into ED physicians' work conditions and respective intervention approaches.

Our results emphasize the significance of work-related influences on ED provider health and well-being as well as ensuing patient care outcomes. It further sheds light on current status of improvement measures.

Our study serves as base for future policy and practice recommendations as well as intervention studies for effective improvement approaches to ameliorate ED providers' well-being on the job, and thereby promoting quality and safety of patient care.

Preliminary results will be shared with you and presented at the EUSEM Congress 2022.

10 Final page

MD candidate & study contact:

Michael Lifschitz
+49 176 317 991 00
Michael.Lifschitz@campus.lmu.de
Working group for Applied Medicine and Psychology at Work (AMPA)
Institute and Outpatient Clinic for Occupational, Social and Environmental Medicine University Hospital, Ludwig-Maximilians-University Munich; 80336 Munich, Germany

Project coordinator & EUSEM contact:

Prof. Dr. med. Christoph Dodt
+49 (0)89 9270 3269
Christoph.Dodt@muenchen-klinik.de
Head of A&E Department; EUSEM Vice-president
München Klinik Bogenhausen; 81925 Munich, Germany

Scientific investigator:

Prof. Dr. phil. Matthias Weigl
+49 228 287-10390
Matthias.Weigl@ukbonn.de
Head of Department
Institute for Patient Safety, University Hospital Bonn, University of Bonn, Venusberg Campus 1; 53127 Bonn, Germany

7.7 List of abbreviations

ACP .... *Advanced clinical practitioner*
AIML .... *Artificial intelligence and machine learning*
AMU .... *Acute medical unit*
BEL.. *Belgium*
CDC.. *Centers for Disease Control and Prevention*
CIRS... *Critical incident reporting system*
COREQ .... *Comprehensive Standards for Reporting Qualitative Research*
COVID-19 .... *Coronavirus disease 2019*
CPOE .... *Computerized provider order entry*
CREDES................................. *Guidance on Conducting and REporting DElphi Studies*
CRM .... *Crisis/Crew resource management*
CT..*Computer tomography*
CVI .... *Content validity index*
DEL-1 .... *Delphi round one*
DEL-2 .... *Delphi round two*
DSGVO... *Datenschutz-Grundverordnung*
ECMO... *Extracorporeal membrane oxygenation*
ED .... *Emergency department*
EHR ....*Electronic health record*
EMS...*Emergency medical service*
EP.. *Emergency physician*
ESI...*Emergency Severity Index*
EUSEM... *European Society for Emergency Medicine*
FIN... *Finland*
FTE... *Full-time equivalent*
GER.. *Germany*
GERD .... Gastroesophageal reflux disease
GP .... *General practitioner*
HFE ....*Human factors and ergonomics*
HIT.. *Health information technology*
ICC .... *Intraclass correlation coefficient*
ICU .... *Intensive care unit*
I-CVI .... *Item-content validity index*
ILI .... *Individual-level intervention*
IOM... *Institute of Medicine*
ITA.. *Italy*
ITO .... *Input-Throughput-Output*
LMU.. *Ludwig-Maximilians-University*
LOS ....*Length of stay*
LWBS .... *Left-without-being-seen*
M ....*Mean*
MAU .... *Medical assessment unit*
MD..*Median, Doctor of Medicine*
MMC... *Morbidity and mortality conference*
MRI... *Magnetic resonance imaging*
MTS.. *Manchester Triage System*
NHS... *National Health Service, UK*
NSM .... *National Society Member*
NSMR .... *National Society Member representative*
OLI... *Organizational-level intervention*
PCR .... *Polymerase chain reaction*

PDTP ....*Patient diagnostic and therapeutic pathways*
PhD .... *Doctor of Philosophy*
PIT .... *Physicians-in-training*
POC...*Point-of-care*
PPE .... *Personal protective equipment*
PS..*Pilot study*
PTE .... *Part-time equivalent*
PTSD...*Post-traumatic stress disorder*
QCA.. *Qualitative content analysis*
RAZ .... *Rapid assessment zone*
ROM ....*Romania*
RQ-1 ....*Research question one*
RQ-2 ....*Research question two*
RQ-3 .... *Research question three*
SCT ....*Study coordination team*
S-CVI.. *Scale-content validity index*
S-CVI/AUA.............................*Adapted universal agreement scale-content validity index*
S-CVI/Ave...*Averaging scale-content validity index*
S-CVI/UA .... *Universal agreement scale-content validity index*
SD .... *Standard deviation*
SEIPS...*Systems Engineering Initiative for Patient Safety*
SME...*Subject matter experts*
SOC...*Source of care*
SOP.. *Standard operating procedure*
SPO.. *Structure-Process-Outcome*
SPP .... *Study participant package*
TeamSTEPPS *Team Strategies and Tools to Enhance Performance and Patient Safety*
TLI .... *Team-level intervention*
UK ....*United Kingdom*
VR .... *Virtual reality*
WPV .... *Workplace violence*
WT .... *Waiting time*

7.8 List of figures and tables

8 Acknowledgements

9 Affidavit

Lifschitz, Michael

(Last name, first name

Pettenkoferstraße 8a, 80336 München

(Address)

I hereby declare, that the submitted thesis entitled

**Identification of key factors for sustainable
working conditions – Results from an EUSEM-
initiated, Europe-wide Delphi consensus
initiative among emergency department (ED)
providers**

is my own work. I have only used the sources indicated and have not made unauthorized use of services of a third party. Where the work of others has been quoted or reproduced, the source is always given.

I further declare that the submitted thesis or parts thereof have not been presented as part of an examination degree to any other university.

Munich, 20.12.2024   Michael Lifschitz

_____   _____

Place, Date   Signature doctoral candidate