Archives of Academic Emergency Medicine. 2026; 14(1): e11

OPEN ACCESS

REVIEW ARTICLE

The Primary Sources of Interruptions Experienced by Physicians and Nurses in Emergency Departments: A Scoping Review

Navaz Emadi[1], Rita Mojtahedzadeh[2], Seyyed Farshad Allameh[3], Kamal Basiri[4], Aeen Mohammadi[2]*

1. Department of Medical Education, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

2. Department of E-learning in Medical Education, Center of Excellence for E-learning in Medical Education, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.

3. Department of Internal Medicine, School of Medicine, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Tehran, Iran

4. Department of Emergency Medicine, School of Medicine, Sina Hospital, Tehran University of Medical Sciences, Tehran, Iran

Received: December 2025; Accepted: January 2026; Published online: 19 February 2026

Abstract: **Introduction:** Interruptions are common in emergency departments (ED) and frequently occur during critical clinical tasks. These interruptions disrupt workflow, reduce situational awareness, increase the risk of errors, and may compromise patient safety. Identifying and mapping their sources is therefore essential to guide targeted strategies and improve the quality of care. This scoping review aimed to identify and categorize the primary sources of work-related interruptions among physicians and nurses in the ED. **Methods:** The review question, developed using the PCC framework (physicians and nurses; work-related interruptions; EDs), sought to identify the primary sources of interruptions in ED settings. A comprehensive search was performed in PubMed, Scopus, Embase, Web of Science, and Google Scholar to locate peer-reviewed studies published up to September 2025. Two reviewers independently screened the studies and extracted the data. **Results:** A total of 12 studies met the inclusion criteria. Reported interruption rates varied across settings and professional roles. The primary sources of interruptions were grouped into six major categories: colleague interference, phone and pager alerts, patient-initiated interruptions, family or companion interference, technical failures and lack of resources, and environmental noise. Most interruptions occurred at nursing or physician workstations and during medication preparation, documentation, or direct patient care. **Conclusion:** This scoping review provides a comprehensive overview of the main sources of interruptions in ED. Understanding where and why these interruptions occur can guide the development of targeted educational, organizational, and environmental interventions. Reducing avoidable interruptions may enhance staff performance, improve patient safety, and optimize the quality of emergency care.

Keywords: Emergency Service, Hospital (MeSH); Workflow (MeSH); Work-related Interruptions; Physicians; Nurses

Cite this article as: Emadi N,Mojtahedzadeh R, Allameh SF, et al. The Primary Sources of Interruptions Experienced by Physicians and Nurses in Emergency Departments: A Scoping Review. Arch Acad Emerg Med. 2026; 14(1): e11. https://doi.org/10.22037/aaem.v14i1.2919.

1. Introduction

In complex and information-dense clinical environments, maintaining focus and delivering high-quality care becomes increasingly challenging for healthcare professionals. The emergency department (ED) is particularly dynamic and unpredictable due to rapid changes in patient conditions and fluctuating demands (1), which can reduce the situational awareness and attention of physicians and nurses and consequently impair performance and compromise patient safety (2). A major contributor to this complexity is the frequent occurrence of distractions and interruptions arising from overcrowding and high service demand in the ED (3, 4). Evidence shows that interruptions and distractions occur more often in ED than in other hospital settings and are reported to be up to three times more frequent than in primary care (5-7). Although some studies use the terms “distraction” and “interruption” interchangeably (8), others distinguish between them. Distraction refers to irrelevant stimuli that unintentionally divert attention from the task at hand, such as background noise during the assessment of a critically ill trauma patient (9). In contrast, interruption is an external stimulus that intentionally diverts attention away from the primary task, for example, when patient companions interfere during clinical care (10). In this review, the term “interruption” is used broadly to encompass both concepts. Interruptions draw clinicians’ attention away from essential tasks and adversely affect cognitive and decision-making processes (11). They increase the likelihood of preventable human errors,

***Corresponding Author:** Aeen Mohammadi; Department of E-learning in Medical Education, School of Medicine, and Health Professions Education Research Center, Tehran University of Medical Sciences, Dolatshahi Alley, Naderi St, Keshavarz Blvd, Tehran, Iran, Email: aeen_mohammadi@tums.ac.ir, Tel: +98 (021) 42036001, ORCID: https://orcid.org/0000-0002-2745-3873.

as professionals exposed to frequent interruptions are more prone to mistakes (2, 12). Interruption during emergency workflows also impacts working memory (13), leading to diminished cognitive performance, reduced information retention, and memory lapses (14, 15). Moreover, resuming primary tasks after an interruption is often difficult (14-16), and interruptions have been linked to patient dissatisfaction (17, 18). Studies report that physicians and nurses in ED experience between 5.1 and 15.5 interruptions per hour (3, 5-7, 16, 19, 20). Despite increasing recognition of the adverse impact of interruptions in ED, the existing evidence remains fragmented across studies with varying definitions, settings, and methodologies. To date, no comprehensive review has systematically mapped the sources, types, or patterns of interruptions experienced by physicians and nurses in EDs. Given the complexity of the ED environment and the diversity of reported interruption-related factors, a scoping review is the most appropriate approach to collate and synthesize current knowledge, identify gaps in the literature, and inform the development of targeted strategies for improving clinical workflow and patient safety. Therefore, this scoping review aimed to identify, categorize, and summarize the primary sources of work-related interruptions experienced by physicians and nurses in EDs.

2. Methods

2.1. Study design and setting

This scoping review was conducted according to the Joanna Briggs Institute (JBI) methodology for scoping reviews and was reported in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) checklist (21). The PCC framework was applied to structure the review question as follows:

• Population: Physicians and nurses
• Concept: Work-related interruptions
• Context: EDs

A scoping review approach was selected due to the heterogeneity in definitions, study designs, and settings across the existing literature and the need to map and categorize current evidence rather than evaluate the effectiveness of interventions. No protocol was registered. In this review, the term "interruption" was defined in accordance with the conceptual clarification presented in the introduction. While some studies use "interruption" and "distraction" interchangeably (8), distraction refers to unintentional stimuli that divert attention from an ongoing task (9), whereas interruption is an intentional stimulus that shifts attention away from the primary activity (10). For the purposes of this review, and consistent with previous literature, the term "interruption" was used as an umbrella term encompassing both unintentional distractions and intentional interruptions, as both disrupt task continuity and may adversely affect cognitive performance and patient safety. The authors confirm that all methods were aligned with the relevant guidelines and regulations in the Declaration of Helsinki. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (No.: IR.TUMS.MEDICINE.REC.1402.058).

2.2. Search strategy and evidence selection

A comprehensive and systematic search strategy was developed in collaboration with an experienced medical librarian to ensure sensitivity, completeness, and reproducibility. The following electronic databases were searched: PubMed, Embase, Scopus, and Web of Science. Additionally, Google Scholar was used to capture supplementary and grey literature. Controlled vocabulary (e.g., MeSH, Emtree) and free-text keywords related to EDs, interruptions, distractions, workflow, and multitasking were combined using Boolean operators, truncation, and proximity operators. Search strategies were tailored to the indexing and syntax of each database, and the full search strategies were documented for transparency and are provided in the Supplementary table 1. The search included original peer-reviewed studies published in English up to September 2025, without restrictions on study design to maximize the breadth of evidence. Reference lists of included studies and relevant reviews were manually screened to identify additional eligible articles. All records were imported into EndNote™ X8.2 (Clarivate Plc, London, UK), where duplicates were automatically and manually removed. Two reviewers independently screened titles and abstracts based on predefined inclusion and exclusion criteria aligned with the PCC framework. Studies focusing on physicians or nurses in EDs and reporting interruptions during clinical workflows were included. Exclusion criteria were: studies conducted outside the ED, non-English publications, conference abstracts, letters, protocols, or full texts unavailable. Full-text articles of potentially relevant studies were retrieved and assessed for eligibility by two independent reviewers. Any disagreements were resolved through discussion and consensus. Reasons for exclusion at the full-text stage were recorded. The study selection process was documented using the PRISMA-ScR flow diagram, indicating the number of records identified, screened, excluded, and included.

2.3. Data extraction and analysis

Data from the included studies were extracted independently by two reviewers using a standardized data extraction form. Extracted information included bibliographic details, study design, setting, sample characteristics, definitions and measures of interruptions, sources and frequency of interruptions, and key findings. Extracted data were synthesized using descriptive and thematic analysis. Studies were grouped according to the types and sources of interruptions, settings, and professional roles (physicians vs. nurses). In accordance with the methodological guidance of the Joanna Briggs Institute (JBI) and the PRISMA-ScR framework, a formal critical appraisal of individual studies was not performed. As

the primary purpose of this scoping review was to map the scope and nature of existing evidence rather than to evaluate the effectiveness or risk of bias, omitting quality assessment is methodologically appropriate and consistent with current best practices. The heterogeneity of study designs and outcome measures across the included literature further supports this decision. However, this is acknowledged as a limitation, and potential implications of study quality are considered in the discussion section. Given the descriptive aim of the review and the substantial variability in study methodologies and outcomes, no meta-analysis was conducted, in line with scoping review methodology.

3. Results

3.1. Articles' Retrieval and Bibliographic Information

The initial database search yielded 11,288 records across all databases. After removing 5,877 duplicate records, 5,411 unique articles remained for title and abstract screening. During this stage, 4,981 records were excluded based on the predefined eligibility criteria, such as irrelevance to the topic or non-clinical settings. The abstracts of the remaining 430 records were examined in greater detail to determine their eligibility for full-text review, resulting in the exclusion of an additional 263 studies. The full texts of 167 articles were then thoroughly assessed for eligibility. At this stage, 155 full-text articles were excluded for the following reasons: 31 studies were conducted in settings other than the ED, 54 studies did not report data on interruptions, 16 studies did not include physicians or nurses as participants, and 54 studies lacked sufficient methodological detail or outcome information. These exclusions were carefully documented to ensure transparency and adherence to the review protocol. Ultimately, 12 studies met all inclusion criteria and were included in this scoping review. Figure 1 presents the PRISMA-ScR flow diagram outlining the detailed study selection process, and Table 1 summarizes the bibliographic and methodological characteristics of the included studies in chronological order.

3.2. Frequency of interruptions

Observational evidence consistently shows that emergency physicians and nurses are frequently exposed to workflow interruptions, although reported rates vary depending on study design, measurement tools, and clinical context. Across the included studies, the frequency of interruptions ranged from 2.55 interruptions per hour (27) to 10.9 interruptions per hour (29), indicating substantial variability. In Forsyth et al.'s prospective observation of emergency nurses, a total of 3,229 interruptions were recorded (equivalent to 8.7 interruptions per hour), and the average duration of each interruption was 13 seconds (26). Similarly, Weigl et al. reported that physicians' workflow was disrupted approximately every 11.25 minutes (23), confirming the high temporal density of interruptions during ED practice. Although methodological differences prevented quantitative pooling, all studies consistently indicate that interruptions are a frequent, routine, and unavoidable feature of emergency clinical workflows. Table 2 provides detailed data on the number of interruptions, observation duration, and calculated interruption frequency per hour or shift.

3.3. Places of interruptions in the ED

Across studies, nurses' and physicians' workstations emerged as the primary locations where interruptions occurred (19, 26). These centralized work areas serve as critical hubs for communication, documentation, and task coordination, making them particularly susceptible. One study reported that nearly 60% of all interruptions took place at these stations (19).

In addition, interruptions were commonly observed during medication preparation, order entry, documentation, and direct patient care, suggesting that they often occur during high-cognitive-load or safety-critical tasks.

3.4. Sources of interruptions in the ED

Across the included studies, a consistent pattern emerged indicating that colleagues and other healthcare staff were the most frequent source of interruptions in the ED. Five studies identified peer-to-peer interactions, including requests from physicians, nurses, and personnel from other departments, as the leading cause of workflow disruptions (23, 25–27, 29). For example, Weigl et al. reported that 30.0% of interruptions originated from ED colleagues, while 27.6% were triggered by staff from other hospital units, highlighting the high level of interdepartmental communication in the ED (29). Similarly, Forsyth et al. observed that interruptions among emergency nurses most commonly stemmed from face-to-face communication with other ED nurses (38.7%), followed by interactions with other healthcare workers such as social workers, patient care assistants, and paramedics (15%), and physicians or medical assistants (8.5%) (26). Another study by Weigl et al. also emphasized that colleagues from outside the ED were the primary initiators of interruptions, with ED colleagues as the next most common source (25).

However, interruptions in the ED are not solely driven by staff interactions. Several studies identified additional systemic and environmental sources that contribute substantially to workflow disruption. These included telephone and pager alerts, which often occurred during documentation or patient care tasks, as well as patients and their companions' seeking information or assistance, which could divert clinicians from ongoing activities. Moreover, technical failures and lack of resources, such as malfunctioning equipment or missing supplies, were frequently reported as operational causes of interruptions. Finally, environmental factors, including noise, crowding, alarms, and overall high activity levels, further contributed to unplanned disruptions in clinical work (13, 19, 23–27, 29–31). Together, these findings demon-

strate that interruptions in the ED are multifactorial in origin, reflecting a combination of interpersonal communication demands, organizational processes, and physical environment challenges, all of which must be considered when designing strategies to minimize unnecessary workflow disruptions. Table 2 provides a comparative synthesis of the sources of interruptions and their relative frequencies as reported in each study, offering a structured overview of how often each type of interruption occurs across different ED settings.

4. Discussion

This scoping review synthesized evidence from 12 studies to identify and categorize the primary sources of workflow interruptions in EDs. Interruptions were consistently described as external stimuli that divert attention from an ongoing task and lead to a task switch, in line with the widely cited definition by Brixey et al. (10). Notably, none of the included studies clearly distinguished between "interruption" and "distraction," treating both as equivalent workflow disruptions. This conceptual inconsistency highlights the need for clearer definitions in future research to ensure consistent measurement and interpretation.

Based on thematic synthesis, we developed a six-category classification of interruption sources: (1) colleagues, (2) phone and pager alerts, (3) patients, (4) patients' companions, (5) technical failures and lack of resources, and (6) environmental noise. Colleagues were consistently the most prevalent source of interruptions across studies, often through face-to-face communication or task delegation (23, 25–27, 29). This reflects the collaborative and fast-paced nature of emergency care, where constant coordination is required. However, not all colleague-initiated interruptions are clinically necessary, and poorly timed or non-urgent interactions may contribute to cognitive overload and workflow fragmentation.

Our classification aligns closely with the taxonomy proposed by Weigl et al. (2017), who identified eight interruption sources (25). We consolidated conceptually similar groups—for example, colleagues from inside and outside the ED were merged into a single category, and "other persons" and "information problems" were integrated into broader contextual categories. These differences reflect heterogeneity in study methodologies and operational definitions. Importantly, the lack of a standardized taxonomy limits comparability across studies and hinders the development of generalizable interventions. Future research should aim to establish a unified framework for classifying interruption sources to improve conceptual clarity and support targeted intervention design.

Substantial variability in interruption rates was observed across studies, ranging from approximately 2.5 to 10.9 interruptions per hour (27, 29). This inconsistency is likely due to differences in measurement tools, observation periods, clinical context, and workload intensity. Studies with longer observation durations or higher patient volumes reported more interruptions, suggesting that interruption frequency is context-dependent rather than a fixed characteristic of the ED environment (31). Therefore, interpreting and comparing interruption rates requires careful consideration of setting, staffing levels, and methodological differences.

Phone and pager alerts were consistently reported as the second most common source of interruptions (24–26, 29). Although these communication tools are essential for coordinating urgent care, they often occur during cognitively demanding tasks and force clinicians to task-switch, increasing the risk of error. Several authors suggested the use of designated communication coordinators or filtered paging systems to manage non-urgent calls and reduce avoidable disruptions (16, 33).

Patients and their companions also contributed to interruptions across multiple studies (28, 30, 31). While some of these interactions are clinically relevant, many are non-urgent and occur during high-risk tasks such as medication administration or clinical decision-making. Structured communication boundaries, clearer triage guidance, and patient/family orientation have been proposed to minimize unnecessary interruptions while maintaining patient-centered care (34).

Environmental noise, crowding, and technical failures were less frequent but highly consequential sources of interruption (25, 26, 29, 30). Noise from alarms, background conversations, and high activity levels increases cognitive load and interferes with team communication. Similarly, malfunctioning equipment or missing supplies can delay care and force clinicians to abandon tasks. Proposed strategies include noise reduction measures, creation of quieter work zones, and proactive equipment maintenance. Workstations and documentation areas emerged as interruption-prone locations because they serve as central hubs for communication, coordination, and access to information (19, 32–34). Interruptions during documentation or decision-making can lead to incomplete data entry, reduced accuracy, and impaired follow-up care. These effects are mediated by cognitive overload and task switching, where frequent shifts in attention increase mental effort and decrease task resumption success. Evidence from both healthcare and cognitive psychology shows that longer interruptions reduce the likelihood of successfully returning to the primary task, and clinicians may attempt to compensate by working faster, which further heightens the risk of errors (12, 30).

Importantly, not all interruptions are harmful. Some are necessary for patient safety (e.g., urgent updates or critical results), whereas others are low-value and avoidable. Few studies explicitly differentiated between necessary and unnecessary interruptions, representing a gap in the literature (32). Future research should prioritize this distinction to guide the development of interventions that preserve essential communication while minimizing disruptive, non-urgent interruptions. Training programs that teach clinicians to recognize, prioritize, and manage interruptions may help reduce

cognitive burden and improve workflow efficiency (26).

Overall, these findings highlight the need for multifaceted, system-level strategies to manage interruptions in EDs. Effective interventions should address both behavioral and organizational factors, such as implementing no-interruption zones or "sterile cockpit" protocols during critical tasks, assigning dedicated personnel to manage communications, optimizing workspace design, and improving equipment reliability (35). Additionally, developing a standardized taxonomy of interruption sources would enhance comparability across studies, support targeted intervention design, and strengthen the evidence base for improving workflow and patient safety in emergency care.

5. Limitations

This scoping review has several limitations that should be considered when interpreting the findings. First, only peer-reviewed studies published in English were included, which may have resulted in the exclusion of relevant evidence published in other languages. Second, substantial heterogeneity was observed across studies in terms of the definition of interruptions, measurement tools, study designs, and units of analysis (e.g., interruptions per hour, per shift, or per task), which limited direct comparison between studies and precluded quantitative synthesis. Third, most included studies relied on observational or self-reported methods, which are prone to observer bias and recall bias and may not fully capture the complexity of real-time clinical workflows. Fourth, the review focused exclusively on hospital-based EDs, and therefore, the findings may not be generalizable to other healthcare settings or systems. Fifth, consistent with the methodological guidance for scoping reviews, no formal quality or risk of bias assessment of the included studies was conducted, which may affect the strength of the conclusions drawn from the evidence. Finally, important contextual factors such as patient volume, shift timing (day vs. night), team composition, organizational culture, and institutional policies were not consistently reported across studies, yet these variables may significantly influence the frequency and nature of interruptions.

6. Conclusions

The wide range of interruption sources identified in this scoping review highlights the need for a multifaceted and system-level approach to managing interruptions in EDs. Effective strategies should extend beyond individual behavior and encompass structured communication management, clear protocols for patient and family interaction, optimization of the physical environment, and improved reliability and maintenance of medical equipment. By categorizing interruption sources into distinct domains, this review provides a practical framework for identifying high-risk situations and prioritizing targeted interventions. In particular, addressing both interpersonal communication patterns (e.g., colleague-initiated and device-mediated interruptions) and environmental or organizational factors (e.g., noise, equipment issues, workspace design) is essential. Ultimately, reducing avoidable interruptions and managing unavoidable ones more effectively can enhance situational awareness, workflow efficiency, clinical decision-making, and patient safety in the high-stress environment of the ED. This classification can serve as a foundation for future research and the development of evidence-based policies and training programs aimed at promoting safer and more focused clinical practice.

7. Declarations

7.1. Acknowledgments

None.

7.2. Ethics Approval

The authors confirm that all methods were aligned with the relevant guidelines and regulations in the Declaration of Helsinki. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (No.: IR.TUMS.MEDICINE.REC.1402.058).

7.3. Competing interests

The authors declare that they have no competing interests.

7.4. Funding and supports

This study was a part of the PhD thesis in E-learning in Medical Education of the first author at Tehran University of Medical Sciences (TUMS). This research was supported by Tehran University of Medical Sciences (Grant No: 1402-2-101-66881). The funders had no role in study design, data collection and analysis, the decision to publish, or preparation of the manuscript.

7.5. Authors' contributions

All authors (NE, RM, KB, SFA, AM) planned and designed this scoping review. NE and AM independently read titles and abstracts to identify possibly relevant articles and read the full-text version of possibly relevant articles. KB, RM, and SFA assessed the relevance of selected articles. Any disagreement was settled by discussion or all authors. All authors participated in writing the manuscript. All authors read and approved the final manuscript.

7.6. Data availability

The datasets generated and/or analyzed during this study can be obtained from the corresponding author on reasonable request.

7.7. Using artificial intelligence chatbots

During the preparation of this manuscript, the authors used the AI-based language model ChatGPT (OpenAI) to assist with translation, academic writing refinement, and gram-

matical optimization. In addition, ChatGPT was utilized to support the development and graphical design of the PRISMA-ScR flow diagram. All AI-generated content was thoroughly reviewed, verified, and edited by the authors to ensure accuracy, clarity, and alignment with the scientific objectives of the study. No AI tool was used for data extraction, data analysis, interpretation of study findings, or drawing scientific conclusions. The authors take full responsibility for the final content of the manuscript and affirm that all intellectual contributions, critical thinking, and interpretation were performed by the authors.

References

1. Wears RL, Woloshynowych M, Brown R, Vincent CA. Reflective analysis of safety research in the hospital accident & emergency departments. Appl Ergon. 2010 Sep 1;41(5):695-700.
2. Westbrook JI, Raban MZ, Walter SR, Douglas H. Task errors by emergency physicians are associated with interruptions, multitasking, fatigue and working memory capacity: a prospective, direct observation study. BMJ Qual Saf. 2018 Aug 1;27(8):655-63.
3. Chisholm CD, Collison EK, Nelson DR, Cordell WH. Emergency department workplace interruptions are emergency physicians "interrupt-driven" and "multitasking"? Acad Emerg Med. 2000 Nov;7(11):1239-43.
4. Brixey JJ, Tang Z, Robinson DJ, Johnson CW, Johnson TR, Turley JP, Patel VL, Zhang J. Interruptions in a level one trauma center: a case study. Int J Med Inform. 2008 Apr 1;77(4):235-41.
5. Chisholm CD, Dornfeld AM, Nelson DR, Cordell WH. Work interrupted: a comparison of workplace interruptions in emergency departments and primary care offices. Ann Emerg Med. 2001 Aug 1;38(2):146-51.
6. Chisholm CD, Weaver CS, Whenmouth L, Giles B. A task analysis of emergency physician activities in academic and community settings. Ann Emerg Med. 2011 Aug 1;58(2):117-22.
7. Walter SR, Li L, Dunsmuir WT, Westbrook JI. Managing competing demands through task-switching and multitasking: a multi-setting observational study of 200 clinicians over 1000 hours. BMJ Qual Saf. 2014 Mar 1;23(3):231-41.
8. Johnson M, Sanchez P, Langdon R, Manias E, Levett-Jones T, Weidemann G, Aguilar V, Everett B. The impact of interruptions on medication errors in hospitals: an observational study of nurses. J Nurs Manag. 2017 Oct;25(7):498-507.
9. Clapp WC, Gazzaley A. Distinct mechanisms for the impact of distraction and interruption on working memory in aging. Neurobiol Aging. 2012 Jan 1;33(1):134-48.
10. Brixey JJ, Robinson DJ, Johnson CW, Johnson TR, Turley JP, Zhang J. A concept analysis of the phenomenon interruption. Adv Nurs Sci. 2007 Jan 1;30(1):E26-42.
11. Cole G, Stefanus D, Gardner H, Levy MJ, Klein EY. The impact of interruptions on the duration of nursing interventions: a direct observation study in an academic emergency department. BMJ Qual Saf. 2016 Jun 1;25(6):457-65.
12. Westbrook JI, Woods A, Rob MI, Dunsmuir WT, Day RO. Association of interruptions with an increased risk and severity of medication administration errors. Arch Intern Med. 2010 Apr 26;170(8):683-90.
13. Mobeen A, Shafiq M, Aziz MH, Mohsin MJ. Impact of workflow interruptions on baseline activities of the doctors working in the emergency department. BMJ Open Qual. 2022 Sep 1;11(3):e001813.
14. Yen PY, Kelley M, Lopetegui M, Rosado AL, Migliore EM, Chipps EM et al. Understanding and Visualizing Multitasking and Task Switching Activities: A Time Motion Study to Capture Nursing Workflow. AMIA Annu Symp Proc. AMIA Symposium. 2016 Jan 1;2016:1264-1273. PMID: 28269924; PMCID: PMC5333222.
15. Walter SR, Dunsmuir WT, Westbrook JI. Studying interruptions and multitasking in situ: the untapped potential of quantitative observational studies. Int J Hum Comput Stud. 2015 Jul 1;79:118-25.
16. Westbrook JI, Coiera E, Dunsmuir WT, Brown BM, Kelk N, Paoloni R, Tran C. The impact of interruptions on clinical task completion. BMJ Qual Saf. 2010 Aug 1;19(4):284-9.
17. Jeanmonod R, Boyd M, Loewenthal M, Triner W. The nature of emergency department interruptions and their impact on patient satisfaction. Emerg Med J. 2010 May 1;27(5):376-9.
18. Berg LM, Källberg AS, Ehrenberg A, Florin J, Östergren J, Djärv T, Brixey JJ, Göransson KE. Factors influencing clinicians' perceptions of interruptions as disturbing or non-disturbing: a qualitative study. Int Emerg Nurs. 2016 Jul 1;27:11-6.
19. Berg LM, Källberg AS, Göransson KE, Östergren J, Florin J, Ehrenberg A. Interruptions in emergency department work: an observational and interview study. BMJ Qual Saf. 2013 Aug 1;22(8):656-63.
20. Myers RA, McCarthy MC, Whitlatch A, Parikh PJ. Differentiating between detrimental and beneficial interruptions: a mixed-methods study. BMJ Qual Saf. 2016 Nov 1;25(11):881-8.
21. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher D, Peters MD, Horsley T, Weeks L, Hempel S. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Annals of internal medicine. 2018 Oct 2;169(7):467-73.
22. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. Health Info Libr J. 2009 June; 26(2):91-108.
23. Weigl M, Müller A, Zupanc A, Glaser J, Angerer P. Hospital doctors' workflow interruptions and activities: an observation study. BMJ Qual Saf. 2011 Jun 1;20(6):491-7.
24. 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 Qual Saf. 2016 Jul 1;25(7):499-508.
25. Weigl M, Beck J, Wehler M, Schneider A. Workflow interruptions and stress at work: a mixed-methods study among physicians and nurses of a multidisciplinary emergency department. BMJ Open. 2017 Dec 1;7(12):e019074.
26. Forsyth KL, Hawthorne HJ, El-Sherif N, Varghese RS, Ernste VK, Koenig J, Blocker RC. Interruptions experienced by emergency nurses: Implications for subjective and objective measures of workload. J Emerg Nurs. 2018 Nov 1;44(6):614-23.
27. Schneider A, Wehler M, Weigl M. Provider interruptions and patient perceptions of care: an observational study in the emergency department. BMJ Qual Saf. 2019 Apr 1;28(4):296-304.
28. Eng MS, Fierro K, Abdouche S, Yu D, Schreyer KE. Perceived vs. actual distractions in the emergency department. Am J Emerg Med. 2019 Oct 1;37(10):1896-903.
29. Weigl M, Catchpole K, Wehler M, Schneider A. Workflow disruptions and provider situation awareness in acute care: An observational study with emergency department physicians and nurses. Appl Ergon. 2020 Oct 1;88:103155.
30. Kwon YE, Kim M, Choi S. Degree of interruptions experienced by emergency department nurses and interruption related factors. Int Emerg Nurs. 2021 Sep 1;58:101036.
31. Lin T, Feng X, Gao Y, Li X, Ye L, Jiang J, Tong J. Nursing interruptions in emergency room in China: An observational study. J Nurs Manag. 2021 Oct;29(7):2189-98.
32. de Freitas Junior WC, Alves VC, Silva Ramos J, Rodrigues Garbis Chagas S, Ferreira da Mata LR, Carrilho Menezes A, Teodoro Couto Ribeiro HC. Distractions and interruptions in medication preparation and administration in inpatient units. Revista Eletronica de Enfermagem. 2019 Jan 1;21.
33. AAEM (2020). Interruptions in the Emergency Department. Retrieved from the American Academy of Emergency Medicine. Available from: https://www.aaem.org/wp-content/uploads/2023/05/5.6.22FinalRvsdBODapvdIntrptEDfrWebPost.pdf
34. Redfern, E., Brown, R., & Vincent, C. A. (2009). Improving communication in the emergency department. Emerg Med J. 26(9), 658-661.
35. Anthony, K., Wiencek, C., Bauer, C., Daly, B., & Anthony, M. K. (2010). No interruptions please: impact of a no interruption zone on medication safety in intensive care units. Crit Care Nurse, 30(3), 21-29.

Table 1: Bibliographic information of included studied in chronological order

First author, year	Study objectives	Study design- participants/setting
Weigl, 2011 (23)	To quantify workflow interruptions among hospital doctors, to identify frequent sources, and to relate sources to doctors' concurrent activities.	Observational study- 32 doctors observed in full work shifts
Berg, 2013 (19)	To explore the interruptions occurring during common activities of clinicians working in EDs*.	Observational and interview study-18 clinicians, licensed practical nurses, registered nurses, and medical doctors.
Weigl, 2016 (24)	To determine the prevalence and associations of ED staff's workflow interruptions, multitasking, and workload with patient care quality outcomes	Multisource study in the ED- time-motion study to observe ED staff reports on workflow interruptions
Weigl, 2017 (25)	To understand the taxonomy of workflow interruptions that takes into account the content and purpose of interruptive communication	Mixed-methods study- physicians and nurses of a multidisciplinary ED. Data was gathered through expert observation sessions and concomitant self-evaluations of ED providers.
Forsyth, 2018 (26)	To identify interruptions experienced by emergency nurses to provide implications for subjective and objective measures of workload	Observation-based prospective study- emergency nurses were observed in real-time across 8- or 12-hour shifts using a previously validated Workflow Interruptions Tool.
Westbrook, 2018 (2)	To understand the relative contributions of interruptions and multitasking by emergency physicians to prescribing errors	Prospective direct observation study- 36 emergency physicians were shadowed over 120hours to record tasks, interruptions, and instances of multitasking.
Schneider, 2019 (27)	To distinguish beneficial and detrimental forms of interruptions of ED providers.	Observational study- ED physicians and nurses were observed.
Eng, 2019 (28)	To compare the perception of distractions and interruptions by emergency medicine physicians with actual occurrences in the ED.	Observational two-phase study- emergency medicine faculty and residents were observed over 9 weeks to record individual interruptions for different levels of training.
Weigl, 2020 (29)	To examine how sources and contents of provider workflow interruptions influence situation awareness of ED physicians and nurses.	Observational, prospective, multi-method study- ED physicians and nurses, data was gathered through observations, self-reports, and ED administrative data on staffing and patient load.
Kwon, 2021 (30)	To examine the degree of interruptions experienced by ED nurses and related factors	Descriptive survey- 23 nurses were observed.
Lin, 2021 (31)	To analyze the frequency and core elements of nursing work interruptions	Observational study -60 EM nurses in three units of an ED
Mobeen, 2022 (13)	To understand the baseline activities of the ED doctors and how these are affected by workflow interruptions.	Mixed-methods study- ED doctors, data collected through a questionnaire survey and a workflow observation about baseline activities and workflow interruptions.

* Emergency Departments

Table 2: The sources and frequency of the interruptions in the ED in included studies

No	Sources and frequency of interruptions	Most frequent interruption	Observation duration	Interruption/ hour/shift
1	N= 1480 - by nurses = 551 (37.2%) - by telephone/beeper calls = 324 (21.9%) - by doctors = 257 (17.4%) - by others = 194 (13.1%) (by patients= 31; 2.1%, by patients' relatives = 35; 2.4%, by other persons = 91; 6.1%) - by Impediments = 154 (10.4%) (Equipment or technical malfunctions= 37; 2.5%, Information impediments = 118; 8.0%, Waiting time = 15; 1.0%, Motor impediments = 21; 1.4%)	Interruptions by nurses in documentation = 302 (39%)	277 hours and 40 minutes	5.3
2	N= 184 Preparation of medication= 2 (1.1) Documentation= 32 (17.4) Patient/family-nurse/doctor interaction= 34 (18.5) Preparation of medical-technical tasks= 4 (2.2) Administration= 21 (11.4) Patient data analysis= 8 (4.3) Transportation= 12 (6.5) Organizational planning= 2 (1.1) Information seeking= 23 (12.5) Maintenance= 5 (2.7) Information exchange= 37 (20.1) Break= 4 (2.2)	Information exchange = 37 (20%) MDs= 14 (19.2) RNs= 14 (28.0) LPNs= 9 (14.8)	32 hours	5.1
3	N= 67 ED colleagues from the same profession= 25 (37.3%) Telephone/beeper= 16 (23.9%) Other ED personnel= 12; 17.9%) Missing information (3; 4.5%) Patient (1; 1.5%)	ED colleagues from the same profession= 25; 37.3%)	11 hours and 35 minutes	5.63
4	N=877 ED colleagues of other professions= 238 (27.1%) ED colleagues of the same profession= 211 (24.1%) Telephone/beeper= 184 (21%) Patients= 70 (8%) Information impediments or problems= 52 (5.9%) Equipment problems= 50 (5.7%) Patient's relatives= 43 (4.9%) other person= 29 (3.3%)	ED colleagues of other professions= 238 (27.1%)	116 hours and 51 minutes	7.51
5	N= 3229 Face-to-face communication with other emergency nurses= 1248 (38.7%) Environmental= 644 (19.9%) Face-to-face communication with other health care staff (e.g. social workers, patient-care assistants, paramedics) =504 (15.6%) Pages and phone calls= 389 (12.0%) Face-to-face communication with physicians, residents, and physician assistants=273 (8.5%) Unanticipated patient care= 167 (5.2%)	Face-to-face communication with other emergency nurses= 1248(38.7%		
6	N= Not mention On average emergency physicians experienced 7.9 interruptions per hour and 9.4 interruptions/hour while prescribing. (The sources of interruptions were not separated)	Not mention	120hours	7.9
7	N= Not mention Overall interruptions (mean rate) = 8.70 (4.92) Interruption sources (interruptions caused…) by patients 0.92 (1.19) by ED colleagues of the same profession 2.55 (2.39) by ED colleagues of another profession 2.47 (2.13) by telephone/beeper 1.79 (1.52) by patient's relatives 0.24 (0.49) by technical malfunctions or missing supplies 0.42 (0.63) by information impediments or problems 0.31 (0.60) Interruption contents (interruption event related…) to current case 1.82 (2.08) to parallel case 2.86 (2.79) to completed cases 0.79 (1.01) to new (time-critical) cases 0.16 (0.45) to coordination activities 1.92 (1.98) to patient comfort 0.27 (0.56) Mean rate: interruptions per hour; n=160 observation sessions.	by colleagues from the same profession (mean, M=2.55 interruptions per hour; SD 2.39)	240 hours and 42 min	2.55
8	N= 333 Actual interruptions per shift=4.26 times per shift Call from Inpatient Provider=1.4 Trauma Evaluation= 0.8 Call from Lab= 0.5 EKG read= 0.5 Call from Outside Hospital= 0.4 Command Phone Call= 0.3 Call from Radiology= 0.2 Neuro Evaluation= 0.1 Other= 0.4	Call from Inpatient Provider=1.4	3-week period	4.26 times per shift
9	N= 1205 ED colleagues of the same profession= 362 (30.04) ED colleagues of another profession= 332 (27.55) Telephone/beeper= 231 (19.17) Patients= 158 (13.11) Technical malfunctions or missing supplies=54 (4.48) Any other person= 35 (2.90) Information impediments or problems= 20 (1.66) Patient's relatives=13 (1.08)	ED colleagues of the same profession= 362(30.04)	110 hours and 40 minutes	10.9
10	N= 765 Interruptions experienced by ED nurses Communication with patients and families= 188 Communication with nurses= 186 Communication with other healthcare professionals = 81 Telephone calls= 72 Medical device alarms= 115 Changes in patient conditions= 41 Missed nursing tasks= 54 Preparation of articles= 66 Preparation of drugs =10 Equipment problems= 4 Environmental problems=7	Communication with patients and families= 188	120 h	6.4
11	N=2333 Patients and their families= 726 (31.2%) Nurses= 686 (29.4%) Doctors=347 (14.9%) Environment= 299 (12.8%) Other staff members= 225 (9.6%) Others= 50 (2.1%)	Patients and their families= 726 (31.2%)	432 hours and 24 minutes	5.4
12	N= Not mention Types of interruptions in urban hospitals (Mean (SD)): Visual and auditory: 4.04 (1.03) Phone calls: 2.85 (1.31) Intrusions: 3.50 (1.22) Rumination: 3.01(1.22)	visual and auditory distractions	Not mention	Not mention

ED, emergency department; LPNs, licensed practical nurses; MDs, medical doctors; RNs, registered nurses.

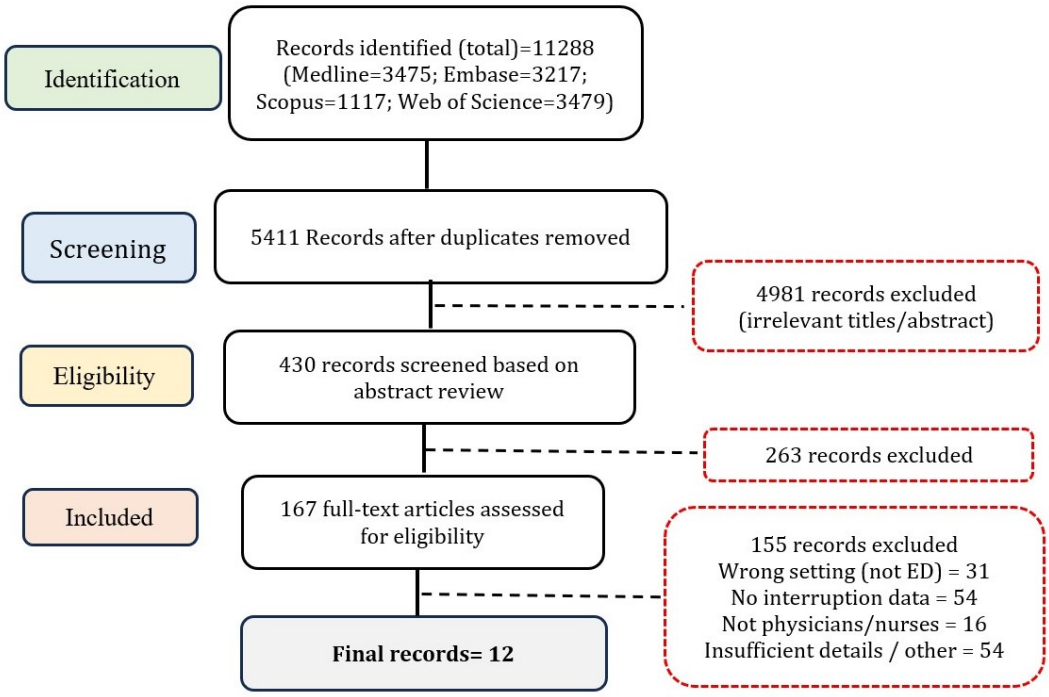

Figure 1: PRISMA-ScR flow diagram for study selection (adapted from Tricco et al., 2018).

Supplementary table 1: Search strategy in studied databases

	Ovid MEDLINE(R) ALL 1946 to September 2025	
1	exp *Emergency Medical Services/ or (emergency adj1 (care or department* or unit* or room* or treatment* or ward* or centre* or center*)).ab,ti. or (trauma adj1 (centre* or center* or department* or unit*)).ab,ti.	243065
2	Multitasking Behavior/ or (interrupt* or distract* or disrupt* or task switch* or multi-task* or multitask* or noise*).ab,ti.	656042
4	1 and 2	3475
	Embase 1974 to September 2025	
1	exp *emergency health service/ or (emergency adj1 (care or department* or unit* or room* or treatment* or ward* or centre* or center*)).ab,ti. or (trauma adj1 (centre* or center* or department* or unit*)).ab,ti.	317382
2	(interrupt* or distract* or disrupt* or task switch* or multi-task* or multitask* or noise*).ab,ti.	797469
3	1 and 2	5221
4	3 not Conference Abstract.pt.	3217
	Scopus	
1	TITLE-ABS ((emergency W/1 (care OR department* OR unit* OR room* OR treatment* OR ward* OR centre* OR center*)) OR (trauma W/1 (centre* OR center* OR department* OR unit*)))	219,266
2	TITLE-ABS (interrupt* OR distract* OR disrupt* OR "task switch*" OR multi-task* OR multitask* OR noise*)	1,950,024
3	1 AND 2	3,593
4	3 AND NOT INDEX (medline)	1117
	Web of Science core collection (SCI-EXPANDED (1900- 2025); SSCI (1900-2025); ESCI (2005-2025))	
1	TS=(((emergency) NEAR/1 (care OR department* OR unit* OR room* OR treatment* OR ward* OR centre* OR center*)) OR ((trauma) NEAR/1 (centre* OR center* OR department* OR unit*)))	204,021
2	TS=(interrupt* OR distract* OR disrupt* OR "task switch*" OR multi-task* OR multitask* OR noise*)	1,267,919
3	1 AND 2	3,479