

Unplanned extubation in adult patients: a narrative review of modifiable and non-modifiable risk factors

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Abstract

Unplanned Extubations (UE) are adverse events of relevant clinical significance, with an incidence ranging from less than 1 per 100 ventilator-days in high-volume academic settings to 19.74% in low-resource referral hospitals. This narrative review, conducted according to SANRA criteria, analyzed 7 studies published between 2021 and 2026 with the aim of identifying clinical, care-related, and organizational factors associated with unplanned removal of airway management devices in adult patients. Three thematic macro-areas were identified: patient-related factors (agitation, physical discomfort, male sex, short intubation duration, use of physical restraints); technical and clinical factors related to the device and its management (endotracheal tube positioning, event timing in relation to shift changes and direct nursing procedures); and organizational and professional factors (nurse-to-patient ratio, staff experience, cognitive continuity during care transitions). The results confirm the multifactorial nature of the phenomenon and highlight two significant gaps in the existing literature: the systematic absence of nursing experience as an independent variable, despite nurses representing the professionals with the highest direct patient contact time; and the exclusive focus on intensive care settings, with a near-total lack of data on rehabilitation and sub-intensive wards, where the progressive increase in tracheostomized patients makes unplanned device removal potentially even more critical. Future research should adopt standardized definitions, prospective multicenter designs, and explicitly include the nursing experience variable, extending the scope to non-intensive care settings.

Key words: unplanned extubation, risk factors, airway management, critical care nursing, patient safety.

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Introduction

Unplanned Extubations (UE) are defined as the autonomous removal of the airway management device by the patient, or as the accidental removal by healthcare staff during care activities. Their incidence ranges from 3% to 16% of intubated patients, or from 0.1 to 3.6 events per 100 days of mechanical ventilation.¹⁻⁴

UEs are events that could negatively affect the survival of the patient, especially in the presence of comorbidities; in particular, the mortality of patients who experience UE has been found to range between 10% and 25%.⁵ At the same time, there has been a reduction in the expected time to transition from ventilation using an endotracheal tube to tracheostomy: in 2023 it was found that, before performing a tracheostomy, an average of 11.4±7.1 days had elapsed, a figure significantly lower than in previous years.⁶ Moreover, despite numerous studies and analyses of unplanned extubation risk factors, the extubation rate has not been reduced: before the year 2000, the extubation rate ranged from 2.6% to 14% (7,8), while subsequent investigations report ranges from 1% to 22%.²⁻⁹ In light of these findings, it becomes necessary to investigate the risk factors for self-removal of the endotracheal tube, in order to improve patient survival and reduce the number of airway management device self-removal events. The aim of this review is to analyze the literature in order to identify the clinical, care-related, and organizational factors associated with the self-removal of airway management devices.

Materials and Methods

This narrative review was conducted according to the criteria proposed by the Scale for the Assessment of Narrative Review Articles (SANRA), in order to ensure methodological rigor and scientific consistency.¹⁰

The review adheres to the six SANRA domains: justification of the choice of narrative format, explicit definition of objectives, documented and reproducible search strategy, systematic citation of sources, scientific argumentation based on available evidence, and structured presentation of results.

The search strategy was structured and documented through the use of MeSH terms and Boolean operators.

The article selection process was carried out in two phases: an initial screening based on the relevance of title and abstract, followed by full-text evaluation conducted in a double-blind manner by independent reviewers. To enhance the transparency of the process, a flowchart inspired by the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) was developed, summarizing the stages of study identification, inclusion, and exclusion.¹¹

Three databases were searched: PubMed, EMBASE, and EBSCOhost. The search was conducted between February and March 2026, using MeSH terms and free terms combined with Boolean operators («AND» and «OR»); the search string was adapted to the syntax of each database to analyze studies published

from 2021 to 2026. The main search terms included «airway extubation», «unplanned extubation», «self-extubation», «accidental extubation», «accidental decannulation», «unplanned decannulation», «tube dislodgement» and «self removal».

Records identified were uploaded to the Rayyan platform for title and abstract screening (after removal of duplicates); full texts were then read to assess eligibility for inclusion. Title and abstract screening was performed independently, and in cases of disagreement between the two reviewers, the conflict was resolved through discussion; if disagreement persisted, full-text reading was performed before reaching a decision on inclusion or exclusion. At the end of the title and abstract screening process, a Cohen's kappa of 0.77 was recorded between the authors.

Experimental or observational studies conducted on adults (age ≥ 18 years) who were intubated or tracheostomized, in any care setting, published in English or Italian, were included. All studies on pediatric populations (involving individuals under 18 years of age), all non-peer-reviewed studies, and literature reviews were excluded.

Study selection

The database search yielded 873 results, and after manual removal of duplicates, a two-phase screening was performed using the Rayyan QCRI platform. In the first phase, the authors independently assessed title and abstract; full texts were then read in the second phase, evaluating inclusion according to the previously specified criteria. At the end of the process, 7 studies were deemed suitable for results analysis.

Results

Seven studies^{12–18} were included in the analysis, from which three recurring and conceptually distinct thematic macro-areas emerged: factors related to the patient, factors related to the endotracheal device and its management, and organizational and professional factors related to healthcare staff.

The first macro-area concerns patient-related factors, including the clinical, demographic, and behavioral characteristics of the patient (including agitation, physical discomfort, sex, duration of intubation, and use of physical restraints), documented convergently by Guillemin *et al.*,¹³ Minda *et al.*,¹⁶ and Zuo *et al.*¹⁸

The second macro-area concerns technical and clinical factors related to the device and its management, including both endotracheal tube positioning in terms of distance from the carina¹⁵ and the timing of events in relation to work shifts and ongoing care activities, a factor documented across studies by Guillemin *et al.*,¹³ Gupta *et al.*,¹⁴ and Tanios *et al.*¹⁷

The third macro-area concerns organizational and professional factors related to healthcare staff, understood both as the level of experience of individual operators and as the nurse-to-patient ratio and structure of care processes, aspects explored by Gupta *et al.*,¹⁴ Minda *et al.*,¹⁶ and Tanios *et al.*¹⁷

The incidence of UE shows marked variability depending on the clinical context, the type of Intensive Care Unit (ICU), and the observation period. In the multicenter prospective Safe-ICU study, conducted across 47 French ICUs with a total of 41,574 Mechanical Ventilation (MV) days, an aggregate incidence of 1.0 UE per 100 MV-days was reported, with an inter-center range of 0 to 4.3/100 MV-days, and UEs accounted for 9% of all extubations.¹³ Lower rates were observed in North American academic settings: in a US neuroscience ICU, the baseline pre-intervention

rate was 0.93/100 ventilator-days (214 patients, 968 ventilator-days), reduced to 0.22/100 ventilator-days in the post-intervention period (576 patients, 2,730 ventilator-days),¹² while in a Californian academic community hospital the pre-intervention rate was 0.43 UE/100 MV-days.¹⁷

Higher rates were documented in an urban ICU in the Bronx, where the incidence was 3.79% in 2015–2017, with a statistically significant reduction to 2.17% in 2021–2023 in a total of 6,397 ventilated patients ($p=0.002$),¹⁴ and in a New York medical-coronary ICU, where the incidence reached 4.9% (54 out of 1,100 ventilated patients).¹⁵ The highest values in the included literature come from referral hospitals in Addis Ababa, with a prevalence of 19.74% (62 episodes out of 314 patients) and 5 patients (1.6%) who had experienced two distinct episodes.¹⁶ Regarding the type of episodes, across the included studies the large majority of UEs is classifiable as voluntary self-extubation. In the Safe-ICU study, of 605 total episodes, 88% were self-extubations and 12% accidental extubations,¹³ a proportion substantially comparable to that of the Ethiopian cohort, where 88.05% of episodes were self-extubations ($n=49$) and 4.8% were accidental ($n=15$), with 90.3% of events occurring within the ICU.¹⁶ The Ju *et al.* cohort showed an even more polarized distribution, with all 54 cases identified in the 2017–2020 period classified as self-extubations and a complete absence of accidental episodes.¹⁵

Three recurring and conceptually distinct thematic macro-areas emerged from analysis of the included studies. The first concerns patient-related factors. Physical discomfort emerges as the primary subjective determinant of self-extubations in communicative patients: in the Safe-ICU study, 76% of communicative patients identified physical discomfort as the primary motivation for the event, followed by involuntary movements in 18% of cases, while among non-communicative patients, clinicians reported agitation in 42% of episodes.¹³ Agitation was also confirmed as the main modifiable predictor in the Ethiopian cohort (AOR=4.934; 95% CI: 1.934–12.586).¹⁶ In multivariate analysis, greater disease severity as quantified by the APACHE II score (OR=1.07; 95% CI: 1.00–1.13) and the need for continuous infusions of sedatives and/or analgesics (OR=10.72; 95% CI: 4.19–27.43) were independently associated with self-extubation.¹⁵

At the demographic and clinical level, the Ethiopian cohort found that male sex was associated with a threefold increased risk compared to female sex (AOR=3.132; 95% CI: 1.276–7.691) and that an intubation duration of less than 5 days carried twice the risk compared to longer intubations (AOR=2.475; 95% CI: 1.039–5.894).¹⁶

The role of physical restraints is heterogeneous across studies and not uniformly interpretable. In the Ethiopian cohort, being physically restrained quadrupled the probability of UE (AOR=4.356; 95% CI: 1.786–10.624), a finding attributed by the authors to the anxiety increase induced by restraint in contexts of inadequate sedation,¹⁶ while in Ju *et al.*,¹⁵ 68% of patients with UE had active restraints at the time of the event compared to 36.8% in the control group ($p<0.001$; OR=2.98 in multivariate analysis), and in the Californian ASQIP study, 86% of patients with UE were restrained at the time of the event.¹⁷ In contrast, in the Bronx cohort, the use of restraints was associated in multivariate analysis with a 64% reduction in the probability of reintubation after UE (OR=0.360; 95% CI: 0.16–0.82; $p=0.016$).¹⁴

The study by Zuo *et al.*,¹⁸ which evaluated a structured protective restraint intervention compared to standard management, reported a reduction in UE incidence from 24.44% (11/45 patients) in the control group to 4.44% (2/45) in the experimental group

($p=0.007$), with improved patient compliance (100% vs 93.33%; $p=0.021$) and a significant reduction in HAD score ($p<0.001$). On the pharmacological side, in the Bronx cohort the use of dexmedetomidine increased from 4.8% in 2015–2017 to 33.3% in 2021–2023 ($p<0.001$), in parallel with a reduction in midazolam use from 14.3% to 4.4%, although the p -value for the latter was not reported.¹⁴

The second macro-area concerns technical and clinical factors related to the device and its management. Regarding endotracheal tube positioning, a distance from the carina of ≥ 6 cm was associated with a significantly increased risk of UE (OR=6.41; 95% CI: 1.1–37.3) after adjustment for confounding variables, with patients who had undergone self-extubation presenting a mean distance from the carina of 4 cm compared to 3.2 cm in the planned extubation group ($p=0.003$) (15). The timing of events in relation to work shifts represents a second relevant element within this macro-area, with apparently divergent directions across studies. In the Ethiopian cohort, the night shift was independently associated with a threefold higher risk of UE compared to the day shift (AOR=3.282; 95% CI: 1.451–7.424; $p=0.004$), with the authors hypothesizing a vigilance impairment related to fatigue accumulation and the biological sleep-wake cycle of staff.¹⁶ In the Safe-ICU study, in contrast, 60% of UEs occurred during the day shift, with a peak at 08:00 for accidental extubations coinciding with shift change and the morning medical round.¹³

In the Californian ASQIP study, 41% of UEs in the pre-intervention period occurred during the night shift, a proportion that dropped to 28.5% in the post-intervention period ($p=0.51$),¹⁷ while in the Bronx cohort the proportion of UEs in the 20:00–02:00 time window decreased from 26.2% in 2015–2017 to 6.7% in 2021–2023 ($p=0.023$).¹⁴

The third macro-area concerns organizational and professional factors related to healthcare staff. The nurse-to-patient ratio did not show a univocal statistical association with the risk of self-extubation across studies: in the Safe-ICU study, this ratio was greater than 1:2 in 68% of participating centers;¹³ in the New York medical-coronary ICU it ranged between 1:2 and 1:3;¹⁵ and in the Bronx cohort it remained stable at 1:2 throughout the 2015–2023 period.¹⁴ In the ASQIP study, where Californian regulations imposed a minimum ratio of 1:2 in ICUs, 100% of pre-intervention patients and 92% of post-intervention patients met this standard ($p=0.11$),¹⁷ while in the Ethiopian study, where 50.6% of patients were managed with a 1:2 ratio and 49.4% with a 1:1 ratio, this variable was not statistically associated with UE in multivariate analysis.¹⁶ Regarding the presence of staff at the time of the event, in the Safe-ICU study, in 87% of self-extubation cases (466 out of 535 episodes), neither healthcare staff nor family members were present in the room at the time of the event,¹³ a descriptive finding with no reported p -value. In the Ethiopian cohort, in contrast, 47.15% of UEs occurred with clinical staff at the bedside and only 4.7% in their absence,¹⁶ also a descriptive finding without reported statistical significance. In the ASQIP study, the most relevant finding concerned nursing activities in progress at the time of UE: in the pre-intervention group, 29.1% of events occurred while the nurse was performing a direct patient intervention, a proportion that dropped to 0% in the post-intervention group ($p=0.03$), while the presence of a respiratory therapist in the room was 35% in the pre-intervention group and 18.2% in the post-intervention group ($p=0.43$).¹⁷

Mere patient visibility from the nursing station was not found to be a sufficient protective factor: 79.4% of patients who had experienced a UE were visible from the station at the time of the

event, with no significant difference between pre- and post-intervention groups (52% vs 50%; $p=1.00$).¹⁷ Medical staff experience finally emerges as a risk factor of considerable magnitude: in the Ethiopian study, management by a junior medical resident was associated with a risk of UE more than five times higher than that of senior staff (AOR=5.890; 95% CI: 2.344–14.800; $p<0.001$), a finding attributed by the authors to the higher workload, stress level, and lesser competence in critical patient management in high-volume training contexts.¹⁶

The clinical outcomes of UEs show a differentiated risk profile depending on the type of event and the need for reintubation. In the Safe-ICU study, 35% of patients with self-extubation required reintubation within 7 days, compared to 83% of those who had experienced an accidental extubation ($p<0.001$); the median time to reintubation was 102 minutes (IQR 14–1,122) for self-extubations compared to 4 minutes (IQR 1–14) for accidental extubations ($p<0.001$) (Guillemin *et al.*).¹³ In Ju *et al.*,¹⁵ 28.3% of patients with UE required reintubation compared to 6.6% of the planned extubation group ($p<0.001$). In the Bronx cohort, reintubation rates progressively decreased, from 45.2% in 2015–2017 to 22.0% in 2018–2020 to 26.7% in 2021–2023 ($p=0.011$).¹⁴ In the neuroscience ICU, where the intervention included RASS targets ≤ -1 , non-violent restraints, continuous observation, and structured nursing handoff at the patient's bedside with mandatory transmission of sedation and analgesia information, none of the 6 patients with UE in the post-intervention period required reintubation, compared to 4 out of 9 in the pre-intervention period.¹² Regarding mortality, the Safe-ICU study documented that accidental extubation was associated with 28-day mortality of 34% compared to 8% for self-extubations ($p<0.001$), and that the latter did not result in increased mortality compared to planned extubations (8% vs 11%; $p=0.075$), showing a protective effect in multivariate analysis (OR=0.53; 95% CI: 0.33–0.85; $p<0.01$) (13). In Ju *et al.*,¹⁵ in-hospital mortality was 26.4% in patients with UE compared to 11.3% in the planned extubation group ($p=0.02$), with the subgroup requiring reintubation reaching a mortality of 53.3% compared to 15.8% in non-reintubated patients ($p=0.005$). In the Bronx cohort, mortality remained stable at around 10% across the three study periods, with no statistically significant differences ($p=0.960$).¹⁴ Regarding tracheostomies, in the same cohort the post-UE rate decreased from 19.0% in 2015–2017 to 0% in 2018–2020 and 2.2% in 2021–2023 ($p<0.001$); in multivariate analysis, age ≥ 71 years (AOR=14.007; 95% CI: 1.41–139.43) and urinary opioid positivity (AOR=45.253; $p=0.019$) emerged as the main independent predictors of tracheostomy.¹⁴ Finally, in the Safe-ICU study the independent predictors of the need for reintubation after self-extubation were the presence of neoplasia (OR=2.80), elevated respiratory rate, absence of an ongoing weaning process (OR=2.26; $p<0.001$), a low PaO₂/FiO₂ ratio, and the presence of a severe immediate respiratory complication (OR=7.54; $p<0.001$).¹³

Discussion

The results of this narrative review outline an etiopathogenetic picture of unplanned extubations that, far from being reducible to a single determining factor, emerges as the product of a dynamic, multilevel interaction between variables pertaining to the patient, the device, and the organizational-professional context. This complexity demands a paradigm shift in the interpretation of the phenomenon: UE can no longer be interpreted as an isolated sentinel event attributable to an identifiable proximate cause, but rather as

the outcome of a systemic vulnerability requiring equally articulated prevention strategies. The wide variability in incidence observed across the included studies – from 0.43/100 MV-days in North American academic settings to 19.74% in Ethiopian referral hospitals^{16,17} is consistent with what has been documented in previous literature: the meta-analysis by Li *et al.*,¹⁹ conducted on 38 studies published between 1990 and 2020, estimated a pooled UE prevalence of 6.69% (95% CI: 5.29–8.24%) with an incidence density of 1.06 events per 100 ventilator-days (95% CI: 0.7–1.3), confirming that inter-center heterogeneity is a structural feature of the phenomenon rather than a methodological artifact. The fact that, more than a decade later and despite the progressive refinement of care practices, the UE rates reported in the most recent studies included in this review remain substantially comparable to those estimated by Li *et al.*¹⁹ suggests that the preventive strategies adopted to date have yielded limited results at the global epidemiological level, making the identification of modifiable risk factors on which to intervene effectively all the more urgent.

The persistence of substantially unchanged incidence rates over time is not a new finding, but takes on a precise interpretive meaning in light of the available literature. Already Kiekkas *et al.*¹³ had emphasized how the multifactorial nature of UEs made it difficult to isolate effective preventive interventions targeting single risk factors, and de Groot *et al.*² had highlighted how agitation, inadequate sedoanalgesia, and organizational factors interacted in a non-linear way to determine risk. Cosentino *et al.*,¹ in their narrative review, further documented that the literature produced up to that point had favored the description of risk factors over the evaluation of the effectiveness of preventive interventions, with a resulting difficulty in translating evidence into structural changes in care practices. The meta-analysis by Li *et al.*¹⁹ subsequently confirmed on a global scale that UE rates do not show a statistically significant reduction as a function of the year of publication of the studies, irrespective of the progressive refinement of knowledge on risk factors. This evidence suggests that the problem does not lie in the quantity of literature produced, but in its methodological quality and clinical translatability: the prevalence of retrospective observational studies, the lack of uniform operational definitions, and the absence of multicomponent interventions evaluated with robust experimental designs have historically limited the ability of research to orient practice effectively. The most recent studies included in this review, which document significant reductions in incidence following structured multimodal interventions,^{12,14,17} suggest that the correct direction is not to produce further descriptive studies on risk factors, but to evaluate the effectiveness of integrated care packages acting simultaneously on the modifiable determinants of the phenomenon.

On the patient side, data converge in identifying agitation and physical discomfort as the most relevant and, above all, most modifiable subjective determinants. This finding fits within an interpretive framework already outlined by previous literature: the meta-analysis by Li *et al.*¹⁹ documented that male sex, confusion, and the presence of physical restraints represent independent risk factors for UE, with a risk profile substantially comparable to that emerging from the studies included in this review. However, while the historical literature tends to treat agitation and restraints as independent variables, more recent data suggest a bidirectional and contextual relationship: agitation predisposes to UE, restraint can amplify it in contexts of inadequate sedoanalgesia, and the quality of pharmacological comfort management represents the determining variable of the final outcome.^{16,18} From this perspective, the progressive reduction in benzodiazepine use in favor of

dexmedetomidine documented in the Bronx cohort¹⁴ is not interpretable as a simple pharmacological substitution, but as the operational expression of a paradigm shift in critical patient sedation management, oriented toward preserving comfort without compromising cooperation.

On the organizational side, the concentration of events during shift changes, direct nursing procedures, and nighttime hours constitutes a recurring pattern that cuts across profoundly different geographical and clinical contexts.^{13,14,16,17}

This finding can be interpreted in light of a common mechanism: it is not the physical absence of staff that determines the risk, but the fragmentation of cognitive surveillance during moments of care discontinuity, when staff attentional resources are partially allocated to competing tasks. The demonstration that mere patient visibility from the nursing station does not constitute a sufficient protective factor – as evidenced by 79.4% of patients who had experienced a UE being visible from the station at the time of the event¹⁷ reinforces this interpretation and diminishes the value of interventions based exclusively on the optimization of physical spaces, shifting the focus toward structured interventions on the cognitive processes of handoff and information transfer.

A critical reflection emerges from analysis of the staff experience factor. The included studies robustly document that management by junior medical residents is associated with a significantly increased risk of UE – in the Ethiopian cohort more than five times higher than for senior staff (AOR=5.890; 95% CI: 2.344–14.800; $p<0.001$) – plausibly due to the convergence of higher cognitive load, lesser mastery in titrating sedoanalgesia, and less assertive management of agitation situations.¹

However, a systematic gap is shared by the entire available literature: nursing experience has never been investigated as an independent variable in the primary studies included, nor in the meta-analysis by Li *et al.*,¹⁹ in which the authors themselves explicitly acknowledge that nurse-related factors were not explored in their analysis, referring to a previous systematic review that documented how an increase of one full-time equivalent nurse per patient-day was associated with a 51% reduction in the probability of UE. Yet it is the intensive care nurse who spends the most significant proportion of care time at the patient's bedside, who personally governs sedation titration, who early intercepts the warning signs of agitation, and who manages the device during nighttime hours – the very same hours in which, as documented across the included studies, a significant proportion of events is concentrated.^{14,16,17}

It is reasonable to hypothesize that the level of nursing experience (understood not only as length of service, but as specific competence in managing the intubated patient, in evaluating sedoanalgesia, and in recognizing at-risk behaviors) represents a predictive factor for UE at least comparable to the medical one, if not superior in certain contexts. Future research should therefore explicitly include this dimension, distinguishing between experienced and newly qualified nurses, and evaluating the impact of specific training programs on event incidence.

A second gap, even more relevant from a clinical projection standpoint, concerns the range of settings in which the phenomenon has been studied to date. Almost all of the available literature (including the meta-analysis by Li *et al.*,¹⁹ which analyzed studies conducted exclusively in medical, surgical, or mixed ICUs) focuses on ICUs – environments characterized by a high nurse-to-patient ratio, continuous surveillance, advanced monitoring equipment, and immediate availability of airway emergency management expertise. This sectoral concentration constitutes a selection bias that risks rendering invisible a potentially more vulnerable

patient population: that of intensive and sub-intensive rehabilitation wards, settings in which there is a progressive increase in tracheostomized patients.²⁰

In these settings, patients with airway management devices – including tracheostomy cannulas in the phase of prolonged weaning from mechanical ventilation – are cared for in structurally different environments: less favorable nurse-to-patient ratios, reduced availability of continuous monitoring, multiprofessional teams with variable composition, and often a more active and unpredictable behavioral and cognitive component of the patient, given the advanced stage of the recovery process. In such a scenario, an unplanned removal of the airway management device can have dramatically more difficult-to-manage consequences than in intensive care: response time is longer, emergency reintubation expertise is less readily available, and the patient, with an often unstable airway or one in the stomal maturation phase, has a significantly reduced therapeutic window for corrective intervention – a context radically different from that in which, for example, in the Safe-ICU study the median time to reintubation after self-extubation was only 102 minutes with fully available intensive resources.¹³

The transposition of risk factors identified in the intensive care context to the rehabilitation setting therefore represents not only a scientifically legitimate extension of the research agenda, but a clinical priority that future studies can no longer continue to ignore.

This review presents certain limitations that must be made explicit. First, the narrative nature of the study selection, although conducted according to SANRA criteria and with an independent double-reviewer screening procedure, entails an intrinsic risk of bias in the selection of included literature, not eliminable with the methodological tools proper to a systematic review. Second, the analyzed corpus is characterized by marked heterogeneity of clinical and geographical contexts, ranging from French and North American intensive care units to Ethiopian referral hospitals and Chinese ICUs, limiting the generalizability of results to care contexts with profoundly different organizational, demographic, and epidemiological characteristics – a limitation shared with the preceding systematic literature, in which Li *et al.*¹⁹ documented an I^2 of 99%, reflecting near-total heterogeneity among studies included in their meta-analysis. Third, the included studies do not adopt a uniform definition of unplanned extubation: some systematically distinguish self-extubation from accidental extubation, others aggregate them into a single category, and the denominators used for incidence calculation vary between events per 100 patients and events per 100 days of mechanical ventilation, making direct comparisons between studies inherently limited.

Finally, the methodological and definitional heterogeneity made it impossible to proceed with statistical synthesis of the data, precluding quantification of the effect of individual risk factors through a pooled estimate and limiting conclusions to the sole narrative synthesis of available evidence.

Conclusions

Unplanned extubations represent a multifactorial and preventable adverse event, whose incidence – despite marked inter-center variability, from values below 1/100 MV-days in high-volume settings to 19.74% in low-resource countries – reflects the overall quality of care processes more than the intrinsic severity of the caseload. The risk factors identified by the literature converge on three priority intervention axes: optimization of sedoanalgesia with

light sedation approaches and reduction of benzodiazepines; structured management of high-risk care transitions (shift changes, direct nursing procedures, nighttime hours); and enhancement of the professional competence of staff involved in the care of the intubated patient.

Two significant gaps remain, however, that the future research agenda cannot ignore. The first concerns the role of nursing experience, systematically absent from the literature as an independent variable to date, despite the nurse representing the professional with the greatest direct patient contact time and the primary operational manager of sedoanalgesia and nighttime surveillance. The second gap concerns the exclusive focus of studies on the intensive care context, with a substantial absence of data from rehabilitation wards – where there is a progressive increase in tracheostomized patients –²⁰ where unplanned removal of an airway management device may constitute an even more critical clinical scenario, owing to less favorable nurse-to-patient ratios, reduced availability of emergency expertise, and greater behavioral unpredictability in the recovering patient.

Extending research to these settings, adopting standardized measurement tools and prospective multicenter designs, is a necessary condition for building effective prevention strategies along the entire care continuum.

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Online supplementary materials
Overview of the analyzed papers.

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