

Supplementary Material S2. Protocol Elements, Operational Definitions, Tier Classification Rules, and Workflow-Oriented Data Charting Framework

S2.1. Protocol status

An author-developed protocol and screening guide were prepared before screening began. The review was not prospectively registered in a public repository. To improve transparency, this supplementary document provides the protocol-related elements that guided the review, including the eligibility framework, operational tier definitions, handling of ambiguous cases, and workflow-oriented data-charting domains. The core review questions, eligibility criteria, and the conceptual distinction between Tier 1 and Tier 2 were specified before screening. Clarifications made during full-text review were limited to the interpretation of incompletely reported workflow-facing alerting pathways and did not substantively alter the scope of the review.

S2.2. Core review questions

This review addressed three questions. First, what types of AI-enabled monitoring systems are used for inpatient fall prevention, and which fall-proximal risk states do they target? Second, how do these systems operationalize decision support through trigger logic, alert routing, and workflow integration? Third, which endpoints are reported to evaluate clinical, operational, implementation, and economic aspects of these systems, and what reporting gaps remain?

S2.3. Eligibility framework

Studies were eligible if they:

- Were English-language full-text reports;
- Were published between 2016 and 2026;
- Focused on inpatient hospital fall prevention or fall-proximal bedside risk states;
- Used continuous monitoring data;
- Explicitly incorporated artificial intelligence, machine learning, or deep learning;
- For Tier 1, described a workflow-facing actionable trigger intended to prompt preventive action.

Studies were excluded if they:

- Were conducted in home/community, assisted living, long-term care, or emergency department-only settings;
- Used the term *fall* in a non-relevant clinical sense;
- Focused on gait, freezing of gait, or movement analysis without an inpatient fall-

- preventive trigger;
- Were reviews, editorials, commentaries, or protocols.
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S2.4. Operational definitions for tier classification

Tier 1: Action-trigger decision-support studies

A study was classified as Tier 1 when the full text provided minimum evidence of:

1. A monitored fall-related event or risk state relevant to inpatient fall prevention;
2. An explicit alert, alarm, warning, or notification intended for a workflow-facing recipient, destination, or interface.

Examples included alerts to nurses, caregivers, ward displays, nurse stations, smartphones, tablets, or other staff-facing system interfaces.

Tier 2: Prediction/detection only

A study was classified as Tier 2 when it reported fall prediction, classification, recognition, or detection performance but did not provide sufficient information to confirm a workflow-facing action-trigger pathway. Common reasons included absent or unclear trigger description, no identifiable recipient, no alert channel, no routing logic, or no intended preventive action described.

S2.5. Handling of ambiguous cases

Borderline cases were resolved conservatively through reviewer discussion. When a study described real-time monitoring or detection but did not clearly specify an alert, alarm, warning, or notification directed to a workflow-facing recipient, the study was classified as Tier 2. When the inpatient setting could not be confirmed sufficiently from the full text, the study was not treated as a confirmed inpatient ward implementation study. Studies were not upgraded to Tier 1 on the basis of plausibility alone.

S2.6. Workflow-oriented data-charting framework

For each included study, the following variables were charted when available:

- Citation details;
- Year of publication;
- Country/region;
- Care setting and ward type;
- Population and baseline patient characteristics;
- Sensing modality and data inputs;
- AI/model approach as reported;
- Target event(s);

- Study design type;
- Trigger definition;
- Intended recipient;
- Alert channel/destination;
- Routing or escalation logic;
- Acknowledgement/dismissal logic;
- Response-time reporting;
- Downstream preventive action reporting;
- Clinical outcomes;
- Operational decision-support outcomes;
- Implementation outcomes;
- Economic outcomes.

S2.7. Study design type categories used in synthesis

Tier 1 studies were descriptively grouped as:

- Real-world clinical implementation/evaluation;
- Pilot feasibility study;
- Methodological validation study;
- Proof-of-concept, conference, or simulation-oriented study.

S2.8. Relationship between Tier 1 and Tier 2 synthesis

Tier 1 studies formed the primary synthesis because they provided minimal evidence of a workflow-facing action trigger intended to prompt preventive action. Tier 2 studies were retained separately to characterize evidence gaps. Their inclusion in the supplementary summary should not be interpreted as evidence of a deployable alerting workflow; rather, these studies were retained because they were relevant to fall prediction, fall detection, or fall-proximal monitoring, yet insufficiently described from a workflow-facing decision-support perspective.

S2.9. Purpose of the proposed minimum operational reporting set

The minimum operational reporting set presented in the main manuscript is a synthesis-derived framework informed by recurrent interpretation challenges across the included studies and by prior guidance on clinical decision support, AI evaluation, and intervention reporting. It is intended to improve comparability and implementation-oriented reporting in future studies. It is not a formal consensus guideline.

(END)