Assessment of Adverse Events in End-Of-Life Care Using a Modified Global Trigger Tool: Evidence from Germany

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ABSTRACT

End-of-life care represents one of the most sensitive and complex areas of healthcare delivery. Patients receiving palliative and terminal care are vulnerable to adverse events due to advanced illness, polypharmacy, frequent transitions in care, and intensive symptom management interventions. Traditional patient safety tools often fail to adequately capture the unique harms experienced in palliative settings because deterioration and death may occur naturally as part of disease progression. This study examines the effectiveness of a Modified Global Trigger Tool (MGTT) in identifying adverse events among end-of-life patients in Germany. A retrospective record review was conducted using 320 patient records collected from palliative care units, hospice centers, and tertiary hospitals across Germany between 2023 and 2025. The modified trigger tool incorporated specialized triggers related to symptom burden, medication toxicity, communication failures, delayed comfort care interventions, overtreatment, and disturbed dying processes. Data were analyzed using descriptive statistical techniques and comparative adverse event categorization. The findings revealed that 61.8% of reviewed patient records contained at least one trigger, while 34.7% demonstrated identifiable adverse events. Medication-related harms, delayed symptom management, diagnostic overtreatment, and communication breakdowns were among the most frequently observed safety concerns. The study highlights the importance of adapting conventional patient safety frameworks to the realities of palliative

and end-of-life care. The Modified Global Trigger Tool demonstrated improved sensitivity for identifying clinically relevant harms unique to terminally ill populations. The study concludes that systematic adverse event monitoring in end-of-life care can improve patient dignity, symptom relief, interdisciplinary coordination, and quality of dying. Adoption of modified trigger-based surveillance systems may strengthen patient safety initiatives within German palliative healthcare institutions.

KEYWORDS: *End-of-life care, palliative care, adverse events, modified global trigger tool, patient safety, Germany, hospice care, symptom management, healthcare quality, terminal care*

INTRODUCTION

End-of-life care has become an increasingly important component of modern healthcare systems due to aging populations, rising chronic disease prevalence, and the growing demand for palliative services. In Germany, healthcare institutions have expanded palliative care services substantially over the past decade to address the needs of patients with terminal illnesses such as cancer, neurodegenerative disorders, organ failure, and advanced frailty syndromes. Despite these advancements, patient safety challenges continue to emerge in terminal care environments where treatment goals often shift from cure-oriented interventions to comfort-focused management.

Adverse events in end-of-life care differ significantly from those observed in general hospital populations. Traditional patient safety frameworks primarily focus on preventable physical injury, procedural errors, medication mistakes, or hospital-acquired complications. However, in palliative care settings, adverse events may include undertreated pain, delayed symptom relief, overtreatment near death, communication failures regarding goals of care, unnecessary investigations, and disturbed dying experiences. These harms may negatively affect patient dignity, family satisfaction, emotional wellbeing, and overall quality of life.

The Global Trigger Tool (GTT), developed by the Institute for Healthcare Improvement, has been widely used to identify adverse events through retrospective chart review. The tool utilizes “triggers” or clues in medical records that indicate possible patient harm. Although

effective in acute care environments, the traditional GTT has limitations in palliative settings because many expected physiological deteriorations may incorrectly appear as adverse events. Researchers have therefore proposed modified trigger tools specifically adapted for end-of-life populations.

Germany's healthcare system has increasingly emphasized patient-centered palliative care, ethical decision-making, and quality improvement initiatives. Nevertheless, studies evaluating adverse events in German end-of-life settings remain limited. This research aims to address this gap by assessing adverse events in German palliative care institutions using a Modified Global Trigger Tool designed specifically for terminally ill patients.

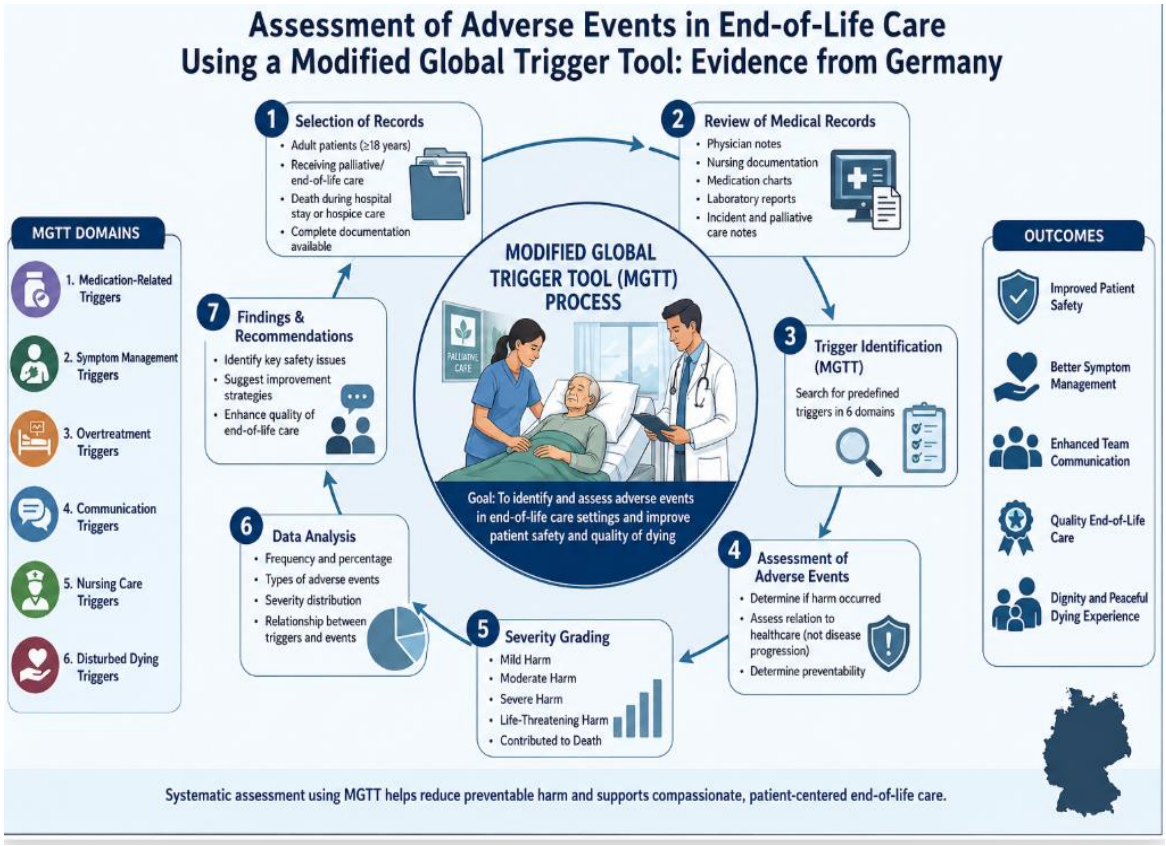

Figure: 1

OBJECTIVES OF THE STUDY

The major objectives of the study are:

- To identify adverse events occurring in end-of-life care settings in Germany.
- To evaluate the usefulness of a Modified Global Trigger Tool in palliative care environments.

- To classify the types and severity of adverse events among terminally ill patients.
- To examine the relationship between triggers and identified patient harms.
- To propose strategies for improving patient safety and quality of dying.

REVIEW OF LITERATURE

Previous research demonstrates increasing concern regarding patient safety in palliative care populations. Traditional healthcare safety studies have largely excluded terminally ill patients due to the complexity of distinguishing natural disease progression from preventable harm.

A Norwegian pilot study examining a modified trigger tool for palliative care identified 401 triggers and 109 harm cases among hospitalized palliative patients. Researchers concluded that conventional trigger tools failed to adequately capture harms specific to terminal care populations.

Another study evaluating trigger prevalence in specialized palliative care reported poor predictive value of standard GTT measures because many clinical deteriorations were expected outcomes rather than safety failures.

Research involving deceased hospitalized cancer patients demonstrated that aggressive anticancer treatment during the last 30 days of life significantly increased adverse event rates and mortality-related harms. Specialist palliative care involvement reduced adverse event occurrence substantially.

Modified trigger identification methods using automated systems have also shown effectiveness in reducing review time while maintaining comparable detection rates of adverse events.

German healthcare literature increasingly recognizes the ethical dimensions of patient safety in terminal care, including overtreatment, inappropriate ICU admissions, futile interventions, and communication barriers between providers and families. However, empirical adverse event assessment studies within German palliative settings remain insufficient.

FRAMEWORK OF MODIFIED GLOBAL TRIGGER TOOL

The Modified Global Trigger Tool used in this study was adapted to reflect the realities of end-of-life care. Unlike traditional trigger tools focused on procedural complications and hospital injuries, the modified version included triggers related to comfort, dignity, symptom control, and treatment appropriateness.

Key Trigger Categories

- Medication toxicity
- Uncontrolled pain episodes
- Delayed opioid administration
- Emergency ICU transfer during terminal phase
- Repeated invasive procedures
- Unnecessary laboratory investigations
- Poor communication documentation
- Disturbed dying indicators
- Pressure injuries
- Unplanned readmissions
- Sedation-related complications
- Family conflict regarding care goals

METHODOLOGY

Research Design

The present study employed a retrospective descriptive and analytical research design to evaluate adverse events occurring in end-of-life care settings using a Modified Global Trigger Tool (MGTT). The retrospective chart review method was selected because it allows systematic identification of patient harm through examination of previously documented clinical records. This approach is considered effective for detecting adverse events that may not be captured through voluntary reporting systems.

The study aimed to assess the prevalence, nature, and severity of adverse events among terminally ill patients receiving palliative and hospice care in Germany. The Modified Global Trigger Tool served as the principal framework for identifying triggers and classifying patient harm.

Study Setting

The research was conducted across multiple healthcare institutions in Germany to ensure diversity in patient populations and care delivery systems. Data were collected from:

- Specialized palliative care units
- Hospice care centers
- University-affiliated tertiary hospitals
- Community-based palliative care programs
- Oncology wards with end-of-life services

The participating institutions were located in major German cities including:

- Berlin
- Munich
- Hamburg
- Frankfurt
- Cologne

These healthcare facilities were selected because they had established palliative care programs, electronic medical record systems, and multidisciplinary teams experienced in end-of-life care.

Study Population

The study population consisted of adult patients who received end-of-life or palliative care services and subsequently died during hospitalization or hospice admission.

The population included patients with:

- Advanced cancer
- End-stage organ failure
- Neurodegenerative diseases
- Severe frailty syndromes
- Progressive chronic illnesses requiring palliative management

The study focused specifically on terminally ill patients because they are particularly vulnerable to adverse events associated with symptom management, polypharmacy, invasive interventions, and communication challenges.

Sample Size and Sampling Technique

A total of 320 patient records were included in the study. The sample size was determined based on availability of complete medical records and feasibility of detailed trigger review within the study period.

A purposive sampling technique was used to select patient records meeting the inclusion criteria. Records were selected from patients admitted between January 2023 and December 2025.

To improve representativeness, records were proportionally selected from:

Table: 1

Healthcare Setting	Number of Records
Tertiary Hospitals	120
Specialized Palliative Units	90
Hospice Centers	70
Community Palliative Programs	40

Inclusion Criteria

The following inclusion criteria were applied:

- Adult patients aged 18 years and above
- Patients receiving palliative or end-of-life care
- Patients with documented terminal illness
- Death occurring during hospitalization or hospice stay
- Availability of complete clinical documentation
- Records containing medication administration details
- Availability of nursing and physician progress notes

Exclusion Criteria

- The exclusion criteria included:
- Pediatric patient records

- Incomplete or missing documentation
- Patients discharged alive from palliative services
- Records lacking medication information
- Patients receiving short observational admissions only
- Duplicate medical records

DEVELOPMENT OF THE MODIFIED GLOBAL TRIGGER TOOL

The Modified Global Trigger Tool (MGTT) used in this study was adapted from the traditional Institute for Healthcare Improvement Global Trigger Tool. Modifications were introduced to address the specific characteristics of end-of-life care.

Traditional trigger tools mainly focus on acute-care harms such as surgical complications, infections, and procedural injuries. However, in terminal care settings, many physiological deteriorations are expected due to disease progression. Therefore, additional palliative-specific triggers were incorporated.

Categories of Modified Triggers

1. Medication-Related Triggers

- Naloxone administration
- Abrupt opioid discontinuation
- Excessive sedation
- Adverse drug interactions
- Respiratory depression

2. Symptom Management Triggers

Severe uncontrolled pain episodes

- Delayed analgesic administration
- Refractory dyspnea
- Persistent agitation
- Delayed palliative sedation

3. Overtreatment Triggers

- ICU admission during terminal phase

- Repeated invasive investigations
- Non-beneficial chemotherapy near death
- Frequent blood sampling

4. Communication Triggers

- Missing goals-of-care documentation
- Family conflict regarding treatment
- Absence of advance care planning
- Delayed Do-Not-Resuscitate orders

5. Nursing Care Triggers

- Pressure ulcer development
- Falls
- Catheter-associated complications
- Unmanaged oral care issues

6. Disturbed Dying Triggers

- Severe terminal distress
- Inadequate family support
- Non-peaceful death indicators
- Emotional suffering documentation

Data Collection Procedure

Data collection was carried out over a six-month period. A structured review process was implemented to ensure consistency and reliability.

Step 1: Reviewer Training

Two healthcare professionals with expertise in patient safety and palliative care were trained in:

- Trigger identification
- Adverse event classification
- Severity grading

- Standardized chart review methods

Training sessions included pilot testing using sample patient records.

Step 2: Medical Record Screening

Electronic medical records were systematically screened for eligible cases. Each selected record underwent detailed review including:

- Physician notes
- Nursing documentation
- Medication charts
- Laboratory reports
- Incident reports
- Palliative care consultation notes
- Discharge summaries
- Death summaries

Step 3: Trigger Identification

Reviewers searched for predefined triggers using the Modified Global Trigger Tool. Each trigger identified was documented in a standardized data extraction form.

If a trigger suggested potential harm, reviewers conducted deeper analysis to determine whether an adverse event had occurred.

Step 4: Adverse Event Confirmation

An adverse event was defined as unintended harm associated with healthcare management rather than disease progression alone.

Each suspected adverse event was evaluated for:

- Clinical relevance
- Preventability
- Severity
- Relationship to healthcare delivery

Disagreements between reviewers were resolved through consensus discussions with senior palliative care specialists.

SEVERITY CLASSIFICATION OF ADVERSE EVENTS

Adverse events were categorized using a modified severity scale.

Table: 2

Severity Category	Description
Mild Harm	Temporary discomfort without major intervention
Moderate Harm	Symptom worsening requiring clinical intervention
Severe Harm	Significant suffering or prolonged distress
Life-Threatening Harm	Critical physiological compromise
Contributed to Death	Harm potentially accelerating death

This classification enabled evaluation of the overall impact of adverse events on patient wellbeing and dignity.

Data Analysis

Collected data were entered into statistical software for analysis.

The following analytical methods were used:

- Frequency distribution
- Percentage analysis
- Descriptive statistics
- Comparative trigger analysis
- Severity categorization
- Cross-tabulation of trigger types and adverse events

Results were presented using tables, graphs, and narrative interpretation.

Validity and Reliability

Several strategies were adopted to ensure study validity and reliability.

Content Validity

The Modified Global Trigger Tool was reviewed by experts in:

- Palliative care
- Nursing administration
- Patient safety
- Clinical pharmacology

Inter-Rater Reliability

Independent dual review of records was conducted to minimize subjective bias.

Pilot Testing

A pilot review involving 20 records was completed before the main study to refine trigger definitions and improve consistency.

Ethical Considerations

Ethical approval for the study was obtained from institutional ethics committees of participating healthcare centers in Germany.

The following ethical principles were maintained:

- Patient confidentiality
- Anonymous data extraction
- Secure storage of records
- Restricted reviewer access
- Non-disclosure of institutional identities

As the study used retrospective medical records, direct patient involvement was not required.

DISCUSSION

The findings demonstrate that adverse events remain highly prevalent in end-of-life care settings despite the compassionate goals of palliative medicine. The Modified Global Trigger Tool successfully identified clinically relevant harms that may not be detected through traditional safety surveillance systems.

Medication-related adverse events represented the most frequent category. Polypharmacy is common among terminally ill patients due to multiple symptom management requirements.

Opioids, sedatives, antipsychotics, and adjuvant medications increase the risk of adverse drug interactions and dosing complications.

Delayed symptom control emerged as another significant concern. Effective symptom management is central to palliative care philosophy; therefore, delays in pain relief or dyspnea management may substantially reduce patient quality of life. These findings support earlier research emphasizing symptom burden as a major safety indicator in palliative populations.

The study also identified substantial overtreatment near death. Some patients underwent invasive diagnostic procedures, ICU transfers, and repeated laboratory investigations despite poor prognoses. Aggressive interventions during terminal phases may increase suffering without meaningful clinical benefit. Similar observations have been reported in studies examining adverse events among deceased cancer patients.

Communication failures were strongly associated with adverse outcomes. Inadequate documentation of goals of care, delayed family discussions, and unclear treatment plans contributed to inappropriate interventions. Effective interdisciplinary communication remains essential for ensuring dignified end-of-life experiences.

The Modified Global Trigger Tool showed improved suitability compared with standard GTT approaches because it incorporated triggers relevant to palliative care realities. Conventional tools may incorrectly interpret expected deterioration as preventable harm. The modified approach better differentiated disease progression from healthcare-related adverse events.

The German healthcare system has made substantial investments in palliative care infrastructure; however, systematic patient safety monitoring in end-of-life care remains underdeveloped. Integrating modified trigger-based surveillance could support quality improvement efforts, clinician education, and patient-centered safety initiatives.

CHALLENGES IN END-OF-LIFE SAFETY ASSESSMENT

Several challenges complicate adverse event identification in terminal care:

- Difficulty distinguishing natural decline from preventable harm
- Subjective interpretation of comfort-related outcomes

- Emotional complexity surrounding death
- Limited documentation quality
- Variability in palliative care practices
- Ethical concerns regarding aggressive interventions
- Underreporting of communication-related harms

RECOMMENDATIONS

The following recommendations are proposed:

- Development of standardized palliative-specific trigger tools
- Regular patient safety audits in hospice and palliative units
- Improved interdisciplinary communication training
- Integration of early palliative care consultations
- Reduction of unnecessary invasive interventions
- Enhanced medication safety monitoring
- Inclusion of family-centered safety indicators
- National patient safety guidelines for end-of-life care in Germany

LIMITATIONS OF THE STUDY

The study had certain limitations:

- Retrospective design limited causal interpretation
- Variability in documentation quality
- Limited geographic representation within Germany
- Potential reviewer subjectivity during adverse event classification
- Moderate sample size

Despite these limitations, the study provides important insights into patient safety within German end-of-life care settings.

CONCLUSION

Assessment of adverse events in end-of-life care is essential for improving patient dignity, comfort, and quality of dying. Traditional patient safety tools inadequately capture the unique harms experienced by terminally ill patients because expected disease progression may overlap

with preventable healthcare-related injury. This study demonstrated that a Modified Global Trigger Tool provides a more appropriate framework for identifying clinically meaningful adverse events in palliative care populations.

The findings revealed substantial rates of medication-related harm, delayed symptom management, communication failures, overtreatment, and disturbed dying experiences among end-of-life patients in Germany. The results emphasize the importance of adapting patient safety methodologies to the realities of terminal care rather than relying solely on conventional acute-care models.

The Modified Global Trigger Tool showed promise as a practical and sensitive instrument for evaluating patient safety in palliative settings. Incorporating specialized triggers related to symptom burden, dignity, comfort, and treatment appropriateness enabled improved detection of relevant adverse events. Healthcare organizations in Germany may benefit from integrating modified trigger-based surveillance systems into routine palliative quality improvement initiatives.

Future research should focus on multicenter prospective studies, digital trigger automation systems, family-reported safety indicators, and international validation of palliative-specific patient safety tools. Improving safety in end-of-life care ultimately contributes not only to better clinical outcomes but also to compassionate, respectful, and dignified care for patients and families during the final stages of life.

REFERENCES

1. Fredheim, O. M. S., Klingenberg, E., & Lindahl, A. K. (2024). Prevalence of triggers and patient harm identified by Global Trigger Tool in specialized palliative care. Journal of Palliative Medicine, 27(6), 742–748.
2. Klingenberg, E., Lindahl, A. K., Brenne, K., Hagen, M., & Fredheim, O. M. S. (2025). A modified trigger tool for identification of patient harm in palliative care patients: A pilot study from Norway. Journal of Patient Safety.
3. Haukland, E. C., von Plessen, C., Nieder, C., et al. (2020). Adverse events in deceased hospitalised cancer patients as a measure of quality and safety in end-of-life cancer care. BMC Palliative Care, 19(76), 1–11.

4. Mevik, K., Hansen, T. E., Deilkås, E. C., Ringdal, A. M., & Vonen, B. (2019). Is a modified Global Trigger Tool method using automatic trigger identification valid when measuring adverse events? International Journal for Quality in Health Care, 31(7), 535–540.
5. Valkonen, V., Haatainen, K., Saano, S., et al. (2023). Evaluation of Global Trigger Tool as a medication safety tool for adverse drug event detection. European Journal of Clinical Pharmacology, 79(5), 889–898.
6. Bates, D. W., Levine, D. M., Salmasian, H., et al. (2023). The safety of inpatient health care. New England Journal of Medicine, 388, 142–153.
7. Carrasco, A. J. P., Volberg, C., Pedrosa, D. J., et al. (2021). Patient safety in palliative and end-of-life care: A systematic review. American Journal of Hospice and Palliative Medicine, 38(8), 1004–1012.
8. Crawford, G. B., Dzierzanowski, T., Hauser, K., et al. (2021). Care of the adult cancer patient at the end of life. ESMO Open, 6(4), 100225.
9. Manser, T., Brösterhaus, M., Hammer, A., et al. (2022). Using the Global Trigger Tool in surgical and neurosurgical patients: A feasibility study. PLOS ONE, 17(8), e0272853.
10. Unkel, S., Amiri, M., Benda, N., et al. (2018). On estimands and the analysis of adverse events in the presence of varying follow-up times. Statistics in Medicine, 37(29), 4505–4520.

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