

Review Article

Monitoring suicidal ideation in adolescents and young adults with cancer: A scoping review about evidence gaps and potential applications of AI-enabled robotics

Yunike^{1*}, Ismar Agustin², Ira Kusumawaty¹, Metha Mahmuda³

¹ Department of Mental Health Nursing, Nursing Department, Poltekkes Kemenkes Palembang, Palembang, Indonesia

² Department of Nursing Management, Nursing Department, Poltekkes Kemenkes Palembang, Palembang, Indonesia

³ Department of Human Resources, Poltekkes Kemenkes Palembang, Palembang, Indonesia

***Corresponding Author:**

Yunike

Department of Mental Health Nursing,
Nursing Department, Poltekkes
Kemenkes Palembang, Palembang,
Indonesia
Email:
yunike@poltekkespalembang.ac.id

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Abstract

Background: Adolescents and young adults (AYAs) affected by cancer may experience suicidal ideation during treatment, survivorship, and end-of-life care. Digital alerts, conversational agents, and robotic interfaces offer potential channels for monitoring, but their applicability to oncology is uncertain.

Objective: To map direct oncology evidence on suicidality, chart adjacent digital and robotic evidence relevant to monitoring or engagement, and identify conditional design and safety requirements for future research.

Methods: This scoping review used a population-concept-context framework and PRISMA-ScR reporting principles. The source review reports English-language evidence from January 2020 through July 2026 and citation searching, with 59 identified records and nine included studies. The retained documentation does not specify the databases, final execution dates, screening/charting reviewer numbers, or protocol registration status; these aspects cannot be independently reconstructed.

Results: Nine studies were retained: five direct oncology reports (a population-based analysis, clinical screening study, longitudinal cohort, survivorship survey, and case report) and four adjacent technology studies (an oncology chatbot pilot, youth alert-system evaluation, simulated chatbot safety assessment, and robot-agent engagement study). Participants ranged from an individual clinical case to a cohort of 500,366; one technology assessment evaluated 29 agents rather than patients. The streams address different outcomes and cannot support pooled estimates. None tested an AI-enabled robotic suicide-monitoring system in young patients with cancer.

Conclusions: Oncology findings support the clinical relevance of repeated, developmentally sensitive suicide-risk assessment; adjacent studies supply only limited implementation and design insights. A human-supervised, oncology-specific monitoring pathway remains a hypothesis for prospective co-design, safety validation, and clinical evaluation, not a proven intervention.

Background

Cancer during adolescence and young adulthood intersects with developmental transitions in autonomy, relationships, education, employment, and family roles. Treatment may introduce pain, fatigue, uncertainty, body-image change, infertility concerns, and interruptions to school or work. These burdens do not necessarily produce suicidal ideation, but they make psychosocial assessment a substantive component of age-appropriate oncology care (Rosgen et al., 2022; Chen et al., 2024; Bergerot et al., 2026).

Throughout this review, adolescent and young adult (AYA) is used operationally for ages 15–39 years, consistent with the population-based oncology study included in the evidence map (Heynemann et al., 2021). The evidence set also includes a pediatric leukemia cohort with participants younger than 15 years and an end-of-life case involving a 14-year-old. These pediatric

studies were retained because they directly address suicidal ideation during cancer care and inform developmental considerations; they should not be interpreted as directly representative of all AYAs.

Suicidal ideation, suicide attempts, suicide deaths, and nonspecific emotional distress are separate outcomes. Population-level mortality data establish a long-term safety concern, while questionnaire responses and clinical narratives characterize distinct aspects of ideation and its context. For example, analyses of young people with cancer indicate elevated suicide mortality in some clinical subgroups, and clinical studies link ideation to symptom burden and psychosocial vulnerability (Heynemann et al., 2021; Giberson et al., 2021; Raghubar et al., 2022; Schwinn et al., 2025). No single depression total score or algorithm should therefore be treated as a substitute for direct clinical assessment.

Emerging digital technologies could make patient-initiated disclosure or scheduled check-ins easier between clinical encounters. They encompass fundamentally different tools: predetermined rule-based alerts, generative conversational agents, nonembodied digital assistants, and embodied robotic agents. Each involves different functions, validation requirements, and error modes. A youth-service alert system may demonstrate a clinical response workflow, whereas an oncology chatbot pilot may illuminate disclosure and acceptability; neither establishes that a robot can identify imminent suicide risk in cancer care (Chong et al., 2024; Hasei et al., 2025).

The rationale for combining direct and adjacent streams is therefore not to estimate a shared treatment effect. The direct stream characterizes the clinical problem and assessment targets; the adjacent stream identifies transferable—but unvalidated—technical design considerations, such as low-burden interaction, clinician notification, transparent risk escalation, and user engagement. Robot-mediated activities for adolescent mental health are relevant to usability, not diagnostic accuracy, while simulated chatbot testing highlights possible safety failures without quantifying harms in oncology patients (Alves-Oliveira et al., 2022; Pichowicz et al., 2025).

This scoping review asks: (1) what is known about suicide-related outcomes and their correlates in younger people with cancer; (2) what evidence from digital alerts, conversational agents, and robotic interfaces is plausibly relevant to assessment, disclosure, or escalation; and (3) what preliminary clinical and governance requirements follow from mapping these separate evidence streams? The third question is an interpretive mapping objective; the resultant framework is not a validated clinical system.

Methods

Study Design

The design is a scoping review: it charts heterogeneous study purposes, settings, interventions, and methodological limitations rather than testing a predefined pooled effectiveness hypothesis. The reporting structure follows the PRISMA extension for Scoping Reviews (PRISMA-ScR; Tricco et al., 2018) and is informed by scoping review guidance (Peters et al., 2020). An item-by-item PRISMA-ScR audit appears in Supplementary Table S1; items unsupported by the available source materials are explicitly

marked as insufficiently documented, rather than described as completed.

Protocol and registration

The retained source material does not provide a dated a priori protocol, registry identifier, protocol platform, or deviation log. Consequently, protocol development and prospective registration cannot be verified. The distinction between direct oncology and adjacent technology evidence is explicit in the supplied manuscript, but its prospective specification cannot be established. These limitations constrain confidence in selection reproducibility.

Eligibility criteria and evidence-stream boundaries

Eligibility was framed using population, concept, and context. The direct stream comprised peer-reviewed empirical reports involving children, adolescents, AYAs, or childhood cancer survivors and reporting suicidal ideation, suicide-related behavior, mortality, or directly relevant correlates in cancer care. Studies of pediatric participants below 15 years were eligible only where the direct oncology and suicidality criteria were met; age-specific interpretation was maintained. The adjacent technology stream covered youth or pediatric/AYA oncology studies with an explicit monitoring, disclosure, clinician-notification, mental health engagement, or crisis-safety function. No adjacent study was counted as direct evidence of robotic suicide-risk prediction in oncology.

Technology categories were kept distinct. Rule-based alerts required a defined threshold and a traceable notification pathway; conversational agents required interaction with users about psychosocial or mental health concerns; robot-mediated interventions required an embodied or explicitly described digital robot-agent format and a measured engagement or acceptability outcome. General-purpose AI prediction papers, surgical robots, and telepresence projects without suicide-related or patient-engagement relevance were not eligible for the nine-study evidence map. This is an operational description of the reported included set, not a claim that archived prospective screening rules have been recovered.

The source describes eligibility as peer-reviewed English-language empirical literature published January 2020–July 2026, including observational reports, longitudinal studies, case reports, pilots,

evaluations, and comparisons; protocols, editorials, unreviewed preprints, and purely technical projects without suitable clinical relevance were excluded. Adjacent evidence informs design feasibility only and cannot establish clinical accuracy or effectiveness in oncology.

Information sources and search provenance

The source manuscript describes structured searches combining controlled and free-text terms, with backward citation searching, and a publication window from January 2020 through July 2026. However, the archived record does not identify the bibliographic databases and platforms actually searched, their exact last search dates, source-specific yields, trial-registry coverage, or gray-literature policy. These details are not inferred from customary scoping-review practice. Supplementary Table S2 offers transparent, unexecuted reconstruction strings for a future verification search; they are not represented as the strategies that produced the reported flow diagram.

Search strategy and sensitivity

The described concepts covered cancer/oncology, pediatric or AYA populations, suicide-related outcomes, digital alerts, AI/chatbots, and robotics. Two logically distinct search streams were needed: a sensitive oncology-suicidality stream without mandatory technology terms, and a technology stream emphasizing youth mental health and clinically relevant alert, conversational, or robotic functionality. The source record reports only a pooled total of 59 records. This unexpectedly small yield, combined with absent database strings and counts, prevents assessment of search completeness. A librarian-assisted rerun and PRESS-informed peer review of exact database-specific strategies (McGowan et al., 2016) would be required to substantiate comprehensive coverage; neither activity is claimed as having occurred.

Study selection

The provided source reports 59 identified records, eight duplicates removed, 51 titles/abstracts screened, 37 records excluded, 14 full-text reports assessed, five full texts excluded, and nine reports included (Figure 1). The aggregate arithmetic is internally consistent. The source does not report the identity or number of screeners,

independent/duplicate selection, software, individual reasons for all five full-text exclusions, or reports not retrieved. Accordingly, it is not possible to establish those procedures retrospectively.

Data charting and synthesis

Data items documented by the source were first author and year, geography and service context, design, sample or assessed technology, suicide-related endpoint, intervention type, key findings, and evidence directness. The revised Table 1 retains all nine originally included studies and corrects attribution errors after comparison with identifiable published records. Source materials do not state who developed or piloted the charting form, how many extractors participated, whether entries were independently verified during the original review, or how disagreements were resolved. A transparent charting-field inventory is provided in Supplementary Table S3 but is not presented as a recovered original extraction log.

A structured descriptive synthesis was organized in two passes: first, study-level evidence was kept within direct oncology and adjacent technology streams; second, four interpretive categories were mapped across them—burden and timing, associated/protective factors, monitored information and escalation, and conversational/robotic engagement and safety. A five-domain design framework then summarized plausible requirements (Table 3). These categories describe the current analytic organization of the nine supplied studies, not an independently verified prospective coding or consensus procedure. Meta-analysis was inappropriate because populations, technologies, and outcomes were incommensurable.

Critical appraisal and interpretation

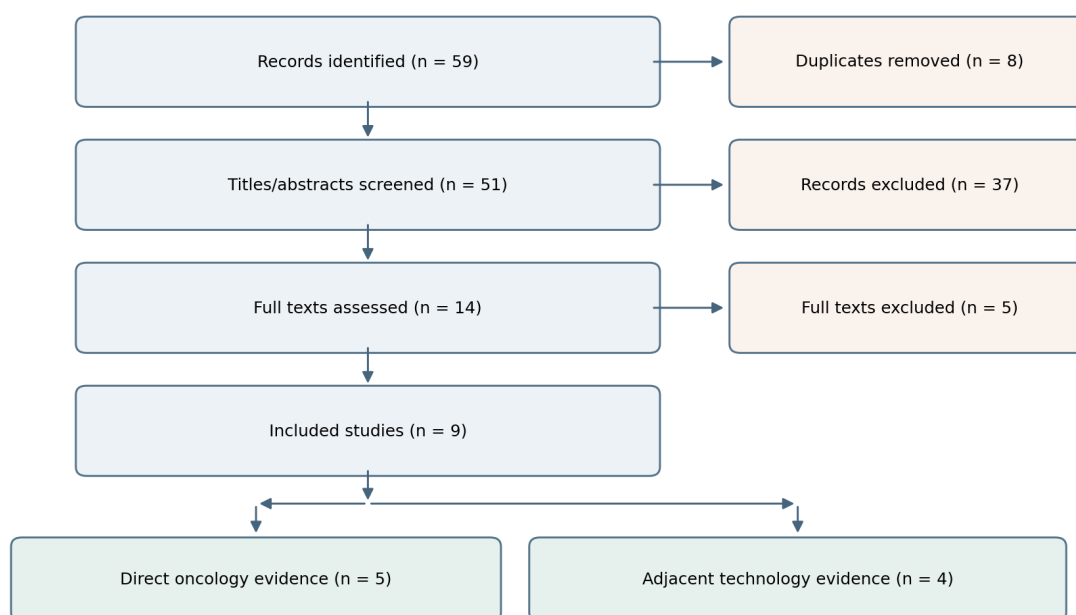
No formal design-specific critical appraisal or risk-of-bias scoring is documented for the original review. Methodological constraints are instead reported study by study in Table 2: observational confounding and selection, small or uncontrolled samples, case-based transferability, simulated safety testing, and absence of oncology-specific evaluation. This descriptive assessment does not substitute for JBI quality appraisal and does not support certainty-of-effect claims.

Results

Nine studies were retained as identified in the source: five directly addressing cancer-related suicidality (Lucas et al., 2024; Heynemann et al., 2021; Giberson et al., 2021; Raghubar et al., 2022; Schwinn et al., 2025) and four technology-adjacent reports (Hasei et al., 2025; Chong et al., 2024; Pichowicz et al., 2025; Alves-Oliveira et al., 2022). They encompassed clinical case,

retrospective population and screening studies, longitudinal and cross-sectional evidence, a small chatbot pilot, an alert-system service evaluation, simulated agent testing, and a robot-agent preference study. Figure 1 keeps all nine; no additional studies were retroactively added to the original included set.

Figure 1. PRISMA-ScR study flow using source-reported aggregate counts.



The characteristics of the nine included studies are summarized in Table 1, comprising five studies providing direct oncology evidence and four studies addressing adjacent digital and robotic

technologies. The table highlights differences in study design, participant characteristics, evidence classification, and the scope of findings.

Table 1. Included Studies

Included source	Setting and design	Sample	Evidence type	Scope of finding
Lucas et al. (2024)	USA; case report	1 patient; age 14	Direct oncology	Suicidality in relapsed leukemia at end of life; clinical goals and autonomy, not robot performance.
Heynemann et al. (2021)	US SEER; retrospective population study	500,366 AYAs; ages 15–39	Direct oncology	922 suicide deaths reported; long-term population-level associations, not individual prediction.
Giberson et al. (2021)	USA; retrospective screening	500 cancer patients; 52 aged 18–39	Direct oncology	Younger subgroup more frequently endorsed ideation among screen-positive patients.
Raghubar et al. (2022)	USA; multisite longitudinal cohort	175 patients; ages 7–18	Direct oncology	SI reported during ALL chemotherapy; longitudinal assessment of depressive/physical symptoms.
Schwinn et al. (2025)	Germany; survivorship survey	633 survivors	Direct oncology	Lower quality of life and support associated with suicidal ideation; cross-sectional.

Included source	Setting and design	Sample	Evidence type	Scope of finding
Hasei et al. (2025)	Japan; 2-week chatbot pilot	5 oncology patients	Adjacent: oncology chatbot	Disclosures and acceptability reported; no suicide detection/triage validation.
Chong et al. (2024)	Australia; youth service observational evaluation	2,021 youth; ages 16–25	Adjacent: clinical alerts	292 rule-based alerts; 222/292 resolved; workflow evidence, not oncologic validation.
Pichowicz et al. (2025)	Simulated app-agent safety evaluation	29 chatbot agents	Adjacent: simulated safety	No agent met strict response adequacy; only simulated crises.
Alves-Oliveira et al. (2022)	USA; preliminary comparative study	19 adolescents; ages 15–18	Adjacent: robot engagement	Robot-agent activities preferred to workbook; no suicide assessment.

Direct oncology evidence

Heynemann et al. (2021) analyzed 500,366 AYAs with cancer aged 15–39 years and identified 922 suicide deaths across 3,198,261 person-years in SEER-based data. These figures establish an association at the population level rather than evidence that a particular app or robot can detect suicide risk. The analysis is not comparable to questionnaire-based ideation studies and is vulnerable to residual confounding and historical variation in services.

Giberson et al. (2021) evaluated screening among 500 people with cancer, including 52 AYAs aged 18–39 years. In the subgroup screened positive for possible depression, reported suicidal ideation was more frequent in AYAs than among older adults, despite limited differences in overall depression screening. This finding supports attention to suicide-related responses at the item level; the subgroup was small, drawn from one clinical context, and cannot establish cancer-specific causal risk.

Raghubar et al. (2022) followed 175 children and adolescents treated for acute lymphoblastic leukemia, aged 7–18 years at diagnosis, and observed suicidal ideation in 14.9% at one or more assessed treatment points. Associations with depressive symptoms and symptom burden underscore the changing context of ideation during treatment. Because most participants were below 15 years, these results should not be generalized unchanged to older AYAs or used to infer predictive accuracy.

Schwinn et al. (2025) examined 633 long-term childhood cancer survivors; lower quality of life and lower perceived social support co-occurred with suicidal ideation. As the design was cross-sectional, directionality remains uncertain. In the case reported by Lucas et al. (2024), a 14-year-old patient with relapsed leukemia faced complex issues at the intersection of suicidal ideation, end-

of-life distress, autonomy, and family goals. A single case illustrates clinical complexity but does not establish prevalence or intervention effectiveness.

Adjacent technology evidence

In a two-week oncology pilot, Hasei et al. (2025) tested generative conversational interfaces in five pediatric/AYA patients with cancer. Reports of disclosure and improvements in emotional experience are exploratory because of the tiny uncontrolled sample, short duration, and absence of a suicide-risk endpoint. Conversational availability must not be interpreted as a clinically reliable safety net.

Chong et al. (2024) evaluated rule-based suicidality notifications embedded in youth mental health services (2,021 users aged 16–25 years). Of 292 notifications, 222 (76%) were recorded as resolved; the median response time was 1.9 days. The study directly documents a notification-to-clinician workflow, but it was not conducted in oncology and cannot support an emergency response-time standard for imminently suicidal patients.

In standardized simulated crisis scenarios, Pichowicz et al. (2025) assessed 29 chatbot agents; none met the study's strict adequacy criteria, 51.72% reached relaxed marginal criteria, and 48.28% were inadequate. These are scenario-based performance results rather than observed real-world clinical harms. Alves-Oliveira et al. (2022) reported preference and engagement with a robot-mediated adolescent mental health micro-intervention relative to a workbook among 19 adolescents. Its purpose was engagement and delivery of activities—not suicide-risk classification or oncology monitoring.

Table 2. Design-linked limitations for each included study

Study	Principal interpretive limitation
Lucas 2024	Case report; no denominator, comparator, or population estimate.
Heynemann 2021	Historical registry exposure; observational associations and possible residual confounding.
Giberson 2021	Single-service retrospective screening, selected PHQ pathway and small AYA subgroup.
Raghubar 2022	Pediatric leukemia-specific cohort; repeated symptom measures, not a prediction study.
Schwinn 2025	Cross-sectional survivors; temporality and direction of association unresolved.
Hasei 2025	Five-person uncontrolled pilot; no suicide-specific clinical outcome.
Chong 2024	Routine youth service evaluation; unresolved alerts and external oncology transfer.
Pichowicz 2025	Simulated scenarios and app sample; no real-world clinical outcome assessment.
Alves-Oliveira 2022	Small short exploratory youth preference comparison; no safety endpoint.

The principal methodological and interpretive limitations of the nine included studies are presented in Table 2. These limitations highlight

the heterogeneity of study designs, restricted generalizability, and the absence of direct clinical validation of AI-enabled robotic systems for suicide-risk monitoring in oncology populations.

The streams converge only at the level of care requirements: clinicians need an interpretable picture of changing distress; technologies may facilitate disclosure and information routing; and safeguards must explicitly address crisis recognition, failure to contact staff, and boundaries of algorithmic autonomy. The strength of this convergence is conceptual. It does not validate risk thresholds, sensitivity, specificity, or clinical benefit in pediatric oncology.

Based on the synthesis of direct oncology and adjacent technology evidence, five preliminary domains for future human-supervised monitoring systems are proposed in Table 3. These domains encompass clinical assessment, human accountability, tiered escalation, accessible design, and data governance and equity, alongside their illustrative requirements and evidence boundaries.

Table 3. Evidence-informed domains for future human-supervised research

Proposed domain	Illustrative requirement	Evidence boundary
1. Clinical assessment	Direct, developmentally appropriate inquiry into ideation, plan, intent, symptoms, functioning, relationships.	Oncology studies; does not imply algorithmic accuracy.
2. Human accountability	Assigned nurse or psycho-oncology professional confirms concern and documents action.	Youth-service alert workflow; oncology transfer untested.
3. Tiered escalation	Unambiguous escalation, emergency contact, and fallback if staff not reached.	Safety issues from simulated chatbot testing.
4. Accessible design	Short age-sensitive interfaces; adaptable conversational/emodied options.	Small oncology chatbot and youth engagement studies.
5. Data and equity	Minimal data collection; auditable alerts; retention limits; accessible nondigital route.	Ethical synthesis; requires prospective policy/legal review.

Discussion

The primary contribution is an explicitly bifurcated evidence map: the clinical need to assess suicide-related risk in younger cancer populations is distinguishable from the limited and indirect evidence for technical delivery. The model does not establish that conversational fluency, robot embodiment, or automated classification improves suicide outcomes. Mapping what each stream can and cannot support is more useful at this stage than presenting a premature integrated “solution.”

The findings are consistent with the broader literature on adolescent mental health and oncology distress, but the contextual gap is material. Pediatric cancer symptoms, recurrence, palliative decisions, caregiver involvement, and treatment-related fatigue may change the meaning of language that a generic model interprets as risk. Moreover, an algorithm’s ability to send notifications differs from its capacity to make safe clinical decisions (Chong et al., 2024; Pichowicz et al., 2025; Rizzo et al., 2025).

Current clinical implications are grounded in oncology care rather than untested robotics. Nursing teams may consider repeated psychosocial assessments at diagnosis, major treatment changes, recurrence, hospital-to-home transitions, survivorship, and end-of-life care. Any expressed suicidal ideation calls for clinically appropriate direct assessment, documentation, symptom management, and referral under local protocols. Evidence from oncology case and cohort studies supports clinical attentiveness, not a universal fixed screening schedule or the performance of a new device (Lucas et al., 2024; Raghubar et al., 2022).

In a possible future digital service, a robot or chatbot could act as an optional interface for check-ins while nurses and qualified mental health clinicians maintain assessment responsibility. An emergency crisis cannot wait for an unattended dashboard: thresholds, after-hours coverage, false-negative pathways, caregiver involvement, and backup communication should be specified before any clinical evaluation. A monitoring system without a staffed response pathway could create risk rather than reduce it.

Because suicidal disclosures involve highly sensitive information, future studies should define how consent and adolescent assent are obtained, when confidentiality is limited by an imminent safety concern, who can access transcripts and gaze/voice data, the purpose and retention of recordings, vendor access, and cybersecurity monitoring. Excluding young people with limited connectivity, disability-related barriers, or language differences would create unexamined inequities; nondigital access and human support must remain available (Rizzo et al., 2025; Park et al., 2025).

Embodied agents can appear more empathic or capable than they are. Systems therefore should identify themselves as technology and never promise 24-hour human response unless it is provided. Model updates and prompt changes demand transparent versioning, simulation-based safety evaluation, prospective subgroup testing, and clinical governance. The simulated crisis failures reported by Pichowicz et al. (2025) reinforce caution but cannot themselves quantify comparative harm in oncology.

Before oncology deployment, a prospectively registered program could begin with co-design

involving patients, families, nurses, psychologists, psychiatrists, oncology and palliative care teams, and accessibility specialists. A fully documented search update should first establish whether newer direct technology studies alter this evidence map. Technical evaluation should then test crisis-response behavior, specificity, sensitivity, missed-risk events, false alerts, workload, and whether clinician follow-up is timely and acceptable. Only supervised feasibility work should precede comparative effectiveness research.

Economic and operational evaluation should count not only software or robot acquisition but also staffing, training, maintenance, cybersecurity, interruption protocols, and follow-up capacity. These are research and governance proposals, not outcomes demonstrated by the nine included studies. A future decision to scale should depend on independently demonstrated safety, equity, and clinical value.

Strengths and limitations

The review retains and identifies all nine originally included studies, separates direct oncology observations from adjacent digital and robotic studies, and reports design-specific interpretive limits. A central weakness is documentary rather than merely statistical: the provided search record lacks the executed search strategies, source counts, final dates, original screening and charting procedures, and protocol status. The 59-record yield is unexpectedly small for a broad multi-technology question, and comprehensiveness cannot be verified. The completed PRISMA-ScR item audit identifies these deficits without filling them with invented details.

Further limitations include English-language coverage, heterogeneous samples and settings, pediatric-to-AYA age differences, small pilots and cases, noncomparative designs, and no validated robot-based oncology suicide-monitoring intervention. No formal risk-of-bias assessment was undertaken. Claims about diagnostic performance, effectiveness, patient safety, and cost-effectiveness are therefore not warranted. Before submission, the authors should recover the search log and screening records, or perform and transparently document a new search and selection process, rather than retrospectively constructing one.

Conclusion and Recommendation

The nine-study evidence map identifies a meaningful clinical need for suicide-related assessment in younger people affected by cancer, but no direct evidence that an AI-enabled robot can monitor or manage their suicidal ideation safely. Digital alerting, conversational support, and robot-mediated engagement each contribute limited, distinct insights. A clinician-supervised, age-sensitive system remains a prospective research concept requiring reproducible literature searching, co-design, safety validation, and oncology-specific evaluation before routine use.

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Declaration of conflict of interest

The authors declare no competing interests.

Declaration on the Use of AI

No AI tools were used in the preparation of this manuscript.

Data Availability Statement

Data sharing is not applicable to this article.

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