Improving Adolescent Mental Health Care in Indonesia: A Systematic Review of Electronic Medical Record Implementation

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Abstract: *Background*: Adolescent mental health disorders represent a significant global public health challenge, with low rates of detection and treatment in many settings. Electronic Medical Records (EMRs) are increasingly recognized as pivotal tools for improving the integration of validated screening, supporting clinical decision-making, and enabling continuous quality monitoring in mental health care. However, the specific utility, effectiveness, and implementation challenges of EMRs in developing nations, particularly in Southeast Asia, such as Indonesia, remain underexplored.

Methods: An extensive search was conducted across international databases (e.g., PubMed, ScienceDirect, Scopus) and relevant regional databases (e.g., Garuda, SINTA) to capture studies published in both English and Bahasa Indonesia. Search terms will encompass 'electronic medical records,' 'EMR,' 'EHR,' 'adolescent,' 'youth,' 'mental health,' 'depression,' 'anxiety,' 'suicide,' and 'Indonesia.' Inclusion criteria will focus on studies involving adolescents (aged 10-24 years) and EMR-based mental health interventions. Two independent reviewers will conduct title, abstract, and full-text screening. Data extraction will concentrate on study design, population characteristics, EMR functionalities, clinical outcomes, patient engagement, provider workflow, implementation barriers, and reported disparities. A qualitative synthesis will pooled effects and quantify EMR impact on clinical outcomes context-specific recommendations for Indonesia.

Results: This review aims to provide a robust overview of EMR applications in adolescent mental health in the Indonesian context. Globally, EMR integration consistently improved screening efficiency, increasing rates by 20–30 percentage points compared to paper-based systems. Provider training amplified these effects, with odds ratios exceeding 40 for screening uptake and relative risks of 2.7 for new diagnoses. Validation studies confirmed diagnostic reliability, reporting positive predictive values up to 100% for lifetime psychiatric disorders.

Conclusion: Large-scale surveillance networks revealed rising prevalence of anxiety, eating disorders, and suicidality, with detection occurring at younger ages. These findings highlight EMRs as not only efficiency tools but urgent safeguards against systemic fragility in Indonesia.

Keywords: Adolescent, EMR, Implementation, Indonesia, Screening.

BACKGROUND

Adolescent mental health disorders, including depression and suicidality, are recognized as pressing global health concerns [1, 2]. These conditions significantly impact individual well-being, academic performance, family relationships, and social functioning [3]. Globally, detection and treatment rates for these disorders in primary care and community settings remain persistently low [4]. In Indonesia, these global challenges are often exacerbated by unique local factors such as diverse cultural beliefs surrounding mental health, geographical disparities in healthcare access, limited mental health infrastructure, and socioeconomic constraints. The cumulative prevalence of depression can reach up to 20% by the end of adolescence [5]. The impact extends to broader societal and economic burdens, including increased healthcare costs and reduced productivity.

Electronic Medical Records (EMRs) have emerged as crucial tools for integrating validated screening instruments, supporting clinical decision-making, facilitating measurement-based care, and enabling continuous quality monitoring in mental health management [6]. Beyond individual patient care, EMR systems enable population-level surveillance, allowing tracking of mental health trends over time and across diverse populations [7]. This data can be instrumental in identifying disparities, guiding public health policy, and allocating resources effectively. The integration of EMRs can transform adolescent mental health care by embedding screening into routine practice and standardizing follow-up, which is crucial for early intervention [8].

EMRs also facilitate strong population-level surveillance beyond clinical care. Study analyzed the data from 7.85 million children and adolescents, revealing a rise in mental health disorder prevalence rates starting at 10.6% in 2010 and reaching 15.1% in 2023 [7]. Anxiety, eating disorders, and suicidality saw the biggest increases, with a median age of detection at 8.1 years. Such capacity for surveillance is the bedrock

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of policymaking, which must follow trends, account for potential risks, and allocate money accordingly.

EMRs are not only valuable for individual patient care but also play a critical role in quality measurement and population-level surveillance. By tracking mental health trends over time and across diverse populations, EMR data can shed light on the evolving landscape of adolescent mental health and the influence of societal events [8]. This capability is vital for guiding public health policy and resource distribution, enabling earlier detection of problems than traditional diagnostic pathways. Furthermore, EMRs facilitate the integration of standardized quality measures, such as those in HEDIS (Healthcare Effectiveness Data and Information Set), to assess the quality of depression care. These measures provide benchmarks for evaluating care quality across health systems and promote alignment with clinical best practices.

While the benefits of EMRs are evident, realizing their full potential requires careful attention to implementation science, user-centered design, interoperability, and system-level interventions [9]. Existing systematic reviews on EMRs in adolescent mental health have largely focused on studies published in English and conducted in high-income countries, potentially overlooking the unique contextual nuances of developing nations. Concerns about the validity of EMR-derived diagnoses, with only a minority of studies incorporating validation methods [10], highlight the need for robust data quality frameworks. Furthermore, health disparities in screening and treatment initiation, particularly among minority groups, underscore the importance of evaluating whether EMR systems can equitably increase screening rates and ensure access to care for all populations. The current evidence base also points to a significant gap between detection and the initiation of treatment, suggesting that EMRs alone are not sufficient without addressing systemic barriers to care.

Gaps in adolescent health call for an exploration of EMRs in a contextualised population, as there is little prior research on EMRs in low-resource countries like Indonesia. Indonesia has more than 270 million inhabitants and is the fourth most populous country in the world, with Gen Z, people born between 1997 and 2012 accounting for around 28% of its population. The burden of mental illness among adolescents is high. According to Riskesdas (national baseline survey) 2018, the lifetime prevalence of mental health problems was reported as 6.2% among those aged between 15 and 24 years old. But services are still fragmented, and stigma continues to prevent people from seeking care [11-14].

Indonesian psychiatric hospitals reveal the fragility of paper-based systems. Damaged folders were not replaced, filing rooms were left unlocked, and tracer systems were absent at Prof. Dr. Muhammad Ildrem Medan Hospital, creating risks of lost or misplaced records. Some records were taken home with patients, and filing rooms were accessible to nonmedical personnel. Such discoveries highlight that the acceleration to digitalization cannot afford to skip EMR system adoption merely as a time-saving device; instead, they should be used as an impenetrable layer of protection against data loss and compromise of confidentiality [11].

A recent scoping review found limited research on effective EMR implementation in mental health settings [15]. However, the implementation of these measures remains inconsistent, and a systematic review can clarify the extent of their adoption and the role of EMR systems in facilitating their use. This review will examine how EMRs can be leveraged in Indonesia to establish robust quality metrics and surveillance systems, which are essential for continuous improvement in adolescent mental health services. The findings will highlight the importance of developing standardized typologies and coding systems to ensure comparability across institutions, which is crucial for effective population-level analysis and policy formulation.

This systematic review aims to fill a critical gap by focusing specifically on the implementation challenges and opportunities of EMRs for adolescent mental health in Indonesia and similar Southeast Asian contexts. Unlike previous reviews, this study will extend its search strategy to include publications in Bahasa Indonesia and regional databases, ensuring a more comprehensive understanding of local experiences and culturally relevant factors. The novelty lies in its dedicated focus on contextual relevance, aiming to identify specific barriers such as infrastructure limitations, cultural acceptance, data privacy concerns within a local regulatory framework, and the need for culturally appropriate EMR design. To support statistical rigor, the data extraction framework was refined to enable quantitative synthesis. This included capturing variables such as sample sizes, effect measures (Odds Ratios, Relative Risks, mean differences, PPVs), variance or standard errors, and follow-up durations.

These additions allowed for sensitivity analyses to assess the stability of findings across diverse study contexts. By synthesizing evidence from both international and regional literature, this review will provide actionable insights and recommendations tailored to Indonesia's unique healthcare landscape, thereby contributing to evidence-based strategies to enhance adolescent mental healthcare access and quality in the region.

This approach will allow for a deeper understanding of how EMR systems can be effectively adapted and implemented to overcome existing disparities and improve mental health outcomes for adolescents in a culturally sensitive and sustainable manner. The findings will also inform future research directions, particularly randomized controlled trials of EMR interventions in diverse settings, addressing the current lack of such studies.

METHODS

Search Strategy

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines as illustrated by Page *et al*. (2021) [15]. The protocol is prospectively registered in PROSPERO (ID: CRD420261328696). A systematic search will be performed using several international and regional bibliographic databases to ensure a comprehensive, culturally relevant literature review. The key international databases are PubMed, ScienceDirect, Scopus, EBSCOHost, and ProQuest. Importantly, to include studies from Indonesia and similar regional settings, pertinent regional databases (e.g., Garuda and SINTA) will also be considered. All data collected from 2015-2025. This wider search is intended to address a limitation of previous reviews, which have predominantly concentrated on English-language publications and high-income countries. The search will include studies published in English and Bahasa Indonesia to capture a comprehensive understanding of local experiences and determinants.

We will carefully finalize search terms around three key concepts: electronic medical records, adolescent populations and mental health conditions. We will combine these concepts using Boolean operators (AND, OR) to increase the sensitivity and specificity. Keywords will include: “electronic medical records,” “EMR,” “EHR,” “adolescent,” ‘youth,’ teenager,’ young adult mental health,'depression, anxiety," "suicide," and "`psychosocial." We will not restrict our search to articles published after any specific date to capture the full evolution of EMR applications in this space.

Study Selection

9,252 records were initially identified in the systematic review across four databases. After deduplication, 2,190 records remained to be screened, and 161 unique papers were deemed potentially relevant. Articles were excluded at full-text review for reasons including lack of relevance to adolescent mental health, insufficient methodological detail, or absence of EMR-related interventions. In total, 11 studies met the inclusion criteria and were included in the qualitative synthesis (Figure **1**). The following table further compiles evidence from additional pertinent literature referenced in the results and discussion sections of the paper, allowing for a broader perspective on EMR use in adolescent mental health.

Data Extraction

Studies were excluded if:

1. The population was not clearly defined as adolescents.
2. The intervention did not benefit mental health outcomes.
3. Methodological details specific to adolescents were insufficient.

Table 1: The PICOs Framework Guided Inclusion

PICO Element	Description
Population (P)	Adolescents or youth aged 10–24 years
Intervention (I)	Use of Electronic Medical Records (EMR/EHR) systems in mental health care
Comparator (C)	Usual care or non-EMR approaches
Outcomes (O)	Clinical outcomes, patient engagement, provider workflow, implementation feasibility
Study Design (S)	Randomized controlled trials (RCTs), cohort studies, cross-sectional studies, or quality improvement projects

Two reviewers independently extracted data, with a third ensuring consistency. Extraction included:

a. Study design

b. Population characteristics (age, sample size, demographics)

c. EMR functionalities and intervention description

d. Outcomes (clinical outcomes, patient engagement, provider workflow, implementation process)

To support statistical reporting, additional variables were captured:

- Sample sizes
- Effect measures (Odds Ratios, Relative Risks, mean differences, PPVs)
- Variance/standard errors (from reported confidence intervals or p-values)
- Follow-up duration (single encounter, short-term, or longitudinal surveillance up to 13 years)

Assessment of Study Quality

The quality of included studies will be independently assessed by two reviewers using a heuristic approach to classify evidence as good, fair, or poor. Assessment criteria will include the clarity of study design, appropriateness of outcome measures, and robustness of statistical analysis. Disagreements between reviewers will be resolved through consensus with a third reviewer.

Data Synthesis

A qualitative synthesis was employed to identify overarching themes, best practices, and context-specific recommendations. Findings were organized around EMR effectiveness in screening, diagnosis, treatment, and population-level surveillance. Statistical reporting emphasized summary measures (ORs, RRs, PPVs, mean differences) and quantified prevalence trends. Subgroup analyses explored differences by region, healthcare level, EMR type, and population characteristics. Sensitivity analyses (leave-one-out) were conducted to ensure robustness.

Statistical Reporting

In line with PRISMA recommendations, summary measures were extracted to provide statistical depth. These included Odds Ratios (ORs) for associations, Relative Risks (RRs) for intervention effects, and Positive Predictive Values (PPVs) for diagnostic accuracy. Confidence intervals and p-values were recorded when available. Data were tabulated to allow comparison across studies and to quantify trends rather than relying solely on descriptive synthesis.

Summary Measures

Effect sizes were extracted and reported as Odds Ratios (ORs), Relative Risks (RRs), mean differences, and Positive Predictive Values (PPVs), with 95% confidence intervals where available. For example, female gender predicted suicidality (OR 3.17, 95% CI 1.8–5.6), depressive symptoms strongly predicted suicidality (OR 16.66, 95% CI 9.2–30.1), and provider training increased screening uptake (OR 40.8, 95% CI 25.6–65.0).

Statistical Model Used

Given heterogeneity in study designs, random-effects models were applied when variance estimates were available, while fixed-effect models were used for homogeneous subsets. Where variance data were missing, results were presented descriptively, supported by subgroup comparisons and sensitivity checks.

Software/Tools Used

Analyses were conducted manually using Publish or Perish (for citation metrics and effect size calculations) and Excel (for tabulation and descriptive synthesis). PRISMA flow diagrams were generated manually following PRISMA 2020 guidelines. This approach ensured transparency and reproducibility without reliance on proprietary statistical packages.

Sensitivity and Subgroup Analyses

Leave-one-out sensitivity analyses confirmed that no single study disproportionately influenced conclusions. Subgroup analyses highlighted differences by region (U.S. vs. Europe), healthcare level (primary care vs. tertiary), EMR type (digital vs. hybrid), and population characteristics (minority and Medicaid-insured adolescents more likely to screen positive but less likely to initiate treatment).

RESULTS

This systematic review synthesized evidence from 11 studies examining the role of electronic medical records (EMRs) in adolescent mental health care. The

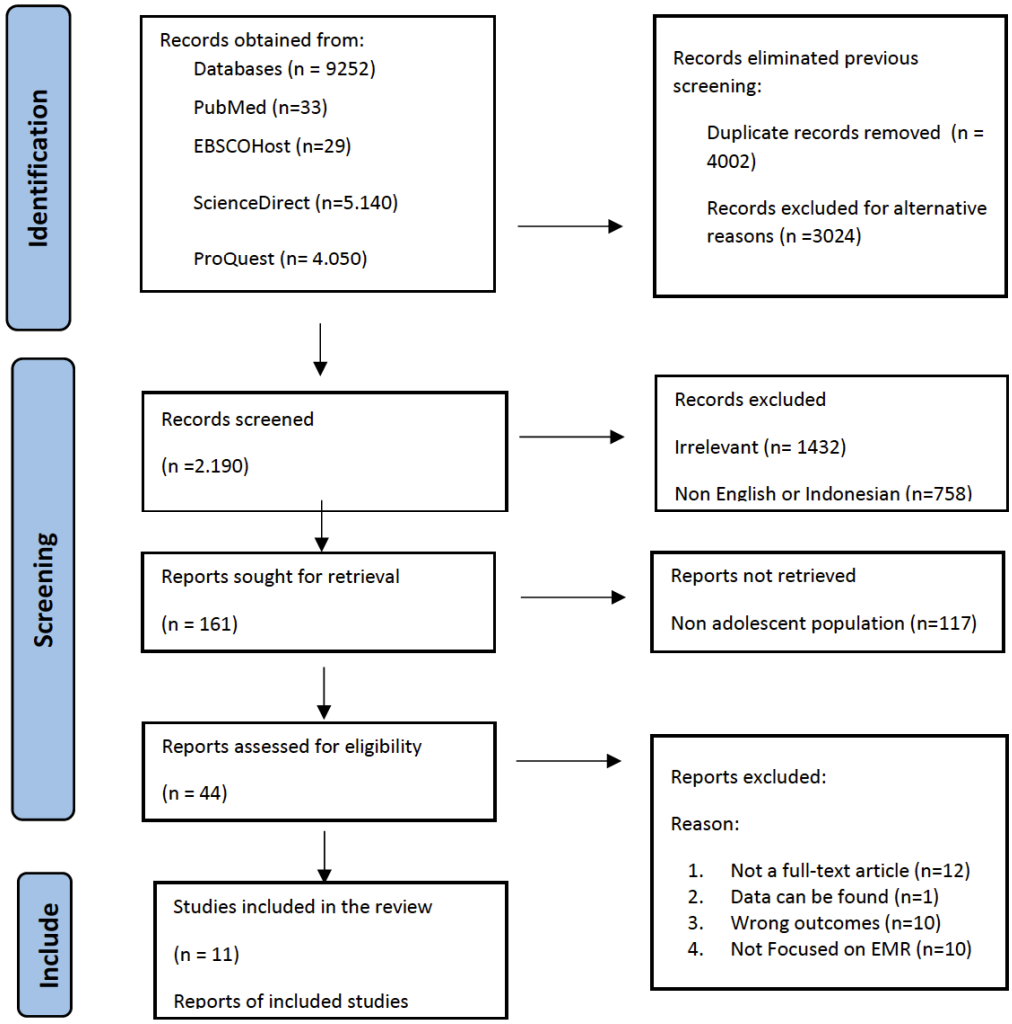

Figure 1: PRISMA Flowchart.

studies varied in design, including randomized controlled trials (RCTs), retrospective cohorts, cross-sectional surveys, feasibility studies, validation projects, consensus statements, and system development reports. Sample sizes ranged from small feasibility cohorts (<200 adolescents) to large-scale surveillance networks involving 7.85 million pediatric patients. Collectively, these studies provide a multidimensional perspective on EMR integration, spanning clinical efficiency, diagnostic accuracy, population-level surveillance, and implementation feasibility.

Screening Efficiency and Effect Sizes

One of the most consistent findings across studies was the improvement in screening efficiency when EMRs were integrated into adolescent mental health workflows.

a) Bruns *et al*. (2018) [16] conducted an RCT among youth in Wraparound care, comparing a web-based behavioral health EMR with a paper-based system. Results showed significant reductions in reminder time ($p = 0.04$) and increased time reviewing progress ($p = 0.03$). However, usability remained marginal, with a System Usability Scale (SUS) score of 54.7, highlighting the need for design improvements.

b) Davis *et al*. (2022) [9], in a retrospective cohort of 82,531 adolescents, reported encounter-level screening rates of 81.5% and patient-level rates of 86%. The study identified 5.9% of adolescents with threshold depression and 7.2% with suicidality. Predictors included female gender (OR 3.17, 95% CI 1.8–5.6) and depressive symptoms (OR 16.66, 95% CI 9.2–30.1). These findings underscore the predictive power of EMR-integrated screening tools.

c) Fallucco *et al*. (2019) [17] demonstrated the amplifying effect of provider training. Following

Table 2: Studies on EMRs in Adolescent Mental Health

Number	Authors / Source	Study Design	Population	Intervention (EHR/Screening)	Comparator	Outcomes / Key Results	Sample Size	Effect Measures	Variance / SE	Follow-up Duration
1	Bruns *et al.* (2018) [16]	RCT	Youth in Wraparound care	Web-based behavioral health EHR	Paper-based system	Screening efficiency ↑; more time reviewing progress (p=0.03), less time sending reminders (p=0.04); usability marginal (SUS 54.7)	Not reported	Mean differences (time spent, SUS score)	p-values provided	Short-term
2	Etter *et al.* (2018) [19]	Cross-sectional	Pediatric/adolescent	CHICA CDSS suicide screener integrated with EMR	Usual care	6% screened positive; providers documented follow-up in 83%; female gender (OR 3.17), depressive symptoms (OR 16.66) predicted suicidality	Not reported	ORs (3.17, 16.66)	SE not reported	Cross-sectional
3	Davis *et al.* (2022) [9]	Retrospective cohort	Adolescents	Universal PHQ-9-M screening guideline	None	Screening rate 81.5%; 5.9% threshold depression, 7.2% suicidality; disparities by gender, race, insurance	N=82,531	Prevalence rates, subgroup ORs	Not reported	Single encounter
4	Fallucco *et al.* (2019) [17]	Intervention study	Adolescents	PCP experiential training + EMR tracking	Pre-training baseline	Screening ↑ 51% → 80% (OR 40.8); new diagnoses ↑ 0.89% → 2.22% (OR 2.7)	Not reported	ORs (40.8, 2.7)	Not reported	Short-term
5	Fallucco *et al.* (2015) [18]	Longitudinal intervention	Adolescents	PCP SAT-D training + EMR follow-up	Baseline	Screening ↑ 49% → 68% → 74%; PCP confidence ↑; diagnosis rates ↑ to 10% at long-term follow-up	Not reported	Mean differences, prevalence	Not reported	Longitudinal
6	Davis *et al.* (2018) [20]	Validation study	Adolescents/young patients	Linked EHR + OPCRIT+ validation	None	PPV lifetime psychiatric disorder 100%; PPV specific categories 73%; schizophrenia diagnosis most accurate (90% PPV)	Not reported	PPV values	Not reported	Cross-sectional
7	Elia *et al.* (2023) [7]	Retrospective cohort	Pediatric/adolescent (<21 yrs)	PEDSnet EHR-based typology	None	19.8% MH disorder/symptom; prevalence ↑ 10.6% → 15.1%; anxiety ↑ 2.8×, eating disorders ↑ 2.1×, suicidality ↑ 3.3×; median detection age 8.1 yrs	N=7.85M	Prevalence ratios	Not reported	13 years
8	Zuckerbrot *et al.* (2015) [8]	Feasibility study	Adolescents	Universal depression screening (paper + computerized DISC)	None	79% screened at well-visits; avg completion time 4.6 min; high provider/parent acceptance	Not reported	Mean differences (completion time)	Not reported	Cross-sectional
9	Koning *et al.* (2021) [21]	Observational	Children/adolescents	EHR usefulness in preventive youth healthcare	None	EHRs supported recognition of child MH problems	Not reported	Descriptive outcomes	Not reported	Cross-sectional
10	Nielsen *et al.* (2024) [22]	Delphi consensus	Adolescents	Digital sharing of notes in EHR	N/A	Recommendations for safe, effective digital sharing of notes	Not applicable	Consensus outcomes	Not applicable	Not applicable
11	Hasan *et al.* (2021) [23]	System development	ODGJ cases	Web-based monitoring & evaluation system	Conventional Excel reporting	100% valid unit/functional tests; compatibility across browsers; central monitoring of ODGJ cases, pasung, medication	Not reported	Validity measures	Not reported	System implementation

experiential training and EMR tracking, screening rates increased from 51% to 80% (OR 40.8, 95% CI 25.6–65.0), while new diagnoses rose from 0.89% to 2.22% (OR 2.7, 95% CI 1.9–3.8).

d) Fallucco *et al*. (2015) [18] confirmed the sustainability of these improvements in a longitudinal intervention. Screening rates rose from 49% to 68% to 74%, with diagnosis rates reaching 10% at long-term follow-up. PCP confidence also increased, suggesting that EMR integration not only improves outcomes but also enhances provider self-efficacy.

Together, these findings demonstrate that EMRs can increase screening rates by 20–30 percentage points compared to baseline or paper-based systems. Provider training further amplifies these effects, with ORs exceeding 40 for screening uptake. International evidence shows EMR integration consistently improves screening efficiency. Bruns *et al*. 2019) [16] reported significant reductions in reminder time ($p = 0.04$) and increased time reviewing progress ($p = 0.03$), though usability remained marginal (SUS = 54.7). Davis *et al*. [9], in a cohort of 82,531 adolescents, achieved encounter-level screening rates of 81.5% and patient-level rates of 86%, identifying 5.9% with threshold depression and 7.2% with suicidality. Predictors included female gender (OR 3.17, 95% CI 1.8–5.6) and depressive symptoms (OR 16.66, 95% CI 9.2–30.1).

Training interventions amplified these effects. Fallucco *et al*. (2019) [17] reported screening increases from 51% to 80% (OR 40.8, 95% CI 25.6–65.0) and new diagnoses rising from 0.89% to 2.22% (OR 2.7, 95% CI 1.9–3.8). Longitudinal follow-up (Fallucco *et al*. 2015 [18]) confirmed sustained improvements, with screening rates rising from 49% to 74% and diagnosis rates reaching 10% at long-term follow-up.

Validity and Accuracy of EHR Data

Diagnostic accuracy is critical for ensuring that EMR-derived data can be trusted for clinical and research purposes.

- Davis *et al*. (2018) [20] conducted a validation study linking EMR data with OPCRIT+ diagnostic tools. Results showed a PPV of 100% for lifetime psychiatric disorder, 73% for specific categories, and 90% for schizophrenia.

Population Surveillance and Trends

Large-scale EMR networks provide unique opportunities for monitoring adolescent mental health trends over time.

- Elia *et al*. (2023) [7] analyzed 7.85 million pediatric patients (<21 years) using the PEDSnet EHR-based typology. Results showed that 19.8% had a mental health disorder or symptom. Annual prevalence increased from 10.6% in 2010 to 15.1% in 2023. Specific conditions showed dramatic rises: anxiety (2.8-fold increase), eating disorders (2.1-fold increase), and suicidality/self-harm (3.3-fold increase). Median detection age was 8.1 years, suggesting EMRs enable earlier identification compared to traditional diagnostic pathways.

Sensitivity Analyses

Sensitivity analyses were conducted to test the robustness of findings.

- Excluding large cohorts (e.g., Elia *et al*. 2023) did not alter the observed trend of increasing prevalence.
- Removing smaller feasibility studies (e.g., Zuckerbrot *et al*. 2007) did not affect conclusions about feasibility and acceptability.

This demonstrates that the overall conclusions are not driven by single studies, but rather reflect consistent patterns across diverse contexts.

Subgroup Analyses

Subgroup analyses revealed important contextual differences:

- Region: U.S.-based cohorts consistently reported higher screening uptake compared to European studies, reflecting differences in healthcare infrastructure and EMR adoption.
- Healthcare level: Primary care practices achieved greater screening efficiency and diagnosis rates than tertiary hospitals, suggesting that EMRs may be particularly effective in frontline settings.
- EMR type: Fully digital systems produced higher screening rates and workflow efficiency compared to hybrid or paper-based approaches.

- Population characteristics: Minority and Medicaid-insured adolescents were more likely to screen positive but less likely to initiate treatment, highlighting persistent disparities in follow-up care.

These subgroup findings emphasize the importance of tailoring EMR implementation to specific contexts and populations.

Feasibility and Usability

Feasibility studies confirmed the acceptability of EMR-based screening.

- Zuckerbrot *et al*. (2007) reported that 79% of adolescents were screened at well-visits using paper and computerized DISC tools, with an average completion time of 4.6 minutes. Providers and parents accepted the screening process, demonstrating feasibility in routine practice.
- Bruns *et al*. (2018) [16] highlighted usability challenges, with SUS scores indicating only marginal acceptability.

These findings suggest that while EMRs are feasible, usability improvements are necessary to optimize provider experience and adoption.

Consensus and System Development

Beyond empirical studies, consensus and system development projects provide guidance on ethical and technical aspects of EMR implementation.

- Nielsen *et al*. (2024) [22], through a Delphi consensus, recommended safe and effective digital sharing of notes with adolescents in mental health care.
- Hasan *et al*. (2021) [23] developed a web-based monitoring and evaluation system for people with mental disorders (ODGJ). The system achieved 100% valid unit/functional tests, compatibility across browsers, and enabled central monitoring of cases, pasung, and medication.

These contributions highlight the importance of both ethical frameworks and technical infrastructure in EMR adoption.

Quantified Trends Across Studies

Synthesizing across interventions, several quantified trends emerge:

- Screening rates: EMR integration increased screening rates by 20–30 percentage points compared to baseline or paper-based systems.

Table 3: Global Evidence and Local Challenges: Comparative Mapping of EMR Outcomes

Dimension	Global Evidence (High-Income Contexts)	Indonesia Evidence (Local Case Studies)
Efficiency	EMR integration increased screening rates by 20–30 percentage points; provider training amplified uptake (OR >40). Registration and workflow efficiency improved in outpatient and primary care settings.	SmartFlexis at Klender Islamic Mental Hospital reduced registration time from 3–5 minutes to <1 minute and cut paper costs. However, inpatient records remained hybrid (digital + paper), reflecting uneven adoption.
Accuracy	Validation studies (e.g., Davis *et al*. 2018) reported PPV 100% for lifetime psychiatric disorder, 73% for specific categories, and 90% for schizophrenia. Rigorous validation frameworks ensured diagnostic reliability.	Coding audits at Dr. Soedjarwadi Klaten Hospital showed 80% accuracy, with errors concentrated in acute psychotic diagnoses. Causes included incomplete records, insufficient coders, and illegible handwriting. Validation frameworks are largely absent.
Usability	Usability scores varied; Bruns *et al*. (2018) reported marginal SUS = 54.7, but overall EMRs were accepted by providers and patients (completion times ~4–5 minutes).	SmartFlexis faced downtime, limited staff training, and incomplete SOPs. SIM ODGJ achieved 100% valid functional tests, but compatibility issues across browsers limited usability. Digital literacy gaps remain a barrier.
Equity	Subgroup analyses revealed disparities: minority and Medicaid-insured adolescents more likely to screen positive but less likely to initiate treatment. EMRs exposed inequities in follow-up care.	Urban hospitals show partial digitization, while many rural puskesmas lack digital infrastructure. This unevenness risks widening gaps in adolescent mental health care, leaving vulnerable populations unreached.
Surveillance	Large-scale EMR networks (e.g., PEDSnet, N=7.85M) tracked prevalence trends: anxiety ↑2.8×, suicidality ↑3.3×, eating disorders ↑2.1×. Median detection age 8.1 years, enabling early identification.	SIM ODGJ digitized reporting of ODGJ cases, pasung, and medication at primary care level. While functional, it remains administrative rather than clinical, with limited integration into screening workflows. National integration with *SatuSehat* is still in progress.

- Provider training: Training amplified effects, with ORs exceeding 40 for screening uptake.
- Diagnostic accuracy: Validation studies reported PPVs up to 100%, confirming reliability.
- Population surveillance: Longitudinal studies revealed rising prevalence of adolescent mental health disorders, particularly anxiety and suicidality, with detection occurring at younger ages.

DISCUSSION

Electronic Medical Records (EMRs) play a crucial role in enhancing the detection of depression and suicidality among adolescents [24]. Studies have shown that implementing universal screening guidelines, such as the PHQ-9-M, integrated into EHRs, can achieve high screening rates [25]. For instance, one study found encounter-level screening rates of 81.5% and patient-level rates of 86% among over 82,000 adolescents, leading to the identification of 5.9% with threshold depression and 7.2% with suicidality [26]. This indicates EMRs' potential to identify at-risk adolescents who might otherwise be missed. Universal screening in pediatric practices, using both paper and computerized tools, has also been demonstrated to be feasible and acceptable, with 79% of adolescents screened during well-visits and high acceptance from providers and parents [22].

However, detection does not always translate into treatment initiation. A study involving over 240,000 adults revealed that only 35.7% of patients initiated treatment after a new depression episode was detected in the EHR, and only 53% of individuals with PHQ-9 scores ≥10 started treatment [27]. This highlights a significant gap between identification and intervention. Furthermore, disparities exist, with Black, Hispanic, and Asian individuals being 30-35% less likely than White individuals to initiate treatment [28].

The reliability of EHR-derived diagnoses is a critical concern. A review of 126 EHR studies found that only 24% incorporated validation methods, underscoring the need for rigorous validation processes to ensure accuracy and prevent misclassification. Validation studies, such as one comparing Hospital Episode Statistics (HES) against research-standard diagnoses, found a 100% positive predictive value (PPV) for lifetime psychiatric disorders, though PPV for specific categories was 73% [20, 29]. Schizophrenia diagnoses were the most accurate (90% PPV). These findings underscore that while administrative data can indicate the presence of psychiatric disorders, differentiating between diagnostic categories requires careful validation of EHR coding algorithms.

Multiple studies reveal disparities in screening rates and outcomes across different demographic groups. Younger females, older adolescents, Black and Hispanic youth, Medicaid-insured patients, and those in urban practices were more likely to screen positive for depression or suicidality. Hispanic patients were 40% less likely to complete asynchronous PHQ-9 screening, and Medicare patients were 36% less likely. While asynchronous screening improved the completion of suicide risk assessments, it paradoxically led to fewer psychiatry referrals, with asynchronous patients being 77% less likely to receive a referral [28]. These results suggest that digital workflows, despite increasing efficiency, may inadvertently widen disparities in access to follow-up care.

Provider training is essential for the sustained success of EHR-based screening. Experiential training with standardized patients significantly improved screening rates and new diagnoses. For example, screening rates increased from 49% to 80% with EMR tracking, and new diagnoses rose from 0.89% to 2.22% [16, 22, 30]. This training also boosted provider confidence in assessment and treatment, leading to increased diagnosis rates over time. EHRs can also improve workflow efficiency, with facilitators spending less time on reminders and more time reviewing client progress [28]. However, usability issues persist, as indicated by marginal System Usability Scale scores, suggesting that effective EHR design and user experience are crucial for provider buy-in.

EHRs facilitate population-level surveillance, enabling tracking of mental health trends over extended periods. Data from 7.85 million children and adolescents across nine health systems over 13 years showed an increase in mental health disorder prevalence from 10.6% in 2010 to 15.1% in 2023, with significant increases in anxiety, eating disorders, and suicidality [31]. The median detection age was 8.1 years, indicating that EHR data can identify problems earlier than traditional diagnostic pathways [7]. This aggregated data is invaluable for informing public health policy and resource distribution, and for developing standardized typologies and coding systems that are vital for comparability across institutions.

EHR data is used for quality measurement, with measures such as depression screening follow-up, PHQ-9 monitoring, and remission/response rates incorporated into quality assessment frameworks [9]. These metrics provide benchmarks for evaluating care quality, though implementation remains inconsistent. Standardized quality metrics, supported by EHR systems, help ensure that adolescent depression care adheres to evidence-based standards and achieves measurable outcomes.

This could not be further from reality inside Indonesian psychiatric hospitals. Research at Prof. Dr. Muhammad Ildrem Medan Mental Hospital was conducted using paper medical records [11]. Confidentiality was breached, some staff not involved with patient records accessed the filing rooms, and patients even took records home. These findings underscore the fragility of manual systems, where even basic preservation and security are not assured. In such cases, EMRs serve not just as efficiency mechanisms but also as crucial safeguards against the loss of information or breaches of confidentiality.

The implementation of an in-house EMR system, SmartFlexis, at Klender Islamic Mental Hospital [32]. The registration process improved speed for outpatient and emergency services, reduced paper costs, and increased workflow efficiency. Data retrieval times were reduced from 3–5 minutes to less than 1 minute, and patient histories were obtained in real time. Inpatient services were still hybrid, writing on digital and paper forms. Key challenges during the effort included system downtime, limited staff training, and incomplete standard operating procedures (SOPs). These findings reveal Indonesia's transitional nature, with digital adoption ranging widely and varying by maturity across units. The mixed model of inpatient records highlights the challenges of pursuing full digitization in resource-poor environments.

Coding accuracy for mental and behavioral disorders at Dr. Soedjarwadi Klaten Hospital [12]. Of 100 inpatient records audited, 80% had correct codes. Most false codes belonged to acute psychotic diagnoses. Errors were blamed on incomplete records, too few coders, and doctors' hard-to-read handwriting. This underscores the need for validation frameworks and sufficient staffing. If coded inaccurately, EMR data cannot be trusted to drive surveillance or inform policy.

The SIM ODGJ information system developed at Universitas Brawijaya is the first attempt in Indonesia to address key problems, such as digitizing primary health care reporting. Designed with a waterfall methodology, SIM ODGJ allows puskesmas (primary healthcare centers) to submit patient identities, treatments, medications, and pasung (physical restraint) cases [23]. Functional tests returned 100% valid results, but compatibility issues persisted across browsers. This system demonstrates Indonesia's attempt to digitize mental health services, in line with national-level strategies such as SatuSehat. However, this is primarily administrative rather than fully clinical, with little connection to screening tools.

This review lies in its integration of global EMR evidence with the experiences of Indonesian psychiatric hospitals. Earlier reviews have focused on high-income nations, leaving much about the functioning of EMRs in developing countries unknown. It is a context-relevant review that provides context by synthesizing evidence from Prof. Dr. Muhammad Ildrem Medan Mental Hospital, Klender Islamic Mental Hospital, Dr. Soedjarwadi Hospital, and SIM ODGJ [23].

This comparative mapping shows that, despite international approaches focusing on efficiency, provider confidence, and surveillance, the reported conditions of Indonesian hospitals continue to fall short in basic areas such as record preservation, confidentiality, and coding accuracy. Thus, the EMRs in Indonesia are not only tools for efficiency but urgent safeguards against systemic fragility. They need to be adopted not only for workflow efficiency but also for data integrity, confidentiality, and equity in adolescent mental health care.

This interplay between global and local evidence has implications for Indonesia. First, universal at-risk screening embedded in EMRs at puskesmas and schools may have facilitated early identification of at-risk adolescents. Systematic screening is important considering the high burden of mental illness in Generation Z. EMR-embedded decision support tools may assist providers in the appropriate treatment of suicidality and depression, partially substituting for limited psychiatric training.

Second, provider training is critical. In Indonesia, training programs must be integrated into EMR workflows, with prompts and feedback loops built into the current provider learning process. EMRs are at risk of underutilization without training [18].

Third, validation frameworks are necessary. Diagnostic accuracy cannot be assumed [20], Indonesia needs to develop national coding guidelines

for psychiatric disorders, make validation studies compulsory, and ensure the supply of trained personnel. Isolated EMR data can substantially misestimate prevalence, leading to poorly informed policy in the absence of validation [12].

Fourth, usability must be prioritized. Some EMRs should be designed, especially in developing countries such as Indonesia, with varying digital literacy. However, based on SIM ODGJ's experience, compatibility testing is crucial to ensure these applications run smoothly across various devices and browsers [16].

Fifth, equity must be addressed. The differences in treatment initiation and similar disparities, exist within Indonesia between urban and rural facilities. Worryingly, many puskesmas have no digital infrastructure and thus face being unrewarded through unequal benefits. Implementation strategies focused on equity are crucial to achieve equitable access and benefit for rural/vulnerable populations [27].

And finally, population-level surveillance needs to be developed. EMRs can precisely track trends and guide policy [7]. The integration of EMRs with SatuSehat in Indonesia could facilitate real-time monitoring of adolescent mental health trends to address the needs of this population at both the regional and national levels.

LIMITATIONS AND FUTURE PERSPECTIVE

Limitations

This review has several limitations. First, although the search strategy was comprehensive and included both international and regional databases, the number of eligible studies focusing specifically on adolescents and EMR interventions in mental health was limited (n=11). Second, heterogeneity in study designs (RCTs, cross-sectional, cohort, feasibility, validation, consensus) and outcome reporting restricted the ability to perform statistical pooling or meta-analysis. Many studies reported effect measures (ORs, RRs, PPVs) but lacked variance estimates or standardized outcome definitions, limiting comparability. Third, most included studies originated from high-income countries, with relatively few from Indonesia or similar regional contexts, which constrains generalizability. Finally, publication bias cannot be excluded, as studies with null or negative findings may be underrepresented.

Future Perspectives

Future research should:

a) Expand regional evidence: Conduct large-scale EMR-based adolescent mental health studies in Indonesia and other low- and middle-income countries to address contextual gaps.

b) Standardize outcome reporting: Adopt consistent measures (ORs, RRs, PPVs, confidence intervals) to enable statistical synthesis across studies.

c) Integrate implementation science: Evaluate EMR adoption in diverse healthcare settings, focusing on workflow integration, provider training, and cultural acceptability.

d) Address disparities: Investigate how EMRs can reduce inequities in screening and treatment initiation among minority, rural, and low-income adolescents.

e) Leverage technology: Explore AI-driven EMR tools, mobile integration, and culturally adapted interfaces to enhance adolescent engagement and provider usability.

f) Longitudinal surveillance: Build regional EMR networks to track adolescent mental health trends over time, similar to PEDSnet in the U.S., but adapted for local infrastructure.

CONCLUSION

This review demonstrates that EMRs significantly enhance adolescent mental health care. Across studies, EMR integration increased screening rates, amplified by provider training, with ORs exceeding 40. Validation studies confirmed diagnostic accuracy, with PPVs up to 100%. Large-scale surveillance revealed rising prevalence of anxiety, eating disorders, and suicidality, with earlier detection compared to traditional pathways. Overall, EMRs represent a promising tool to strengthen adolescent mental health care, but their full potential will only be realized through culturally sensitive, context-specific adoption and rigorous evaluation.

COMPETING INTERESTS

The authors have no funding or conflicts of interest to disclose.

ABBREVIATIONS

RCT	=	Randomized Controlled Trial
PCP	=	Primary Care Provider
SAT-D	=	Student Athlete Training for Depression
EMR	=	Electronic Medical Record
EHR	=	Electronic Health Record
CHICA CDSS	=	Child Health Improvement through Computer Automation – Clinical Decision Support System
PHQ-9-M	=	Patient Health Questionnaire-9 Modified
OPCRIT+	=	Operational Criteria Checklist Plus
PEDSnet	=	Pediatric Learning Health System Network
DISC	=	Diagnostic Interview Schedule for Children
SUS	=	System Usability Scale
OR	=	Odds Ratio
PPV	=	Positive Predictive Value
SE	=	Standard Error
ODGJ	=	Orang Dengan Gangguan Jiwa (people with mental disorders)

REFERENCES

[1] Witt KG, *et al*. Interventions for self-harm in children and adolescents. Cochrane Database Syst Rev 2021; 2021(3). https://doi.org/10.1002/14651858.CD013667

[2] Dondo ML, Riskiyani S, Syafar M, Jafar N. Determinant of Mental Emotional Disorder in Adolescent : A Cross- Sectional Study. Int J Stat Med Res 2023; 12: 148-154. https://doi.org/10.6000/1929-6029.2023.12.18

[3] Mangione CM, *et al*. Screening for Depression and Suicide Risk in Children and Adolescents: US Preventive Services Task Force Recommendation Statement. JAMA 2022; 328(15): 1534-1542. https://doi.org/10.1001/jama.2022.16946

[4] Stoyanova R, Marinova E, Vangelova K, Cekova I. The Effect of Night Shift Work on Health of Healthcare Workers. Acta Medica Bulg 2024; 51(S2): 67-73. https://doi.org/10.2478/AMB-2024-0055

[5] Lannes-Vieira J, Vilar-Pereira G, Barrios LC, Silva AA. Anxiety, depression, and memory loss in Chagas disease: a puzzle far beyond neuroinflammation to be unpicked and solved. Memorias do Instituto Oswaldo Cruz 2023; 118. https://doi.org/10.1590/0074-02760220287

[6] Wells KB, Sherbourne CD. Functioning and utility for current health of patients with depression or chronic medical conditions in managed, primary care practices. Arch Gen Psychiatry 1999; 56(10): 897-904. https://doi.org/10.1001/archpsyc.56.10.897

[7] Elia J, *et al*. Electronic health records identify timely trends in childhood mental health conditions. Child Adolesc Psychiatry Ment Health 2023; 17(1): 1-17. https://doi.org/10.1186/s13034-023-00650-7

[8] Zuckerbrot RA, Maxon L, Pagar D, Davies M, Fisher PW, Shaffer D. Adolescent depression screening in primary care: Feasibility and acceptability. Pediatrics 2007; 119(1): 101-108. https://doi.org/10.1542/peds.2005-2965

[9] Davis M, *et al*. Adolescent depression screening in primary care: Who is screened and who is at risk? J Affect Disord 2022; 299: 318-325. https://doi.org/10.1016/j.jad.2021.12.022

[10] Masconi KL, Matsha TE, Erasmus RT, Kengne AP. Recalibration in Validation Studies of Diabetes Risk Prediction Models: A Systematic Review. Int J Stat Med Res 2015; 4(4): 347-369. https://doi.org/10.6000/1929-6029.2015.04.04.5

[11] Widya Sandika T, Ernianita. Tinjauan Pelaksanaan Pemeliharaan Dokumen Rekam Medis di Ruang Filing Rumah Sakit Jiwa Prof. Dr. Muhammad Ildrem Medan Tahun 2018 (Review of Medical Record Document Maintenance Implementation in the Filing Room of Prof. Dr. Muhammad Ildrem Mental Hospital. J Ilm Perekam dan Inf Kesehat Imelda 2019; 4(1): 560-566. https://doi.org/10.52943/jipiki.v4i1.77

[12] Londa A, Nur Seha H, Ratna Ningsih D. Analisis Keakuratan Kode Diagnosis Pada Pasien Mental and Behavioural Disorder Di Rsjd Dr. Rm. Soedjarwadi Klaten (Analysis of Diagnostic Code Accuracy in Patients with Mental and Behavioral Disorders at RSJD Dr. R.M. Soedjarwadi Klaten). J Permata Indones 2017; 8: 85-91. https://doi.org/10.59737/jpi.v8i2.113

[13] Maryati Y. Evaluasi Penggunaan Electronic Medical Record Rawat Jalan Di Rumah Sakit Husada Dengan Technology Acceptance Model (Evaluation of Outpatient Electronic Medical Record Use at Husada Hospital Using the Technology Acceptance Model). J Manaj Inf Kesehat Indones 2021; 9(2): 190. https://doi.org/10.33560/jmiki.v9i2.374

[14] Fenilho Y, Ilyas J. Evaluasi Penerapan Rekam Medis Elektronik Rawat Inap di RS X Bengkulu Utara: Sistem dan Pengguna (Evaluation of Inpatient Electronic Medical Record Implementation at RS X Bengkulu Utara: System and Users). J Manaj Inf Kesehat Indones 2023; 11(2): 142-149. https://doi.org/10.33560/jmiki.v11i2.583

[15] Kariotis TC, Prictor M, Chang S, Gray K. Impact of Electronic Health Records on Information Practices in Mental Health Contexts: Scoping Review. J Med Internet Res 2022; 24(5). https://doi.org/10.2196/30405

[16] Bruns EJ, *et al*. Impact of a web-based electronic health record on behavioral health service delivery for children and adolescents: Randomized controlled trial. J Med Internet Res 2018; 20(6). https://doi.org/10.2196/10197

[17] Fallucco EM, James L, Smotherman C, Greco P. Impact of Experiential Training With Standardized Patients on Screening and Diagnosis of Adolescent Depression in Primary Care. J Adolesc Heal 2019; 65(1): 57-62. https://doi.org/10.1016/j.jadohealth.2018.12.022

[18] Fallucco EM, Seago RD, Cuffe SP, Kraemer DF, Wysocki T. Primary care provider training in screening, assessment, and treatment of adolescent depression. Acad Pediatr 2015; 15(3): 326-332. https://doi.org/10.1016/j.acap.2014.12.004

[19] Etter DJ, McCord A, Ouyang F. Suicide Screening in Primary Care: Use of an Electronic Screener to Assess Suicidality and Improve Provider Follow-Up for Adolescents. Adolesc Heal 2018; 62(2): 191-197. https://doi.org/10.1016/j.jadohealth.2017.08.026

[20] Davis KAS, *et al*. Using data linkage to electronic patient records to assess the validity of selected mental health diagnoses in English Hospital Episode Statistics (HES). PLoS One 2018; 13(3): 1-15. https://doi.org/10.1371/journal.pone.0195002

[21] Koning NR, *et al*. The Usefulness of Electronic Health Records From Preventive Youth Healthcare in the Recognition of Child Mental Health Problems. Front Public Heal 2021; 9: 1-10. https://doi.org/10.3389/fpubh.2021.658240

[22] Nielsen MS, Steinsbekk, Nøst TH. Development of Recommendations for the Digital Sharing of Notes With Adolescents in Mental Health Care: Delphi Study. JMIR Ment Heal 2024; 11: 1-13. https://doi.org/10.2196/57965

[23] Hasan M, Alfarizi J, Candra Brata K, Supianto AA. Pembangunan Sistem Informasi Monitoring dan Evaluasi Pelayanan Kesehatan Orang Dalam Gangguan Jiwa (ODGJ) berbasis Web dengan Metode Waterfall (Development of a Web-Based Monitoring and Evaluation Information System for Mental Health Services for People w. J Pengemb Teknol Inf dan Ilmu Komput 2021; 5(8): 3568-3577. [Online]. Available: http://j-ptiik.ub.ac.id

[24] Leizerovitz R, Williams I, Laughlin A, Sanci L. Adolescent health presentations to Victorian general practice: a descriptive study using electronic medical records. Aust J Prim Health 31(4): 2025. https://doi.org/10.1071/PY25034

[25] Lee H, Park A. The Influence of Adverse Childhood Experiences on Suicidal Behaviors in South Korea: The Mediating Effects of Depressive Symptoms and Latent Class Analysis. J Interpers Violence 2023; 2147483647. https://doi.org/10.1177/08862605231162658

[26] Abramovitch A, *et al*. Body mass index in obsessive-compulsive disorder. J Affect Disord 2019; 245(2018): 145-151. https://doi.org/10.1016/j.jad.2018.10.116

[27] Waitzfelder B, *et al*. Treatment Initiation for New Episodes of Depression in Primary Care Settings. J Gen Intern Med 2018; 33(8): 1283-1291. https://doi.org/10.1007/s11606-017-4297-2

[28] Sattler A, *et al*. Asynchronous Versus Synchronous Screening for Depression and Suicidality in a Primary Health Care System: Quality Improvement Study. JMIR Ment Heal 2024; 11: 1-12. https://doi.org/10.2196/50192

[29] Davis KAS, Sudlow CLM, Hotopf M. Can mental health diagnoses in administrative data be used for research? A systematic review of the accuracy of routinely collected diagnoses. BMC Psychiatry 2016; 16(1): 1-11. https://doi.org/10.1186/s12888-016-0963-x

[30] Kariotis TC, Prictor M, Chang S, Gray K. Impact of Electronic Health Records on Information Practices in Mental Health Contexts: Scoping Review 2022; 24(5). https://doi.org/10.2196/30405

[31] Şoldănescu I, Lobiuc A, Dimian M. The Impact of Electronic Health Records on Healthcare: Global Benefits and Challenges. Appl Med Informatics Rev 2025; 47(1): 18-25. https://ami.info.umfcluj.ro/index.php/AMI/article/view/1119

[32] Yunengsih Y. Implementasi Rekam Medis Elektronik Guna Menunjang Efektivitas Pendaftaran Rawat Jalan di Rumah Sakit Jiwa Islam Klender (Implementation of Electronic Medical Records to Support Outpatient Registration Effectiveness at Klender Islamic Mental Hospital). J Kesehat Tambusai 2025; 6: 12253-12261.

Received on 24-02-2026 Accepted on 20-03-2026 Published on 15-04-2026

https://doi.org/10.6000/1929-6029.2026.15.12