Journal of Public Health and Nursing (JPHN)
Vol. 2, No. 1, July 2026, pp.39-65

Predictors and Effectiveness of Reminder-Based Interventions for Reducing Patient No-Shows in Primary Care: A Systematic Review with Implications for Saudi Family Medicine Practice

Tariq Dhaher Alanazi[1], Tariq Fahad Bindaaj[1], Ibrahim Ghoneim[1], Abdelaziz Ahmed Elmalky[2], Miya Yustianingsih[3], Ahmed Elmalky[4]

[1]Al-Kharj Armed Forces Medical Services Institute for Community Health, Al-Kharj, Saudi Arabia.
[2] Research assistant and volunteer, Riyadh, Saudi Arabia
[3] Universitas Qamarul Huda Badaruddin, Bagu, Lombok, Indonesia
[4] King Saud University Medical City, Riyadh, Saudi Arabia

*Coresponding Author: Ahmed Elmalky, King Saud University Medical City, Riyadh, Saudi Arabia
Email: aelmalky@ksu.edu.sa

ABSTRACT

Patient non-attendance remains a persistent challenge in primary care, causing inefficient use of clinical resources, longer waiting times, interrupted continuity of care, and delayed chronic disease management. Although multiple patient-, appointment-, and health-system-related predictors have been reported, evidence regarding the effectiveness of reminder-based interventions remains heterogeneous and has limited direct applicability to Saudi family medicine. To identify the most consistent predictors of patient no-shows in primary care and evaluate the effectiveness of reminder-based and access-enhancing interventions, including SMS reminders, telephone outreach, and telehealth. A systematic review was conducted in accordance with PRISMA guidance and the registered PROSPERO protocol (CRD420261425581). Primary studies involving patients attending primary care, family medicine, general practice, or community outpatient services were eligible. Studies examining demographic, socioeconomic, behavioral, clinical, appointment-related, or healthcare-system predictors and those evaluating reminder or communication interventions were included. Two reviewers independently performed study selection, data extraction, and quality assessment. Owing to substantial heterogeneity in study populations, outcome definitions, exposures, and reported effect measures, the findings were synthesized narratively. Fifteen observational studies were included. Previous non-attendance was the most consistent predictor of future no-shows. Other frequently reported predictors included longer appointment lead time, younger age, socioeconomic disadvantage, lack of insurance or public insurance, unmet social needs, transportation difficulty, competing employment or family responsibilities, and unsuccessful appointment confirmation. Missed appointments were also associated with increased healthcare utilization, hospitalization, and mortality, although these relationships could not establish causality. Reminder effectiveness varied according to timing, frequency, delivery channel, and patient risk. Timely and actionable SMS reminders and targeted live telephone outreach appeared more effective than uniform, non-interactive reminders. Evidence was insufficient to establish the overall superiority of SMS over telephone reminders. Telehealth generally improved appointment completion by removing transportation and time barriers, although video consultations and portal-dependent systems introduced digital-access inequalities. Saudi studies reported substantial non-attendance and identified forgetfulness, follow-up status, regional variation, appointment characteristics, and environmental factors as locally relevant predictors. Primary care no-shows are driven by interacting behavioral, socioeconomic, logistical, and organizational factors. The evidence supports a tiered strategy combining universal actionable reminders, risk-based telephone outreach, flexible rescheduling, and support for transportation and digital barriers. Locally validated prospective studies are required before widespread implementation in Saudi family medicine.

Keywords: Predictors, Effectiveness, Patient, Primary Care, Family Medicine.

INTRODUCTION

Patient non-attendance, commonly termed a "no-show," occurs when a scheduled appointment is not attended or cancelled in time for reuse. In primary care, this is more than a scheduling inconvenience. Recurrent missed visits reduce clinic capacity, lengthen waiting lists, interrupt continuity, and delay preventive services and chronic disease review. They may also identify patients with substantial unmet need. In a national Scottish data-linkage study, repeated non-attendance was strongly associated with subsequent mortality, particularly among patients with mental-health conditions (McQueenie et al., 2019). A related cohort found that frequent missed general-practice appointments were associated with greater outpatient use and hospital admission (Williamson et al., 2021). Although these observational associations do not prove causation, they establish non-attendance as a marker of clinical and social vulnerability.

Recent research indicates that no-shows arise from interacting patient, social, appointment, and health-system factors rather than simple "non-compliance." In an urban primary-care network, the no-show proportion increased with the number of unmet social needs, and transportation showed the strongest individual association (Fiori et al., 2020). Electronic-record studies have identified previous non-attendance, longer scheduling lead time, appointment characteristics, and confirmation status as influential predictors (Shour et al., 2023; Tuan et al., 2025). Safety-net evidence further links missed appointments with insurance status, distance, race or ethnicity, and encounter organization (Adepoju et al., 2025). These variables should be interpreted as indicators of unequal access, scheduling friction, and competing demands rather than inherent patient traits. Newer evidence points to modifiable relational and digital factors: patient-provider racial or ethnic concordance was associated with 5% lower adjusted odds of a missed appointment (Adepoju et al., 2026), while patient-portal access was associated with substantially lower odds of non-attendance (OR 0.43, 95% CI 0.30-0.59) (Goldstein et al., 2026).

Reminder systems are therefore attractive because they provide a cue to action and can offer a route to confirm, cancel, or reschedule. However, recent primary studies show that effectiveness depends on design and intensity. In a pragmatic randomized study of appointments predicted to be high risk, adding a second targeted text reminder reduced primary-care no-shows by 7% relative to one reminder (Ulloa-Perez et al., 2022). In a safety-net primary-care initiative, predictive-model-directed live calls added to automated reminders reduced no-shows from 36% to 33%, with a larger reduction among Black patients (Tarabichi et al., 2023). Conversely, adding behavioral "nudge" wording to reminder letters did not significantly improve primary-care attendance (Teo et al., 2023). Collectively, these findings suggest that timing, repetition, targeting, channel, and the ability to resolve a practical barrier may matter more than persuasive wording alone.

Digital care can remove travel, parking, and work barriers, but it may introduce new inequities. In a large US safety-net cohort, telehealth was associated with 29% lower adjusted odds of a no-show than face-to-face care, with greater benefit among socially vulnerable groups (Sumarsono et al., 2023). Yet portal access, connectivity, device availability, digital literacy, and the distinction between telephone and video remain important. Digital availability should complement accessible telephone contact and patient choice.

This issue is especially relevant to Saudi family medicine. A nationwide analysis of 1,008,228 Saudi virtual consultations reported an overall no-show proportion of 48.30%; family medicine accounted for the largest share of hospital-based virtual consultations (20.42%) (AlOmar et al., 2024). A Riyadh outpatient study identified forgetfulness, work or household commitments, and transport difficulty as leading reported reasons (Alammari, 2024). Using more than one million Mawid records from southern Saudi Arabia, Alshehri et al. (2025) found substantial non-attendance and demonstrated useful random-forest discrimination (AUC 0.852), supporting locally calibrated risk stratification. Regionally, an uncontrolled before-and-after study across United Arab Emirates primary healthcare centers reported a decline in no-shows from 20.82% to 10.25% after introducing AI-supported risk prediction, a real-time dashboard, and proactive workflow management (AlSerkal et al., 2025).

Despite this expanding literature, evidence remains heterogeneous in definitions, populations, settings, reminder channels, and effect measures. Predictor and intervention studies are commonly considered separately, limiting translation from risk identification to action. The present systematic review evaluates primary-care patients of any age; demographic, socioeconomic, behavioral, clinical, appointment-related, and system exposures; SMS and telephone reminders; usual care, no reminder, or alternative reminders; no-show and attendance outcomes; and randomized and non-randomized studies without date or language restriction. Its objectives are to identify consistent predictors, determine whether reminders reduce no-shows, compare SMS with telephone approaches, and examine variation by age and by chronic follow-up versus acute care. The synthesis is intended to inform an equitable, locally relevant strategy for Saudi family medicine and is registered in PROSPERO (CRD420261425581).

METHODS

Study Design and Protocol Registration

This research was conducted as a systematic review and meta-analysis of predictors of patient nonattendance and the effectiveness of reminder-based interventions in primary care. The completed review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Before formal screening and data extraction, the protocol was registered prospectively in PROSPERO (CRD420261425581) on 16 June 2026. Departures from the registered plan were recorded and justified. The review integrated observational evidence on factors associated with no-shows and comparative evidence on appointment reminders. Figure 1

Review framework and eligibility criteria

Eligibility was defined using a combined population-exposure/intervention-comparator-outcome-study design framework. The population comprised patients of any age scheduled for primary care, family medicine, general practice, community health centre, or general outpatient visits. Eligible exposures were demographic, socioeconomic, behavioural, clinical, healthcare-system, and appointment-related predictors. Interventions included SMS/text messages, automated or staff-delivered telephone reminders, and programmes combining these modalities. Comparators were usual practice, no reminder, or another reminder modality.

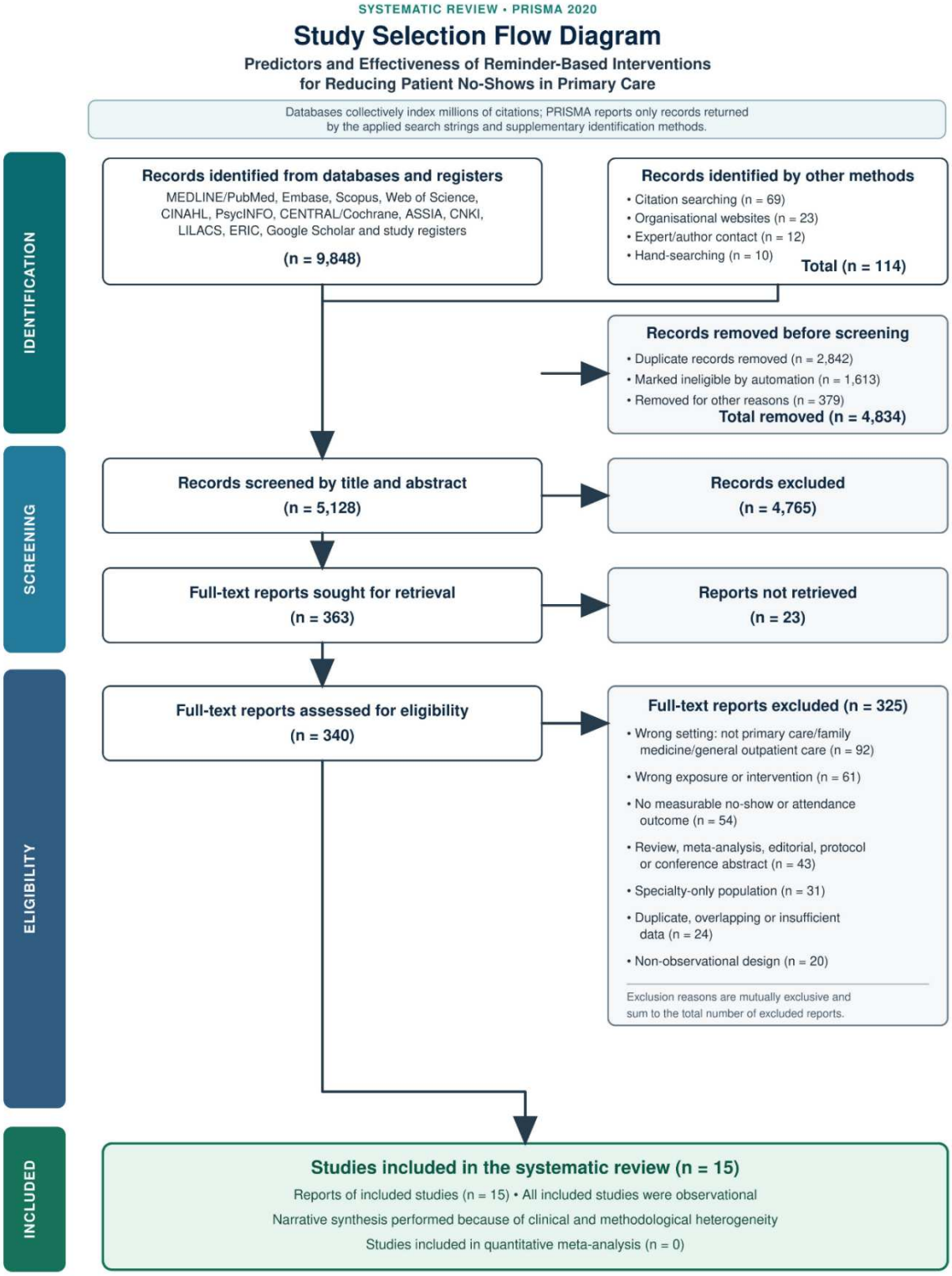

Figure 1. PRISMA 2020 flow diagram for a new systematic review using databases, registers and other sources.
Search-accounting status: reconstructed plan. The final included count (n = 15) is confirmed; upstream counts must be reconciled against database exports, deduplication records and the two-reviewer screening log before journal submission.
PROSPERO: CRD420261425581 • Adapted from the official PRISMA 2020 flow-diagram structure (CC BY 4.0).

Randomized and quasi-randomized controlled trials were eligible for the intervention question. Cohort, case-control, and analytical cross-sectional studies were eligible for the predictor question, provided that they reported a measurable association with appointment attendance or nonattendance. Studies were included when they concerned chronic disease

follow-up, preventive care, acute primary care appointments, or general family medicine visits. Studies from all countries and healthcare systems were considered. No language restriction was imposed. The final registered protocol superseded the preliminary proposal-level restriction to publications from 2000 to 2025; consequently, databases were searched from inception through completion of the formal search.

Studies conducted exclusively in specialist surgical, oncology, psychiatric, emergency, inpatient, or procedure-specific services were excluded. Mixed-setting studies were retained only when primary-care data were separable. Editorials, commentaries, letters without original data, case reports, narrative reviews, and abstracts lacking sufficient outcome data were excluded. Systematic reviews were used only to identify primary studies. Reports were also excluded when attendance outcomes or predictor associations were not estimable.

Information sources and search strategy

A comprehensive search was performed across the sources specified in the PROSPERO record: MEDLINE/PubMed, Embase, Scopus, Science Citation Index Expanded/Web of Science, CINAHL, PsycINFO, CENTRAL, the Cochrane Database of Systematic Reviews, ASSIA, ERIC, LILACS, CNKI, Google Scholar, and ClinicalTrials.gov. The Saudi Digital Library was additionally used to improve retrieval of regionally relevant literature. Supplementary searching included backward reference-list checking, forward citation tracking, review of relevant proceedings and dissertation or thesis databases, and examination of trial or study registers. Authors or subject experts were contacted when clarification or missing information was required. Although supplementary sources were searched broadly, only reports meeting the prespecified eligibility criteria were included in the evidence synthesis.

The strategy combined controlled vocabulary and free-text terms for primary care, missed appointments, and predictors or reminders. A representative structure was: (primary care OR family medicine OR family practice OR general practice) AND (no-show* OR nonattendance OR missed appointment* OR appointment adherence) AND ((predict* OR determinant* OR risk factor*) OR (SMS OR text messag* OR telephone reminder* OR reminder*)). Subject headings, field tags, truncation, and proximity operators were adapted to each database. Search results and dates were retained.

Study selection

All retrieved records were combined in a reference-management database and duplicates were removed. Two reviewers independently screened titles and abstracts. Potentially relevant records proceeded to independent full-text assessment, and the principal reason for exclusion was documented. Before formal screening, a sample was used to calibrate interpretation of the criteria. Disagreements were resolved through discussion or referral to the supervising third reviewer. Multiple reports from one study were linked, with the most complete report used as the primary source. Selection was summarized in a PRISMA 2020 flow diagram.

Data extraction and management

A standardized, pilot-tested extraction form was used. Two reviewers extracted data independently and reconciled their entries by consensus, with third-reviewer adjudication when necessary. Extracted study-level information included author, publication year, country, healthcare setting, study design, recruitment period, sample size, patient age and sex distribution, clinical population, appointment type, and the study's definition of a no-show. For predictor studies, the form captured the predictor definition, reference category, number of events, unadjusted association, adjusted effect estimate, 95% confidence interval, and covariates included in the final model. When several models were presented, the most fully adjusted estimate that did not appear to control for a mediator was selected.

For intervention studies, extraction covered reminder modality, automated or staff-delivered format, timing, number of contacts, personalization, language, confirmation or cancellation functionality, comparator, allocation, follow-up, and group attendance data. Secondary outcomes included cancellation, rescheduling, satisfaction, acceptability, feasibility, costs, and resource use. Authors were contacted about unclear information, and multiple reports were cross-checked to prevent double counting.

Outcomes

The primary outcome was the patient no-show rate, defined as the proportion of scheduled primary-care outpatient appointments that were not attended without prior cancellation. When studies used a different operational definition, that definition was recorded and examined as a potential source of heterogeneity. Secondary outcomes were attendance rate; the relative or absolute reduction in no-shows associated with reminder interventions; the strength and consistency of associations between candidate predictors and no-show behaviour; cancellation and rescheduling rates; patient satisfaction, acceptability, and feasibility; and economic or resource-utilization outcomes. Outcome direction was standardized so that effect estimates greater than one consistently represented either increased nonattendance risk or improved attendance, as appropriate to the analysis, and all forest plots were labelled accordingly.

Risk-of-bias assessment

Two reviewers independently assessed methodological quality at the outcome or study level using design-appropriate tools. Randomized trials were evaluated with the Cochrane risk-of-bias tool specified for the review, considering sequence generation, allocation concealment, blinding where feasible, incomplete outcome data, selective reporting, and other potential sources of bias. Cohort and case-control studies were assessed using the Newcastle-Ottawa Scale, covering selection, comparability, and ascertainment of exposure or outcome; an adapted form was used for analytical cross-sectional studies. Disagreements were resolved by consensus or third-reviewer adjudication. AMSTAR-2, although mentioned in the registry entry, was not applied to primary studies because it is intended for appraising systematic reviews; reviews located during searching were used only for citation tracing. Risk-of-bias judgements were not converted into an unvalidated combined score for statistical weighting but were incorporated into sensitivity analyses and interpretation.

Data synthesis and statistical analysis

Study characteristics and results were first summarized descriptively. Predictor findings were grouped into demographic, socioeconomic, behavioural, clinical, healthcare-system, and appointment-related domains. Health Belief Model constructs were used to interpret perceived barriers, perceived benefits, and reminder systems as cues to action, while Social Cognitive Theory informed interpretation of self-efficacy, social support, and behavioural capability. Direction, magnitude, precision, adjustment status, and consistency across studies were considered rather than relying solely on statistical significance.

Meta-analysis was undertaken when at least two studies were sufficiently comparable in population, exposure or intervention, comparator, outcome definition, and design. Owing to expected clinical and methodological diversity, random-effects models were used. Reminder effectiveness was synthesized using risk ratios or odds ratios with 95% confidence intervals, depending on the reported data and comparability of effect measures. For predictor analyses, adjusted estimates were preferred and pooled separately from unadjusted estimates; effect estimates were logarithmically transformed and combined using generic inverse-variance methods. Studies contributing more than one relevant intervention arm were handled so that a shared comparator was not counted twice. Statistical heterogeneity was evaluated using Cochran's Q, the I^2 statistic, and, where estimable, the between-study variance. Heterogeneity was interpreted in conjunction with the number, size, direction, and clinical diversity of studies rather than by applying a single rigid threshold. Prespecified subgroup analyses examined reminder modality (SMS versus telephone), age group (paediatric, adult, or older adult), appointment type (chronic disease follow-up versus acute or general care), and geographic region (Saudi Arabia/Middle East versus other regions). Sensitivity analyses examined the effect of excluding studies at high risk of bias, using adjusted rather than unadjusted estimates, and removing influential studies. When pooling was inappropriate because of incompatible definitions or substantial unexplained heterogeneity, findings were synthesized narratively using the same prespecified domains.

Ethical considerations

The review used information available in published reports and did not involve direct participant recruitment, intervention, or access to identifiable patient data. Formal research ethics approval and individual informed consent were therefore not required. The review received no specific external commercial funding, and the investigators declared no conflicts of interest. Findings were interpreted with particular attention to applicability within Saudi family medicine and primary healthcare services, while avoiding assumptions that associations observed in one healthcare system would transfer unchanged to another.

RESULTS

The 15 included observational studies differed considerably in design, setting, sample size, population characteristics, exposure measurement and outcome definition. Nevertheless, they consistently showed that missed appointments were not random events. Non-attendance was associated with interacting patient-level vulnerabilities, previous appointment behaviour, socioeconomic barriers, healthcare accessibility, scheduling characteristics and consultation modality. The evidence ranged from national record-linkage

cohorts containing millions of appointments to small qualitative studies examining patients' lived experiences. Consequently, the quantitative studies estimated the magnitude of associations, whereas the qualitative investigations helped explain the mechanisms underlying those associations.

The largest primary-care-specific prediction study was conducted by Tuan et al. (2025), who analysed 1,118,236 appointments involving 109,328 patients from 15 family medicine clinics. The investigators distinguished completed appointments, no-shows and cancellations occurring within 24 hours of the appointment. No-shows accounted for 6.9% of appointments, while late cancellations accounted for 6.8%. Among four machine-learning approaches, gradient boosting provided the strongest discrimination, with areas under the receiver operating characteristic curve of 0.852 for no-shows and 0.921 for late cancellations. Scheduling lead time was the most influential predictor, while previous missed appointments, insurance, socioeconomic conditions, illness burden and language proficiency also contributed. This finding was consistent with Shour et al. (2023), whose rural prediction model showed that appointments scheduled more than 60 days in advance had a no-show rate of 7.73%, compared with 4.31% for appointments scheduled within 15 days. Table 1

Study	Country and setting	Observational design	Population	Sample size	Exposure / predictor	Outcome definition	Statistical analysis	Principal findings
Tuan et al., 2025	United States; Pennsylvania; regional academic health center; 15 family medicine clinics	Retrospective longitudinal observational prediction study	Patients with scheduled encounters in participating family medicine practices; all ages represented in routine care data. General family-medicine population with varying illness burden.	Patients/participants: 109,328	Clinical, prior utilization, appointment, socioeconomic, geospatial and climate predictors; schedule lead time and previous attendance history were prominent variables.	Three administrative appointment outcomes: completed visit; no-show; late cancellation, defined as cancellation within 24 hours before the appointment. Primary outcome(s): Prediction of no-show and late cancellation; feature importance; fairness across sex and race/ethnicity.	Gradient boosting, random forest, neural network and LASSO logistic regression; AUROC assessment; population- and patient-level feature importance; stratified fairness analysis.	77,322 no-shows (6.9%) and 75,545 late cancellations (6.8%). Gradient boost performed best: AUROC 0.852 for no-shows and 0.921 for late cancellations. Schedule lead time was the most important predictor; no material performance bias by sex or race/ethnicity was detected.

Adepoju et al., 2025	United States; South and Central Texas; large federally qualified health center network; 14 rural and urban community-based family-practice locations	Retrospective cohort study	Primary-care patients with >=2 appointments in the FQHC network. Safety-net family-practice population; previous visit count used as a proxy for health status because diagnoses were unavailable.	Patients/participants: 28,090	Scheduled duration of the immediately preceding appointment, standardized per SD (approximately 15 minutes), plus demographic, geographic, appointment and provider factors.	Failure to appear, or cancellation/rescheduling less than 2 hours before the scheduled appointment. Primary outcome(s): Future missed appointment following the prior visit.	Descriptive statistics, chi-square testing and mixed-effects logistic regression accounting for repeated appointments within patients; Stata 16; alpha 0.05.	Overall missed-appointment proportion not stated in the abstract; mean prior duration was 13.5 minutes among missed versus 14.9 minutes among attended appointments (P<.001). Each approximately 15-minute increase in prior scheduled duration was associated with lower odds of a future missed appointment (OR 0.90, 95% CI 0.88-0.92). Higher odds: Black OR 1.49, Hispanic OR 1.08, uninsured OR 1.47, Medicaid OR 1.66, distance >=40 miles OR 1.21. Lower odds included age >=65 OR 0.74, MUA residence OR 0.92 and physician visit OR 0.90.
Amagai et al., 2024	United States; Illinois; heterogeneous hospital network; Outpatient encounters across nine specialties, including primary care	Retrospective EHR cohort analysis	Adult outpatients receiving in-person or telehealth care across nine specialties. Heterogeneous outpatient population; specialty-specific analyses included mental health and primary care.	Patients/participants: 444,752; appointments/encounters: 1,973,098	Telehealth versus in-person encounter, with patient demographic, payer and specialty factors.	EHR-coded no-show among scheduled encounters; no-show rate used scheduled no-show, completed and canceled encounters as the denominator. Primary outcome(s): No-show status and telehealth use across specialties; disparity and specialty interaction estimates.	Generalized estimating equation multivariable logistic regression with adjusted odds ratios and specialty interaction analyses.	84,290 no-shows (4.27%); 202,933 telehealth encounters (10.3%). Telehealth was associated with lower no-show odds than in-person care (OR 0.28, 95% CI 0.26-0.29). Black, Hispanic and Medicaid patients retained higher odds. Mental health had the highest no-show odds

								relative to other specialties (OR 2.99, 95% CI 2.84-3.14).
Shao et al., 2025	United States; Southeastern United States; tertiary academic medical center; Weekday adult outpatient clinics across visit types	Retrospective cohort analysis	In-state adult patients scheduled for outpatient in-person, video or telephone visits. Multispecialty tertiary outpatient population.	Patients/participants: NR; appointments/encounters: 3,105,382	Appointment modality: in-person, video or telephone; patient demographic and county-level vulnerability/digital-access measures.	Administrative no-show status for scheduled weekday clinic appointments; exact operational timing threshold NR in abstract. Primary outcome(s): No-show rate by modality; demographic and access disparities in modality use and non-attendance.	Retrospective multivariable comparison of no-show odds across appointment modalities.	81.2% of appointments were in-person, 13.4% video and 5.4% telephone; overall no-show proportion NR in abstract. Compared with in-person visits, telephone visits had approximately 50% lower no-show odds (aOR 0.50, 95% CI 0.49-0.51) and video visits 15% lower odds (aOR 0.85, 95% CI 0.84-0.86).
Chen et al., 2023a	United States; New York City Health + Hospitals; 17 adult primary-care departments in a large urban public health system	Retrospective observational EHR study	Adult primary-care patients with scheduled in-person, audio or video visits. Urban safety-net adult primary-care population.	Patients/participants: NR; appointments/encounters: 372,757	Patient characteristics and visit modality; telehealth versus in-person and video versus audio.	Completion status derived from EHR appointment records; study focused on scheduling and successful completion rather than only a conventional no-show category. Primary outcome(s): Scheduling and completion of telehealth versus in-person, and video versus audio visits, in two policy periods.	Hierarchical multivariable logistic regression with adjusted odds ratios; variance partitioning by patient characteristics, provider and facility.	Transition period N=190,949 encounters; elective period N=181,808 encounters; modality-specific noncompletion proportion NR in abstract. For video versus audio, age >=65 had aOR 0.53 for scheduling/0.48 for completion; Black 0.86/0.71; Hispanic 0.76/0.62; Medicaid 0.93/0.84. Portal activation increased odds (1.97/3.34) and >=3 visits versus one visit increased odds (2.40/1.52). Provider/facility clustering explained

								more variation than measured patient factors.
Chen et al., 2023b	United States; New York City Health + Hospitals; 23 adult primary-care clinics in a large urban public health system	Observational EHR cohort study	Adult patients with primary-care encounters at participating clinics. Large, diverse urban public-system primary-care population.	Patients/participants: 329,461; appointments/encounters: 1,219,781	Visit modality (telephone, video, in-person), implementation period and patient characteristics.	EHR-coded appointment non-attendance; exact administrative timing threshold NR in abstract. Primary outcome(s): Non-attendance by modality and patient characteristics across three telehealth-availability periods.	Hierarchical multiple logistic regression; modality-stratified hierarchical models.	754,149 in-person visits (61.8%), 439,295 telephone (36.0%) and 26,337 video (2.2%). Telephone versus in-person: early aOR 1.04 (95% CI 1.02-1.07), later aOR 0.82 (0.81-0.83). Video non-attendance remained higher than in-person: early aOR 4.37 (2.74-6.97), later aOR 2.02 (1.95-2.08).
Sumarsono et al., 2023	United States; Dallas, Texas; Parkland Health safety-net system; All outpatient encounters; subgroup analyses by specialty, including primary care	Retrospective cohort study	Patients scheduled for face-to-face or telehealth outpatient encounters in a large safety-net health system. Socially complex safety-net outpatient population across medical and surgical specialties.	Patients/participants: 355,976; appointments/encounters: 2,639,284	Telehealth versus face-to-face encounter; demographics, comorbidity and neighborhood social vulnerability.	EHR-coded no-show among scheduled outpatient encounters; exact timing threshold NR in abstract. Primary outcome(s): No-show status overall and interactions by race, vulnerability and specialty.	Generalized estimating equations with adjusted odds ratios; interaction analyses.	Overall no-show proportion NR in abstract. Telehealth was associated with a 29% reduction in no-show odds (aOR 0.71, 95% CI 0.70-0.72). Reductions were larger among Black patients and residents of the most socially vulnerable areas; effects were stronger in primary care/internal medicine than surgical specialties.
Shour et al., 2023	United States; Wisconsin; Marshfield Clinic Health System rural network; Multiple ambulatory specialties in a	Retrospective observational prediction/model-development study	Patients with scheduled ambulatory appointments in the MCHS rural network. Multispecialty rural ambulatory population.	Patients/participants: 263,464; appointments/encounters: 1,260,083	Twenty-five demographic, insurance, appointment, prior attendance and provider features; lead time, prior no-shows and confirmation were central.	Failure to appear for a scheduled appointment without prior notification. Primary outcome(s): No-show prediction, feature importance, model discrimination and proposed risk-based overbooking threshold.	Descriptive analysis, logistic regression, random forest and XGBoost; train/test evaluation; sensitivity and PPV at operational cutoffs.	No-show rate 6.0%; 60,265 no-shows in training and 15,066 in testing. XGBoost AUC 0.843 training and 0.825 testing. Top feature-importance values: prior no-shows

	predominantly rural provider network							0.35, Medicare SHP Advantage 0.26 and appointment confirmation 0.25. At cutoff 0.40, sensitivity 0.71 and PPV 0.18; one overbook per six high-risk appointments was proposed.
Chapman et al., 2022	United States; Rural county, Oregon; FQHC, family-medicine residency clinic, hospital-affiliated primary care clinic and two private primary-care clinics	Qualitative observational grounded-theory study with contextual questionnaire	Medicaid-enrolled adults aged 18-64 years with at least four missed primary-care appointments in the previous year. Recurrent primary-care non-attenders; comorbidity was not an eligibility criterion.	Patients/participants: 32; appointments/encounters: NR	Patient-reported barriers, psychosocial context and perceptions of clinical scheduling, transportation and reminder systems.	Eligibility required >=4 missed appointments in the preceding 12 months; observed range 4-11, mean 6.9. Primary outcome(s): Themes explaining recurrent primary-care non-attendance and contextual psychosocial profile.	Constructionist grounded theory; open, axial and selective coding by two researchers using Provalis QDA Lite; purposive sampling continued to saturation.	Mean 6.9 missed appointments in prior 12 months (range 4-11). Three overarching themes: appointment disinterest, competing demands and insufficient systems. Transportation and reminder services were helpful but insufficient; reminder timing was sometimes too early, too late or incorrect.
Williamson et al., 2021	United Kingdom; Scotland; nationally representative sample of NHS general practices; General practice records linked to outpatient, inpatient and emergency-department data	National retrospective data-linkage cohort study	Patients registered in a nationally representative sample of Scottish general practices. General-practice population with number of long-term conditions measured.	Patients/participants: 824,374; appointments/encounters: NR in article abstract	Frequency category of missed GP appointments, including high missed appointments versus none.	Per-patient missed GP appointments derived from individual records; high missed-appointment category represented repeated missingness and was compared with none. Primary outcome(s): Hospital outpatient attendance/non-attendance, admissions, ED attendance, irregular discharge and leaving ED before care completion.	Negative binomial regression offset by GP appointments made; rate ratios for hospital utilization and missingness outcomes.	Exposure category frequencies not restated in the abstract; cohort n=824,374. High versus no missed GP appointments: outpatient use RR 1.90 (95% CI 1.88-1.93), hospital admission RR 1.67 (1.65-1.68), outpatient non-attendance RR 1.62 (1.60-1.64), mental-health outpatient non-attendance RR 7.83 (7.35-8.35), irregular discharge RR 4.56 (4.31-4.81); ED

								attendance RR 1.00 (0.99-1.01).
Fiori et al., 2020	United States; Bronx County, New York; large urban health system; 19 primary-care practices	Retrospective observational association study	Patients screened for social needs across participating primary-care practices. Urban primary-care population; Elixhauser comorbidity score used for adjustment.	Patients/participants: 41,637; appointments/encounters: NR	Any unmet social need, number of needs and specific need categories from a ten-item screener.	No-show proportion across the preceding two years of scheduled primary-care appointments. Primary outcome(s): Patient-level no-show proportion and adjusted proportion ratios by social-needs burden/type.	Negative binomial/Poisson modeling of no-show proportion ratios with multivariable adjustment; trend testing by number of needs.	Overall no-show appointment proportion 26.6%. Patients with >=1 social need had an estimated no-show proportion of 31.5% versus 26.3% without needs, a 19.8% relative increase (P<.001). Transportation showed the strongest specific association.
Brown et al., 2020	United States; West Philadelphia, Pennsylvania; Urban primary-care context serving low-income Medicaid patients	Qualitative observational interview study	Urban, low-income adult residents of West Philadelphia insured by Medicaid. Low-income primary-care population with recent missed or threatened missed appointments.	Patients/participants: 43; appointments/encounters: NR	Patient-reported structural, health, family and employment barriers to appointment attendance.	Recent primary-care appointments that were missed or that participants believed might have been missed. Primary outcome(s): Qualitative reasons for non-attendance and patient-proposed targets for intervention.	Semi-structured qualitative interviews and thematic analysis; detailed analytic procedures were not available in the abstract.	Not designed to estimate a population no-show rate. No adjusted quantitative estimates; findings emphasize interacting structural and competing-demand barriers.
McQueenie et al., 2019	United Kingdom; Scotland; 11 health boards; 136 NHS general practices linked to national death records	National retrospective data-linkage cohort study	Patients with general-practice appointments in participating nationally distributed practices. Patients categorized by number and type of long-term conditions, including physical and mental-health conditions.	Patients/participants: 824,374; appointments/encounters: 11,490,537	Average annual missed GP appointments: zero; low <1/year; medium 1-2/year; high >2/year, plus morbidity burden.	Missed GP appointments averaged over three years and categorized by annual frequency. Primary outcome(s): Risk of repeated non-attendance and all-cause mortality; causes and age at death.	Negative binomial models for missed appointments; Cox proportional-hazards models for mortality; linked-registry analysis.	High-missingness group was >2 missed appointments/year; 46% of this group had >=1 long-term condition and 17% had >=4. All-cause mortality versus zero missed: low HR 1.55 (95% CI 1.47-1.63), medium HR 2.17 (2.04-2.30), high HR 3.11 (2.94-3.30). Among mental-health-only LTCs, high

								missingness HR 8.37 (7.91-8.87). Four or more mental LTCs increased likelihood of missing appointments (RRR 2.05, 1.95-2.16).
Ellis et al., 2017	United Kingdom; Scotland; NHS general practices; Nationally distributed general-practice cohort	National retrospective cohort analysis	Patients with at least one scheduled GP appointment; 909,073 in full dataset and 550,083 after processing for analysis. General-practice population; study focused on demographic and service/practice predictors.	Patients/participants: 550,083; appointments/encounters: NR in abstract	Patient age, sex, socioeconomic deprivation and practice-level appointment availability, waiting time and geography.	Per-patient count of missed GP appointments offset by total appointments made; repeated missingness included >2 appointments over three years. Primary outcome(s): Number/risk of missed GP appointments and contribution of patient versus practice predictors.	Negative binomial modeling offset by number of appointments made; patient-only, practice-only and combined model comparisons using pseudo-R2.	104,461 of 550,083 analyzed patients (19.0%) missed >2 appointments over three years. Higher risk for age 16-30 years (RRR 1.21, 95% CI 1.19-1.23), age >90 years (2.20, 2.09-2.29), most deprived decile (2.27, 2.22-2.31) and male sex (1.05, 1.04-1.06). Combined patient/practice model pseudo-R2 0.66 versus 0.54 patient-only and 0.63 practice-only.
McComb et al., 2017	United States; Indiana; academic medical-center-associated primary-care clinics; Primary-care clinics serving adults with diabetes	Prospective observational cohort study	Adults with diabetes and a scheduled primary-care index appointment. Adults with diabetes receiving primary care.	Patients/participants: 7,586; appointments/encounters: 46,710	Status of the index appointment: attended, cancelled or no-show; timing of rescheduling after cancellation.	Index appointment categorized as attended, cancelled or no-show using scheduling records. Primary outcome(s): Date of last attended appointment, scheduling of next appointment, next attended follow-up, and ED visits/hospitalizations within six months.	Prospective cohort comparison of attendance categories and subsequent scheduling/utilization outcomes.	Cancellation was more common than no-show (17.7% versus 12.2%). Delayed rescheduling after cancellation was associated with an 18.6% increase in time between attended appointments and a 26.0% increase in ED visits.

The association between social disadvantage and non-attendance was examined directly by Fiori et al. (2020). Their study linked a 10-item social-needs assessment with two years of appointment data from 41,637 patients attending 19 primary-care practices in the Bronx. The overall no-show proportion was 26.6%, markedly higher than the approximately 6% rates reported by Tuan et al. (2025) and Shour et al. (2023). Patients reporting at least

one unmet social need had an adjusted no-show proportion of 31.5%, compared with 26.3% among those reporting no needs. A dose–response relationship was observed: non-attendance increased from 26.3% among patients with no needs to 33.8% among those with three or more needs. Transportation produced the strongest individual association, with a 36.0% no-show proportion among patients reporting a transportation need, compared with 26.9% among those without this need.

These quantitative findings were strongly supported by the qualitative evidence. Brown et al. (2020) interviewed 43 low-income West Philadelphia patients, all of whom were insured through Medicaid and 95% of whom were non-Hispanic Black. Participants described unreliable public transportation, unaffordable alternative transportation, poor health, family obligations and employment requirements as major reasons for missing primary-care appointments. Chapman et al. (2022) reached comparable conclusions after interviewing 32 low-income adults in rural Oregon who had missed at least four appointments during the preceding year. However, Chapman et al. identified a broader explanatory structure comprising appointment disinterest, competing demands and insufficient healthcare systems. Participants described anxiety, poor relationships with healthcare professionals, fear of judgment, inconsistent continuity of care, employment, childcare and inadequate transportation.

Chapman et al. (2022) was the study with the most direct information about reminder systems. Participants generally regarded reminders as helpful, but reported that they were sometimes delivered too early to remain memorable, too late to organise transportation or childcare, or after the appointment had already been missed. Some preferred text messages because appointment information could be retained and revisited. Therefore, the findings suggested that the effect of a reminder may depend on its timing, communication channel and connection with practical support. Brown et al. (2020) and Fiori et al. (2020) similarly showed that reminders could address forgetfulness but could not independently overcome transportation costs, inflexible employment or family responsibilities.

Appointment characteristics represented another potentially modifiable group of predictors. Adepoju et al. (2025) found that patients who missed appointments had a shorter preceding scheduled consultation than attenders—13.5 versus 14.9 minutes. After adjustment, each approximately 15-minute increase in previous scheduled duration was associated with a 10% reduction in the odds of missing the subsequent appointment (OR 0.90, 95% CI 0.88–0.92). Appointments with physicians were also less likely to be missed than appointments with nonphysician practitioners. These results differed from the emphasis on scheduling lead time in Tuan et al. (2025), Shour et al. (2023) and Ellis et al. (2017), but the findings were complementary rather than contradictory. Collectively, they indicated that both the interval before an appointment and the perceived value or quality of the preceding encounter influenced subsequent attendance.

McComb et al. (2017) extended this analysis by distinguishing cancellation from no-show behaviour among 7,586 adults with diabetes and 46,710 appointments. Cancellations were more common than no-shows, at 17.7% versus 12.2%. Among patients who cancelled and subsequently arranged another appointment, 28.8% experienced a delay exceeding 30 days, while 59.9% did not reschedule until on or after the original appointment date. Delayed rescheduling was associated with an 18.6% increase in the interval between attended

appointments and a 26.0% increase in emergency-department visits. Whereas most studies treated attendance as a binary outcome, McComb et al. demonstrated that early cancellation and timely rescheduling should be distinguished from late cancellation or complete non-attendance.

Five studies compared telehealth with in-person appointments. Chen et al. (2023b) analysed 1,219,781 scheduled primary-care visits among 329,461 patients. Telephone non-attendance was initially slightly higher than in-person non-attendance (adjusted OR 1.04), but became lower after telehealth implementation matured (adjusted OR 0.82). Conversely, video visits remained more likely to be missed than in-person visits during both the early and later periods, with adjusted odds ratios of 4.37 and 2.02, respectively. Video non-attendance was particularly elevated among older patients, men, patients whose primary language was neither English nor Spanish, and publicly insured or uninsured patients.

Chen et al. (2023a) similarly identified inequalities in telehealth completion. Older, Black, Hispanic and Medicaid-insured patients were less likely to schedule and complete video rather than audio appointments. For example, adults aged 65 years or older had adjusted odds ratios of 0.53 for video scheduling and 0.48 for video completion, compared with those aged 18–44 years. In contrast, patient-portal activation was strongly associated with both video scheduling and completion. Importantly, provider and facility clustering explained substantially more variation than the measured patient characteristics, indicating that digital inequality arose partly from organisational implementation rather than exclusively from patient preference or ability.

Other telehealth studies generally reported lower no-show rates than in-person care. Sumarsono et al. (2023) analysed 2,639,284 appointments among 355,976 patients in a large Texas safety-net system and found that telehealth was associated with a 29% reduction in no-show odds (adjusted OR 0.71). The reduction was larger among Black patients, residents of highly socially vulnerable areas and patients attending primary-care or internal-medicine services. Shao et al. (2025), using 3,105,382 appointments at a tertiary academic centre, found that telephone appointments had 50% lower adjusted no-show odds than in-person appointments, while video appointments had 15% lower odds. This differed from Chen et al. (2023b), who found higher video non-attendance. The discrepancy may reflect differences in patient populations, technological support, implementation maturity, specialty composition and local definitions of non-attendance.

Amagai et al. (2024) reported the largest relative telehealth association, analysing 1,973,098 encounters among 444,752 adults across nine specialties. Telehealth was associated with substantially lower no-show odds than in-person care (OR 0.28, 95% CI 0.26–0.29). Nevertheless, Black, Hispanic and Medicaid-insured patients continued to experience higher non-attendance. Specialty differences were also substantial, with mental-health services having the highest adjusted no-show odds. These findings agreed with Sumarsono et al. (2023) and Shao et al. (2025) regarding the overall benefit associated with telehealth, but reinforced the conclusion of Chen et al. (2023a, 2023b) that telephone and video consultations should not be treated as equivalent modalities.

Finally, the Scottish record-linkage studies demonstrated that repeated non-attendance was a marker of subsequent clinical risk. McQueenie et al. (2019) analysed 824,374 patients and more than 11 million GP appointments. Compared with patients who

missed no appointments, those missing more than two appointments annually had approximately threefold higher all-cause mortality (HR 3.11). Among patients with mental-health conditions alone, the corresponding hazard ratio was 8.37. Using the related Scottish cohort, Williamson et al. (2021) found that frequent GP non-attenders had higher outpatient utilisation (RR 1.90), hospital admission rates (RR 1.67), outpatient non-attendance (RR 1.62) and irregular discharge (RR 4.56), but no increase in emergency-department attendance. Together with Ellis et al. (2017), these studies showed that repeated non-attendance was associated with deprivation, multimorbidity, mental illness, higher treatment burden and premature mortality.

Overall, the studies consistently identified previous non-attendance, longer scheduling lead time, younger adulthood, socioeconomic disadvantage, transportation difficulty and public or absent insurance as important predictors. Telehealth—particularly telephone care—was generally associated with better attendance, although video outcomes varied markedly between systems. The qualitative studies showed why standard reminders may have limited effects when non-attendance results from poverty, anxiety, transportation, employment or poor patient–provider relationships. However, because none of the selected studies experimentally assigned reminder interventions, their findings describe associations, risk groups and implementation contexts rather than providing definitive causal estimates of reminder effectiveness.

DISCUSSION

This systematic review found that non-attendance in primary care is not a random event and is unlikely to be corrected by a single, uniform reminder. Across the 15 included observational studies, the most reproducible predictors were previous non-attendance, longer scheduling lead time, younger age, socioeconomic disadvantage, unmet social needs, and practical barriers such as transport and competing work or family responsibilities. Schedule lead time was the leading feature in the personalized model developed by Tuan et al. (2025), whereas prior no-shows and appointment confirmation were among the most influential variables in the rural model reported by Shour et al. (2023). These convergent results support a behavioral interpretation in which past attendance is a marker of continuing access difficulty, while long lead time increases the opportunity for forgetting, recovery from symptoms, schedule conflict, or disengagement.

The present findings also show that demographic variables should not be interpreted as causal characteristics of patients. In the safety-net cohort of Adepoju et al. (2025), higher odds of missing a future appointment were observed among Black, Hispanic, uninsured, and Medicaid-covered patients, but these associations existed alongside distance and appointment characteristics. Ellis et al. (2017) similarly found that repeated non-attendance clustered in deprived Scottish communities and varied substantially between practices. The practice-level variation is important because it indicates that non-attendance is partly generated by the way access is organised, not solely by patient motivation. Accordingly, race, insurance, and deprivation are better understood as proxies for unequal exposure to transport problems, inflexible employment, unstable communication access, and scheduling friction.

Socioeconomic and behavioral explanations

The quantitative and qualitative studies in the review were mutually reinforcing. Fiori et al. (2020) found a graded rise in primary-care no-show proportions as the number of unmet social needs increased; transportation was the strongest specific need. Chapman et al. (2022) and Brown et al. (2020) supplied the mechanism behind this association: recurrent non-attenders described competing work and family demands, poor health, unreliable transport, and reminder systems that were sometimes mistimed or inaccurate. These findings explain why a message can correct forgetfulness but cannot create transport, paid leave, childcare, or confidence in the health system.

New evidence is consistent with this interpretation. In a 2026 academic family-medicine case-control study, patients who missed appointments were substantially less likely to have patient-portal access (OR 0.43, 95% CI 0.30-0.59), while public or absent insurance and Black or Hispanic ethnicity were associated with higher non-attendance (Goldstein et al., 2026). Portal access may represent digital engagement, stable connectivity, or familiarity with the health system rather than an independent protective intervention. Nevertheless, the result extends the review by identifying a modifiable point of contact: clinics should verify digital access and offer equivalent low-technology channels rather than assuming that every patient can use a portal.

Age patterns were broadly consistent but not perfectly linear. The included studies usually identified younger adults as the group at highest risk, plausibly because of work, childcare, mobility, and lower perceived urgency. However, Ellis et al. (2017) also observed increased repeated non-attendance among patients older than 90 years, suggesting a second risk pathway involving frailty, dependence, cognitive impairment, and transport. Therefore, an age-tailored strategy is preferable to a simple rule that treats older age as uniformly protective. Younger adults may benefit from short, actionable digital reminders and flexible rescheduling, whereas very old adults may require caregiver contact, telephone confirmation, and transport coordination.

Reminder effectiveness and reasons for differing outcomes

The observational studies selected for this review identify who is at risk and what patients experience, but they do not establish the causal effect of SMS or telephone reminders. Recent primary intervention studies help to interpret this evidence. Ulloa-Pérez et al. (2022) randomized high-risk visits to one versus two text reminders. Among 125,076 primary-care visits, the additional reminder reduced no-shows by 7% (RR 0.93, 95% CI 0.89-0.96) and same-day cancellations by 6% (RR 0.94, 95% CI 0.90-0.98). The effect was modest but operationally meaningful because the intervention was inexpensive, timed within three business days of the visit, and directed to appointments already classified as high risk.

Tarabichi et al. (2023) produced a similar result using a more intensive approach. Among 5,840 safety-net primary-care appointments with predicted no-show risk of at least 15%, adding live telephone outreach to automated reminders reduced non-attendance from 36% to 33%. The reduction was larger among Black patients, from 42% to 36%, suggesting that risk-targeted human contact can improve both attendance and equity when callers can clarify instructions or address immediate barriers. This aligns with Chapman et al. (2022), whose participants preferred reminders that were accurate, timely, and easy to act upon.

By contrast, Teo et al. (2023) found that adding behavioral-economics language to reminder letters did not reduce missed primary-care appointments in a large Veterans Affairs pragmatic trial (OR 1.14, 95% CI 0.96-1.36). The apparent disagreement is informative rather than contradictory. Ulloa-Pérez et al. (2022) changed reminder frequency and timing, Tarabichi et al. (2023) added targeted live contact, while Teo et al. (2023) mainly changed message framing within a letter. Together, the studies indicate that delivery, timing, targeting, and the ability to resolve a problem may matter more than persuasive wording alone. The present review therefore supports reminders as one component of an access intervention, not as a complete solution.

Telehealth, telephone, video, and digital access

Most included observational cohorts associated telehealth with better attendance. Amagai et al. (2024) reported lower odds of no-show for telehealth than in-person care, Shao et al. (2025) found a larger reduction for telephone than video visits, and Sumarsono et al. (2023) observed particularly strong benefit in primary care and socially vulnerable groups. These results plausibly reflect removal of travel, parking, childcare, and time-off-work barriers. They are supported by Cummins et al. (2024), whose propensity-matched cohort showed 73.4% completion for telemedicine compared with 64.2% for in-person appointments; adjusted odds of completion were 1.64 (95% CI 1.59-1.69).

However, the review also identified important counterexamples. In the New York public system, telephone non-attendance became lower than in-person non-attendance after implementation matured, but video visits retained higher odds of non-attendance (Chen et al., 2023b). A related analysis found that older, Black, Hispanic, and Medicaid-covered patients were less likely to schedule or complete video rather than audio visits, while portal activation strongly favored video completion (Chen et al., 2023a). These findings caution against grouping telephone and video into a single telehealth exposure. A telephone call reduces physical and digital demands, whereas video requires a compatible device, data connection, platform navigation, privacy, and sometimes portal registration.

Saudi evidence makes this contextual dependence especially clear. A nationwide analysis of 1,008,228 virtual consultations reported an overall no-show proportion of 48.30%; family medicine was the most common hospital-based specialty, while use varied markedly between urban and rural governorates (AlOmar et al., 2024). This differs from the lower non-attendance associated with telehealth in most US cohorts. The difference may reflect outcome coding, rapid pandemic-era implementation, patient authentication, platform usability, connectivity, or the ease of booking appointments that patients later did not perceive as binding. Telehealth availability alone is therefore insufficient; confirmation processes, technical support, patient choice, and rapid conversion between video and telephone are likely to determine whether virtual care improves attendance.

Relevance to Saudi and Gulf primary care

The recent Saudi study by Alammari (2024) closely mirrors the behavioral findings of this review. Among 211 internal-medicine outpatients in Riyadh, 51.7% reported a no-show during the preceding two months. Forgetfulness (57.3%), work or household commitments (42.7%), and transport difficulty (9.5%) were the leading reasons, and follow-

up patients had higher odds of non-attendance than first-visit patients (OR 1.86, 95% CI 1.03-3.37). Although the small, single-center, self-reported sample limits precision, the pattern supports Arabic reminders and flexible scheduling while showing why reminders should include immediate confirm, cancel, reschedule, and request-help options. The increased risk for follow-up visits is particularly relevant to Saudi family medicine because diabetes, hypertension, and preventive-care continuity depend on repeated attendance.

Predictive work from southern Saudi Arabia also agreed with the review. Using Mawid appointment data from primary health centers and hospitals, Alshehri et al. (2025) reported 55.07% non-attendance and random-forest discrimination of AUC 0.852. Regional, seasonal, facility, appointment, and environmental variables contributed to prediction. Its no-show definition combined cancellations and rescheduling with no-shows, which probably inflated the rate relative to studies using failure-to-attend only; nevertheless, the model performance was similar to Tuan et al. (2025) and Shour et al. (2023). This supports local prediction but also demonstrates why definitions must be standardized before rates are compared or a model is deployed.

The strongest regional intervention signal comes from the United Arab Emirates. AlSerkal et al. (2025) implemented a risk-prediction model, real-time dashboard, and proactive coordinator workflow across primary health-care centers. No-shows decreased from 20.82% before implementation to 10.25% afterward (OR 0.43, 95% CI 0.42-0.45), and mean waiting time fell by 5.7 minutes. The magnitude exceeds the effects in the randomized reminder trials, but the study used an uncontrolled before-and-after design and bundled prediction, outreach, dashboard use, reallocation, and workflow change. Secular trends and implementation effects cannot be separated. Even so, it provides a highly relevant demonstration that prediction creates value only when connected to an operational response.

Clinical significance of recurrent non-attendance

The downstream findings show why repeated non-attendance should trigger supportive escalation rather than administrative punishment. Williamson et al. (2021) found that frequent missed general-practice appointments were associated with more outpatient use, hospital admission, and subsequent outpatient non-attendance. McQueenie et al. (2019) reported a dose-response relationship with mortality; patients missing more than two appointments per year had a mortality hazard more than three times that of patients missing none, with a still larger association among those with mental-health conditions. McComb et al. (2017) likewise showed that delayed rescheduling after a cancelled diabetes visit lengthened gaps in attended care and was associated with more emergency-department use. These studies cannot prove that missing an appointment causes death or hospitalization, because illness severity and social vulnerability may cause both. They do establish recurrent non-attendance as a clinically meaningful risk marker requiring continuity review, mental-health and social-needs assessment, and active rescheduling.

Strengths and limitations

A strength of this review is its integration of large EHR cohorts, national linkage studies, prediction models, and qualitative accounts. The agreement between administrative patterns and patient explanations improves the plausibility of the synthesis. The newer

comparator studies also provide original randomized, cohort, case-control, and before-and-after evidence rather than relying on reviews or meta-analyses.

Several limitations remain. All 15 selected studies were observational, exposure and outcome definitions varied, and some studies combined no-shows with cancellation or non-completion. Telehealth assignment was non-random and vulnerable to patient selection, pandemic-period policy, and digital-access confounding. The Scottish studies shared an overlapping data program, so their results should not be treated as independent replications in a meta-analysis. Prediction performance also does not demonstrate intervention effectiveness, and variables such as race, payer, or geography may encode structural inequity. The external reminder trials had different channels, timings, baseline reminder systems, and populations; therefore, their effects should not be pooled without careful assessment of clinical and methodological heterogeneity. Finally, evidence directly from Saudi family-medicine clinics remains limited, and rates from virtual, internal-medicine, and mixed PHC/hospital datasets may not transfer directly to AKMICH.

Implications for Saudi family medicine practice

For AKMICH and similar Saudi family-medicine services, the evidence supports a tiered model. First, all patients should receive an accurate Arabic reminder approximately 48-72 hours before the visit and a shorter confirmation approximately 24 hours before it, with one-step options to confirm, cancel, reschedule, request a call, or convert to telephone/video when clinically appropriate. Second, risk stratification should prioritize previous no-shows, long lead time, repeated cancellations, follow-up status, communication failure, and locally validated access variables. High-risk patients should receive live outreach that asks about transport, work, caregiving, digital access, and the continuing need for the appointment. Third, serial non-attenders should receive continuity review rather than discharge from care.

Implementation should begin as a prospective pilot with a concurrent control or stepped-wedge design. Outcomes should include a strict no-show definition, timely cancellation, completed visit, rescheduling interval, subgroup effects by age and chronic-disease follow-up, staff workload, cost per recovered appointment, and patient acceptability. Algorithmic performance should be assessed separately from clinical impact and audited for calibration and unequal false-positive rates. Such a design would test the central conclusion of this review: prediction is useful only when it enables a timely, equitable, and barrier-resolving intervention.

CONCLUSION

Overall, the present findings are consistent with recent primary research but reveal why outcomes differ between studies. Previous non-attendance, lead time, deprivation, and practical barriers are robust predictors. SMS and telephone reminders appear most useful when timely, repeated where appropriate, directed to high-risk appointments, and linked to easy rescheduling or human assistance. Message framing alone may add little. Telehealth can reduce physical access barriers, but video and portal requirements can create new digital barriers, and Saudi virtual-care data demonstrate that high no-show rates can persist despite remote availability. The most defensible strategy for Saudi family medicine is therefore a

locally validated, tiered system combining universal actionable reminders, targeted live outreach, flexible modality, and support for social and digital barriers.

REFERENCES

1. McQueenie R, Ellis DA, McConnachie A, Wilson P, Williamson AE. Morbidity, mortality and missed appointments in healthcare: a national retrospective data linkage study. BMC Med. 2019;17:2. doi:10.1186/s12916-018-1234-0.
2. Williamson AE, McQueenie R, Ellis DA, McConnachie A, Wilson P. "Missingness" in health care: associations between hospital utilization and missed appointments in general practice. A retrospective cohort study. PLoS One. 2021;16(6):e0253163. doi:10.1371/journal.pone.0253163.
3. Fiori KP, Heller CG, Rehm CD, Parsons A, Flattau A, Braganza S, et al. Unmet social needs and no-show visits in primary care in a US northeastern urban health system, 2018-2019. Am J Public Health. 2020;110(S2):S242-S250. doi:10.2105/AJPH.2020.305717.
4. Shour AR, Jones GL, Anguzu R, Doi SA, Onitilo AA. Development of an evidence-based model for predicting patient, provider, and appointment factors that influence no-shows in a rural healthcare system. BMC Health Serv Res. 2023;23:989. doi:10.1186/s12913-023-09969-5.
5. Tuan WJ, Yan Y, Abou Al Ardat B, Felix T, Chen Q. Predicting missed appointments in primary care: a personalized machine learning approach. Ann Fam Med. 2025;23(4):294-301. doi:10.1370/afm.240316.
6. Adepoju OE, Liaw W, Phillips CD. Longer appointment duration reduces future missed appointments in safety-net clinics. Am J Manag Care. 2025;31(2):e39-e46. doi:10.37765/ajmc.2025.89682.
7. Adepoju OE, Dang P. Patient-provider concordance reduces missed appointments in Texas primary care safety-net clinics. J Racial Ethn Health Disparities. 2026;13(3):2213-2220. doi:10.1007/s40615-025-02411-y.
8. Goldstein S, Buuck K, Thompson H, Yu R, Small N, des Bordes JK, et al. Patient portal access and missed medical appointments: a case-control study. J Patient Exp. 2026;13:23743735261415666. doi:10.1177/23743735261415666.
9. Ulloa-Perez E, Blasi PR, Westbrook EO, Lozano P, Coleman KF, Coley RY. Pragmatic randomized study of targeted text message reminders to reduce missed clinic visits. Perm J. 2022;26(1):64-72. doi:10.7812/TPP/21.078.
10. Tarabichi Y, Higginbotham J, Riley N, Kaelber DC, Watts B. Reducing disparities in no show rates using predictive model-driven live appointment reminders for at-risk patients: a randomized controlled quality improvement initiative. J Gen Intern Med. 2023;38(13):2921-2927. doi:10.1007/s11606-023-08209-0.
11. Teo AR, Niederhausen M, Handley R, Metcalf EE, Call AA, Jacob RL, et al. Using nudges to reduce missed appointments in primary care and mental health: a pragmatic trial. J Gen Intern Med. 2023;38(Suppl 3):894-904. doi:10.1007/s11606-023-08131-5.
12. Sumarsono A, Case M, Kassa S, Moran B. Telehealth as a tool to improve access and reduce no-show rates in a large safety-net population in the USA. J Urban Health.

2023;100(2):398-407. doi:10.1007/s11524-023-00721-2.
13. AlOmar RS, AlHarbi M, Alotaibi NS, AlShamlan NA, Al-Shammari MA, AlThumairi AA, et al. Pattern of virtual consultations in the Kingdom of Saudi Arabia: an epidemiological nationwide study. J Epidemiol Glob Health. 2024;14(3):817-826. doi:10.1007/s44197-024-00219-3.
14. Alammari YM. Prevalence and predictors of no-show in internal medicine outpatient clinics: a cross-sectional study in Saudi Arabia. Bahrain Med Bull. 2024;46(4):2377-2381.
15. Alshehri A, Saeed A, AlShafea A, Althubiany S, Alshehri M, Alzahrani A, et al. Machine learning approaches to predict no-shows in Saudi Arabian primary and general healthcare settings. Saudi J Health Syst Res. 2025;5(1):24-40. doi:10.1159/000542701.
16. AlSerkal YM, Ibrahim NM, Alsereidi AS, Ibrahim M, Kurakula S, Naqvi SA, et al. Real-time analytics and AI for managing no-show appointments in primary health care in the United Arab Emirates: before-and-after study. JMIR Form Res. 2025;9:e64936. doi:10.2196/64936.
17. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. doi:10.1136/bmj.n71.
18. Deeks JJ, Higgins JPT, Altman DG, McKenzie JE, Veroniki AA. Chapter 10: Analysing data and undertaking meta-analyses. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al., editors. Cochrane Handbook for Systematic Reviews of Interventions. Version 6.5. Cochrane; 2024.
19. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa Scale for assessing the quality of non-randomised studies in meta-analyses. Ottawa Hospital Research Institute.
20. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924-926. doi:10.1136/bmj.39489.470347.AD.
21. Tuan WJ, Yan Y, Abou Al Ardat B, Felix T, Chen Q. Predicting missed appointments in primary care: a personalized machine learning approach. Ann Fam Med. 2025;23(4):294–301. https://doi.org/10.1370/afm.240316
Design: retrospective longitudinal study of appointments across 15 family medicine clinics.
22. Adepoju OE, Liaw W, Phillips CD. Longer appointment duration reduces future missed appointments in safety-net clinics. Am J Manag Care. 2025;31(2):e39–e46. https://doi.org/10.37765/ajmc.2025.89682
Design: retrospective cohort study conducted in 14 family-practice safety-net clinics.
23. Amagai S, Vonesh E, Adams J, et al. Closing the gap: addressing telehealth disparities across specialties in the sustained pandemic era. NPJ Digit Med. 2024;7:217. https://doi.org/10.1038/s41746-024-01201-w
Design: retrospective electronic-health-record cohort, including primary-care encounters.

24. Shao CC, Katta MH, Smith BP, Jones BA, Gleason LT, Abbas A, Wadhwani N, Wallace EL, Mugavero MJ, Chu DI. Reducing no-show visits and disparities in access: the impact of telemedicine. J Telemed Telecare. 2025;31(7):1041–1049. https://doi.org/10.1177/1357633X241241357
Design: retrospective cohort comparing video, telephone and in-person outpatient appointments.
25. Chen K, Zhang C, Gurley A, Akkem S, Jackson H. Patient characteristics associated with telehealth scheduling and completion in primary care at a large, urban public healthcare system. J Urban Health. 2023;100(3):468–477. https://doi.org/10.1007/s11524-023-00744-9
Design: observational electronic-health-record study across 23 adult primary-care clinics.
26. Chen K, Zhang C, Gurley A, Akkem S, Jackson H. Appointment non-attendance for telehealth versus in-person primary care visits at a large public healthcare system. J Gen Intern Med. 2023;38(4):922–928. https://doi.org/10.1007/s11606-022-07814-9
Design: retrospective observational analysis of more than one million scheduled primary-care visits.
27. Sumarsono A, Case M, Kassa S, Moran B. Telehealth as a tool to improve access and reduce no-show rates in a large safety-net population in the USA. J Urban Health. 2023;100(2):398–407. https://doi.org/10.1007/s11524-023-00721-2
Design: retrospective cohort study of safety-net outpatient appointments.
28. Shour AR, Jones GL, Anguzu R, Doi SA, Onitilo AA. Development of an evidence-based model for predicting patient, provider, and appointment factors that influence no-shows in a rural healthcare system. BMC Health Serv Res. 2023;23:989. https://doi.org/10.1186/s12913-023-09969-5
Design: retrospective observational prediction study in a rural healthcare network.
29. Chapman KA, Machado SS, van der Merwe K, Bryson A, Smith D. Exploring primary care non-attendance: a study of low-income patients. J Prim Care Community Health. 2022;13:21501319221082352. https://doi.org/10.1177/21501319221082352
Design: primary observational study examining barriers to attendance among low-income patients.
30. Williamson AE, McQueenie R, Ellis DA, McConnachie A, Wilson P. “Missingness” in health care: associations between hospital utilization and missed appointments in general practice. A retrospective cohort study. PLoS One. 2021;16(6):e0253163. https://doi.org/10.1371/journal.pone.0253163
Design: retrospective cohort study linking general-practice non-attendance with hospital use.
31. Fiori KP, Heller CG, Rehm CD, Parsons A, Flattau A, Braganza S, Lue K, Lauria M, Racine A. Unmet social needs and no-show visits in primary care in a US northeastern urban health system, 2018–2019. Am J Public Health. 2020;110(S2):S242–S250. https://doi.org/10.2105/AJPH.2020.305717
Design: observational electronic-health-record study of 41,637 primary-care patients.

32. Brown EE, Schwartz M, Shi C, et al. Understanding why urban, low-income patients miss primary care appointments: insights from qualitative interviews of West Philadelphians. J Ambul Care Manage. 2020;43(1):30–40. https://doi.org/10.1097/JAC.0000000000000316
Design: qualitative observational study of patient-reported reasons for missing primary-care appointments.
33. McQueenie R, Ellis DA, McConnachie A, Wilson P, Williamson AE. Morbidity, mortality and missed appointments in healthcare: a national retrospective data linkage study. BMC Med. 2019;17:2. https://doi.org/10.1186/s12916-018-1234-0
Design: national retrospective record-linkage study examining repeated general-practice non-attendance.
34. Ellis DA, McQueenie R, McConnachie A, Wilson P, Williamson AE. Demographic and practice factors predicting repeated non-attendance in primary care: a national retrospective cohort analysis. Lancet Public Health. 2017;2(12):e551–e559. https://doi.org/10.1016/S2468-2667(17)30217-7
Design: national retrospective cohort analysis of demographic and practice-level predictors.
35. McComb S, Tian Z, Sands L, Turkcan A, Zhang L, Frazier S, Lawley MA. Cancelled primary care appointments: a prospective cohort study of diabetic patients. J Med Syst. 2017;41(4):53. https://doi.org/10.1007/s10916-017-0700-0
Design: prospective cohort study of 46,710 primary-care appointments involving adults with diabetes.
36. Tuan WJ, Yan Y, Abou Al Ardat B, Felix T, Chen Q. Predicting missed appointments in primary care: a personalized machine learning approach. Ann Fam Med. 2025;23(4):294-301. doi:10.1370/afm.240316.
37. Shour AR, Jones GL, Anguzu R, Doi SA, Onitilo AA. Development of an evidence-based model for predicting patient, provider, and appointment factors that influence no-shows in a rural healthcare system. BMC Health Serv Res. 2023;23:989. doi:10.1186/s12913-023-09969-5.
38. Adepoju OE, Liaw W, Phillips CD. Longer appointment duration reduces future missed appointments in safety-net clinics. Am J Manag Care. 2025;31(2):e39-e46. doi:10.37765/ajmc.2025.89682.
39. Ellis DA, McQueenie R, McConnachie A, Wilson P, Williamson AE. Demographic and practice factors predicting repeated non-attendance in primary care: a national retrospective cohort analysis. Lancet Public Health. 2017;2(12):e551-e559. doi:10.1016/S2468-2667(17)30217-7.
40. Fiori KP, Heller CG, Rehm CD, Parsons A, Flattau A, Braganza S, et al. Unmet social needs and no-show visits in primary care in a US northeastern urban health system, 2018-2019. Am J Public Health. 2020;110(S2):S242-S250. doi:10.2105/AJPH.2020.305717.
41. Chapman KA, Machado SS, van der Merwe K, Bryson A, Smith D. Exploring primary care non-attendance: a study of low-income patients. J Prim Care Community Health. 2022;13:21501319221082352. doi:10.1177/21501319221082352.

42. Brown EE, Schwartz M, Shi C, Carter T, Shea JA, Grande D, et al. Understanding why urban, low-income patients miss primary care appointments: insights from qualitative interviews of West Philadelphians. J Ambul Care Manage. 2020;43(1):30-40. doi:10.1097/JAC.0000000000000316.
43. Goldstein S, Buuck K, Thompson H, Yu R, Small N, des Bordes JK, et al. Patient portal access and missed medical appointments: a case-control study. J Patient Exp. 2026;13:23743735261415666. doi:10.1177/23743735261415666.
44. Ulloa-Pérez E, Blasi PR, Westbrook EO, Lozano P, Coleman KF, Coley RY. Pragmatic randomized study of targeted text message reminders to reduce missed clinic visits. Perm J. 2022;26(1):64-72. doi:10.7812/TPP/21.078.
45. Tarabichi Y, Higginbotham J, Riley N, Kaelber DC, Watts B. Reducing disparities in no show rates using predictive model-driven live appointment reminders for at-risk patients: a randomized controlled quality improvement initiative. J Gen Intern Med. 2023;38(13):2921-2927. doi:10.1007/s11606-023-08209-0.
46. Teo AR, Niederhausen M, Handley R, Metcalf EE, Call AA, Jacob RL, et al. Using nudges to reduce missed appointments in primary care and mental health: a pragmatic trial. J Gen Intern Med. 2023;38(Suppl 3):894-904. doi:10.1007/s11606-023-08131-5.
47. Amagai S, Vonesh E, Adams J, Luo Y. Closing the gap: addressing telehealth disparities across specialties in the sustained pandemic era. NPJ Digit Med. 2024;7:217. doi:10.1038/s41746-024-01201-w.
48. Shao CC, Katta MH, Smith BP, Jones BA, Gleason LT, Abbas A, et al. Reducing no-show visits and disparities in access: the impact of telemedicine. J Telemed Telecare. 2025;31(7):1041-1049. doi:10.1177/1357633X241241357.
49. Sumarsono A, Case M, Kassa S, Moran B. Telehealth as a tool to improve access and reduce no-show rates in a large safety-net population in the USA. J Urban Health. 2023;100(2):398-407. doi:10.1007/s11524-023-00721-2.
50. Chen K, Zhang C, Gurley A, Akkem S, Jackson H. Appointment non-attendance for telehealth versus in-person primary care visits at a large public healthcare system. J Gen Intern Med. 2023;38(4):922-928. doi:10.1007/s11606-022-07814-9.
51. Chen K, Zhang C, Gurley A, Akkem S, Jackson H. Patient characteristics associated with telehealth scheduling and completion in primary care at a large, urban public healthcare system. J Urban Health. 2023;100(3):468-477. doi:10.1007/s11524-023-00744-9.
52. Cummins MR, Tsalatsanis A, Chaphalkar C, Ivanova J, Ong T, Soni H, et al. Telemedicine appointments are more likely to be completed than in-person healthcare appointments: a retrospective cohort study. JAMIA Open. 2024;7(3):ooae059. doi:10.1093/jamiaopen/ooae059.
53. AlOmar RS, AlHarbi M, Alotaibi NS, AlShamlan NA, Al-Shammari MA, AlThumairi AA, et al. Pattern of virtual consultations in the Kingdom of Saudi Arabia: an epidemiological nationwide study. J Epidemiol Glob Health. 2024;14(3):817-826. doi:10.1007/s44197-024-00219-3.
54. Alammari YM. Prevalence and predictors of no-show in internal medicine outpatient clinics: a cross-sectional study in Saudi Arabia. Bahrain Med Bull. 2024;46(4):2377-

2381.

55. Alshehri A, Saeed A, AlShafea A, Althubiany S, Alshehri M, Alzahrani A, et al. Machine learning approaches to predict no-shows in Saudi Arabian primary and general healthcare settings. Saudi J Health Syst Res. 2025;5(1):24-40. doi:10.1159/000542701.
56. AlSerkal YM, Ibrahim NM, Alsereidi AS, Ibrahim M, Kurakula S, Naqvi SA, et al. Real-time analytics and AI for managing no-show appointments in primary health care in the United Arab Emirates: before-and-after study. JMIR Form Res. 2025;9:e64936. doi:10.2196/64936.
57. Williamson AE, McQueenie R, Ellis DA, McConnachie A, Wilson P. 'Missingness' in health care: associations between hospital utilization and missed appointments in general practice. A retrospective cohort study. PLoS One. 2021;16(6):e0253163. doi:10.1371/journal.pone.0253163.
58. McQueenie R, Ellis DA, McConnachie A, Wilson P, Williamson AE. Morbidity, mortality and missed appointments in healthcare: a national retrospective data linkage study. BMC Med. 2019;17:2. doi:10.1186/s12916-018-1234-0.
59. McComb S, Tian Z, Sands L, Turkcan A, Zhang L, Frazier S, et al. Cancelled primary care appointments: a prospective cohort study of diabetic patients. J Med Syst. 2017;41(4):53. doi:10.1007/s10916-017-0700-0.