Revisiting the Information Motivation Behavioral Skills Model in Antiretroviral Therapy Adherence: A Systematic Review of Mechanisms, Contextual Barriers, and Policy Implications in HIV Care

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Abstract: Antiretroviral therapy (ART) adherence remains essential for viral suppression, prevention of drug resistance, and improved long-term outcomes among people living with HIV. This systematic review examined how the Information–Motivation–Behavioral Skills (IMB) model explains ART adherence, how its constructs interact, and how contextual barriers influence intervention effectiveness. PubMed, ProQuest, and Google Scholar were searched for peer-reviewed studies published between 2019 and 2024 in accordance with PRISMA 2020 guidelines. Nineteen studies were included, comprising randomized controlled trials, quasi-experimental studies, cross-sectional analyses, mixed-methods studies, structural equation modeling, and developmental research, and were synthesized narratively because of substantial clinical and methodological heterogeneity. Across studies, information and motivation were associated with adherence-related outcomes, but behavioral skills, particularly self-efficacy, problem-solving, communication, and medication-management ability, emerged as the most consistent proximal mechanism linking these constructs to adherence. Psychosocial and structural barriers, including stigma, depression, substance use, limited social support, and health-system constraints, weakened these pathways when not directly addressed. The findings support an integrated, context-sensitive application of the IMB model combining education, motivational support, practical skill development, and structural interventions. Further longitudinal and randomized studies using standardized, objective adherence measures are needed to strengthen causal inference and guide scalable HIV programs and policy.

Keywords: IMB Models, HIV Infections, Anti-Retroviral Agents, Self Efficacy, Health Behavior.

INTRODUCTION

The global expansion of antiretroviral therapy (ART) has transformed HIV infection from a frequently fatal condition into a manageable chronic disease, substantially reducing HIV-related morbidity and mortality [1,2]. Nevertheless, the benefits of ART depend heavily on sustained adherence. Suboptimal adherence may compromise viral suppression, increase the risk of virological failure and antiretroviral drug resistance, and contribute to ongoing HIV transmission [3,4]. As healthcare systems increasingly adopt long-term models of HIV care, maintaining optimal ART adherence remains essential for improving the survival, quality of life, and long-term health outcomes of people living with HIV/AIDS (PLHIV) [5]. ART adherence is influenced by the interaction of individual, interpersonal, psychosocial, and structural factors, including treatment knowledge, beliefs about ART, motivation, social support, mental health conditions, stigma, patient–provider relationships, and the practical ability to integrate medication-taking into everyday routines [6–8]. Although simplified treatment regimens and improved medication availability have reduced several barriers to ART access, they have not fully resolved challenges related to long-term adherence. Consequently, increasing attention has been directed toward theory-driven frameworks that can explain the multiple pathways through which cognitive, motivational, behavioral, and contextual factors influence ART adherence [9,10].

One of the most widely applied behavioral frameworks in this area is the Information–Motivation–Behavioral Skills (IMB) model, which proposes that the performance of a health-related behavior is determined by three interrelated constructs: information, motivation, and behavioral skills [11,12]. Information refers to accurate and relevant knowledge about HIV, ART benefits, medication schedules, treatment requirements, possible adverse effects, and appropriate responses to missed doses. Greater treatment literacy may support informed decision-making and adherence, although knowledge alone does not necessarily result in sustained behavioral change [4,13]. Motivation incorporates personal and social dimensions, including attitudes toward ART, beliefs about treatment effectiveness, perceived benefits and disadvantages of adherence, social norms, family or partner support, and relationships with healthcare providers [4,14]. Behavioral skills include self-efficacy, problem-solving ability, communication competence, medication-management skills, and the capacity to maintain treatment routines when confronted with practical or

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psychosocial barriers [8,11]. A central proposition of the IMB model is that information and motivation influence adherence primarily through behavioral skills [4,15]. Thus, individuals may understand the importance of ART and be motivated to adhere but may still experience non-adherence when they lack the confidence, resources, communication abilities, or practical strategies needed to manage treatment consistently.

The IMB model has been applied in observational research and adherence-related interventions across diverse populations and healthcare settings. Existing evidence suggests that interventions combining informational, motivational, and skill-building components may improve ART adherence, treatment engagement, and related health behaviors [2,16,17]. However, findings have not been uniform because studies differ substantially in population characteristics, research designs, intervention content, duration of follow-up, delivery modalities, and methods of measuring adherence [18-20]. Some studies evaluate the complete IMB pathway, whereas others focus on individual constructs such as knowledge, social support, treatment motivation, or self-efficacy. Evidence from specific populations further demonstrates the complexity of ART adherence. Studies involving children and pregnant women receiving ART indicate that social support, treatment disclosure, food security, self-efficacy, and other contextual factors may influence adherence and virological outcomes [21,22]. Technology-assisted approaches, including mobile health applications, have also incorporated IMB-related principles through treatment information, personalized reminders, motivational support, and opportunities for patient engagement [23,24]. In addition, supportive family relationships, peer networks, and patient–provider communication can provide informational, emotional, and practical resources that strengthen adherence-related motivation and behavioral skills [8,24,25]. Conversely, stigma, fear of disclosure, unsupportive relationships, and social isolation may weaken motivation and disrupt medication-taking routines.

Despite the growing literature on IMB-informed approaches, several important gaps remain. Existing studies have predominantly emphasized individual-level determinants, while structural, cultural, socioeconomic, and health-system influences have received less systematic attention. Barriers such as poverty, food insecurity, transportation difficulties, medication availability, limited service accessibility, healthcare-worker attitudes, and discontinuity of care may restrict an individual's ability to act on adequate information and motivation. Furthermore, the operationalization of the IMB constructs and adherence outcomes varies considerably across studies [17,26]. Information may be assessed as general HIV knowledge, ART literacy, or understanding of medication instructions; motivation may include treatment attitudes, perceived benefits, social support, stigma, or patient–provider communication; and behavioral skills may be represented by self-efficacy, problem-solving ability, communication competence, or medication-management practices. Adherence may also be measured using self-reports, dose- or timing-based indicators, pharmacy records, clinic attendance, treatment engagement, or biological outcomes. Innovative interventions involving mobile applications, social-media platforms, peer-support programs, and gamified strategies have shown promise, but the extent to which they comprehensively integrate information, motivation, and behavioral skills remains unclear [28-30]. Technology-based interventions may effectively deliver information and reminders but may have limited impact when stigma, depression, substance use, poverty, or health-system barriers are not simultaneously addressed [9,14,27].

Accordingly, this systematic review aims to synthesize empirical evidence on the application of the Information–Motivation–Behavioral Skills model to ART adherence among PLHIV. Specifically, the review examines how information, motivation, and behavioral skills have been conceptualized and operationalized; evaluates their relative and interacting contributions to ART adherence; assesses evidence supporting behavioral skills as a mediating mechanism between information, motivation, and adherence; and identifies psychosocial, cultural, structural, and health-system factors that may facilitate or constrain IMB pathways. The review also explores the practical implications of IMB-informed approaches for clinicians, HIV program managers, and policymakers. By integrating evidence on theoretical mechanisms, intervention components, contextual barriers, and implementation considerations, this review moves beyond determining whether IMB-informed interventions are effective to examine how, for whom, and under what circumstances they may improve ART adherence. The findings are expected to support the development of more comprehensive, context-sensitive, and sustainable adherence interventions and to inform the integration of IMB-based strategies into routine HIV services, program planning, community engagement, and public health policy.

RESEARCH METHODS

Review Design and Reporting

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines. The review question, eligibility criteria, information sources, search strategy, study-selection

process, data-extraction procedures, methodological quality assessment, and synthesis approach were established before the final analysis. The review protocol was not prospectively registered in PROSPERO; however, the review procedures were defined in advance and applied consistently throughout the study. The completed PRISMA 2020 checklist is provided as supplementary material.

Eligibility Criteria

Eligibility criteria were defined using the Population, Intervention or Exposure, Comparison, Outcome, and Study Design framework. Studies were included if they applied the Information–Motivation–Behavioral Skills model as an intervention framework, theoretical model, or analytical approach; examined people living with HIV receiving or initiating antiretroviral therapy or assessed IMB mechanisms relevant to HIV-related adherence behavior; reported ART adherence, treatment engagement, medication management, or closely related behavioral outcomes; presented original quantitative, qualitative, or mixed-methods findings; were published in peer-reviewed journals between January 2019 and December 2024; and were available in English. Studies directly measuring ART adherence were treated as primary evidence, whereas studies examining HIV prevention or comparable self-management behaviors were used only as supportive evidence for interpreting IMB mechanisms. Reviews, meta-analyses, protocols, editorials, letters, conference abstracts, dissertations, and conceptual papers without original empirical findings were excluded.

Information Sources and Search Strategy

A systematic search was conducted in PubMed, ProQuest, and Google Scholar for studies published from January 2019 to December 2024, with the final search completed on December 31, 2024. Search terms represented four main concepts: the IMB model, HIV, antiretroviral therapy, and adherence. Examples included “Information–Motivation–Behavioral Skills,” “IMB model,” “HIV,” “people living with HIV,” “antiretroviral therapy,” “ART adherence,” and “viral suppression.” These terms were combined using the Boolean operators AND and OR and adapted to each database. A representative search combination was: “IMB model” OR “Information–Motivation–Behavioral Skills” AND HIV AND “antiretroviral therapy” AND adherence. Searches were limited to English-language publications from 2019 to2024, and the first 300 Google Scholar results ranked by relevance were screened. Reference lists and forward citations of relevant articles were also examined. Complete database-specific search strings, filters, search dates, and numbers of retrieved records are presented in Table **1**.

Study Selection Process

All retrieved records were imported into reference-management software, and duplicate records were removed before screening. Titles and abstracts were assessed against the predefined eligibility criteria, followed by full-text evaluation of potentially relevant articles. Screening and eligibility assessment were conducted by members of the review team, and disagreements were resolved through discussion and consensus. Reasons for exclusion at the full-text stage were recorded, including ineligible population, absence of an IMB framework, lack of an adherence-related outcome, inappropriate publication type, and publication outside the specified period. Studies reporting direct ART adherence outcomes were distinguished from studies providing indirect theoretical or contextual evidence. The complete selection process, including the numbers of records identified, screened, excluded, and included, is presented in the PRISMA 2020 flow diagram.

Data Collection and Data Items

Data were extracted using a standardized form developed for this review and checked for completeness and consistency by the review team. Extracted information included author, publication year, country, study design, sample size, participant characteristics, healthcare setting, intervention or exposure, comparator, follow-up period, IMB constructs assessed, adherence measurement, and principal findings. Information was also collected on how information, personal and social motivation, behavioral skills, self-efficacy, stigma, communication, and contextual barriers were defined and measured. The primary outcome was ART adherence, assessed through self-reported adherence, dose- or timing-based measures, pill counts, pharmacy-refill records, electronic monitoring, or viral suppression. Secondary outcomes included treatment engagement, retention in care, medication-management ability, treatment knowledge, motivation, and adherence self-efficacy. Objective adherence indicators were prioritized where available, while self-reported findings were interpreted cautiously because of potential recall and social-desirability bias.

Methodological Quality and Risk-of-Bias Assessment

The methodological quality of each included study was assessed using the Joanna Briggs Institute Critical Appraisal Tools appropriate to its design, including checklists for randomized controlled trials, quasi-experimental studies, cohort studies, cross-sectional studies, qualitative studies, and other eligible designs. The assessment considered participant selection,

group comparability, randomization where applicable, validity and reliability of measurements, control of confounding factors, completeness of follow-up, appropriateness of statistical analyses, and consistency between study methods and conclusions. Each item was classified as yes, no, unclear, or not applicable. Studies were subsequently categorized as having low, moderate, or high risk of bias according to the number and importance of identified methodological limitations. No study was excluded solely because of its quality rating; instead, the risk-of-bias findings were considered when interpreting the strength and consistency of the evidence. Detailed appraisal results are presented in Supplementary Table S2.

Assessment of Heterogeneity and Data Synthesis

Clinical heterogeneity was assessed by comparing study populations, geographical settings, intervention content, modes of delivery, comparator conditions, follow-up durations, and definitions of adherence. Methodological heterogeneity was examined through differences in study design, sampling procedures, outcome measurements, analytical methods, adjustment for confounding factors, and risk-of-bias profiles. Considerable variation was identified across the included studies, particularly in the operationalization of IMB constructs and the measurement of ART adherence and related behaviors. Some studies reported self-reported adherence, while others examined treatment engagement, medication-management behavior, or viral suppression. These differences prevented the identification of a sufficiently comparable group of studies for statistical pooling. A structured narrative synthesis was therefore conducted, grouping findings according to study design, population, intervention type, adherence measure, and the roles of information, motivation, and behavioral skills. Studies with direct ART adherence outcomes and lower risk of bias received greater interpretive weight.

Publication Bias, Reporting Bias, and Certainty of Evidence

Formal statistical assessment of publication bias using funnel plots or Egger's test was not performed because no meta-analysis was conducted and fewer than ten sufficiently comparable studies were available for a single outcome. Potential publication bias was considered narratively by examining study size, the predominance of favorable findings, and the restriction to peer-reviewed English-language publications. Selective reporting was evaluated by comparing outcomes described in the methods sections of the included studies with those reported in their results and, where available, with trial protocols or registry records. A formal Grading of Recommendations Assessment, Development and Evaluation assessment was not undertaken because of substantial heterogeneity in designs, populations, outcomes, and effect measures. Nevertheless, confidence in the evidence was judged narratively according to risk of bias, consistency, directness to ART adherence, precision, and possible publication bias. Findings based on cross-sectional designs, small samples, self-reported outcomes, or indirect evidence were interpreted cautiously.

Ethical Considerations

Ethical approval was not required because this systematic review used data from previously published studies and did not involve direct contact with participants, primary data collection, or access to identifiable individual-level information.

RESULTS

Study Selection

The database search identified 5,507 records from PubMed, ProQuest, and Google Scholar. After duplicate and clearly ineligible records were removed, 4,659 records were screened by title and abstract. Of 292 reports sought for retrieval, 250 full-text articles were assessed against the predefined eligibility criteria. Following the exclusion of 231 articles because of ineligible populations, outcomes, publication types, or insufficient application of the Information–Motivation–Behavioral Skills model, 19 studies were included in the narrative synthesis. The study-selection process is presented in the PRISMA 2020 flow diagram in Figure **1**.

Characteristics of the Included Studies

The 19 included studies were conducted across Asia, Africa, North America, and Europe and represented clinical, hospital, community, and digital-health settings. Study designs included randomized controlled trials, quasi-experimental and pre–post interventions, prospective cohort research, mixed-methods studies, cross-sectional analyses, structural equation modeling, and intervention-development studies. Sample sizes ranged from small pilot samples to studies involving more than 2,000 participants. The IMB model was applied as an intervention framework, analytical model, or basis for examining relationships among information, motivation, behavioral skills, and adherence-related outcomes [31-49]. Considerable variation was observed in populations, outcome definitions, intervention duration, follow-up periods, and measurement instruments. Detailed characteristics and principal findings are presented in Table **1**.

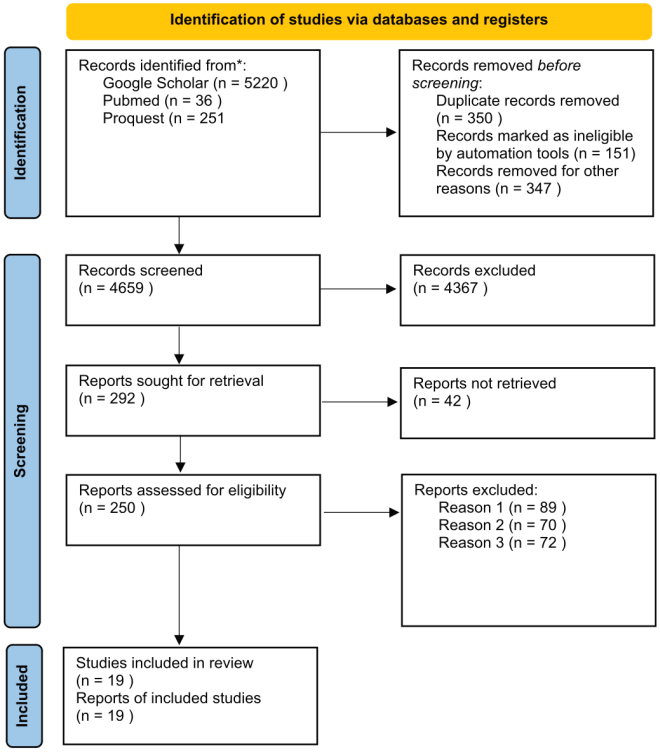

Figure 1: PRISMA 2020 flow diagram of the study-selection process.

Table 1: Characteristics and Main Findings of the Included Studies

Author, year	Country and population	Sample	Study design and follow-up	IMB intervention or exposure	Outcome or measurement	Main findings
Zareipour *et al.*, 2021 [33]	Iran; adults living with HIV	122	Controlled intervention; 3-month assessment	Eight-session IMB education versus routine services	Dietary adherence and depression	The intervention improved several dietary-adherence indicators, although depression did not improve significantly.
Jozani *et al.*, 2019 [37]	Iran; women living with HIV	80	Randomized controlled trial; six sessions and short-term follow-up	HBM–IMB education versus routine counseling	Information, motivation, and behavioral skills	Knowledge, motivation, and safer-health behavioral skills improved in the intervention group.
Shen *et al.*, 2021 [45]	China; patients with aplastic anemia	90	Randomized controlled study; post-discharge follow-up	IMB-based continuous nursing versus routine care	Medication adherence and quality of life	The study reported improved medication adherence and self-care, but the publication was subsequently retracted.
Ameri *et al.*, 2020 [32]	Iran; adults living with HIV	122	Controlled intervention; 3-month follow-up	IMB-based education versus routine care	Medication, diet, and physical-activity adherence	Information, motivation, behavioral skills, and adherence-related behaviors improved after the intervention.
McCuistian *et al.*, 2021 [34]	United States; youth and young adults living with HIV	Not fully reported	Pilot intervention-development study	Video counseling and bidirectional text messaging	HIV-care engagement, mental health, and substance use	The study developed an integrated technology-assisted intervention, but definitive effectiveness estimates were not reported.
Chen *et al.*, 2025 [46]	China; adults with COPD	331	Prospective cohort	IMB-related predictors; no comparator	Self-management behavior	Motivation, cognitive function, depression, and patient activation were associated with self-management behavior.
Liang *et al.*, 2020 [43]	China; general population	957	Pre–post follow-up study; 6 months	WeChat-based HIV education	IMB constructs and condom use	Information, motivation, behavioral skills, and reported preventive behavior improved significantly.
Ramaiya *et al.*, 2020 [31]	Haiti; adults initiating ART	128	Cross-sectional mixed-methods study	Patient–provider communication and IMB constructs	LifeWindows IMB ART Adherence Questionnaire	Better communication was positively associated with information, motivation, and behavioral skills.

(Table 1). Continued.

Author, year	Country and population	Sample	Study design and follow-up	IMB intervention or exposure	Outcome or measurement	Main findings
Morowatisharifabad *et al*., 2019 [35]	Iran; adults living with HIV	119	Cross-sectional study	IMB constructs and depression	ART-adherence questionnaire	Motivation and behavioral skills were associated with ART adherence, while depression adversely affected adherence.
Gutin *et al*., 2021 [36]	Botswana; women living with HIV	356	Cross-sectional study	Relationship factors, stigma, and IMB constructs	Safer-conception information, motivation, and skills	Stigma reduced behavioral skills, whereas information, motivation, and partner support strengthened them.
Wang *et al*., 2020 [39]	China; transgender women	198	Cross-sectional structural equation modeling	HIV-prevention IMB constructs	Condom-use skills and behavior	Motivation and behavioral skills were associated with condom use, while information showed no significant direct association.
Sinno *et al*., 2021 [44]	Canada; healthcare professionals	80	Cross-sectional survey	PrEP knowledge, motivation, and prescribing skills	PrEP knowledge and prescribing practices	Previous prescribers demonstrated greater PrEP knowledge than non-prescribers.
Hu *et al*., 2020 [38]	China; men who have sex with men	1,141	Cross-sectional structural equation modeling	Extended IMB constructs	Information, motivation, skills, and condom use	Behavioral skills directly predicted condom use, with differences between rural and urban participants.
Jiang *et al*., 2019 [40]	China; men who have sex with men	976	Cross-sectional structural equation modeling	Modified IMB model	Information, motivation, skills, and condom use	Behavioral skills directly predicted condom use and mediated the effects of information and motivation.
Shen *et al*., 2019 [41]	China; unmarried female migrants	2,270	Cross-sectional structural equation modeling	Modified IMB model	Psychological factors and condom use	Psychological and personality factors strengthened the explanatory pathways of the IMB model.
Ge *et al*., 2022 [48]	China; pregnant women	525	Cross-sectional structural equation modeling	Integrated behavioral and IMB constructs	Weight-management behavior	Information, self-efficacy, and behavioral skills predicted weight-management practices.
Taştekin Ouyaba and Öztürk, 2021 [49]	Turkey; pregnant women	350	Cross-sectional structural equation modeling	IMB constructs	Eating behavior	Motivation and behavioral skills contributed to the explanation of healthy-eating behavior.
Hwang *et al*., 2023 [47]	South Korea; adults with chronic disease	35	Single-group pre–post study; 12 weeks	Web-based IMB self-management program	Self-management and self-efficacy	The program improved selected self-management and self-efficacy outcomes, although no control group was included.
Wan Mohamad Darani *et al*., 2024 [42]	Malaysia; adolescents	Expert and adolescent evaluation	Research and development using ADDIE	IMB-based HIV-education kit	Content validity and usability	The educational kit demonstrated satisfactory validity, understandability, and usability.

Abbreviations: ADDIE, Analysis, Design, Development, Implementation, and Evaluation; ART, antiretroviral therapy; COPD, chronic obstructive pulmonary disease; HBM, Health Belief Model; IMB, Information–Motivation–Behavioral Skills.

Methodological Quality and Risk of Bias

The JBI critical appraisal identified five studies with low risk of bias, twelve with moderate risk, one with high risk, and one with critical methodological concerns. Frequent limitations included cross-sectional designs, convenience sampling, small samples, self-reported outcomes, inadequate adjustment for confounding, absence of comparison groups, and short follow-up periods. These limitations reduced causal certainty and increased the possibility of recall, selection, and social-desirability bias. No study was excluded solely because of its appraisal rating; however, direct ART-adherence studies with lower risk of bias were given greater interpretive weight. The retracted study was retained for transparency but was not used to strengthen the review conclusions. The appraisal results are summarized in Table **2**.

Synthesis of IMB Constructs

Information was commonly assessed through HIV knowledge, ART literacy, treatment benefits, and understanding of medication schedules. Greater information was generally associated with more favorable outcomes, although knowledge alone was insufficient to maintain adherence [31–35]. Motivation included treatment attitudes, perceived benefits, social support, stigma, relationship factors, and patient–provider communication [31,34,36]. Stronger

Table 2: Joanna Briggs Institute Methodological Quality and Risk-of-Bias Assessment

Author, year	JBI appraisal tool	Criteria met	Risk of bias	Main methodological limitations
Zareipour *et al*., 2021	Quasi-experimental checklist	7/9	Moderate	Limited allocation information, self-reported outcomes, and single-center recruitment.
Jozani *et al*., 2019	Randomized controlled trial checklist	9/13	Moderate	Allocation concealment and blinding were unclear, and follow-up was short.
Shen *et al*., 2021	Randomized controlled trial checklist	3/13	Critical	Inadequate reporting of randomization and blinding and subsequent article retraction.
Ameri *et al*., 2020	Quasi-experimental checklist	7/9	Moderate	Single-center sampling, self-reported outcomes, and short follow-up.
McCuistian *et al*., 2021	Quasi-experimental checklist	4/9	High	Development-focused design without controlled effectiveness estimates.
Chen *et al*., 2025	Cohort checklist	9/11	Moderate	Single-hospital recruitment, prediction-model limitations, and limited causal interpretation.
Liang *et al*., 2020	Quasi-experimental checklist	7/9	Moderate	No independent control group and possible selection bias related to digital access.
Ramaiya *et al*., 2020	Analytical cross-sectional checklist	6/8	Moderate	Cross-sectional design, purposive sampling, and limited statistical power.
Morowatisharifabad *et al*., 2019	Analytical cross-sectional checklist	6/8	Moderate	Self-reported adherence, single-center sampling, and limited confounding control.
Gutin *et al*., 2021	Analytical cross-sectional checklist	7/8	Low	Cross-sectional design and indirect outcome for ART adherence.
Wang *et al*., 2020	Analytical cross-sectional checklist	7/8	Low	Non-probability sampling and self-reported behavioral outcomes.
Sinno *et al*., 2021	Analytical cross-sectional checklist	5/8	Moderate	Small self-selected sample and possible non-response bias.
Hu *et al*., 2020	Analytical cross-sectional checklist	7/8	Low	Self-reported behavior and possible residual confounding.
Jiang *et al*., 2019	Analytical cross-sectional checklist	7/8	Low	Convenience recruitment and inability to establish causal mediation.
Shen *et al*., 2019	Analytical cross-sectional checklist	6/8	Moderate	Convenience sampling, self-reporting, and limited directness to ART adherence.
Ge *et al*., 2022	Analytical cross-sectional checklist	7/8	Low	Single-hospital sample and inability to establish temporal relationships.
Taştekin Ouyaba and Öztürk, 2021	Analytical cross-sectional checklist	6/8	Moderate	Single-center sampling, self-reported behavior, and limited relevance to ART.
Hwang *et al*., 2023	Quasi-experimental checklist	6/9	Moderate	Small sample, no control group, and short follow-up.
Wan Mohamad Darani *et al*., 2024	Validation-study appraisal	6/8	Moderate	Small expert panel and absence of direct behavioral or adherence outcomes.

motivation and social support facilitated engagement, whereas depression, stigma, substance use, and poor communication weakened readiness to adhere [31,34-37].

Behavioral skills, particularly self-efficacy, problem-solving, communication competence, and practical medication management, were the most consistent proximal predictors of adherence-related outcomes [32,33,35]. Structural equation modeling and intervention studies indicated that information and motivation often influenced behavior through behavioral skills [38-41]. However, confidence in the mediation pathway was limited because many studies used cross-sectional designs or indirect outcomes.

Heterogeneity, Bias, and Certainty of Evidence

Meta-analysis was not conducted because the studies differed substantially in populations, designs, intervention components, follow-up periods, outcome definitions, and reported effect estimates. The evidence was therefore synthesized narratively according to IMB construct, study design, intervention type, contextual factors, and methodological quality. Formal funnel-plot and Egger's-test assessments were not appropriate because fewer than ten sufficiently comparable studies were available for any single outcome. A formal GRADE assessment was not conducted; nevertheless, confidence in the evidence was evaluated according to risk of bias, consistency, directness, precision, and possible publication bias.

Overall confidence was limited by methodological heterogeneity, indirect evidence, self-reported outcomes, and the predominance of cross-sectional studies.

DISCUSSION

This review synthesized 19 studies applying the IMB model across ART adherence, HIV care, prevention, and related self-management contexts. The findings support the IMB model as a theoretically coherent framework for explaining adherence behavior, particularly through the interaction of information, motivation, and behavioral skills [31-35,38-41]. Nevertheless, only some studies directly measured ART adherence, while others provided indirect evidence from HIV-prevention or non-HIV behavioral contexts. The findings therefore provide stronger evidence for the theoretical mechanisms of the IMB model than for a precise estimate of intervention effectiveness.

Behavioral skills emerged as the most consistent and proximal component of the IMB pathway [32,33,35]. Knowledge of HIV, treatment benefits, and medication requirements was important, but information alone did not consistently produce sustained behavioral change [38-40]. Self-efficacy, problem-solving ability, communication competence, and medication-management skills appeared to translate information and motivation into action [45-47]. Individuals may understand and value ART but remain vulnerable to non-adherence when they lack practical strategies to manage adverse effects, disrupted routines, disclosure concerns, and communication with providers [48,49]. However, much of the mediation evidence came from cross-sectional analyses, limiting conclusions about temporal and causal relationships.

Motivation influenced adherence through personal attitudes, perceived treatment benefits, stigma, social norms, partner support, and patient–provider communication [31,34,36]. Its effects were often indirect through self-efficacy, communication, and problem-solving capacity [37,44]. This pattern was observed across PLHIV, women, youth, and key populations [31-33], supporting interventions that combine treatment information, motivational counseling, and skill development rather than relying only on education [34,35,38].

The findings are broadly consistent with previous systematic reviews reporting that multicomponent adherence interventions are generally more effective than information-only approaches [50-52]. The present review extends those findings by emphasizing behavioral skills as an important mechanism connecting knowledge and motivation with treatment behavior. Nevertheless, differences in adherence measures, intervention intensity, follow-up duration, and comparator conditions prevented quantitative comparison of effect sizes. Consequently, the effectiveness of individual IMB components and their optimal combination remain uncertain.

Psychosocial and contextual barriers, including depression, substance use, stigma, food insecurity, and poor patient–provider communication, may weaken motivation and restrict the application of behavioral skills [50,52,53]. Previous evidence similarly associates stigma, substance use, and social vulnerability with non-adherence [54-58]. IMB-informed interventions may therefore be more effective when counseling and skill development are combined with mental health support, stigma reduction, social support, and improved provider communication [50,59]. Youth-focused digital and peer-support programs demonstrate the adaptability of the model [60,61], although privacy, internet access, digital literacy, and sustained engagement must be considered [50-52,62].

Evidence from HIV-prevention and non-HIV studies should be interpreted as indirect support rather than equivalent evidence for ART adherence [38-40]. Nevertheless, these studies consistently showed that information and motivation were more likely to affect behavior when translated into practical self-management skills [41-43,45-47]. Counseling, therapeutic mentoring, continuous support, stigma reduction, and effective communication may further improve treatment engagement [63-68]. Integrated IMB-informed and technology-assisted approaches may therefore support adherence and quality of life across diverse settings, particularly when adapted to local needs and healthcare resources [69-71,74-76].

The findings have practical implications for clinicians, HIV program managers, and policymakers. Clinicians should assess treatment knowledge together with motivation, self-efficacy, mental health, stigma, social support, and medication-management difficulties. HIV programs should integrate education, counseling, peer support, behavioral skill development, and mental health referral within routine services. Policymakers should incorporate IMB-informed counseling into HIV guidelines, strengthen continuity of ART supply, support stigma-reduction initiatives, and ensure that digital interventions remain accessible and complement face-to-face care.

The conclusions are limited by clinical and methodological heterogeneity, frequent cross-sectional designs, small samples, short follow-up periods, self-reported outcomes, and indirect evidence. These

limitations reduced causal certainty and may have inflated favorable associations. Publication and language bias were also possible because the review focused on peer-reviewed English-language studies, while formal meta-analysis and GRADE assessment were not conducted. Future studies should use adequately powered randomized or longitudinal designs, standardized and objective adherence measures, prospective mediation analyses, and longer follow-up periods, with greater attention to structural determinants and implementation in low- and middle-income settings.

CONCLUSION

This systematic review synthesized evidence from 19 studies examining the application of the Information–Motivation–Behavioral Skills (IMB) model to ART adherence and related health behaviors among people living with HIV/AIDS. The findings suggest that the IMB model provides a useful theoretical framework for understanding ART adherence, with behavioral skills particularly self-efficacy, problem-solving ability, patient–provider communication, and practical medication management emerging as the most proximal mechanisms through which information and motivation influence adherence. However, knowledge and motivation alone appear insufficient when psychosocial and contextual barriers, including stigma, depression, substance use, limited social support, and communication difficulties, remain unaddressed. IMB-informed interventions may therefore be most effective when they integrate treatment education, motivational support, behavioral skill development, and strategies targeting broader social and healthcare barriers. Nevertheless, these conclusions should be interpreted cautiously because of substantial heterogeneity in study populations, designs, interventions, and adherence measures, as well as the reliance of several studies on cross-sectional designs and self-reported outcomes. Overall, the evidence supports the IMB model as a promising and context-sensitive framework for guiding ART adherence interventions, although further well-designed longitudinal and randomized studies using standardized and objective adherence measures are needed to confirm its effectiveness and mechanisms in routine HIV care.

ETHICAL DECLARATION

Not applicable.

LIST OF ABBREVIATIONS

ART = Antiretroviral Therapy

CI = Confidence Interval

COPD = Chronic Obstructive Pulmonary Disease

HBM = Health Belief Model

R&D = Research and Development

HIV = Human Immunodeficiency Virus

ICT = Information and Communication Technology

IMB = Information–Motivation–Behavioral Skills

JBI = Joanna Briggs Institute

PICO = Population, Intervention, Comparison, Outcom

PLHIV = People Living with HIV/AIDS

PrEP = Pre-Exposure Prophylaxis

PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses

RCT = Randomized Controlled Trial

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

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AUTHOR CONTRIBUTIONS

Idhar Darlis contributed to the conceptualization, methodology, literature search, study selection, data extraction, formal analysis, and preparation of the original manuscript draft. A. Arsunan Arsin contributed to the conceptualization, methodological supervision, validation, interpretation of findings, and critical revision of the manuscript. Shanti Riskiyani contributed to the literature screening, data verification, quality assessment, interpretation of findings, and manuscript

review and editing. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for the accuracy and integrity of the work.

USE OF ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (AI) tools were used solely for language editing, grammar checking, and manuscript formatting assistance. All study design, data collection, analysis, interpretation of findings, and final manuscript content were completed, reviewed, and approved by the authors, who take full responsibility for the integrity and accuracy of the work.

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