

Adaptive Personalization in Digital Therapeutics: A Systematic Review of Real-Time Patient-Centered Tailoring Mechanisms and Their Clinical Outcomes

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Introduction

Digital therapeutics (DTx) are increasingly used to support chronic disease management, behavioral health, and rehabilitation. While many platforms claim to deliver “personalized” care, the underlying adaptive mechanisms—how interventions change in real time in response to patient behavior, symptoms, adherence, or physiologic signals—remain poorly defined and inconsistently evaluated.

This systematic review examines real-time personalization strategies in DTx and assesses their impact on patient-centered outcomes, engagement, and clinical effectiveness.

Objective

To evaluate real-time adaptive personalization strategies in digital therapeutics and assess their effects on patient engagement, adherence, and clinical outcomes.

Methods

We searched PubMed, Embase, PsycINFO, and IEEE Xplore for studies published from January 2015 to November 2025. Eligible studies evaluated DTx platforms incorporating adaptive tailoring mechanisms such as dynamic feedback loops, sensor-driven adjustments, reinforcement-learning algorithms, rule-based personalization, or real-time symptom monitoring. Two independent reviewers screened articles, extracted data, and assessed methodological quality using PRISMA guidelines. Personalization mechanisms were categorized into algorithmic, behavioral, and physiological tailoring modalities.

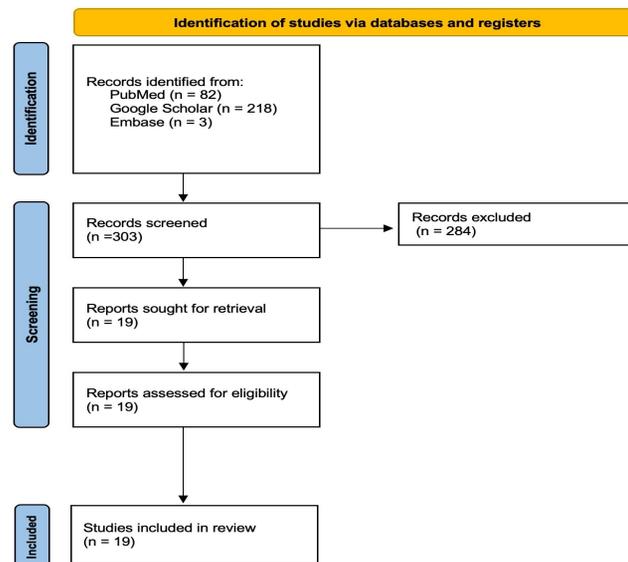
Methods cont.

Inclusion and Exclusion Criteria

Inclusion	Exclusion
<ul style="list-style-type: none"> DTx studies Adaptive personalization reported Healthcare application Healthcare application Patient or clinical outcomes measured 	<ul style="list-style-type: none"> Non-DTx studies No adaptive component No relevant outcomes Insufficient methods

Results

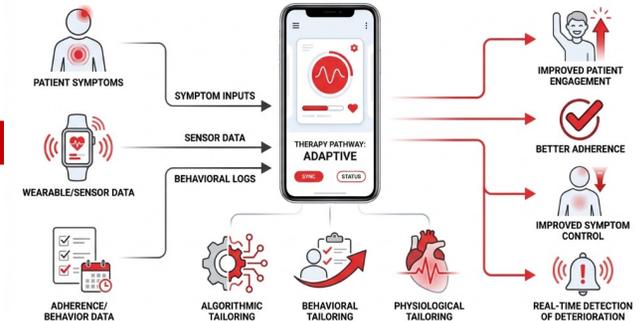
Of 303 studies identified, 19 met inclusion criteria. Adaptive personalization improved engagement across chronic disease, mental health, and rehabilitation settings. Algorithmic approaches showed the greatest gains in adherence and symptom control, while physiological tailoring improved real-time responsiveness.



Results Cont.

Transparency remained limited across most studies. Few interventions reported explainability, auditability, or incorporation of patient preferences into adaptive decision-making.

Adaptive Personalization in Smartphone-based Digital Therapeutics



Future Perspectives

- Standardized Reporting**
Develop consistent frameworks for describing adaptive personalization methods and outcomes
- Explainability & Auditability**
Improve transparency in how real-time tailoring decisions are generated and evaluated
- Patient-Centered Co-Design**
Build DTx systems around patient preferences and shared decision-making

Conclusions

Adaptive personalization is a promising strength of DTx, but current implementations remain heterogeneous and insufficiently transparent. Standardized reporting and patient-centered design are needed to improve trust, safety, and equity.