AI-Enabled Asynchronous Teledermatology within Interoperable Digital Ecosystems: A Scalable Framework for Precision Tele-Monitoring

Lukas Schramm[1,3], Dominik Haller[3], Christian Greis[2,3] | 1 University of Bamberg, Department of General Psychology and Methodology, Germany | 2 University Hospital Zurich, Department of Dermatology, Switzerland | 3 Derma2go AG, Zurich/Munich

** Corresponding author: Christian Greis*

Objective

Artificial intelligence (AI) is rapidly gaining momentum in telemedicine, particularly in dermatology, a visually driven specialty well suited to digital diagnostics. We hypothesize that effective integration of AI into interoperable digital ecosystems can enable scalable, high-quality teledermatological care.

Framework / Methods

Conceptual framework for asynchronous teledermatology platforms in which patients submit structured clinical information and images independent of time constraints.
Multimodal AI systems integrating vision and language models support lesion characterization, structured intake, risk stratification and clinician-assisted triage.
Large language models enable clinical summarization, structured data extraction and differential diagnosis support, optionally grounded via retrieval-augmented approaches.
Interoperability links electronic health records, imaging data and digital therapeutics (DTx) into a continuous data ecosystem.
DTx applications enable longitudinal monitoring of chronic skin conditions such as psoriasis and atopic dermatitis.

Expected Results / Impact

Dermatologist-level performance is achievable in defined image-classification tasks when validated AI models are used appropriately.
AI-assisted triage can prioritize high-risk cases and streamline physician workflows.
Asynchronous care can improve access and reduce unnecessary in-person visits, lowering system burden.
Longitudinal patient-generated data supports adaptive treatment decisions and personalized care pathways.

Challenges and Guardrails

Data privacy and security requirements constrain integration across systems.
Regulatory frameworks for AI and DTx remain heterogeneous across regions.
Bias from underrepresentation of diverse skin types can affect generalizability and equity.
Clinical deployment requires validation, transparent escalation criteria and physician oversight.

Conclusion

The convergence of AI, interoperable ecosystems, DTx and asynchronous platforms represents a robust, hypothesis-driven framework for next-generation dermatological care. The model is designed to improve diagnostic accuracy, workflow efficiency, access and patient outcomes while preserving clinician accountability.

Keywords

AI triage | Teledermatology | DTx | Interoperability | Precision monitoring | EHR integration | Asynchronous care

Scalable Digital-Care Architecture

From patient-generated data to physician-led precision tele-monitoring

1. Patient submission

Structured history + Questionnaire Data + smartphone images are uploaded asynchronously.

2. AI pre-analysis

Multimodal AI systems integrating vision and language models support lesion detection, risk stratification and triage.

3. Dermatologist review

High-risk cases are escalated; physicians validate outputs and decide care.

4. Precision tele-monitoring

DTx and EHR data enable longitudinal monitoring and adaptive pathways.

Core Enablers

Interoperable ecosystem
EHR + imaging + DTx data are exchanged across compatible systems.

Asynchronous platform
Time-independent submissions improve access and reduce bottlenecks.

Validated AI models
Task-specific accuracy, calibration and escalation thresholds are required.

Governance
Privacy, security, regulation, bias mitigation and clinician oversight.

Measurable Improvement Domains

1. **Accuracy** — AI-assisted image analysis for selected diagnostic tasks
2. **Efficiency** — Reduced manual sorting and faster prioritization
3. **Access** — Fewer avoidable in-person visits and lower system burden
4. **Outcomes** — Longitudinal monitoring supports personalized decisions

Clinical implementation principle

AI should not replace physician judgement. Its role is to structure submissions, surface risk, improve prioritization and support evidence-based monitoring within privacy-preserving, interoperable workflows.

Reference focus: AI-assisted dermatological image analysis, store-and-forward teledermatology, digital therapeutics, interoperability, privacy, bias and regulatory governance.

USZ Universitäts Spital Zürich · Universität Zürich[UZH] · University of Bamberg · derma2go Ihre Experten für gesunde Haut