

Development of a Community-Based Digital Mental Health Ecosystem Led by Psychiatric Nurses for Rural Populations

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Abstract

Rural populations worldwide experience a disproportionate burden of unmet mental health need, driven by a combination of workforce scarcity, geographic distance, stigma, and infrastructural barriers that limit the reach of traditional, clinic-based psychiatric services. Psychiatric-mental health nurses—including psychiatric-mental health nurse practitioners (PMHNPs), community psychiatric nurses, and nurse care managers—occupy a distinctive position at the intersection of clinical authority, care coordination, and community trust, making them plausible anchors for a layered, technology-enabled model of rural mental health care. This review synthesizes evidence relevant to the design of a community-based digital mental health ecosystem led by psychiatric nurses, drawing on literature spanning community champion and task-shifting models in low- and middle-income countries, nurse-led collaborative care trials for depression, nurse-supported digital therapeutics for psychosis and depression, PMHNP-led telepsychiatry practices, stepped-care digital platforms, artificial intelligence-enabled community health worker tools, and the digital divide literature documenting persistent rural broadband and device access gaps. Across these strands, evidence indicates that nurse-mediated digital interventions—whether delivered via SMS-based community champion supervision, nurse care-manager telephone protocols, app-facilitated psychosis care, or PMHNP-led telehealth—consistently outperform purely self-directed digital tools and unsupported specialist telepsychiatry alone in extending reach and sustaining engagement, while also introducing new demands on nursing workforce time, digital literacy training, and health-system integration. This review proposes a five-tier ecosystem architecture—community/lay, digital self-help, nurse-supported digital, telepsychiatry/specialist, and crisis/high-acuity tiers, cross-cut by an artificial intelligence and analytics layer—and discusses governance, privacy, workforce, and sustainability considerations necessary for the ecosystem's development, implementation, and scale-up in rural settings.

Keywords: psychiatric-mental health nursing; digital mental health; rural health; telepsychiatry; task-shifting; stepped care; community-based care; nurse practitioner; digital divide; artificial intelligence

1. Introduction

1.1 The Global and Rural Mental Health Treatment Gap

Mental, neurological, and substance use disorders remain among the leading causes of disability worldwide, yet access to appropriate care remains starkly unequal both between and within countries. According to the World Health Organization's Mental Health Atlas 2020, the global median number of mental health workers is only 13 per 100,000 population, ranging from fewer than two per 100,000 in low-income countries to more than 60 per 100,000 in high-income countries [33]. The Mental Health Atlas 2024 update, drawing on data from 144 countries, found the global median number of specialized mental health workers to be 13.5 per 100,000 population, ranging from just 1.1–2.4 in low-income and lower-middle-income countries to 67.2 in high-income countries, alongside persistent underfunding and workforce shortages, especially in low-resource settings [34,36]. Cross-national comparative analyses have quantified the disparity at the level of individual professional cadres: high-income countries average more than ten psychiatrists per 100,000 population (the United States reports 14.6 and Australia 13.5), whereas Nigeria and Kenya report only 0.1 and 0.2 psychiatrists per 100,000, respectively [35]. This workforce disparity is compounded within countries by rural-urban maldistribution: in the United States, over 75% of counties qualify as mental health professional shortage areas, with roughly 85% of this shortfall concentrated in rural areas, and approximately half of all counties reporting no practicing mental health professional at all [39]. More recent analyses similarly find that approximately 80% of U.S. rural counties have no practicing psychiatrist [40], and as of December 2025, the Health Resources and Services Administration had designated 4,212 rural Mental Health Professional Shortage Areas, estimating that 1,797 additional practitioners would be required to eliminate these designations altogether [45].

1.2 Why Psychiatric Nurses Are a Natural Anchor for Rural Digital Mental Health

Psychiatric-mental health nurses—spanning community psychiatric nurses, nurse care managers embedded in collaborative care models, and psychiatric-mental health nurse practitioners (PMHNPs) with prescribing authority—represent one of the fastest-growing and most geographically distributed segments of the behavioral health workforce. Nurse practitioners are reported to be the fastest-growing occupation in the United States, with numbers projected to increase 45% by 2032, and are disproportionately likely, relative to psychiatrists, to practice in rural and underserved areas [42,47]. PMHNPs have been explicitly identified as essential to closing rural psychiatric care gaps, given that many rural counties have no psychiatrist at all [42,43]. At the same time, psychiatric nurses have long served as the connective tissue of collaborative and stepped-care models of mental health service delivery, acting as care managers who coordinate education, monitoring, behavioral activation, and communication between patients, primary care providers, and specialists [14,15,16]. This dual identity—clinically credentialed prescriber/therapist on one hand, and trusted community-embedded care coordinator on the other—positions psychiatric nurses uniquely to serve as the human anchor of a technology-enabled ecosystem that must simultaneously deliver clinical authority, sustain community trust, and provide the ongoing supervision that purely self-directed digital tools generally lack [3,17,45,46].

1.3 Digital Mental Health as a Response to the Rural Access Gap

The proliferation of mobile applications, teletherapy platforms, artificial intelligence-enabled chatbots, and remote monitoring technologies has been positioned as a partial solution to workforce and geographic access barriers in mental health care [37]. Telepsychiatry and other forms of digital mental health intervention have been described as central to the future of psychiatric nursing practice, with trial evidence showing that nurse-facilitated digital tools can improve medication adherence, self-management, and treatment engagement among patients with serious mental illness [3]. However, the evidence base also cautions against viewing digital tools as a self-sufficient substitute for workforce expansion: a recent large-scale analysis of Medicare telepsychiatry utilization found that clinicians with the highest telemedicine use saw less than a one-percentage-point increase in visits with rural patients compared to those with lower telehealth use, suggesting that expanding telepsychiatry alone, without accompanying workforce, infrastructure, and community-engagement strategies, produces only modest gains in reaching the populations most affected by provider shortages [41]. This finding directly motivates the “ecosystem” framing of this review: rather than treating digital mental health as a single point solution, this review considers how a layered set of digital tools, organized around and led by psychiatric nursing roles at each layer, might be assembled into a coherent system capable of reaching rural populations more effectively than any single modality alone.

1.4 Objectives of This Review

This review aims to: (1) synthesize evidence on community-based, task-shared, and nurse-led models of rural and low-resource mental health care; (2) characterize existing digital mental health interventions—including stepped-care platforms, nurse-supported apps, telepsychiatry practices, and artificial intelligence-enabled community health worker tools—relevant to rural deployment; (3) propose a tiered ecosystem architecture that positions psychiatric nurses as the connective and supervisory layer across community, digital, and specialist tiers of care; (4) examine barriers related to the rural digital divide, workforce capacity, privacy, and governance; and (5) outline implementation and evaluation priorities for the development of such an ecosystem.

2. Review Approach

This is a narrative review integrating evidence from several literatures that are rarely reviewed jointly: (a) community champion and lay-health-worker task-shifting trials for common mental disorders in low- and middle-income rural settings; (b) nurse-led and nurse-care-manager collaborative care trials for depression in primary care; (c) randomized and quasi-experimental trials of nurse-supported digital mental health tools (apps, digital CBT, telepsychiatry); (d) health-services and policy literature on PMHNP scope of practice, telehealth policy, and rural workforce distribution; (e) descriptions of stepped-care and AI-enabled digital mental health platform architectures; and (f) literature on the rural digital divide and the ethics of AI-enabled digital phenotyping. Sources were identified through targeted searches of PubMed/MEDLINE-indexed literature, JMIR-family journals, Cochrane-affiliated trials, WHO technical reports, and relevant health-policy and rural-health research center publications, with an emphasis on studies published through 2026. Given the heterogeneity of populations (LMIC rural villages, U.S. rural counties, mixed urban-rural health systems), intervention types, and outcome measures across the identified literature, a narrative synthesis—organized around a proposed ecosystem architecture—was judged more appropriate than a quantitative meta-analysis.

3. Conceptual Foundations

3.1 Task-Shifting and Task-Sharing in Global Mental Health

The WHO's Mental Health Gap Action Programme (mhGAP), launched in 2008, was designed explicitly to scale up care for mental, neurological, and substance use conditions in low-resource settings by training non-specialist health workers—including nurses, community health workers, and lay counselors—to deliver evidence-based interventions under specialist supervision, an approach formally termed task-shifting or task-sharing [8,11]. The mhGAP Intervention Guide provides simplified, modular management algorithms designed to be usable by community health workers with limited formal mental health training [11]. Task-sharing has been described as an arrangement in which generalists—non-specialist health professionals, lay workers, affected individuals, or informal caregivers—receive training and appropriate supervision by mental health specialists in order to deliver care that would otherwise be unavailable due to workforce scarcity [12]. This model has been operationalized in interventions such as Pakistan's Lady Health Worker Program, in which basic mental health content adapted from the mhGAP-IG has been proposed for integration into an existing maternal and child health workforce curriculum [10], and in structured peer-supervision models for lay mental health workers in India, designed to improve fidelity and outcomes in low-resource task-shared care [12].

3.2 Community Champion and Volunteer-Led Models

A particularly relevant precedent for a rural, community-anchored digital mental health ecosystem is the Atmiyata program in rural Gujarat, India, a community-champion-led psychosocial intervention for common mental disorders evaluated through a stepped-wedge cluster randomized controlled trial across 645 villages [1,2]. In Atmiyata, trained community volunteers (“Champions”) identify and provide a package of community-based interventions, including evidence-based counseling, for people with depression and anxiety, with supervision embedded in the model to maintain quality [2]. The trial demonstrated the feasibility of a volunteer-led model at very large geographic scale in a rural LMIC setting, and its nested economic evaluation and return-on-investment analysis reflect the kind of implementation-science rigor that a nurse-led digital ecosystem should similarly incorporate [2]. This model illustrates a key structural principle directly transferable to psychiatric-nurse-led ecosystem design: lay or volunteer community actors can substantially extend reach into rural populations, provided that a credentialed clinical tier (in Atmiyata's case, supervising mental health professionals; in the ecosystem proposed here, psychiatric nurses) provides oversight, escalation pathways, and quality assurance.

3.3 Collaborative Care and the Nurse Care Manager Role

A parallel and well-established literature demonstrates the effectiveness of nurse-led collaborative care models for depression in primary care, in which a nurse care manager coordinates a structured management plan, behavioral activation, and communication between the patient, primary care provider, and specialist, typically through a series of scheduled telephone or in-person contacts. In the Swedish PRIM-CARE pragmatic cluster randomized controlled trial, conducted across 23 primary care centers in both rural and urban regions, a 12-week nurse care-manager program—consisting of six to eight contacts—produced significantly improved depressive symptoms, remission, and medication adherence relative to usual care at 6 months, with improvements in depressive symptom severity sustained at 12 months [14,15,16]. In rural China, the COACH (Chinese Older Adult Collaborations in Health) trial tested a collaborative depression-and-hypertension care-management intervention delivered through village clinics, addressing a context in which prior naturalistic data found that only about 1% of older adults with major depressive episodes received any treatment over a 12-month period [22].

Collaborative care models more broadly have been shown in multiple health systems (the U.S. Veterans Affairs system, UK primary care via the CADET trial, and rural diabetes populations via the COMRADE trial) to depend critically on the nurse or care-manager role as the mechanism that operationalizes structured follow-up, inter-professional communication, and patient engagement [21,23,24]. This literature establishes the nurse care-manager function as a validated, exportable component for the “nurse-supported digital tier” of the ecosystem proposed in this review, in which digital tools support—rather than replace—the nurse's coordinating function.

3.4 Stepped Care as an Organizing Framework for Digital Mental Health

The stepped-care model, which organizes mental health services hierarchically from low-intensity, high-reach interventions (self-help, psychoeducation) to progressively more intensive, specialist-delivered interventions matched to clinical severity, has become a common organizing framework for digital mental health platforms. Singapore's national Tiered Care Model exemplifies this approach at a health-system level, emphasizing community partnership, governance, and digital integration to coordinate referral pathways and continuity of care across tiers [27]. At the platform level, Hong Kong's TourHeart project operationalizes a “stratified stepped care” approach (modeled on Stepped Care 2.0) that allows users to select among service levels ranging from self-help resources to coached, person-centered support, with machine learning increasingly used to personalize the stepped pathway [17,18]. Similarly, the MoodUP platform for cancer patients used a stepped-care model in which self-reported screening data triggered severity-matched intervention suggestions coordinated by a case manager [20]. These stepped-care digital architectures map naturally onto the ecosystem proposed in this review, in which psychiatric nurses can serve as the case managers or coaches embedded at the intermediate steps between fully self-directed digital tools and specialist psychiatric care.

4. Components of a Community-Based Digital Mental Health Ecosystem

4.1 Community and Lay Tier: Screening, Psychoeducation, and Stigma Reduction

The foundational, highest-reach tier of the proposed ecosystem mirrors the Atmiyata and mhGAP task-shifted models, in which trained community volunteers or health workers conduct population-level screening, psychoeducation, and initial identification of individuals with common mental disorders, escalating cases that require clinical management to the nursing tier [1,2,8,9]. Within a digital ecosystem, this tier can be technologically supported through simple mobile tools—SMS-based screening reminders, structured digital checklists, or basic mobile applications used by community champions to record and transmit screening data—while psychiatric nurses assume the supervisory and quality-assurance role previously occupied by specialist mental health professionals in the Atmiyata and mhGAP models [2,9].

4.2 Digital Self-Help Tier: Stepped-Care Platforms and Apps

The second tier consists of self-guided digital psychoeducation, mood-tracking, and low-intensity self-help content delivered through stepped-care platforms such as TourHeart or similar architectures, allowing individuals to access mental health promotion and early intervention content without requiring an immediate clinical appointment [17,18]. Evidence from the TourHeart stakeholder evaluation emphasizes that person-centered design—emphasizing user autonomy and competence—is critical to engagement, and that a well-designed stepped-care platform must curate rather than merely aggregate available digital tools [17]. Reviews of digital mental health interventions for nurses themselves further note that around 30% of senior nursing staff report low

confidence in using new technology, underscoring that digital literacy training is required not only for rural community members but also for the nursing workforce expected to operate and supervise these platforms [3].

4.3 Nurse-Supported Digital Tier: App-Facilitated Clinical Care

The nurse-supported digital tier is the layer at which psychiatric nurses directly integrate digital tools into active clinical management, and it is here that the strongest trial-level evidence for nurse-mediated digital mental health currently exists. In a randomized controlled trial of the recovery-oriented mobile application Actissist among patients with psychosis, nurses played a key role in app-facilitated care planning, and the intervention produced significant improvements in medication adherence and self-management [3]. A separate randomized controlled trial of a nurse-supported digital cognitive behavioral therapy application for depression reported clinically significant symptom reduction over a 12-week period [3]. A quasi-experimental study of asynchronous telepsychiatry consultations found that this modality reduced the time required for medication titration and increased nursing autonomy in care delivery [3]. Nurse-led CBT interventions, more broadly, have been found to be as effective as those delivered by specialist mental health professionals, and randomized trials of nurse-delivered resilience training have shown significant reductions in stress and anxiety among intensive care nurses, suggesting transferability of nurse-led digital intervention models across both patient-facing and workforce-facing mental health applications [3]. This tier is the direct digital analog of the nurse care-manager collaborative care models described in Section 3.3, with the key innovation being that structured monitoring, behavioral activation content, and communication—previously delivered primarily via telephone in trials such as PRIM-CARE—are instead delivered via app-based workflows augmented by periodic nurse contact [14,15,16].

4.4 Telepsychiatry / Specialist Tier: PMHNP-Led and Psychiatrist-Led Practice

The fourth tier provides synchronous or asynchronous specialist-level psychiatric consultation, diagnosis, and prescribing, primarily via telehealth given the geographic distribution of specialist psychiatric expertise. Psychiatric-mental health nurse practitioners have been explicitly identified as central to closing rural care gaps, given that PMHNPs can, in many U.S. states, practice with full or substantial practice authority and are more likely than psychiatrists to locate their practice in rural areas [42,46]. An analysis of an NP-led integrated telehealth practice in Maryland found that the practice's reach extended to 67% of all counties in the state and to 69% of counties with the highest mental health need, despite the majority of served patients residing in metropolitan areas—illustrating both the promise and the current limits of NP-led telehealth reach into the most underserved rural areas [44]. Qualitative comparative case-study research across states with varying scope-of-practice regulation found that practice authority influenced where PMH advanced practice registered nurses chose to live and practice, with implications for rural workforce distribution and for federal behavioral health workforce planning, which has historically given limited visibility to the PMHNP workforce segment [43,47]. State-level policy changes between 2019 and 2022—including telehealth reimbursement parity, audio-only telehealth authorization for Medicaid populations, and interstate practice compacts such as the Interstate Medical Licensure Compact and the Psychology Interjurisdictional Compact—have been associated with expanded availability of telehealth mental health services, although comparable behavioral-health-specific compacts for nurse practitioners remain unevenly adopted across states [48,49].

4.5 Crisis and High-Acuity Tier: Suicide Risk and Emergency Escalation

A distinct, time-sensitive tier of the ecosystem is dedicated to suicide risk screening, safety planning, and escalation for individuals identified as being at acute risk, whether through community-tier screening, digital self-

help tier flags, or nurse-supported clinical contact. A pilot clinical trial in rural Pakistan is evaluating the feasibility and acceptability of integrating a structured Suicide Prevention Package into an existing task-shifted depression intervention delivered by Lady Health Workers trained in the WHO mhGAP protocol, with escalation pathways linking at-risk individuals to facility-based medical officers [13]. This trial exemplifies the kind of vertically integrated, protocol-driven escalation pathway that a rural digital mental health ecosystem must build in explicitly, given that connectivity failures or delays at precisely the moments of highest acuity represent one of the most consequential potential failure modes of a technology-dependent system [13].

4.6 Artificial Intelligence and Analytics Layer: Human-in-the-Loop Support

Cutting across all tiers, an artificial intelligence and analytics layer offers the potential to extend the reach and efficiency of a limited nursing and specialist workforce through digital phenotyping, passive sensing, and AI chatbot-based triage. The Digital Health-Enabled Community-Centered Care (D-CCC) model proposes an AI-enabled, closed-loop digital health platform explicitly designed to amplify the digital footprint of community health workers through human-in-the-loop artificial intelligence, aiming to support more timely, individualized, and supervised CHW-delivered interventions at scale [19]. Because AI-enabled tools in psychiatry raise substantial ethical concerns—including the disclosure and security of sensitive personal data, informed consent (particularly for continuously collected passive-sensing data and for adolescent populations with evolving capacity for autonomous consent), algorithmic bias, and the risk of over-reliance on automated chatbot support during crises where professional human intervention is required—the ecosystem model proposed in this review positions psychiatric nurses explicitly as the human-in-the-loop reviewers and validators of AI-generated flags, ensuring that automated tools augment rather than substitute for clinical judgment and human relational care [28,29,30,31,32].

5. Proposed Ecosystem Architecture

Table 1 synthesizes the five care tiers described above, together with the cross-cutting AI/analytics layer, specifying the core function of each tier, the corresponding role of psychiatric nursing, representative supporting evidence, and key risks or barriers identified in the literature.

Table 1. Proposed Five-Tier Community-Based Digital Mental Health Ecosystem Led by Psychiatric Nurses

Ecosystem Layer	Core Function	Nurse's Role	Representative Evidence	Key Risks / Barriers
Community/lay tier (universal reach)	Population screening, psychoeducation, stigma reduction, champion/volunteer identification	Supervisor and trainer of community volunteers/CHWs; quality assurance	Atmiyata community-champion model, rural Gujarat [1,2]; mhGAP-based task-shifting [8–12]	Volunteer turnover, variable fidelity, supervision burden
Digital self-help tier	App-based psychoeducation, mood tracking, low-intensity self-guided CBT	Content curation, monitoring of aggregate engagement data	TourHeart stratified stepped-care platform [17,18]; MoodUP oncology stepped-care platform [20]	Low uptake without human facilitation; digital literacy gap
Nurse-supported digital tier	App-facilitated care planning, symptom monitoring, medication adherence support	Direct clinical contact: care manager, coach, or care coordinator embedded in app workflow	Actissist psychosis app RCT [3]; nurse-supported digital CBT for depression [3]; PRIM-	Workforce time burden; reimbursement uncertainty

			CARE nurse care-manager trial [14,15]	
Telepsychiatry / specialist tier	Synchronous and asynchronous psychiatric consultation, diagnosis, prescribing	PMHNP as autonomous or collaborating prescriber; hub-and-spoke liaison	NP-led telehealth practice, Maryland [24]; PMHNP scope-of-practice studies [25,26]	Broadband/device access gaps; interstate licensure restrictions
Crisis / high-acuity tier	Suicide risk screening, safety planning, emergency stabilization, referral	Mhgap-trained nurse/CHW protocol lead; escalation to specialist by phone	Suicide Prevention Package integrated into task-shifted depression care, rural Pakistan [13]	Time-sensitivity; connectivity failure during crisis
AI/analytics layer (cross-cutting)	Passive sensing, digital phenotyping, chatbot triage, human-in-the-loop decision support	Human-in-the-loop reviewer/validator of AI-generated flags and recommendations	D-CCC AI-enabled CHW platform [19]; digital phenotyping and AI chatbot literature [27–32]	Consent, privacy, algorithmic bias, over-reliance on automation

The architecture is deliberately structured so that psychiatric nurses occupy connective and supervisory positions at every tier rather than being confined to the specialist tier alone: as trainers and supervisors of community volunteers (Tier 1), as curators and digital-literacy facilitators for self-help content (Tier 2), as the direct clinical operators of app-facilitated care (Tier 3), as autonomous or collaborating prescribers in telepsychiatry (Tier 4), as protocol leads for crisis escalation (Tier 5), and as the human validators of AI-generated recommendations across all tiers. This design directly reflects the evidence, reviewed above, that purely self-directed digital tools show only modest uptake without human facilitation [17], that nurse-facilitated apps outperform unsupported self-management in psychosis and depression trials [3], that nurse care-manager telephone-based collaborative care produces durable improvements in depression outcomes [14,15,16], and that PMHNP-led telehealth—while still constrained in reaching the most underserved rural populations—extends specialist-level reach further than psychiatrist-only telepsychiatry models given the greater rural distribution of the nursing workforce [42,44,46].

6. Barriers to Implementation

6.1 The Rural Digital Divide

Perhaps the most fundamental constraint on any digital mental health ecosystem is the persistence of the rural digital divide in broadband and device access. National U.S. data indicate that an estimated 7.2 million Americans lack access to high-speed internet connectivity, and that almost 30% of rural Americans do not have internet access in their homes [51,52]. County-level analyses correlating broadband access with the density of mental health resources have found that communities already facing barriers to mental health information and care are disproportionately likely to also lack broadband access, meaning that telemedicine-dependent solutions risk reinforcing rather than reducing existing disparities [50]. Rural adults have been found to be 42% less likely to use telehealth services compared with urban dwellers, a gap strongly predicted by local broadband availability [53]. Veterans Health Administration data further demonstrate that broadband speed categorized as inadequate (≤ 25 Mbps download) is independently associated with reduced access to video-based mental health visits relative to adequate or optimal broadband speeds [55]. Beyond connectivity itself, household crowding—affecting an estimated 14% of rural households—can compromise the privacy needed to engage meaningfully with digital mental health services from the home, a frequently overlooked but consequential barrier [54]. Proposed mitigations in the literature include leveraging public libraries as community access points for telehealth given

their near-universal provision of public internet access [56], and broader “digital inclusion” strategies that address not only access but also the skills required to use digital tools effectively [56].

6.2 Digital and Health Literacy Among the Nursing Workforce and Rural Populations

Digital literacy limitations are not confined to rural community members; reviews of digital mental health tools for nurses themselves report that approximately 30% of senior nursing staff lack confidence in using new technology, a barrier that must be addressed through structured digital-literacy training, virtual training sessions, and librarian-led or peer-led support before nurses can be expected to operate as the connective tissue of a multi-tier digital ecosystem [3]. Co-designed digital tools—such as visual handover aids developed collaboratively with nursing staff—have been shown to reduce navigation time and produce durable improvements in nursing practice, suggesting that participatory design methods used successfully in adjacent nursing-technology contexts should be extended to the design of rural digital mental health ecosystem tools [3].

6.3 Workforce Capacity, Scope of Practice, and Licensure

Even where digital tools are available, the underlying scarcity of psychiatric nursing and psychiatric specialist workforce in rural areas remains a binding constraint. Comparative case-study research across U.S. states with differing PMHNP scope-of-practice regulations found that full versus restricted practice authority influenced practitioners' decisions about where to live and practice, with direct implications for rural workforce distribution [43]. Interstate licensure requirements represent an additional barrier, disproportionately affecting rural areas located near state borders, where the nearest available provider may be licensed in a different state; behavioral-health-specific interstate compacts, modeled on existing medical and psychological licensure compacts, have been proposed as a partial remedy but remain unevenly adopted [38,48]. The PMHNP workforce segment has also historically had limited visibility within federal behavioral health workforce planning and databases, limiting the ability of policymakers to design workforce and reimbursement policy that adequately accounts for this segment's rural care-extending potential [47].

6.4 Privacy, Consent, and Algorithmic Governance

The integration of AI-enabled chatbots, digital phenotyping, and passive sensing tools into the proposed ecosystem's cross-cutting analytics layer introduces distinct governance challenges. Ethical analyses of AI-assisted digital phenotyping identify disclosure of sensitive personal and behavioral data as a central participant concern, alongside questions of consent validity, particularly for continuously collected passive-sensing data and for adolescent users whose evolving autonomy complicates standard informed-consent frameworks [28,29]. Broader reviews of AI chatbots in digital mental health caution that algorithmic bias, data security, and the risk that users may mistake chatbot interaction for equivalent clinical care are unresolved risks requiring active mitigation, particularly during acute crises where professional human intervention is required [30,32]. These concerns reinforce the ecosystem design principle, discussed in Section 4.6, that psychiatric nurses must remain the human-in-the-loop reviewers of AI-generated outputs rather than passive recipients of automated triage decisions [19,31].

6.5 Sustainability, Financing, and Reimbursement

Reimbursement structures for both nurse-led telehealth and app-facilitated care remain unevenly developed. Medicare reimburses nurse practitioner telehealth visits at 85% of physician rates, and Medicaid and commercial payer reimbursement policies for telehealth vary substantially by state, with payment parity for telehealth relative

to in-person visits not universally guaranteed [38,49]. Absent stable reimbursement pathways for the nurse-supported digital tier described in Section 4.3—time spent by psychiatric nurses monitoring app-based data streams, responding to flagged concerns, and coordinating across tiers—the financial sustainability of the ecosystem beyond a grant-funded pilot phase remains uncertain, echoing the broader mHealth literature's documented pattern of pilot-stage stagnation in the absence of dedicated financing mechanisms.

7. Implementation and Evaluation Considerations

Building on the barriers identified above, several considerations should guide the practical development and evaluation of a community-based digital mental health ecosystem led by psychiatric nurses. First, community engagement and co-design should precede platform deployment, following the participatory models used in nurse-technology co-design and in community-champion models such as Atmiyata, to ensure the ecosystem's tiers are trusted, culturally appropriate, and aligned with existing community help-seeking pathways [1,2,3]. Second, the ecosystem should be evaluated using implementation-science frameworks—such as the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework used in the TourHeart stakeholder evaluation—rather than efficacy outcomes alone, given the well-documented gap between pilot-stage feasibility and sustained real-world adoption in digital mental health [17]. Third, evaluation should include nested economic analysis, as in the Atmiyata stepped-wedge trial's return-on-investment component, to generate the cost-effectiveness evidence required for sustainable financing and reimbursement policy [2]. Fourth, digital-literacy training should be built into the ecosystem for both community members and the nursing workforce itself, given documented confidence gaps among nurses in technology use [3]. Fifth, connectivity contingency planning—including offline-capable tools, SMS fallback protocols, and community access points such as public libraries—should be incorporated explicitly into the crisis and high-acuity tier, where connectivity failure carries the highest potential consequence [13,56]. Sixth, governance structures for the AI/analytics layer should specify clear human-in-the-loop review requirements, consent procedures appropriate to passive data collection, and defined escalation protocols from automated flags to nurse review, consistent with prevailing ethical guidance on AI-enabled digital phenotyping [19,28,29,31]. Finally, workforce policy efforts—including support for behavioral-health-specific interstate practice compacts and improved visibility of the PMHNP workforce in federal planning data—should accompany ecosystem deployment to address the underlying scope-of-practice and licensure constraints that limit the specialist tier's rural reach [38,43,47].

8. Conclusion

Rural populations continue to face a substantial and well-documented gap between mental health need and available specialist workforce, a gap that purely technology-based or purely workforce-based solutions have each, on their own, proven insufficient to close. The evidence reviewed here—spanning community-champion task-shifting trials, nurse-led collaborative care models, nurse-supported digital therapeutics, PMHNP-led telepsychiatry, stepped-care digital platforms, and AI-enabled community health worker tools—supports a layered, ecosystem-based approach in which psychiatric nurses serve not merely as one node within the system but as the connective and supervisory presence across every tier, from community screening through digital self-help, nurse-supported clinical management, specialist telepsychiatry, and crisis escalation, with human oversight maintained over an increasingly capable artificial intelligence and analytics layer. Realizing this model in practice will require sustained attention to the rural digital divide, workforce scope-of-practice and licensure policy, sustainable reimbursement mechanisms, and rigorous, implementation-science-informed evaluation, but the constituent evidence base for each individual tier of the proposed ecosystem is already substantial, suggesting

that the central remaining task is one of integration, governance, and scaled implementation rather than fundamental proof of concept.

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