Digital Health-Enabled Primary Care Dermatology: Review of Integrated Management Models for Chronic Skin Diseases

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Abstract

Chronic skin disease is highly prevalent in China and is frequently accompanied by psychological and metabolic comorbidities, yet primary healthcare systems remain insufficiently equipped to provide continuous and integrated management. This review examines how digital health can strengthen primary care dermatology and support general practitioners (GPs) in the prevention, early identification, treatment, follow-up, and comorbidity management of chronic skin disease. Drawing on literature from PubMed and Ovid MEDLINE, as well as relevant guidelines and policy documents, the review synthesizes current evidence on primary care dermatology, digital health technologies, and integrated care models. Recent advances indicate that artificial intelligence (AI)-assisted diagnosis, teledermatology, and digital follow-up tools can enhance diagnostic capacity, facilitate specialist-primary care collaboration, and improve continuous patient management and self-management support. These technologies may help primary care move beyond fragmented, single-visit care toward a more integrated, lifecycle-based model. However, important barriers remain, including limited dermatology training among GPs, insufficient infrastructure, fragmented referral pathways, and variability in digital literacy and resource availability. Overall, digital health

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provides an important opportunity to strengthen primary care-based dermatology services and integrated chronic disease management. Future efforts should focus on workforce capacity building, system integration, and patient empowerment to support more accessible, coordinated, and sustainable care for people with chronic skin disease.
Keywords: chronic skin disease; primary care dermatology; digital health; artificial intelligence; general practitioner

Introduction

As the largest organ of the human body, the skin not only functions as a barrier, defender, and immune regulator, but also serves as an important "window" reflecting overall health status. Global burden of disease studies consistently show that skin and subcutaneous diseases rank among the leading causes of non-fatal disease burden, with disability-adjusted life years (DALYs) occupying a substantial proportion of the chronic disease spectrum in many countries[1,2]. Chronic skin diseases impose a substantial global burden, affecting quality of life, psychosocial well-being, and long-term healthcare utilization across diverse populations and healthcare settings. Skin diseases are also highly prevalent in clinical practice, accounting for approximately 15%–25% of outpatient visits[3]. However, patients often have limited disease awareness, low risk perception, and experience social stigma, leading to delayed healthcare-seeking behavior and non-standardized treatment, which in turn exacerbate the disease burden[4]. In addition, dermatological conditions are frequently under-recognized and undertreated, particularly in settings where access to appropriate care is limited. In China, the burden is also substantial, further highlighting the need for more accessible and continuous models of skin disease management[5–7].

A key structural challenge lies in the imbalance of healthcare resources. Across healthcare systems, the organization of dermatological care varies considerably depending on specialist availability, referral structures, service integration, and digital infrastructure. In many settings, limited access to dermatologists and fragmented care pathways constrain the timely diagnosis and long-term management of chronic skin diseases. The traditional single-visit, specialist-centered model lacks long-term follow-up, comorbidity management, and psychological support, making it poorly suited for chronic disease management. This fragmentation limits continuity of care and creates barriers for patients requiring sustained treatment and monitoring. These challenges are also evident in China, where high-quality dermatology resources remain concentrated in tertiary hospitals, while primary healthcare participation is comparatively limited.

Against this backdrop, primary care systems offer an important opportunity to address these challenges. Primary healthcare institutions, with their accessibility, continuity, and community engagement, are well positioned to support chronic skin disease prevention and management. Although the roles and capacity of primary care in dermatology differ across countries, its importance in early identification, ongoing management, referral coordination, and patient education is increasingly recognized worldwide. Meanwhile, digital health technologies, including artificial intelligence (AI), teledermatology, and mobile health, can enhance diagnostic accuracy, specialist collaboration, and continuous patient management, helping transform primary care dermatology into an integrated, lifecycle-based system. Within this broader international context, China represents an important example of both the challenges and opportunities involved in strengthening primary care dermatology through digital health.

This review aims to synthesize current evidence on digital health-enabled primary care dermatology and to examine how general practitioners (GPs) can support integrated, continuous management of chronic skin diseases and their associated comorbidities.

Methods

To inform this review, a structured review of the literature was conducted to identify peer-reviewed

studies examining primary care dermatology, digital health applications, and chronic disease management. Relevant articles published in recent years were identified through searches of major medical databases, including Ovid MEDLINE and PubMed, using terms related to primary care dermatology, chronic skin diseases, digital health, teledermatology, AI-assisted diagnosis, and integrated disease management. Studies were included if they addressed the management of skin diseases in primary or community-based settings, evaluated digital health interventions, or explored integrated care models involving GPs, while articles focusing exclusively on specialist settings, single highly specific conditions without broader relevance, or lacking clinical applicability were excluded. In addition to database searches, relevant clinical guidelines, policy documents, and key reports were reviewed to provide contextual insights into healthcare systems, digital health implementation, and chronic disease management frameworks, and reference lists of included studies were screened to ensure comprehensive coverage. The review process was informed by preferred reporting items for systematic reviews and meta-analyses (PRISMA) principles and included title and abstract screening, full-text review, and the application of predefined inclusion and exclusion criteria. Because this was a structured review rather than a formal systematic review, studies were selected to provide representative evidence on care models, implementation pathways, clinical applications, and reported outcomes in primary care dermatology. Given the heterogeneity of study designs, populations, and outcomes, formal quality appraisal was not performed; instead, findings were synthesized qualitatively with attention to the strengths, limitations, and knowledge gaps of the current evidence base.

Discussion

Current status of skin disease prevention and control and implementation pathways in primary care

Primary care is shifting from fragmented, hospital-based, and delayed care to a continuous, GP-led, whole-cycle management model for chronic skin diseases, supported by digital tools like AI, teledermatology, and mobile apps, as shown in Figure 1.

Transformation of care models: from episodic treatment to primary care-led lifecycle management

The prevention and management of skin diseases are undergoing a fundamental transition from a traditional, treatment-centered model—primarily focused on medication and physical therapies—toward a comprehensive, integrated approach that spans prevention, screening, diagnosis, treatment, and follow-up. This shift supports the development of a continuous care system anchored in primary healthcare settings. Within this evolving model, primary care is progressively transitioning from a passive "referral outpost" to an active "first-contact and long-term management hub", assuming core responsibilities in early disease identification and continuous care. Previous studies indicate that although specialist-centered models offer high levels of clinical expertise, they are often associated with delayed access, insufficient follow-up, and poor continuity, particularly in the management of chronic skin diseases[8]. In contrast, shifting dermatological care toward primary healthcare significantly enhances accessibility and continuity. For example, integrating specialist dermatology resources into primary care systems can shorten waiting times, improve patient experience, and optimize the allocation of healthcare resources[9]. Furthermore, collaborative mechanisms between primary care and specialists—such as structured referral pathways and consultation systems—can further improve diagnostic efficiency and continuity of care[10]. Therefore, establishing a tiered care model centered on primary care, supported by specialist collaboration, has emerged as a key direction for the transformation of skin disease prevention and control.

Primary care implementation pathways: from initial screening to long-term management

Under a lifecycle-based management framework, primary care institutions operationalize dermatological care through a continuous service pathway encompassing initial screening, standardized diagnosis and treatment, and long-term follow-up, enabling integrated management of skin diseases and their associated comorbidities. During the initial screening stage, GPs, as "gatekeepers of health", are responsible not only for identifying common skin conditions such as eczema, acne, and urticaria, but also for conducting early assessment of comorbid

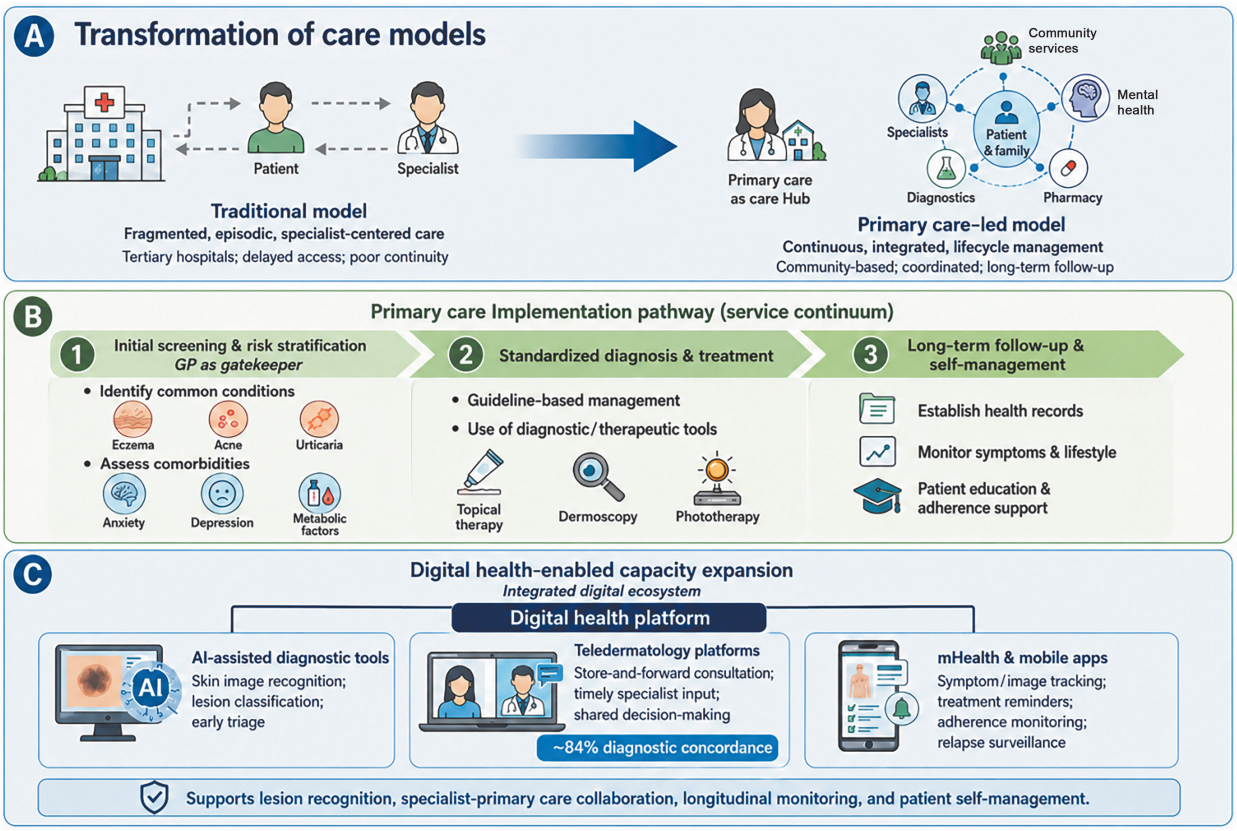

Figure 1: Digital health-enabled integrated primary care management for chronic skin diseases.

Abbreviations: AI, artificial intelligence; GP, general practitioner; mHealth, mobile health.

risks. This includes screening for psychological conditions (e.g., depression and anxiety) and metabolic abnormalities, thereby facilitating early identification of high-risk individuals who may require referral or targeted management[11,12]. In the standardized diagnosis and treatment stage, primary care providers deliver guideline-based management, primarily using topical therapies and, where appropriate, adjunctive physical treatments. For chronic conditions such as psoriasis and vitiligo, the use of dermoscopy and phototherapy can enhance diagnostic accuracy and treatment outcomes. Additionally, for patients with coexisting psychological or metabolic conditions, integrated care models that combine dermatological treatment with psychological support and chronic disease management are increasingly applied to improve overall outcomes[13,14].

In the long-term follow-up stage, primary care institutions provide continuous management through the establishment of patient health records. Follow-up care extends beyond monitoring dermatological symptoms to include assessment of psychological status and lifestyle factors. Through ongoing medication guidance, health education, and self-management support, primary care providers aim to improve adherence, reduce recurrence, and enhance quality of life[15]. Despite these structured pathways, primary care implementation remains constrained by several challenges, including insufficient dermatology training, limited clinical experience, and inadequate diagnostic equipment. These limitations restrict the ability of primary care providers to manage complex conditions and comorbidities effectively, highlighting the need to strengthen service capacity.

Digital health-enabled capacity expansion: from capability limitation to capability enhancement

In the context of constrained primary care capacity, digital health technologies provide critical support for enhancing dermatological service delivery, facilitating a

transition from experience-based practice to technology-assisted care. AI-assisted diagnostic tools, particularly skin image recognition systems, can improve the ability of primary care physicians to identify common dermatological conditions. This advantage is especially relevant in dermatology, where diagnosis relies heavily on the accurate visual recognition of lesion morphology, including color, shape, border, distribution, and surface characteristics. Because AI excels in image recognition and pattern analysis, it has a natural application advantage in dermatology and can serve as a valuable adjunct for lesion classification, early triage, and diagnostic support in primary care settings[16]. Teledermatology platforms enable rapid linkage between primary care providers and specialists through remote consultation, improving access to expertise and reducing unnecessary referrals[10]. Beyond facilitating access, teledermatology can support store-and-forward image consultation, timely specialist input, and shared decision-making between GPs and dermatologists, thereby strengthening triage efficiency and continuity of care in primary care settings.

In addition, digital follow-up tools based on mobile applications and electronic health records support dynamic disease monitoring and individualized management, thereby strengthening long-term care. These tools can also facilitate symptom and image tracking, treatment reminders, adherence monitoring, and relapse surveillance, helping patients and primary care providers to manage chronic and recurrent skin diseases more proactively. Evidence demonstrates the effectiveness of these approaches. For example, the United Kingdom (UK)'s Digital Eczema Management Project has shown that remote monitoring combined with online guidance can significantly improve patient adherence and symptom control[17]. Domestic studies have reported that teledermatology achieves diagnostic concordance rates of approximately 84%, with favorable time and cost efficiency[18]. Furthermore, mobile-based health education interventions have been shown to reduce short-term recurrence rates of eczema[19]. Overall, digital health technologies function primarily as supportive tools for screening, risk stratification, diagnostic assistance, and follow-up management, rather than as replacements for clinical decision-making. Taken together, AI-assisted diagnosis, teledermatology, and digital follow-up tools should be viewed not as isolated interventions, but as an integrated digital ecosystem that can enhance lesion recognition, specialist-primary care collaboration, longitudinal monitoring, and patient self-management. Their integration into primary healthcare systems is driving a shift from "capacity-limited" to "capacity-enhanced" dermatology care, providing essential support for achieving comprehensive, lifecycle-based management of chronic skin diseases.

Key determinants of effective primary care dermatology implementation

The successful implementation of primary care dermatology models is influenced by multiple interacting factors at the environmental, patient, provider, and health system levels. Understanding these determinants is essential for optimizing the management of chronic skin diseases in primary care settings. Environmental factors play an important role in shaping both the prevalence and severity of skin diseases. Extreme temperatures, hot and humid climates, and environmental exposures can exacerbate inflammatory skin conditions such as atopic dermatitis, while also altering the epidemiological patterns of infectious skin diseases and increasing overall disease burden[20]. These contextual factors require primary care providers to adapt management strategies according to local environmental conditions.

Healthcare resource availability is another critical determinant. Although primary care institutions are generally accessible, many lack essential dermatological tools such as dermatoscopes, phototherapy equipment, and adequate medication supplies. As a result, GPs must often tailor diagnostic and treatment approaches based on available resources, while ensuring appropriate screening for serious conditions such as malignant skin lesions to maintain safety and standardization of care. Psychosocial factors are particularly significant in dermatology. Chronic skin diseases are often visible, long-lasting, and associated with social stigma, leading to psychological distress such as shame, social avoidance, anxiety, and depression[21,22]. These factors can negatively influence healthcare-seeking behavior, treatment adherence, and follow-up compliance. Given their continuous patient relationships, GPs are uniquely positioned to address these issues by integrating psychological assessment, patient

education, family involvement, and self-management support into routine care, thereby enabling more holistic and effective interventions.

At the provider and health system levels, workforce capacity and system integration remain key challenges. Many GPs have limited dermatology training and insufficient experience in dermatoscopy and image interpretation, which can reduce diagnostic confidence and affect clinical decision-making. In addition, incomplete chronic disease follow-up pathways and fragmented collaboration between primary care and specialists further hinder continuity and coordination of care[23]. Evidence suggests that GPs who have received targeted dermatology training or have relevant clinical experience demonstrate improved diagnostic accuracy and management capabilities. Moreover, structured training programs, standardized clinical guidelines, specialist support, and coordinated action plans have been shown to significantly enhance the ability of primary care providers to manage common chronic skin diseases such as atopic dermatitis and eczema.

As has been summarized in Figure 2, addressing these multifaceted challenges requires targeted strategies that strengthen workforce training, improve resource allocation and infrastructure, and enhance integration between primary and specialist care. Such efforts are essential to improving the effectiveness and sustainability of primary care-based dermatology services.

Challenges and future directions

Primary dermatology management still faces multiple challenges, which constrain prevention and control effectiveness. Firstly, primary physicians lack specialized

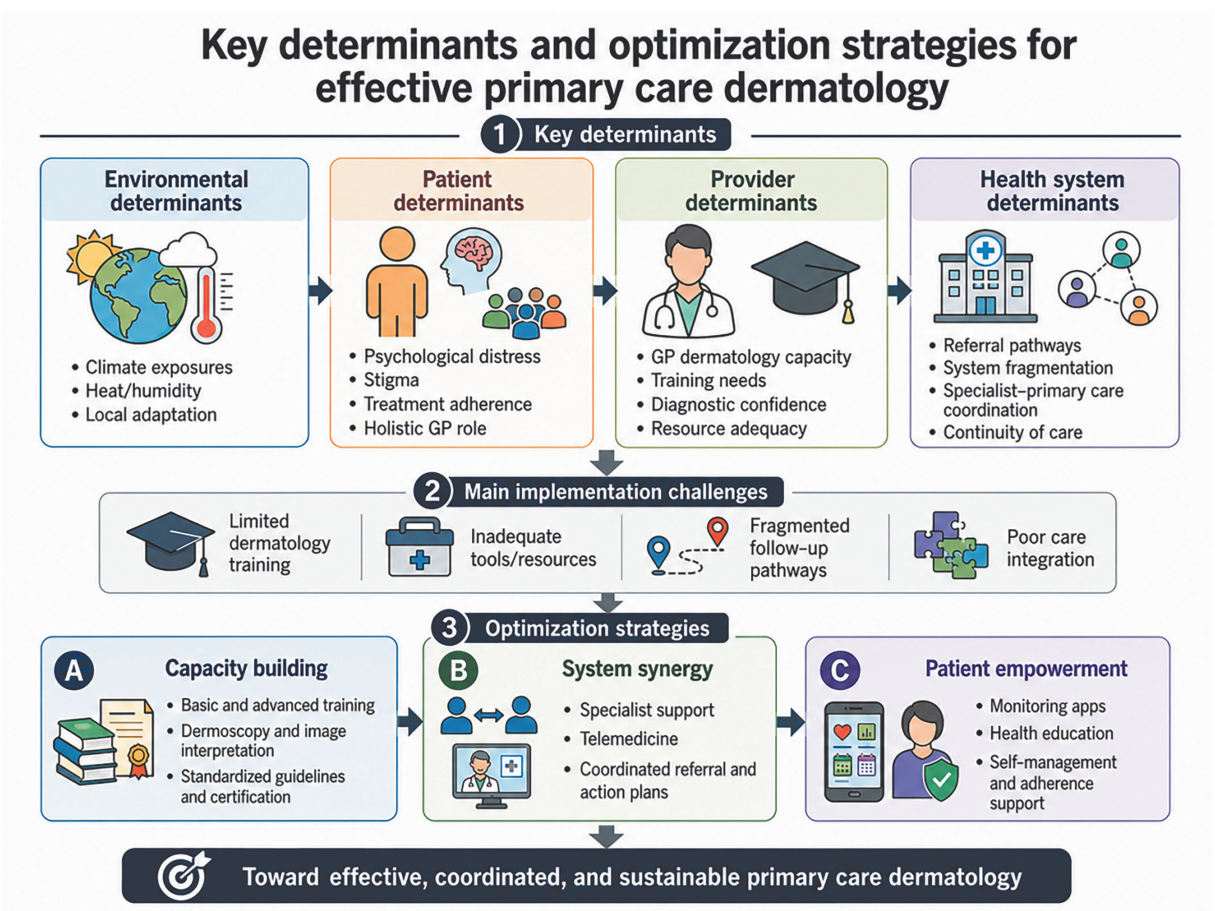

Figure 2: Key determinants and optimization strategies for an effective primary care dermatology model.

Abbreviations: GP, general practitioner.

skills, and most GPs lack systematic training. Their ability to identify and differentiate complex dermatological diseases and comorbidities is limited, making it difficult to meet the diverse needs of patients[23]. Secondly, the coordination between tiered diagnosis and treatment is poor. The referral mechanisms between primary care and higher-level hospitals, as well as dermatology departments, are imperfect, and there are barriers to information sharing. This leads to repeated visits or excessive referrals, resulting in a waste of medical resources[24]. Furthermore, chronic dermatological diseases have a long course and are prone to recurrence. Factors such as low patient compliance, insufficient disease awareness, inconvenient medical treatment, and stigma lead to unauthorized drug withdrawal, non-standardized care, and failure to follow up on time. These factors affect treatment efficacy and increase the risk of recurrence[25].

To move beyond these challenges, primary care dermatology can be advanced through three strategies: capacity building, system integration, and patient empowerment. Drawing on the UK's General Practitioner with an Extended Role (GPwER) in Dermatology training system, a hierarchical training model of "basic training—advanced training—specialist certification" can be established. Dermatological diagnosis and treatment as well as comorbidity management can be incorporated into the core curriculum of GPs. In addition, training in AI-assisted image interpretation, teledermatology workflows, and digital follow-up tools should be integrated into GP education, so that primary care physicians can more effectively use digital technologies for lesion recognition, early triage, and longitudinal disease management[10,16,18]. Combined with online and offline training and certification mechanisms, the theoretical and practical abilities of grassroots physicians can be enhanced, ensuring standardized and homogenized services[26,27].

Secondly, system synergy can improve resource utilization efficiency. Drawing on the experiences of Finland's "specialty embedded in grassroots" and New Zealand's tiered diagnosis and treatment, dermatologists from higher-level hospitals can be encouraged to regularly provide teaching and guidance at the grassroots level, optimizing the referral process and achieving "grassroots first diagnosis, tiered diagnosis and treatment, and bidirectional referral". Digital health platforms can further strengthen this process by enabling store-and-forward image consultation, real-time teledermatology support, and more timely specialist input, thereby improving referral accuracy, reducing unnecessary referrals, and enhancing continuity of care across different levels of the health system[9,10,28,29]. Real-time consultations and case discussions between grassroots and specialist physicians can be facilitated through telemedicine, alleviating the shortage of specialist resources at the grassroots level[9,28,29].

Lastly, patient empowerment is crucial. Relying on skin health monitoring apps, online science popularization platforms, and self-management groups, personalized health education, medication guidance, and follow-up reminders can be provided to patients, enhancing their self-management ability and treatment compliance, reducing recurrence, and lowering the disease burden[17]. Beyond simple reminders, digital follow-up tools can support symptom and image tracking, treatment adherence monitoring, relapse surveillance, and ongoing communication between patients and primary care providers, thereby strengthening long-term management of chronic and recurrent skin diseases[17,19,30]. Taken together, these digital health approaches extend beyond isolated technical applications and form an integrated support system for primary care dermatology, linking diagnosis, referral, follow-up, and patient self-management.

Despite the significant potential of digital health–enabled primary care dermatology, several challenges remain that may hinder effective implementation. Workforce limitations, including insufficient dermatology training among GPs, remain a key barrier. In addition, disparities in infrastructure, unequal access to diagnostic tools, and variability in digital literacy among both patients and healthcare providers can affect the adoption and sustainability of digital interventions. These challenges highlight the need for systematic strategies to support the transformation of primary care dermatology.

Current evidence supporting digital health-enabled primary care dermatology is promising, but it remains heterogeneous and uneven in scope. Existing studies

provide several important strengths, including pragmatic evaluations of teledermatology, real-world implementation experience, and randomized evidence for selected digital self-management interventions, particularly in eczema care[10,17–19,24]. These studies suggest that digital tools can improve access, support symptom monitoring, and strengthen continuity of care. However, the current evidence base also has important limitations. Many studies are conducted in specialist-led or mixed-care settings rather than routine primary care, and several reports are single-country or single-center studies with limited generalizability[10,18,28,29]. Follow-up duration is often short, outcome measures are not always standardized, and evidence on long-term clinical effectiveness, cost-effectiveness, and scalability remains limited[17,19,24]. In addition, relatively few studies have examined how digital tools can support integrated management of dermatological, psychological, and metabolic comorbidities in primary care, or how these interventions perform across diverse healthcare systems and resource settings[11–14,30,31]. These gaps indicate that more rigorous, primary care-focused, and implementation-oriented research is needed, particularly multicenter studies with longer follow-up, standardized outcomes, and stronger attention to equity, interoperability, and real-world sustainability.

To address these issues, a strategic framework based on three key pillars is proposed. Capacity building focuses on strengthening dermatology training for GPs through structured education programs, tiered certification systems, and continuous professional development. System integration emphasizes improving collaboration between primary care and specialists through standardized referral pathways and telemedicine platforms, enabling more efficient allocation of healthcare resources. Patient empowerment highlights the use of digital tools to enhance health education, support self-management, and improve treatment adherence, particularly for chronic and relapsing skin conditions. Looking ahead, digital health technologies are expected to further transform primary care dermatology. Advances in AI, wearable devices, and intelligent monitoring tools enable real-time collection and analysis of skin conditions and physiological data, providing precise and personalized support for diagnosis and treatment[16]. Telemedicine is also evolving from a traditional one-way consultation model to a bidirectional collaborative system, allowing deeper integration of specialist expertise into primary care settings and improving care quality and efficiency[29].

At the system level, chronic disease management frameworks are increasingly expanding to include dermatological conditions. Primary care institutions are incorporating standardized processes for diagnosis, treatment, and follow-up of skin diseases into routine general practice, enabling integrated management alongside chronic conditions such as hypertension and diabetes[30]. This shift enhances the systematic and comprehensive nature of care delivery. In parallel, comorbidity-integrated management is emerging as a key focus. Primary care physicians can leverage digital tools to simultaneously monitor and manage dermatological conditions in conjunction with metabolic disorders, psychological conditions, and other systemic diseases. Multidisciplinary collaboration is becoming increasingly normalized, facilitating the development of personalized and integrated care plans that promote synergistic improvements in both skin health and overall health outcomes[31]. Furthermore, community-based screening and early identification are gaining importance, particularly for high-risk populations. Digital screening tools help simplify workflows, improve efficiency, and enable earlier detection and intervention, thereby reducing disease burden at its source[32].

Overall, as summarized in Table 1, primary care dermatology is transitioning from a “diagnostic and treatment executor” to a “comprehensive health management platform”. Through digital empowerment, strengthened chronic disease management, enhanced comorbidity integration, and expanded community screening, primary care systems are evolving from passive, episodic care toward proactive, continuous, and integrated service delivery. This transformation provides comprehensive, full-cycle healthcare for patients with chronic skin diseases and supports the high-quality development of primary care-based chronic disease management.

Conclusions

Digital health is reshaping the role of primary care in dermatology by improving diagnostic capacity, access to specialist expertise, and continuous patient

Table 1: Transformation of primary care dermatology: from current challenges to optimized models.

Feature	Current state (challenges)	Optimized future state
GP skillset	Limited dermatology training; generalist practice	Enhanced competency (e.g., GPwER); structured certification
Referral system	Fragmented, one-way referrals	Integrated, bidirectional pathways with telemedicine support
Disease scope	Skin-focused, single-disease approach	Comorbidity-integrated care (metabolic, psychological)
Patient role	Passive participation; low adherence	Empowered, technology-supported self-management
Care delivery model	Episodic, reactive care	Proactive, continuous lifecycle management
Digital health role	Limited or supportive use only	Embedded across screening, diagnosis, and follow-up
Data and monitoring	Intermittent, visit-based data	Continuous, real-time monitoring (apps, wearables)
Care integration	Fragmented across levels of care	Coordinated, multidisciplinary, and system-integrated care

Abbreviations: GP, general practitioner; GPwER, General Practitioner with an Extended Role.

engagement, thereby supporting a shift from episodic care to integrated, lifecycle-based management of chronic skin diseases. Empowered by digital health, GPs play an increasingly pivotal role in the prevention, early detection, and management of chronic skin diseases and their associated comorbidities at the primary care level. Technologies such as AI-assisted diagnosis, teledermatology, and digital follow-up systems help address limitations in specialist availability, enabling more effective initial screening, standardized diagnosis and treatment, and full-cycle disease management. Through coordinated strategies encompassing capacity building, system integration, and patient empowerment, primary care systems can significantly improve diagnostic efficiency, treatment quality, and comorbidity management. These advances are further supported by expanding chronic disease management frameworks and community-based screening. Overall, primary care is transitioning from a "diagnostic and treatment executor" to a "comprehensive health management platform". This transformation reflects a broader shift from passive, reactive care toward proactive prevention and control, and from single-disease management to integrated, patient-centered services. Such evolution is essential for addressing the growing burden of chronic skin diseases and for delivering continuous, comprehensive healthcare that improves long-term patient outcomes.

Author contributions

Haiyan Yu and Tong Xiang contributed equally to this article. Haiyan Yu, Tong Xiang, Guanghui Jin, Jiandong Zhou, and Hao Wu conceived and designed the review. Haiyan Yu, Tong Xiang, Mingyuan Fu, Bofeng Lu, and Haolin Pu conducted the literature search. Haiyan Yu and Tong Xiang performed the evidence synthesis and drafted the original manuscript. Haiyan Yu, Tong Xiang, Guanghui Jin, Mingyuan Fu, Bofeng Lu, Haolin Pu, Jiandong Zhou, and Hao Wu critically reviewed and revised the manuscript. Hao Wu contributed to project administration. Jiandong Zhou and Hao Wu supervised the work. All authors read and approved the final manuscript and agreed to its publication.

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Not applicable.

Ethics statement

All figures are either original to this work or properly attributed. No original images have been previously published, and all comply with research integrity standards without inappropriate manipulation or misrepresentation.

Data availability statement

No datasets were generated or analyzed during the current study. All data supporting this review are derived from previously published studies cited in the reference list.

AI statement

The authors used ChatGPT (OpenAI, online version)

only as a language-editing tool to improve grammar, clarity, readability, and manuscript organization. The AI tool was not used for data analysis, data generation, image processing, or scientific content creation. All outputs were carefully reviewed and verified by the authors, who take full responsibility for the final content of the manuscript.

Conflicts of interest

The authors declare no financial or non-financial conflicts of interest.

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