AI AND IOT-ENHANCED SKIN CANCER DETECTION AND CARE

PART 2

Editors:

Akhil Sharma

Shaweta Sharma

Shivkanya Fuloria

Sudhir Kumar

Bentham Books

AI and IoT-Enhanced Skin Cancer Detection and Care

(Part 2)

Edited by

Akhil Sharma
R.J. College of Pharmacy
Raipur, Uttar Pradesh, India

Shaweta Sharma
School of Medical and Allied Sciences
Galgotias University, Greater Noida
Uttar Pradesh, India

Shivkanya Fuloria
Faculty of Pharmacy, AIMST University
Semeling Campus, Bedong-08100
Kedah, Malaysia

&

Sudhir Kumar
Faculty of Pharmaceutical Sciences
DAV University, Jalandhar
India

AI and IoT-Enhanced Skin Cancer Detection and Care *(Part 2)*

Editors: Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar

ISBN (Online): 979-8-89881-198-3

ISBN (Print): 979-8-89881-199-0

ISBN (Paperback): 979-8-89881-200-3

Published by Bentham Science Publishers Pte. Ltd. Singapore,

in collaboration with Eureka Conferences, USA.

First published in 2025.

Bentham Science Publishers Pte. Ltd.
No. 9 Raffles Place
Office No. 26-01
Singapore 048619
Singapore
Email: subscriptions@benthamscience.net

BENTHAM SCIENCE

CONTENTS

FOREWORD

Skin cancer is one of the fastest-growing global health concerns, demanding timely detection, innovative treatment, and personalized management strategies. This book, a multidisciplinary collaboration among healthcare professionals, engineers, and researchers, captures the convergence of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, mobile applications, and genomics in revolutionizing skin cancer diagnostics and care. The book examines how digital dermoscopy, wearable sensors, remote patient monitoring, and AI-driven diagnostic systems are reshaping conventional dermatological practices. It explores not just technological integration but also its societal, ethical, and regulatory implications, offering both depth and practicality. From early detection *via* mobile apps to genomic profiling for precision treatment and the role of 5G in real-time consultations, this text reflects the future of dermatology. It empowers clinicians, researchers, policy-makers, and students with the insights necessary to navigate and contribute to this digital transformation. This book stands as a testament to the power of interdisciplinary innovation and its potential to improve outcomes in skin cancer care. I wholeheartedly commend the editors and contributors for their vision, commitment, and scholarly rigor in creating this timely and impactful resource.

Pankaj Kumar Singh
Institute of Biomedicine, University of Turku, Finland

PREFACE

The genesis of this book lies in a shared vision: to harness technology for transforming skin cancer detection and care. As the incidence of skin cancer rises, the need for non-invasive, rapid, and accessible diagnostic solutions has become more pressing. This book addresses that need through a comprehensive exploration of how AI, IoT, mobile health, digital imaging, and genomics are reshaping modern dermatology. We, a group of researchers, have curated these chapters to reflect the evolving landscape, from AI-powered lesion classification and blockchain-enabled health records to wearable UV monitors and real-time dermatology consultations via 5G. Special emphasis is given to challenges like ethical AI use, data privacy, and interoperability, ensuring the content is not only forward-thinking but also grounded in reality. This volume is designed to be both a reference and an inspiration for healthcare professionals, technologists, and students alike, encouraging cross-disciplinary collaboration to build intelligent, patient-centered skin cancer care systems. We hope this book serves as a catalyst for continued research, clinical adoption, and innovation in the realm of digital dermatology.

Akhil Sharma
R.J. College of Pharmacy
Raipur, Uttar Pradesh, India

Shaweta Sharma
School of Medical and Allied Sciences
Galgotias University, Greater Noida
Uttar Pradesh, India

Shivkanya Fuloria
Faculty of Pharmacy, AIMST University
Semeling Campus, Bedong-08100
Kedah, Malaysia

&

Sudhir Kumar
Faculty of Pharmaceutical Sciences
DAV University, Jalandhar
India

List of Contributors

Aarti Sati	School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Patel Nagar, India
Anand Singh Pimoli	Amity University, Punjab, Mohali, India
Akanksha Sharma	R.J. College of Pharmacy, Raipur, Uttar Pradesh, India
Arvind Kumar Gupta	Dr. S. N. Dev College of Pharmacy, Sikka, Shamli (U.P.), 247776, India
Akhil Sharma	R.J. College of Pharmacy, Raipur, Uttar Pradesh, India
Ashish Verma	Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh, 201306, India
Akanksha Sharma	R.J. College of Pharmacy, Raipur, Uttar Pradesh, India
Pankaj Kumar Singh	Institute of Biomedicine, University of Turku, Turku, Finland
Shipra Omar	School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Patel Nagar, India
Suneha Rani	School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Dehradun, Patel Nagar, India
Sunita	R.J. College of Pharmacy, Raipur, Uttar Pradesh, India
Shaweta Sharma	School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh, 201310, India
Sudhir Kumar	Faculty of Pharmaceutical Sciences, DAV University, Jalandhar, India

CHAPTER 1

Mobile Apps for Self-Examination and Early Detection of Skin Cancer

Shipra Omar[1], **Aarti Sati**[1], **Suneha Rani**[1], **Anand Singh Pimoli**[2] and **Akhil Sharma**[3,*]

[1] *School of Pharmaceutical Sciences, Shri Guru Ram Rai University, Patel Nagar, Dehradun, India*

[2] *Amity University, Punjab, Mohali, India*

[3] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

Abstract: The rising incidence of skin cancer worldwide underscores the critical need for effective early detection methods. Mobile health applications (mHealth apps) have recently emerged as promising methods for enhancing self-examination and improving early diagnosis, equipping individuals to observe skin lesions and identify aberrant modifications in the comfort of their homes. This chapter discusses the purpose of mHealth apps for skin cancer detection and the historical development of skin cancer detection technologies based on AI and machine learning (ML) and hyperspectral imaging. These technologies and non-invasive techniques are transforming the landscape of skin cancer screening by making it more accessible and efficient. It also describes the functioning of mobile-based applications to perform self-examination, including image capture and analysis, guided self-assessment, and compatibility with healthcare providers. These apps also provide educational materials on skin cancer awareness and prevention. Key mHealth apps, such as Derma Compare, Lubax, SkinVision, and Doctor Mole, are discussed in detail in terms of their functionality and contribution towards skin cancer detection. In addition, this chapter evaluates the effect of these mobile applications on health. It discusses whether they can reduce healthcare costs, improve population health outcomes, and be embedded into current healthcare systems. It also covers the barriers to access and the necessity for continuous post-market surveillance. Finally, future research directions are proposed to enhance the precision, accessibility, and implementation ability of these technologies to ensure their continued utility in skin cancer detection.

Keywords: Healthcare, Mobile application, Post-market surveillance, Self-examination, Skin cancer.

* **Corresponding author Akhil Sharma:** R.J. College of Pharmacy, Raipur, Uttar Pradesh, India;
E-mail: xs2akhil@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

INTRODUCTION

Malignant melanoma (MM), squamous cell carcinoma (SCC), and basal cell carcinoma (BCC) are the three types of skin cancers, whereas SCC and BCC are also called keratinocyte carcinoma (KC). It was estimated that around 91,000 people would be diagnosed with melanoma and 9300 die from MM in the United States in 2018; moreover, over 5 million cases of KC were diagnosed, and over three million were treated (2012), more than all other cancers combined. In 2015, there were an estimated about 351,000 incident melanoma cases worldwide and 60,000 melanoma deaths, with the greatest burden of disease in Australia, North America, and Europe [1, 2].

Over the past three decades, MM incidence adjusted for changes in the distribution of ages of a population more than doubled in the US (Caucasians only) and the UK, almost doubled in Norway, Sweden, and New Zealand, and increased by 75% in Australia. Such an increase is largely attributable to various risk factors like exposure to ultraviolet light and indoor tanning. Because these risk factors are mainly preventable, more comprehensive prevention programs targeting improved sun protection behavior have been introduced in several countries, *e.g.*, SunSmart in Australia [3, 4].

While multiple organizations have suggested recommendations regarding the frequency of skin surveillance for high-risk patients (*e.g.*, Fitzpatrick scale I-III; family history of melanoma; previous sun-damaged skin or multiple atypical nevi), these range from every 3 months to every year and there is no organized early detection program up to date in most countries [5, 6].

Currently, there are only two nationwide skin screening programs: the American Academy of Dermatology (founded 1985), which has incorporated skin cancer awareness and education into its screened population, and a German comprehensive national screening program started in 2008; this latter initiative seems to have little efficacy in reducing mortality and morbidity related to skin cancers [7].

In practice, high-quality skin checks are not available even for individuals at elevated risk. Delays in access and, in some regions, shortages of dermatologists, costs not covered by medical insurance, or the money needed to get to the closest dermatologist may prevent people at risk from going through with a visit. For instance, a study in the United States showed that melanoma mortality is reduced by 35% when a dermatologist can be found within the county. A different US estimate showed that just one in four at risk of skin cancer have ever had a total skin body examination [8, 9].

In many other countries, such as the United Kingdom and the Netherlands, skin checks are initially performed by a general practitioner (GP, also often referred to as a primary care provider), who might then opt to refer a patient to a dermatologist if skin cancer is suspected. Nevertheless, some studies indicate that the sensitivity of GPs for skin cancer detection is low. British and Dutch studies assessed the sensitivity of GPs (without specific skin cancer training) to detect skin cancer at less than 60%. In a US study, only 35% of patients had been accurately diagnosed. All of this can lead to late diagnoses or misdiagnosis of cancer at an earlier point, where it would have provided a better chance of saving the patient and, incidentally, much lower treatment cost [2, 10, 11].

Furthermore, many GP consultations and subsequent referrals to a specialist to inspect the skin for cancer are benign. In the Netherlands, a study found that 69% of GP consultations involving suspicious skin lesions were benign, and two other studies have shown that a significant proportion (40%) of referred cases to the dermatologist for suspicion of skin cancer are benign. Two studies (in the United States and Germany), including more than 70 dermatologists, found that dermatologists' disease classification decisions have a specificity of 60%-80%, which may result in unnecessary biopsies/excisions [12, 13].

Mobile health (mHealth) apps could provide opportunities for early detection and surveillance of skin cancer, given the widespread availability and use of smartphones. An example of a smartphone app for self-assessment of skin lesions for skin cancer is the SkinVision app (SVA), developed by SkinVision, BV, (The Netherlands) [2].

Mobile health applications (mHealth apps) are among the important tools that have the potential to close these gaps by allowing individuals to perform self-examinations and track suspicious changes in their skin using a mobile phone. Such apps are often paired with artificial intelligence (AI) and machine learning functionality that analyze skin lesions to give instantaneous feedback from which the user may adopt a proactive health approach. MHealth apps can transform early skin cancer detection as they present a feasible, low-cost, and accessible solution for populations that face barriers to formal healthcare services [14 - 16]. Table **1** compares traditional and mobile applications for self-examination and early skin cancer detection.

SKIN CANCER DETECTION TECHNOLOGIES

Technology has dramatically changed how we detect skin cancer and makes diagnosis occur sooner with better outcomes. From AI-powered tools to noninvasive imaging technologies, these advances promise improved accuracy, efficiency, and accessibility for skin cancer diagnosis. This section explores key

CHAPTER 2

Blockchain for Secure and Interoperable Health Records

Sunita[1], **Akhil Sharma**[1], **Shaweta Sharma**[2], **Pankaj Kumar Singh**[3] and **Ashish Verma**[4,*]

[1] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[2] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

[3] *Institute of Biomedicine, University of Turku, Finland*

[4] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

Abstract: Skin cancer is one of the most common forms of cancer found in human beings around the world and is a major hurdle to health systems due to its high frequency and difficult diagnosis. While early and accurate detection is key for better patient outcomes, traditional methods depend heavily on the clinical expertise of individual physicians. Recent developments in artificial intelligence (AI), especially deep learning (DL) and transfer learning (TL), present new, powerful methods for improving the detection of skin lesions. In this chapter, DL algorithms such as convolutional neural networks (CNNs) were applied, with operations leveled up concerning TL, where pre-trained models are leveraged for accurate diagnosis, along with overcoming important issues like scarcity of annotated datasets and inconsistency in dermoscopic images. This redundancy also hinders the development of model training with small, domain-specific datasets, which is why TL can overcome many common bottlenecks of medical images. We review the incorporation of AI-enabled systems into clinical workflows, the efficacy of deep learning models in the detection of different skin cancer types, and the capacity of such technologies to augment dermatologic serendipity. This chapter offers perspectives on research needs, such as hybrid models combining AI and non-AI data, the integration of ethnic and structural racism in AI systems in healthcare, as well as a need to centralize current AI ethics literature in the healthcare field. We aim to utilize DL and TL to assist in the early detection of skin cancer that can redirect to more targeted treatment approaches.

Keywords: Convolutional neural networks (CNNs), Deep learning, Skin cancer detection, Transfer learning.

* **Corresponding author Ashish Verma:** Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India; E-mail: ashishsing264@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

INTRODUCTION

Health records are central to the healthcare ecosystem, an indispensable document that includes a round-up of information about a patient, covering every significant aspect of their medical history, such as diseases, diagnoses, treatments, medications, and surgical procedures. They play a significant role in clinical decision-making, continuity of care, and, ultimately, patient outcomes. However, the way we handle health records today is fraught with challenges that can make the process less effective. The biggest problem of all is that healthcare institutions, clinics, and systems barely interoperate. Because much of the health data is stored in different databases with varying formats and standards, providers are unable to obtain the complete picture of a patient in emergencies or when patients go to several providers for care. Functional separation of care sectors thus causes inefficient, delayed, and costly duplication of diagnostic tests and increases the risk of medical errors that can lead to severe patient safety risks [1, 2].

Beyond matters of interoperability, there is the issue of data security. Since health records comprise delicate personal and medical data, they have become the priority of cyber-criminals. The number of healthcare data breaches is increasing, too, showing hundreds of millions of records in the hands of hackers while jeopardizing patient privacy. A centralized health record system can also be susceptible to mass attack, in which the infraction of a single entry point could expose thousands of patient records. The lack of transparency on how to share or revoke their data leaves the patient at the mercy of the system. It just makes people mistrust the healthcare system even more because they cannot trust it [3, 4].

Further issues are that maintaining and updating conventional electronic health record (EHR) systems is costly. Regulatory compliance is a headache as well, and so is managing the massive amounts of data from numerous sources in the setting of precision medicine and rational drug development. However, to allow for these critical advances in care delivery, solutions must also be developed that keep health records both safe and interoperable, yet always patient-centered and without harm. Blockchain technology, in action, offers a reassuring solution to these hitches *via* its decentralized, anti-tampering architecture, allowing a high standard of data security and interoperability on and off the platform and giving the patient more ownership of their health data [5, 6].

Overview of Blockchain

Blockchain technology is a groundbreaking digital ledger system that enables secure, decentralized, and transparent recording of transactions. Unlike traditional databases controlled by a central authority, blockchain operates on a distributed network of computers, ensuring that data remains tamper-resistant, immutable, and accessible to authorized participants. Its core principles include decentralization, which eliminates single points of failure; immutability, meaning recorded transactions cannot be altered; transparency, allowing all network participants to view transaction histories; and security, where cryptographic techniques safeguard transactions and verify their authenticity [7, 8].

The blockchain process begins when a transaction occurs, which is grouped with others to form a block. This block is then verified by network participants using consensus mechanisms such as proof-of-work (PoW) or proof-of-stake (PoS). Once validated, the block is added to the existing chain, creating a chronological, unchangeable record of transactions. Blockchain networks can be public, like Bitcoin and Ethereum, allowing open participation; private, where access is restricted to a single organization; or consortium-based, where multiple entities share control [9, 10].

Blockchain has a wide range of real-world applications. In cryptocurrencies, it ensures secure and decentralized transactions for digital assets like Bitcoin and Ethereum. Supply chain management enables end-to-end tracking of goods, ensuring authenticity and efficiency. The healthcare sector leverages blockchain for secure storage and sharing of patient records, enhancing data integrity and accessibility. Voting systems benefit from blockchain's tamper-proof and transparent nature, ensuring fair elections, while digital identity management allows for secure verification and authentication of personal information [11, 12].

Several technical aspects make blockchain powerful. Hashing ensures data integrity by creating unique cryptographic fingerprints for each block. Smart contracts, which are self-executing agreements encoded on the blockchain, automate transactions and eliminate intermediaries. Distributed Ledger Technology (DLT) underpins the blockchain's decentralized structure, ensuring efficient data storage and synchronization across nodes. However, blockchain also faces challenges such as scalability, as processing large volumes of transactions remains a concern, regulatory uncertainty, with governments developing legal frameworks, and security threats, as vulnerabilities and cyberattacks need to be mitigated [13, 14].

Blockchain continues to evolve, with research focusing on enhancing scalability, security, and interoperability. Innovations such as layer-2 solutions, sharding, and cross-chain protocols aim to improve transaction speeds and connectivity between different blockchain networks. As adoption grows across industries, blockchain has the potential to redefine financial systems, digital identities, and global

CHAPTER 3

Genomic Diagnostics in Precision Skin Cancer Treatment

Ashish Verma[1], **Sunita**[2], **Akhil Sharma**[2], **Shaweta Sharma**[3], **Pankaj Kumar Singh**[4] and **Akanksha Sharma**[2,*]

[1] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

[2] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[3] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

[4] *Institute of Biomedicine, University of Turku, Finland*

Abstract: Skin cancer is the most common type of cancer, whereby genomic alterations contribute to both its pathogenesis and evolution as well as its response to treatment. Genomic diagnostics play a crucial role in aiding the precise management of skin cancers based on the detection of mutations or genomic alterations that guide targeted treatment. The chapter outlines the clinical presentation of these skin cancers and their genomic landscape, highlighting important genotype-specific alterations such as BRAE NRAS and CDKN2A mutations in melanoma, PTCH1, SMO, and TP53 mutations in BCC and HRAS, NOTCH1, and combined gene inactivation in SCC. It also reviews copy number variations (CNVs) closely related to the development of different skin cancers. The area of genomic profiling has advanced over the years, with techniques such as next-generation sequencing (NGS), liquid biopsies, and targeted gene panels that are able to provide a comprehensive look into informative genetic alterations non-invasively. The technologies allow for early detection, quantitating response to systemic therapy, and uncovering mechanisms of resistance, which altogether can promote better therapeutic success. Genomic diagnostics play a pivotal role in the treatment of personalized strategies based on genome markers; nowadays, doctors can make therapies according to genetic profiles. Molecular profiling enhances early detection and diagnosis, which results in timely interventions and better prognoses. By sequencing treatment response and resistance mechanisms, we gain real-time insight into the evolution of tumor behavior and can develop adaptive therapeutic strategies that respond to those changes. Genomic diagnostics have an important role to play both in risk assessment and prognosis of diseases by detecting the presence or absence of genetic markers associated with aggressive behavior, which can then be used to classify patients according to their risk profile.

* **Corresponding author Akanksha Sharma:** R.J. College of Pharmacy, Raipur, Uttar Pradesh, Inida;
E-mail: akankshasona012@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

Keywords: Basal cell carcinoma, BRAF mutation, Genomic diagnostics, Liquid biopsy, Melanoma, Next-generation sequencing, NRAS mutation, Skin cancer, Squamous cell carcinoma, TP53.

INTRODUCTION

Skin cancer, especially melanoma and non-melanoma types, including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), is a growing worldwide medical problem [1], with increasing incidence due to UV exposure, tanning bed use, and genetically susceptible populations. Current therapies such as surgical excision, radiation, and chemotherapy focus on individualized protocols but fail to address differences in patients due to variations in tumor biology and response to the therapies. Genomic diagnostics have opened the door to skin cancer management that aligns with precision medicine. Genomic information can inform treatment strategies based on the molecular characteristics of a given patient's tumor [2].

Genomic diagnostics include next-generation sequencing, gene expression profiling, and liquid biopsies that enable a global analysis of the genetic aberrations in skin tumors. This helps clinicians analyze target mutations, copy number variations, and other genomic properties associated with tumorigenesis features [3]. BRAF mutations, most commonly BRAF V600E, occur in 40–60% of melanoma patients and have quickly become important biomarkers for targeted therapies, including BRAF and MEK inhibitors. These actionable mutations can markedly change patient outcomes with targeted therapies as opposed to traditional treatment strategies [4].

Because skin cancer is characterized by tumor heterogeneity, genomic diagnostics can help understand the degree of histological variability. Tumors contain heterogeneous mixtures of cell types that can be genetically and behaviourally different from each other. Using methods such as single-cell sequencing, they can help clarify the evolutionary histories of tumors and pinpoint potentially treatment-resistant subclonal populations [5].

Understanding these interactions of the tumor microenvironment is the key point in genomic diagnostics of skin cancer treatment. Immune cells, fibroblasts, and extracellular matrix components make up the tumor microenvironment, which is associated with tumor progression and response to therapy. Unusual genes and pathways associated with immune processes hidden in genomic profiling could thus offer unique prognostic capabilities concerning the immunotherapy response [6].

In addition to advancing treatment plans, genomic diagnostics may also help increase patient success by facilitating early detection and increased monitoring. Liquid biopsies based on the analysis of circulating tumor DNA (ctDNA) from blood samples constitute a new non-invasive tool in early cancer detection and minimal residual disease monitoring. The prognostic and predictive roles of ctDNA have been demonstrated by several studies, including treatment response, recurrence, and prognosis [7].

CLINICAL PRESENTATION OF SKIN CANCER AND GENOMIC LANDSCAPE

Skin cancer should be explored with a genomic focus on its etiology and the genomic landscape that underlies its development and progression. Both exposure to environmental factors, especially ultraviolet (UV) radiation, and genetic predisposition play an important role in skin cancer induction. Recent technological advances in genomic profiling, including next-generation sequencing of cancer genomes, have allowed for detailed mapping of the mutational landscape of skin tumors [8].

Skin cancer can be broadly classified into three types; the type of skin cancer is determined by the original location and behavior of the disease as well as its severity. To sum up, melanoma, BCC (basal cell carcinoma), and SCC (squamous cell carcinoma). The most serious type is melanoma, and it develops from pigment-producing cells in the skin called melanocytes. Its aggressive nature can lead to metastasis (early spreading) towards other organs if not diagnosed in time. Melanoma is frequently associated with mutations in genes like BRAF and is extensively driven by UV exposure [9].

The most common type of skin cancer, basal cell carcinoma (BCC), originates in the deep part of the epidermis, where basal cells are found. At the same time, slow growth and rarely metastasizing, leaving it unattended can lead to considerable local destruction. Basal cell carcinoma (BCC) shows a strong association with chronic sun exposure and mutations in the Hedgehog signaling pathway [10].

Squamous cell carcinoma (SCC), which arises from squamous cells present in the top layer of the skin/epidermis, is more aggressive than BCC but not as aggressive as melanoma. SCC has the potential to metastasize and is commonly associated with chronic exposure to sunlight and mutations in the TP53 gene if it arises in high-risk areas such as the lips or ears. Each skin cancer has unique biological traits that require different strategies with regard to diagnosis, treatment, and prevention [11].

CHAPTER 4

The Impact of 5G on Real-time Dermatology Consultations

Akanksha Sharma[1], **Ashish Verma**[2], **Sunita**[1], **Akhil Sharma**[1], **Arvind Kumar Gupta**[3] and **Shaweta Sharma**[4,*]

[1] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[2] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

[3] *Dr. S. N. Dev College of Pharmacy, Sikka, Shamli (U.P.) - 247776, India*

[4] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

Abstract: 5G is believed to revolutionize telemedicine and dermatology in this regard by enhancing real-time consultations and the accuracy of diagnosis. 5G can offer faster connectivity and lower latencies than 4G, which is vital in telehealth and remote diagnostics. This also helps establish real-time interactive communication between patients and doctors for faster consultations and remote collaboration amongst multi-disciplinary teams. The benefit of 5G is the ability to send clearer images, which enables dermatologists to analyze skin problems better. With AI integration, real-time data processing further enhances diagnostic capabilities by allowing for more specific and faster assessments. Telehealth gains new ground through the expansion of 5G, which can benefit rural and underserved populations by enabling patients to avoid travel time or costs. Wearable devices and IoT-enabled sensors can be used in dermatology to monitor skin conditions in real-time digitally; tracking and managing chronic skin diseases remotely is possible. Video consultations aid in increasing patient engagement *via* education and adherence to treatment plans. At the same time, emerging technologies such as augmented reality (AR) or virtual reality (VR) are being integrated into treatment/education for patients. Telemedicine can leverage 5G for new skin monitoring, diagnosis, and personalized care through real-time image transmission. Updated 5G infrastructure is forthcoming and will certainly impact the future of dermatology, access, equity, and care quality.

Keywords: 5G technology, Dermatology, High-resolution imaging, Real-time, Remote patient monitoring.

* **Corresponding author Shaweta Sharma:** School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India; E-mail: shawetasharma@galgotiasuniversity.edu.in

INTRODUCTION

5G technology, or fifth-generation wireless technology, is a revolutionary upgrade in mobile networks that provides unparalleled speed, connectivity, and reliability of communication. 5G, the successor of the 4G network, has been developed to facilitate the increasing data demand by enabling billions of devices with high-speed data transfer capacity, ultra-low latency, and high capacity. It is engineered to transform industries beyond traditional telecommunications, enabling revolution in healthcare, manufacturing, and smart cities [1, 2].

The 5G technology utilizes higher frequency bands, and millimeter waves allow much faster data transmission, even if they also have a shorter range than previous generations. This requires deploying more network infrastructure, such as small cell towers and antennas, to keep the coverage seamless. 5G offers theoretical peak data speeds of up to 10 Gbps and latency under 1 milliseconds, making it well-suited for real-time applications such as autonomous vehicles, virtual reality (VR), and large-scale IoT networks [3, 4].

In healthcare, 5G will boost virtual consultations in real-time, remote diagnostics, and data-intensive applications (telemedicine AI tools). This new standard will be the foundation of future technology ecosystems where innovation requires seamless real-time communications [5].

Comparison with Previous Generations

Table **1** compares previous generations of mobile technology, representing an exponential improvement in speed, latency, bandwidth, and application capabilities that support technologies such as artificial intelligence (AI), Internet of Things (IoT), and actions like real-time medical applications.

Table 1. Comparison between 5G and previous mobile network generations.

Feature	3G	4G	5G
Introduction year	2001	2009	2019 [6]
Max data speed	Up to 2 Mbps	Up to 100 Mbps - 1 Gbps	Up to 10 Gbps [7]
Latency	100-500 milliseconds	30-50 milliseconds	1 millisecond or less [8]
Frequency bands	1.8–2.5 GHz	1.8–2.5 GHz, 700 MHz	1 GHz to 6 GHz, >24 GHz (mmWave) [9]
Bandwidth	5–20 MHz	Up to 100 MHz	Up to 1,000 MHz [10]

(Table 1) cont.....

Feature	3G	4G	5G
Technology used	Code-Division Multiple Access (CDMA), Universal Mobile Telecommunications System (UMTS)	LTE (Long-Term Evolution)	New Radio (NR), Millimeter Waves [11]
Coverage	Wide, including rural areas	Wide, good urban and rural coverage.	Dense in urban areas, emerging in rural [12]
Connection density	Limited device connectivity	Improved but limited	Supports millions of devices per km^2 [13]
Power consumption	High	Moderate	Lower, more energy-efficient [14]
Download times	Large file downloads take minutes	Large file downloads take seconds	Instantaneous, near real-time [15]
Applications	Voice calls, basic internet	HD video streaming, online gaming	VR/AR, AI, autonomous cars, telemedicine [16]

Importance of 5G in Telemedicine and Remote Diagnostics

The limitations imposed by previous generations of networks will be alleviated through the rollout of 5G technology, bringing new levels of speed and connectivity and unparalleled data processing capabilities to telemedicine and remote diagnostics. The high speed and low latency of 5G facilitate dual interactive communication, simulating consultation between patients and medical staff in reality. This is especially important in telemedicine, where immediate feedback and diagnostics are vital. Further, 5G allows the immediate transmission of large medical files such as high-resolution images and standardized videos. This is especially important in dermatology, radiology, and pathology domains, where high image quality is critical for making correct diagnoses [17, 18].

5G high-speed connectivity facilitates the integration of cloud-based systems for AI diagnosis, primarily by enabling real-time processing of large volumes of medical data. This increases the speed and accuracy of diagnoses, promoting early detection of diseases like skin cancer. With IoT devices and wearables, 5G enhances patient care by allowing for real-time remote monitoring, supporting the constant observation of vital signs or long-lasting ailments patients live with to help doctors manage diseases before they explode [19, 20].

5G expands access to healthcare by facilitating services like telemedicine, which is especially valuable in rural and underserved areas where specialists may be more difficult to find. Video consultations and diagnoses in real-time minimize travel and enhance health equity. The technology also supports seamless collaboration within the ecosystem as healthcare professionals can place multi-

CHAPTER 5

Community Engagement in Skin Cancer Prevention Program

Shaweta Sharma[1], **Akanksha Sharma**[2], **Ashish Verma**[3], **Arvind Kumar Gupta**[4] and **Akhil Sharma**[2,*]

[1] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

[2] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[3] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

[4] *Dr. S. N. Dev College of Pharmacy, Sikka, Shamli (U.P.) - 247776, India*

Abstract: This chapter explores the vital importance of embedding community engagement in the planning and execution of successful skin cancer prevention initiatives. It highlights the need for collaborative action among community members, local organizations, healthcare providers, and local and state policymakers to fight the growing incidence of skin cancer. This chapter explains that increasing community engagement may include focused outreach programs, culturally adapted education, and free resources such as skin screening and sun protectants. It explores challenges to successful engagement, including poor recognition of UV risks, cultural norms about tanning behaviors, and access to preventive services, and represents an opportunity to advance solutions. By examining effective examples and evidence-informed approaches, the chapter offers guidance on the role of inclusivity and responsiveness to community needs in policy and practice to facilitate the uptake of sun-safe behaviors. Finally, it identifies some future directions for community participation, suggesting that innovative, flexible, and participatory approaches to health promotion could leverage technology and aid in collaboration among individuals at risk of skin cancer and in the identification of skin cancer prevention advocates, which may help empower individuals and communities to take more responsibility for their skin health. This chapter ultimately seeks to motivate a proactive rather than a passive collaborative model for preventing skin cancer, recognizing that all of us must work together to reduce this preventable disease.

Keywords: Community engagement, Health education, Outreach strategies, Skin cancer prevention, Sun safety.

* **Corresponding author Akhil Sharma:** R.J. College of Pharmacy, Raipur, Uttar Pradesh, India;
E-mail: xs2akhil@gmail,.com

INTRODUCTION

Skin cancer is the most common cancer, which occurs when skin cells grow abnormally, most often due to the sun or other sources of ultraviolet (UV) radiation. There are three types of skin cancer: basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and melanoma; the latter two are the most common types, while melanoma is the most aggressive and fatal form of skin cancer. Most skin cancers develop as new growths or changes in existing moles and, if detected early, can be successfully treated. With skin cancer rates increasing, it is necessary to have effective prevention tools, such as the promotion of UV awareness messages and sun protection behaviors [1, 2].

Importance of Prevention

Skin cancer is one of the most prevalent cancers around the world and poses a significant challenge to individuals and public health, hence underscoring the need for prevention. Skin cancer is the most frequently occurring cancer in the United States, affecting millions of people every year. Although incidence rates of skin neoplasms as a whole seem to be decreasing, findings suggest that more attention is needed for melanoma, given the increased rates of melanoma incidence [3].

Many skin cancers can be easily avoided by preventing the condition; hence, prevention is only one of the primary reasons for focus. Preventing skin cancer is also straightforward. Using high SPF broad-spectrum sunscreen, and protective clothing in sun exposure at peak hours dramatically reduces risk. Such measures gain greater importance for people with fair skin, previous incidences of sunburn, and a family history of skin cancer [4].

Therefore, self-examinations and regular visits to a dermatologist are the keys to early detection. Most skin cancers, especially basal and squamous cell carcinoma, can be treated easily when diagnosed in the early stages, often requiring minor surgery. Melanoma is the deadliest of the skin cancers and, when not detected early, can be fatal. However, awareness campaigns to inform people about the warning signs, such as changes in moles or new skin lesions, can facilitate prompt medical attention and lead to increased survival rates [5].

Skin cancer prevention is also important for public health systems nationwide, not just for individual health benefits. Often, skin cancer treatment comes with a pricey tab that weighs down healthcare systems and patients alike with more skin-related medical bills. Focusing on prevention can further lessen the economic burden of the treatment of skin cancer, freeing up funds that can be put to better use in dealing with other major health problems [6].

Skin cancer prevention not only decreases the incidence of the disease but also increases public health and quality of life and reduces overall healthcare costs. With education, awareness, and preventative action, society can take on the rising threat of skin cancer and move towards a healthier future [4].

Role of Community Engagement

The importance of community engagement in skin cancer prevention is multifaceted; it can improve awareness, increase proactive behavioral change, promote early detection, and address disparities in healthcare access. Education campaigns focused not just on school children but the community at large through workshops and social media give people the knowledge to understand the threat of UV exposure and the importance of regular sun protection [7]. This might help communities know how meaningful sunscreen, protective clothing, and avoidance of harm, such as tanning beds, can be. Second, community-wide engagement in sun safety is crucial because it empowers schools, workplaces, and public institutions to instill sun-safe policies that enable people to adopt sun-safe behaviors that become normalized in the community, making prevention part of the community fabric [8].

Community-driven programs that increase skin cancer screening and promote measures to access early-detection services can most often be implemented through frameworks that work with the community to promote healthy behaviors, such as free or low-cost skin checks within disadvantaged or high-risk communities [9]. Timely detection is important, as it greatly enhances treatment success and lowers mortality. By targeting vulnerable populations like outdoor employees, athletes, or those in community-determined healthcare deserts with these preventive strategies, the community caters education and resources to those who need it the most [10].

Community engagement at this level leads to long-term benefits as partnerships between healthcare providers, schools, and community organizations help integrate skin cancer primary prevention into the community's culture. Modeling of protective behavior, the practice of peers educating peers, and sun-safe leadership ultimately extend the reach and impact of many more individuals adopting (or transmitting) protective behavior. Most importantly, community engagement also tackles the social and economic determinants of health that lead to inequitable access to preventive services and health care, making these more accessible and inclusive. Community-based initiatives promote equity and wide-scale implementation of skin cancer prevention by engaging populations targeted with culturally appropriate and socio-economically relevant approaches,

CHAPTER 6

Personalized Treatment Plans: AI-Driven Decision Support for Optimal Care Paths

Akhil Sharma[1], Shaweta Sharma[2], Akanksha Sharma[1], Sudhir Kumar[3] and **Sunita[1,*]**

[1] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[2] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

[3] *Faculty of Pharmaceutical Sciences, DAV University, Jalandhar, India*

Abstract: Personalized treatment plans are becoming the norm in modern healthcare, with AI-driven decision support systems creating the optimal care paths based on individual patient needs. Artificial intelligence technologies like Machine learning, Natural language processing (NLP), Predictive analytics, and reinforcement learning utilize diverse data sources, such as electronic health records (EHRs), data from wearable devices, and genetic profiles. AI can use real-time and historical data to provide customized treatments, follow up on progress, and dynamically update care plans, delivering more specific and accurate solutions. With fewer trial-and-error-based processes, the capacity of AI to assist decision-making translates to improved patient outcomes through targeted therapies and support for accurate diagnosis. Realizing these benefits, however, necessitates addressing data privacy, the ethics of large language models, and the risks of biases embedded in AI models. Building trust around these systems requires transparency, explainability, and compliance with regulatory standards (HIPAA, GDPR). Although AI holds immense potential to enhance patient engagement and operational efficiency, integrating extensive data and acceptability among clinicians still holds back its benefits. However, with the advancements in AI technologies, there is hope for real-time, adaptive treatment adjustments and improved collaboration between AI systems and healthcare professionals. AI-based systems are ready to revolutionize personalized healthcare, turning optimal, tailored treatment pathways from an idea into a reality in multiple patient cohorts.

Keywords: Electronic health records, Machine learning, Natural language processing, Personalized treatment plans, Predictive analytics.

* **Corresponding author Sunita:** R.J. College of Pharmacy, Raipur, Uttar Pradesh, India;
E-mail: ssunitaathakur@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

INTRODUCTION

Personalized medicine is transforming the healthcare industry, and the role of artificial intelligence (AI) is paramount in this change. AI technologies represent an incredible leap forward in our ability to analyze complex, large-volume data, resulting in enhanced diagnosis and treatment. Conventional medicine was treated in a very generalized way with an expectation that it would be a one-size-fits-all approach. However, it has become increasingly clear that individual variations in genetics, lifestyle, and environment significantly impact an individual's response to treatment. This realization sparked the emergence of personalized medicine, an approach that tailors medical interventions to the unique characteristics of each patient [1].

The field of personalized medicine has transformed the healthcare landscape, emphasizing that not every patient will respond the same way to treatment. This enables providers to create more effective, tailored interventions for patients based on their genetic makeup, environment, and lifestyle choices. The change in focus from traditional medicine to personalized medicine has resulted in better patient outcomes and created a more patient-centric approach to healthcare [2].

With AI's help, the potential of personalized medicine has been realized. AI can devise individualized treatment plans by analyzing vast amounts of patient data, such as genetic information, medical histories, and lifestyle factors. AI can also recognize hidden insights and predict individual responses to treatment with an accuracy never seen before by analyzing patterns and correlations in this data [3].

AI's role in personalized medicine has created unprecedented ground for novel research and treatment development. AI algorithms can quickly analyze a vast amount of data, allowing them to uncover subtle patterns and associations that may not otherwise have been detected. These have facilitated the identification of emerging biomarkers, genetic variants, and therapeutic targets for more effective and precise interventions [4].

Furthermore, AI-based personalized medicine can also improve preventive measures. AI algorithms can assess genetic risks, lifestyle choices, and environmental factors to identify individuals at higher risk of developing specific diseases. Early identification enables preventive measures and interventions by healthcare professionals, reducing disease burden and improving population health [5].

Another key benefit of AI integration in personalized medicine is the continuous learning and adaptability offered. AI algorithms can analyze treatments and who did best in real time, allowing treatment plans to be tailored and perfected. Such an iterative process ensures that interventions are progressively refined and adapted, which, over time, is likely to improve patient outcomes [6].

AI integration in personalized medicine will have associated challenges and ethical considerations. However, several factors must be addressed, such as privacy concerns, data security, and algorithm bias, to ensure AI's responsible and ethical use in healthcare. To avoid these risks, transparency, accountability, and strong regulatory frameworks are essential so that AI integration in personalized medicine benefits everyone [7].

This evolution of personalized medicine from the time-tested traditional approaches to successfully implementing AI-based therapeutic pathways is revolutionizing medicine. Personalized medicine has become more patient-oriented and has improved patient outcomes by considering individual differences in genetics, lifestyle, and environment. Now, AI has elevated the accuracy and efficiency of personalized medicine by identifying targeted interventions and unraveling new facts. However, such integration demands careful consideration of the ethical implications of integrating AI into healthcare practices [8].

Deep learning algorithms are particularly good at tasks like image recognition, natural language processing, and speech recognition. In personalized medicine, these algorithms can be trained to interpret medical images (*e.g.*, MRI scans or pathology slides) and even recognize subtle patterns or abnormalities, perhaps indicating a certain disease or condition. Deep learning can allow healthcare professionals to create more accurate diagnoses and develop personalized treatments for individual patients [9].

Furthermore, AI-powered systems can help health providers predict patient outcomes and the best treatment and intervention approaches. AI algorithms can analyze large data sets containing datasets about patients who were similar in background, circumstances, and health and provide insight for clinicians about treatment decisions. This results in improved patient outcomes and optimal allocation of healthcare resources, whereby those who need the resources the most are allocated accordingly [10].

AI, particularly machine learning and deep learning, can potentially change the way for personalized medicine. Healthcare providers can process large data sets, recognize patterns, and forecast through AI, leading to more precise diagnoses and individualized care plans. Nevertheless, we must exercise restraint in implementing AI in healthcare and adhere to ethically acceptable practices by ensuring robust privacy measures and unbiased models whilst considering the implications of different governance options. As AI technology and crossdisci-

CHAPTER 7

Early Intervention and Prevention: Leveraging AI and IoT for Sun Protection and Risk Management

Sunita[1], **Akhil Sharma**[1], **Shaweta Sharma**[2], **Sudhir Kumar**[3] and **Ashish Verma**[4,*]

[1] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[2] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

[3] *Faculty of Pharmaceutical Sciences, DAV University, Jalandhar, India*

[4] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

Abstract: The most significant dangers of sun exposure to skin health are skin cancer, sunburn, and premature aging. Addressing these risks requires effective early intervention and prevention strategies. New technologies, particularly Artificial Intelligence (AI) and the Internet of Things (IoT), are changing how we interact with and protect ourselves from the dangers of the sun. AI technology provides an in-depth assessment of skin health and calculates individual risk through predictive modeling of UV exposure, thus providing personalized recommendations for sun protection. AI-based solutions allow for customization of interventions to individual needs, leading to better effectiveness and adherence. Sun exposure can be managed through real-time monitoring of UV levels using IoT devices. Smart bands and UV sensors integrated into smart clothing and accessories with inherent SPF provide real-time sun exposure feedback. Mobile app integration improves engagement and ensures timely protection against sun damage. Risk management is primarily based on data-driven insights. AI and IoT data allow one to track long-term sun exposure and calculate a risk assessment based on how sun rays damage their skin over this long period. High-performance cloud-based platforms allow for full storage and analytics of the data, but these must be secured against privacy and security concerns. By leveraging gamification, awareness campaigns, or community-based apps, AI and IoT technologies can improve public knowledge and comprehension by making sun protection habits more tangible. These technologies provide benefits but face many challenges, including technical limitations, high costs, privacy issues, and ethical concerns. The future trends involve new AI algorithms and IoT space innovations for enhanced UV detection and skin health monitoring. Such developments can lead to major advancements in global skin cancer preventative strategies and public health outcomes.

[*] **Corresponding author Ashish Verma:** Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India; E-mail: ashishsing264@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

Keywords: Artificial intelligence, Internet of things, Premature aging, Skin cancer, Sun exposure, Sunburn.

INTRODUCTION

Exposure to the sun is a common cause of almost all skin problems, from simple sunburn to serious skin cancer and aging. Identifying these risks is important for instituting effective protective measures and creating public awareness. One of the most severe consequences of excessive exposure to sunlight is skin cancer. It is mainly classified into three classes: basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and melanoma [1].

Melanoma is a more aggressive type, although BCC and SCC are both more common and typically less severe, with lesser mortality rates. It usually develops in atypical moles or preexisting freckles and is highly associated with an intermittent pattern of sun exposure, such as during sunburn. Skin cell DNA is damaged by ultraviolet (UV) radiation, resulting in mutations that can cause tumors to grow. Cumulative UV exposure over a lifetime increases the risk of skin cancer. Hence, everyone of all ages, especially older people, must protect themselves from the sun [2].

Sunburn (symptomatic) is an acute response to excessive UV exposure, presenting as redness, pain, and skin inflammation. It is caused by the body trying to heal damage caused by the UV rays and can range from mild to severe. Getting burnt often, particularly as a child, raises the chances of skin cancer in later life. While sunburn is an acute condition, the long-term implications for skin health can be significant due to the contribution of cellular damage, ultimately leading to cancer [3].

Excessive exposure to the sun will result in premature aging or photoaging. UV radiation is also responsible for skin aging through the degradation of collagen and elastin fibers, which cause wrinkles, sagging, and age spots. This damage presents itself through fine lines, a leathery skin texture, and uneven pigmentation. In many cases, photoaging creates an appearance that is even older than what the skin truly is, which can affect how one feels about their face and overall appearance [4].

Skin disorders other than skin cancer also result from prolonged sun exposure, such as actinic keratosis, which are precancerous rough and scaly patches that can be invasive if not treated. The immune system can be inhibited by UV rays, resulting in lower defense power to resist pathogens and recover from wounds. Protective behavior such as sunlight avoidance, sun cream use, or protective clothing is an important preventive measure to reduce these risks. Raising awareness of the risks associated with sun exposure and proper sun safety can help avoid these health conditions, promoting healthier skin behaviors [5 - 7].

Importance of Early Intervention and Prevention

Providing the earliest possible intervention is crucial to preventing skin cancer. Some skin cancers, especially melanoma, can quickly become life-threatening if not treated promptly. Early identification of a suspicious mole or skin changes is possible through regular skin checks and self-examinations. Identifying these issues early gives time to carry out medical investigation and treatment, if necessary, which can improve outcomes and survival. Preventive strategies, such as reducing exposure to the sun and using sunscreen, can lower the chances of developing skin cancer. Implementing these initiatives early in life can reduce cumulative UV exposure and decrease skin cancer risk [8 - 10].

Early intervention and preventive measures are cost-effective in the long run by reducing the need for more expensive treatment and interventions later. Prevention of sun-related diseases can save money. Fewer skin cancer cases, milder sunburns, and lower rates of premature aging can be possible with early sun safety habits, ultimately lowering healthcare costs and increasing life quality [11, 12].

Role of Emerging Technologies in Sun Protection and Risk Management

Innovative technologies are revolutionizing sun protection by implementing tech-based solutions to combat the hazards of sun exposure. The emergence of new technology has changed how people track their sun exposure and has provided more effective and personalized ways to take care of their skin. Recent advances in sun protection technologies are listed in Table **1**, focusing on mechanisms of action for effective risk management of ultraviolet radiation exposure.

Table 1. Recent developments and their roles in managing risk associated with ultraviolet radiation.

Emerging Technologies in Sun Protection and Risk Management	Description
Advanced UV filters	The substances in UV filters are especially effective in blocking UVA rays (notably new filters like Tinosorb S and Mexoryl SX, which provide broad-spectrum protection with greater stability to both UVA and UVB rays so that reanimating is not essential) [13].
Chromophore-based sunscreens	This type of sunscreen absorbs certain lengths of UV and transforms destructive energy into harmless heat. It protects UVA and UVB rays through a specific wavelength and prevents them from breaking down [14].

CHAPTER 8

Remote Patient Monitoring: Supporting Treatment Adherence and Early Intervention

Ashish Verma[1], **Sunita**[2], **Akhil Sharma**[2], **Shaweta Sharma**[3] and **Akanksha Sharma**[2,*]

[1] *Mangalmay Pharmacy College, Greater Noida, Uttar Pradesh-201306, India*

[2] *R.J. College of Pharmacy, Raipur, Uttar Pradesh, India*

[3] *School of Medical and Allied Sciences, Galgotias University, Uttar Pradesh-201310, India*

Abstract: Remote Patient Monitoring (RPM) has evolved into an influential modality within the field of dermatology, aiding in both treatment compliance engagement and early detection of skin cancer. RPM technologies have emerged as a critical modality in these efforts, including artificial intelligence (AI) and machine learning (ML), and smartphone applications for skin monitoring, screening, and treatment of melanoma. This chapter explores the importance of RPM in treatment compliance and engagement and how effectively aligned patient engagement strategies contribute to adherence monitoring with a compliant clinical treatment regimen. Teledermoscopy is among the most important fields of RPM, and it allows the diagnosis and monitoring of skin lesions remotely through a smartphone with an accuracy equivalent to that of conventional visits. This highlights the significance of early detection of skin cancer, portraying how RPM can help in making timely interventions that lead to better patient outcomes. The most prominent benefits of RPM for skin cancer patients are increased communication between patients and providers, more access to specialized dermatological care, and overall improved satisfaction with the treatment process. The chapter identifies challenges and limitations as well, including technology obstacles, difficulties in data integration, patient privacy issues, and the necessity for enhancing patients' digital health literacy. The chapter concludes by contemplating the future of RPM for skin cancer monitoring, including new imaging technology trends, potential expansion into preventive dermatology, and policy/regulatory challenges that must be addressed to facilitate broader adoption of RPM. This chapter identifies these elements to guide an understanding of how RPM can assist treatment adherence and early detection of skin cancer.

Keywords: Artificial intelligence, Early detection, Machine learning, Remote patient monitoring, Skin cancer, Teledermoscopy.

* **Corresponding author Akanksha Sharma:** R.J. College of Pharmacy, Raipur, Uttar Pradesh, India; E-mail: akankshasona012@gmail.com

Akhil Sharma, Shaweta Sharma, Shivkanya Fuloria & Sudhir Kumar (Eds.)

INTRODUCTION

Remote Patient Monitoring (RPM) in dermatology is an innovative healthcare delivery approach to monitor and manage the physical aspects of the health of patients outside of conventional clinical places [1]. RPM enables dermatologists to remotely monitor skin diseases by using connected devices, mobile applications, and telehealth platforms for timely and proactive care without requiring most visits in person. This is especially useful for detecting early skin diseases (skin cancer) and chronic conditions such as psoriasis, eczema, and acne by using visual data in less time without human error [2].

Among the essential elements of RPM in dermatology is a smartphone application integrated with either high-resolution lenses or machine learning algorithms. With these apps, patients can take images of skin lesions or affected areas, which can be analyzed by dermatologists or artificial intelligence (AI) for change or diagnosis without an in-person visit. This, however, helps find irregularities at an earlier stage to make early corrective procedures if required [3].

Teledermoscopy is another key RPM tool within dermatology; it refers to the remote diagnosis of skin conditions using non-invasive digital dermatoscopes that take high-resolution images of the skin and enable monitoring with higher image magnification than that seen on naked eye examination. These images can be safely transmitted to dermatologists, who can assess the disease without a physical consult. Teledermoscopy has a high level of diagnostic accuracy, similar to in-person face-to-face examinations, and serves as an effective tool for long-term surveillance [4].

Some benefits of RPM in dermatology include better access to care (a particularly important benefit for patients who live in rural or underserved areas) and real-time monitoring of treatment compliance. RPM improves convenience for patients by cutting down on costly, time-consuming, unnecessary travel to physical visits and, at the same time, improving the quality of care *via* improved surveillance and early detection of skin problems [5].

Importance of Treatment Adherence and Early Intervention in Skin Cancer Detection

Successful outcomes among patients with skin cancer rely on treatment compliance and early intervention. Skin cancer (melanoma, basal cell carcinoma, and squamous cell carcinoma) is one of the most fundamental (in particular) cancers around. Both prognosis and survival depend upon early detection of the disease, followed by adherence to proven treatment regimens [6]. The role of treatment adherence and early detection in skin cancer is summarized in Fig. (**1**) and discussed below:

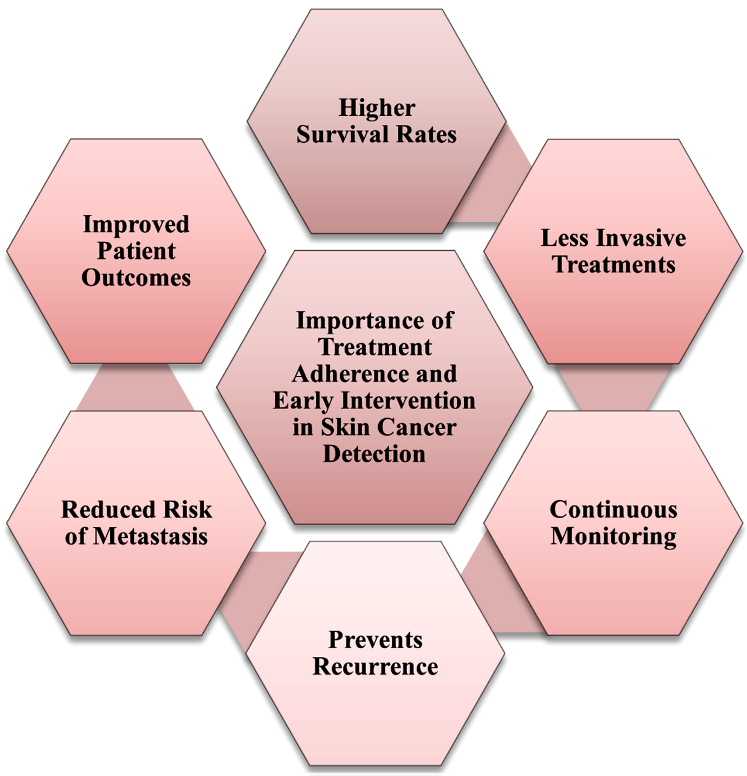

Fig. (1). Importance of treatment adherence and early intervention in skin cancer detection.

Early Intervention in Skin Cancer Detection

The cancer prognosis depends on how quickly the skin cancer is diagnosed, which is the reason behind early intervention. If diagnosed early (especially in the case of melanoma), skin cancers have a significantly higher rate of success in being treated. When melanoma is at a stage in which it has not spread below the upper levels of the skin (*in situ*), the 5-year survival rate is as high as 99%. If cancer metastasizes to deeper tissue or other body parts, though, survival rates significantly decrease [7].

Remote Patient Monitoring (RPM) improves early intervention through continuous skin tracking. Patients can regularly capture pictures of moles or lesions that may be concerning with AI-driven smartphone apps, teledermoscopy, and other RPM tools. All of this allows skin lesions to be changed and reacted faster, which can prevent further progress [8].

SUBJECT INDEX

A

B

C

D

E

S

T

U

V

Akhil Sharma

Dr. Akhil Sharma, M.Pharm., Ph.D., is currently serving as Professor and Principal at R.J. College of Pharmacy, Raipur, Aligarh, Uttar Pradesh, India. He earned his Ph.D. in 2016 from Teerthanker Mahaveer University, Moradabad, Uttar Pradesh. With over 15 years of experience in the field of pharmacy, Dr. Sharma has published numerous articles in peer-reviewed national and international journals.

Shaweta Sharma

Dr. Shaweta Sharma, M.Pharm., Ph.D., is a Professor at Galgotias University, Greater Noida, India. She obtained her Ph.D. in 2017 from Teerthanker Mahaveer University, Moradabad, Uttar Pradesh. With more than 15 years of academic experience, she has contributed extensively to the field and published research articles in peer-reviewed national and international journals.

Shivkanya Fuloria

Dr. Shivkanya Fuloria, Ph.D., is a Senior Associate Professor in the Department of Pharmaceutical Chemistry, Faculty of Pharmacy, AIMST University, Kedah Darul Aman, Malaysia. With over 20 years of experience spanning academia, research, and industry, she holds degrees in B.Pharm., M.Pharm., Ph.D. in Pharmacy, and a PDCTM.

Her research contributions include 3 MOOCs, 5 books, 11 book chapters, 14 patents, and 166 research papers. She has supervised 1 Ph.D., 5 M.Pharm., 2 M.Sc., and 27 B.Pharm. students and participated in 87 conferences, trainings, webinars, and seminars. She has also been honored with six awards for her outstanding contributions to the field.

Sudhir Kumar

Dr. Sudhir Kumar is a distinguished pharmaceutical scientist with over 17 years of teaching and research experience. He currently serves as Dean and Professor at the Faculty of Pharmaceutical Sciences, DAV University, Jalandhar, India.

He earned his Ph.D. in Pharmaceutics from UIPS, Panjab University, Chandigarh, with research focused on nano drug delivery systems for skin cancer. A recipient of the ICMR Senior Research Fellowship, he has also been awarded ICMR and DBT International Travel Grants to present his research globally. His research interests include nanotechnology-based drug delivery, topical formulations, and dermatological therapeutics, with several publications in leading international journals.