

AI-INTEGRATED HYDROGEL WEARABLE PATCHES FOR NON-INVASIVE SKIN CANCER BIOMARKER DETECTION

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INTRODUCTION

Skin cancer is among the most prevalent malignancies worldwide, and early detection is critical to improving outcomes. Current diagnostic pathways rely on dermoscopy and invasive biopsies, which can be costly and distressing. Hydrogel-based wearable patches offer a promising non-invasive alternative, interfacing directly with skin and interstitial fluid to capture disease-related biomarkers such as inflammatory cytokines. However, translating raw sensor signals into clinically meaningful outputs remains a challenge. Integrating machine learning with hydrogel biosensors offers a pathway toward automated, non-destructive screening for early-stage skin cancer.

AIM

To propose a machine learning framework using hydrogel-based wearable skin patches for non-invasive detection and characterization of biomarkers associated with skin cancer.

METHODS

This study proposes a conceptual framework where a flexible hydrogel patch is applied directly to the skin, enabling continuous sensing of biomarkers including inflammatory cytokines and tumor-associated proteins.

Flexible hydrogel patch applied directly to skin; embedded electrochemical/optical nanosensors for continuous sensing (inflammatory cytokines, tumor-associated proteins).

Sensor output fed into machine learning pipeline for automated signal analysis.

Supervised models (logistic regression) proposed as baselines for biomarker classification.

Performance assessed via AUC, sensitivity; all detection remains fully non-invasive.

EXPECTED RESULTS

- Enable accurate and early-stage detection of skin cancer-associated biomarker profiles
- Outperform conventional approaches while maintaining a non-invasive detection technique.

CONCLUSION

This work presents a novel framework for non-invasive skin cancer biomarker detection, combining advanced hydrogel sensing technology with machine learning to support earlier diagnostic screening.