Research Questions and Future Directions

1. Research Questions

1. How can federated learning improve diagnostic fairness in multi-institutional skin cancer detection models?
2. What are the performance trade-offs between model interpretability and diagnostic accuracy in explainable AI systems for dermatology?
3. How does synthetic data augmentation impact rare skin cancer class prediction in low-resource environments?
4. What regulatory and ethical frameworks are necessary for the safe deployment of AI-driven skin cancer diagnostic tools?
5. To what extent can edge AI enable real-time, privacy-preserving skin cancer screening in mobile and rural settings?

2. Future Research Directions

1. Federated Learning Advancements:
Future research can explore more efficient and communication-optimized federated learning protocols to enable wider clinical collaborations across hospitals, ensuring patient privacy while addressing bias in skin type representation.

2. Explainable AI and Clinician Trust:
Developing visual and natural language-based explainability tools that integrate with clinician workflows can bridge the gap between black-box AI decisions and human trust in diagnostic systems.

3. Synthetic Data for Minority Classes:
Advanced GAN-based data synthesis for underrepresented skin cancer types (e.g., acral lentiginous melanoma) can mitigate class imbalance, improving generalizability in real-world models.

4. Edge AI and On-device Inference:
Exploring lightweight, low-latency AI models that can run offline on mobile devices would enable scalable and equitable access to diagnostic tools, especially in low-income and remote areas.

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5. AI Policy, Ethics, and Standardization:

Establishing interdisciplinary frameworks combining technical validation, legal compliance, and ethical review will be critical for regulatory approval and global adoption of AI systems in dermatology.