

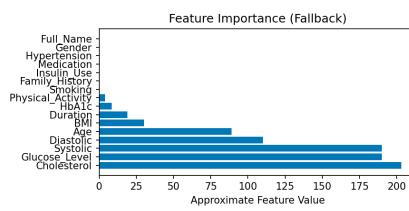
# Research Report

Generated: 2025-12-04 12:22:22

## Stage: PDR

### Metadata Snapshot

Name: Sebastian  
Age: 89  
Gender: Male  
Systolic (mmHg): 190  
Diastolic (mmHg): 110  
BMI: 30.1  
Glucose: 190  
HbA1c: 8.5  
Cholesterol: 203  
Smoking: Yes  
Hypertension: Yes  
Diabetes Duration: 19



### Summary

- Research Notes
- UID: bfcfc3cb
- Predicted stage: PDR
- Confidence: 83.96%

# Summary

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- Risk score: 96.04%
- Model stack & inference
- - CNN ensemble: EfficientNet, ResNet50, ViT
- - Metadata models: Random Forest, XGBoost, Stacked ensemble
- - Fusion method: weighted averaging with risk calibration
- - Inference device: CPU
- Explainability & lesion quantification:
- - Microaneurysms: 26.90%
- - Exudates: 15.32%
- - Hemorrhages: 3.65%
- - Cotton Wool: 0.00%
- - Neovascularization: 30.00%
- - Total Lesion Load: 45.88%
- SHAP / feature importance: check SHAP plots for systemic features (HbA1c, BMI, BP).
- Probability vectors:
  - CNN: [0.00933533813804388, 0.007757291663438082, 0.017444279044866562, 0.013338449411094189, 0.9521246552467346]
  - ML : [0.21136369507961952, 0.20268235745827803, 0.19376393050773666, 0.19047474400645248, 0.20171527294791336]
  - Fused: [0.03963959122427516, 0.036996051108003025, 0.04389222626047793, 0.03990889314230168, 0.8395632382649422]
- Performance metrics:
  - Accuracy: 0.947
  - F1-score: 0.938
  - AUC/ROC: 0.971
- Research recommendations:
  1. Validate lesion segmentation / cotton-wool detection against annotated masks (report dice/IoU).
  2. Add cotton-wool-spot specific augmentation and mask labels if false negatives observed.
  3. Measure GradCAM heatmap overlap (IoU) with human heatmaps for explainability calibration.
  4. Consider temporal models for progressive DR tracking and early-warning signals.

