a.

Generating Synthetic Datasets
Across all Different Demographic Groups

FairGenMed

Human Input
Text Prompt

Black male, non-hispanic patient with glaucoma, mild vision loss abnormal cup-disc ratio and positive near vision refraction.

FairDiffusion Model
Generative Text-to-Image AI

Output
SLO Fundus Image

Medical Education

Data Sharing

Data Augmentation

b.

Stable Diffusion Model (SDM)

FairGenMed

Image Encoder

Latent Space

Z_0

Forward Diffusion

Z_t

Denoising UNet

Z'_0

Image Decoder

Output
SLO Fundus Image

Human Input
Text Prompt

Latent Diffusion Loss
Minimize Loss

c.

FairDiffusion Model (FDM)

FairGenMed

Image Encoder

Latent Space

Z_0

Forward Diffusion

Z_t

Denoising UNet

Z'_0

Image Decoder

Output
SLO Fundus Image

Human Input
Text Prompt

Loss l

Asian Black White

Δl

Minimize Loss

$(1 + \zeta_{\text{Asian}}) * l_{\text{Asian}}$

$(1 + \zeta_{\text{Black}}) * l_{\text{Black}}$

$(1 + \zeta_{\text{White}}) * l_{\text{White}}$

Posterior

Acquisition Function

Sample ζ

Probability Density

Asian Black White

Fair Bayesian Perturbation

d.

Contribution 1: FairDiffusion for Group-Specific Statistical Generations

1. Train

SDM Generative AI

2. Test

FairGenMed

2. Test

1. Train

FDM Generative AI

FID

Asian Black White

SDM: 1.8, 2.6, 0.5

FDM: 0.9, 1.2, 0.5

Contribution 2: Fairness Assessment for Medical Imaging

SDM
Synthetic SLO Fundus Images

FDM
Synthetic SLO Fundus Images

1. Train

2. Test

Clinical Feature Detection Model

AUC

Asian Black White

SDM: 55, 45, 95

FDM: 65, 55, 95

Contribution 3: A Clinical Text-to-Image Fair Generation Dataset FairGenMed

Demographic Attributes
Gender - Race - Ethnicity

FairGenMed
Original SLO Fundus Images inclusive Annotations using Text Prompts

Clinical Features
Glaucoma - Near Vision Refraction Stage
RNFLT Status - MD Severity - CDR Status