# A Study across pediatric development

**Pediatric ECGs**
Proposed ages 1-16 years
Age | Rhythm

**Patient split**
Training
Validation
Real test

**Controlled ECG generation**
A Age-conditioned diffusion
B Age + physiology + simulation
Matched backbone, training budget and count

**Synthetic ECGs**
A B

**Classifier training**
Real only
Real + A
Real + B
Same classifier, separate runs

Shared real training ECGs

Trained models

**Transferability**
Existing methods
Adults → Young adults → Children
Direct use + pediatric adaptation

**Proposed pediatric range: 1-16 years**
1 4 8 12 16

Real test patients only

# B Development-guided generation

**Shared conditions: A + B**
Exact age | Rhythm label
Shared patient metadata

**Age-dependent profiles: B**
Heart rate
PR / QRS / QT
Morphology
Normal training ECGs + age references

**Physiological simulation: B**
Age-dependent parameters + intended rhythm
**Preserve the abnormal rhythm**

Condition encoder

Physiology guidance

**Conditional diffusion**
Same backbone for A and B
Time step t
Noisy ECG
Conditioned denoiser
Predicted noise
Reverse update
t to t - 1
$x_t$
Updated ECG
Repeat reverse steps: T to 0

**Where to add synthetic ECGs**
Planned mix
Preset age-rhythm proportions
vs
Target difficult groups
More ECGs where errors occur
**Test both with A and B, using the same total count**

**Synthetic ECG checks**
Age-specific plausibility
Rhythm preservation
Diversity / memorization

# C Evaluation across pediatric ages

**REAL CHILDREN / EACH AGE GROUP**

## Study across ages
Age groups
Adult-to-child transfer
Development by age + rhythm
Profiles / simulator ablations

## Classification by age + rhythm
TP FP FN TN
Sensitivity / specificity
AUPRC / calibration
Label budget: 10% | 25% | 50% | 100%
Include conventional augmentation baseline

## Decision-making by age
**Fixed capacity**
Detected arrhythmias
**Fixed sensitivity**
False alarms + workload
**Missed cases / 1,000**