



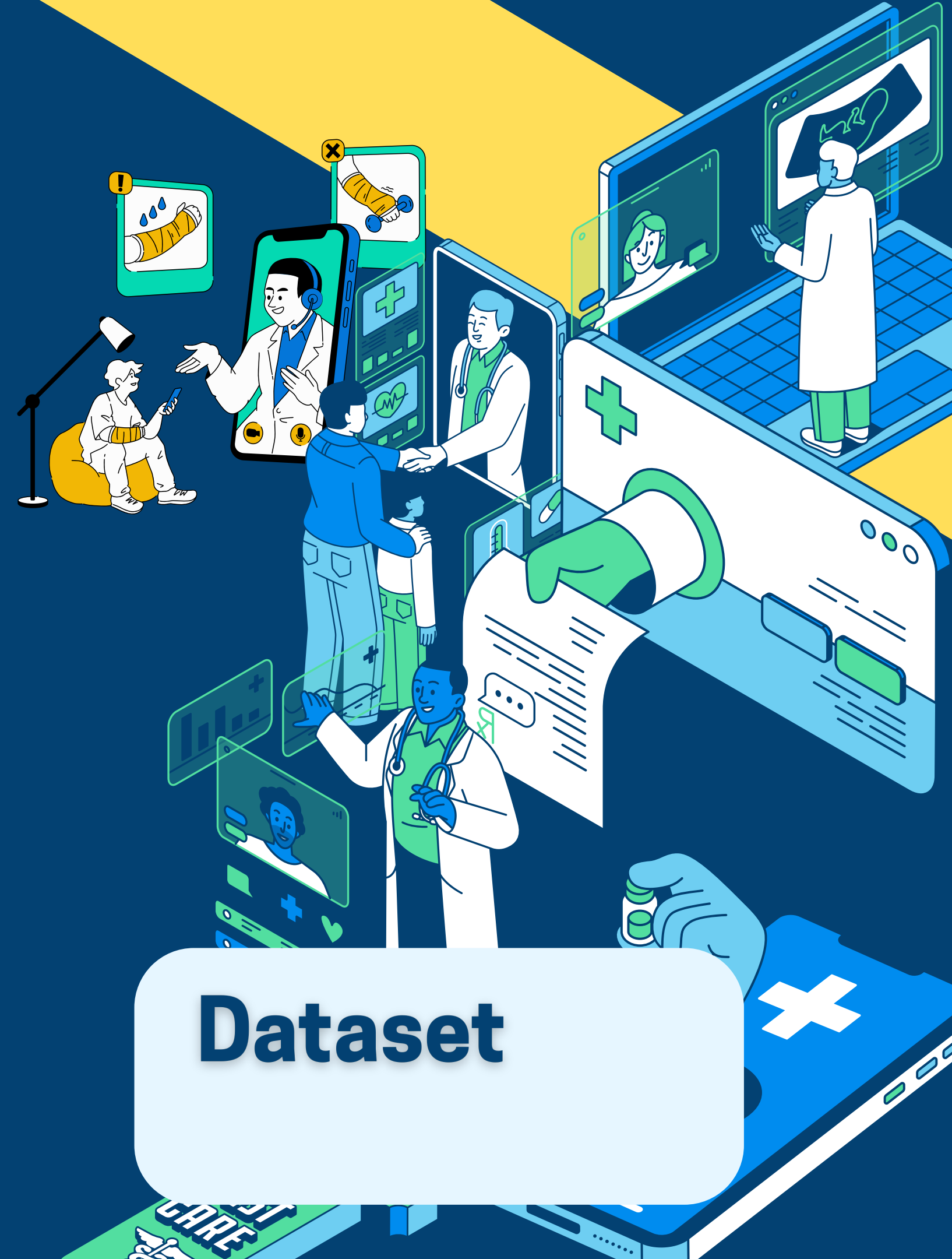
Heart Rate Detection: BCG



- Dynamic time alignment of BCG/ECG timestamps via cross-correlation
- Wavelet/bandpass filtering to isolate cardiac components
- Adaptive movement detection using windowed standard deviation
- Error metrics: MAE, RMSE, MAPE, Bland-Altman, Pearson correlation

Key Steps

- BCG Data:
 - Raw accelerometer signals (140 Hz → resampled to 50 Hz)
 - Timestamps in Unix format (millisecond precision)
- ECG (RR) Data:
 - RR intervals derived from ECG
 - Heart rate values at irregular intervals
- Key Issue:
 - No direct overlap in BCG/ECG timestamps (required dynamic alignment)
 - Gaps between BCG and ECG recordings



Dataset

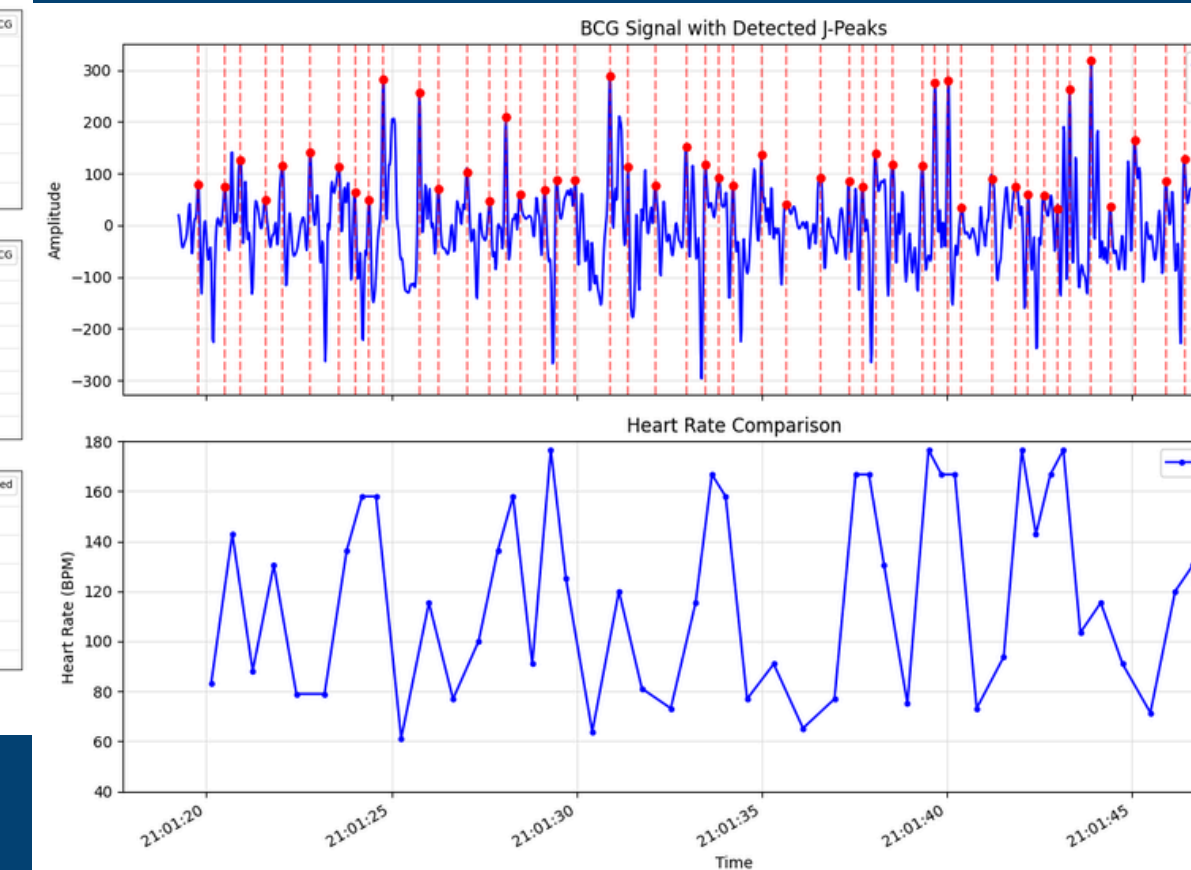
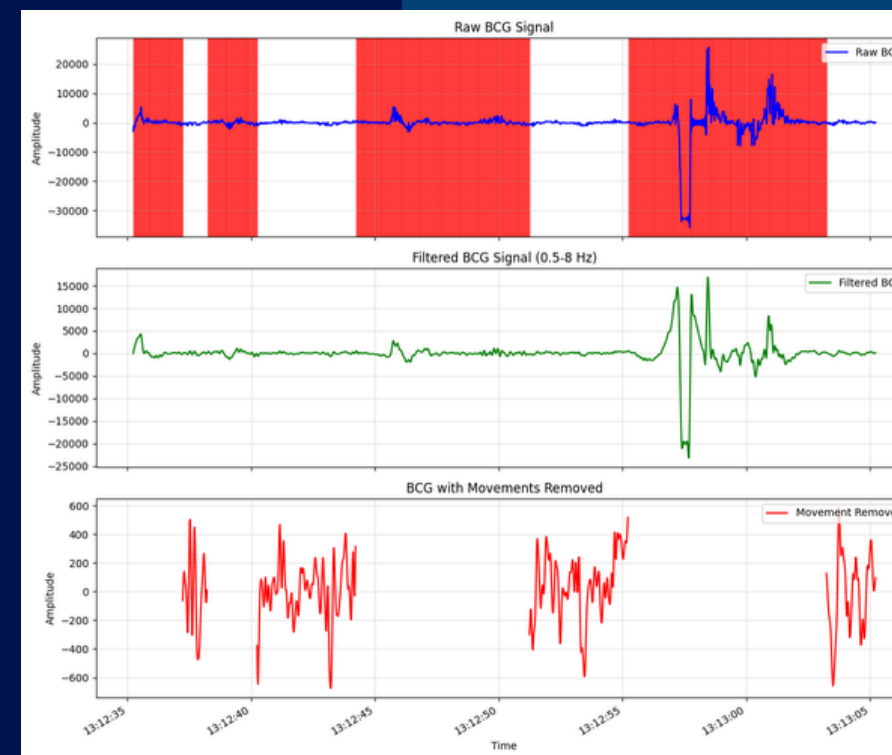
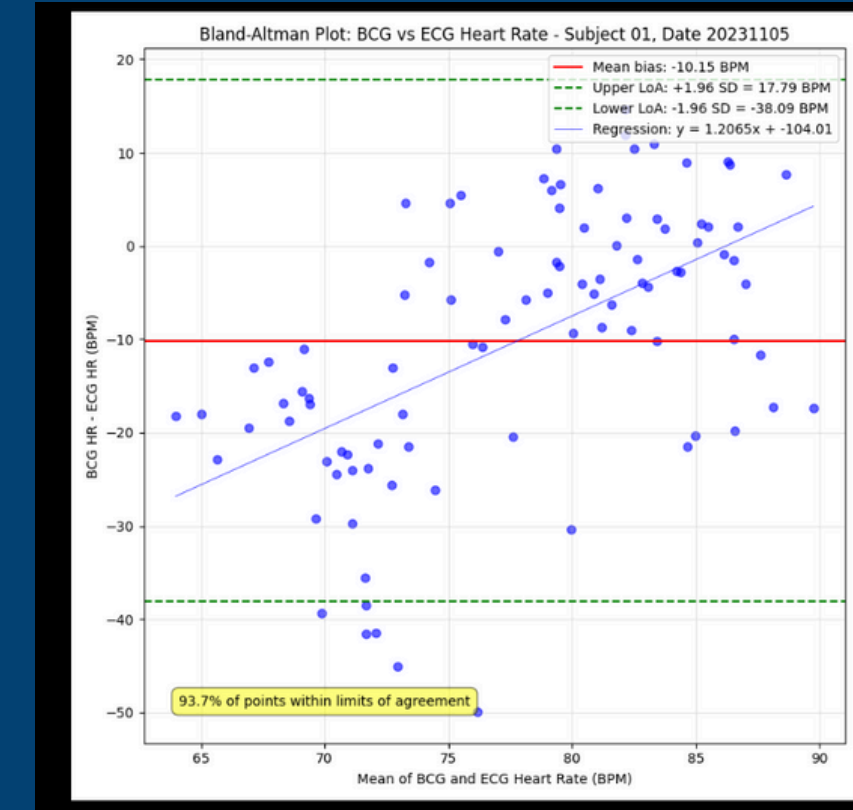
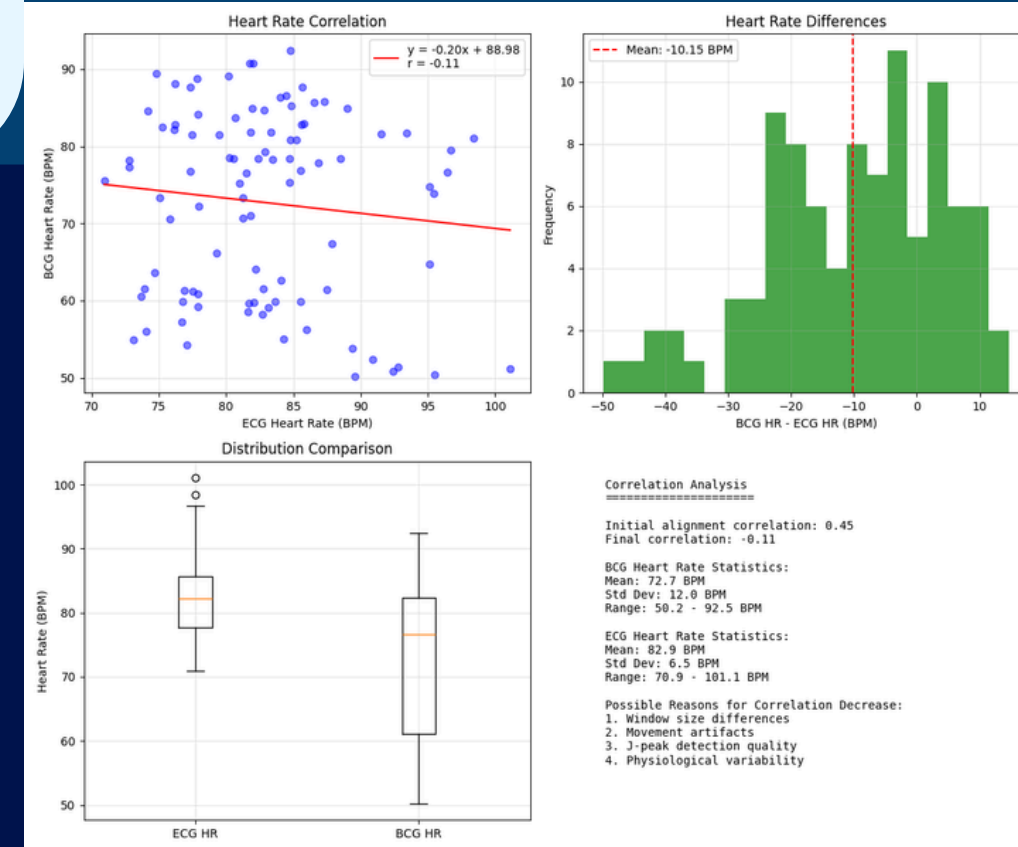


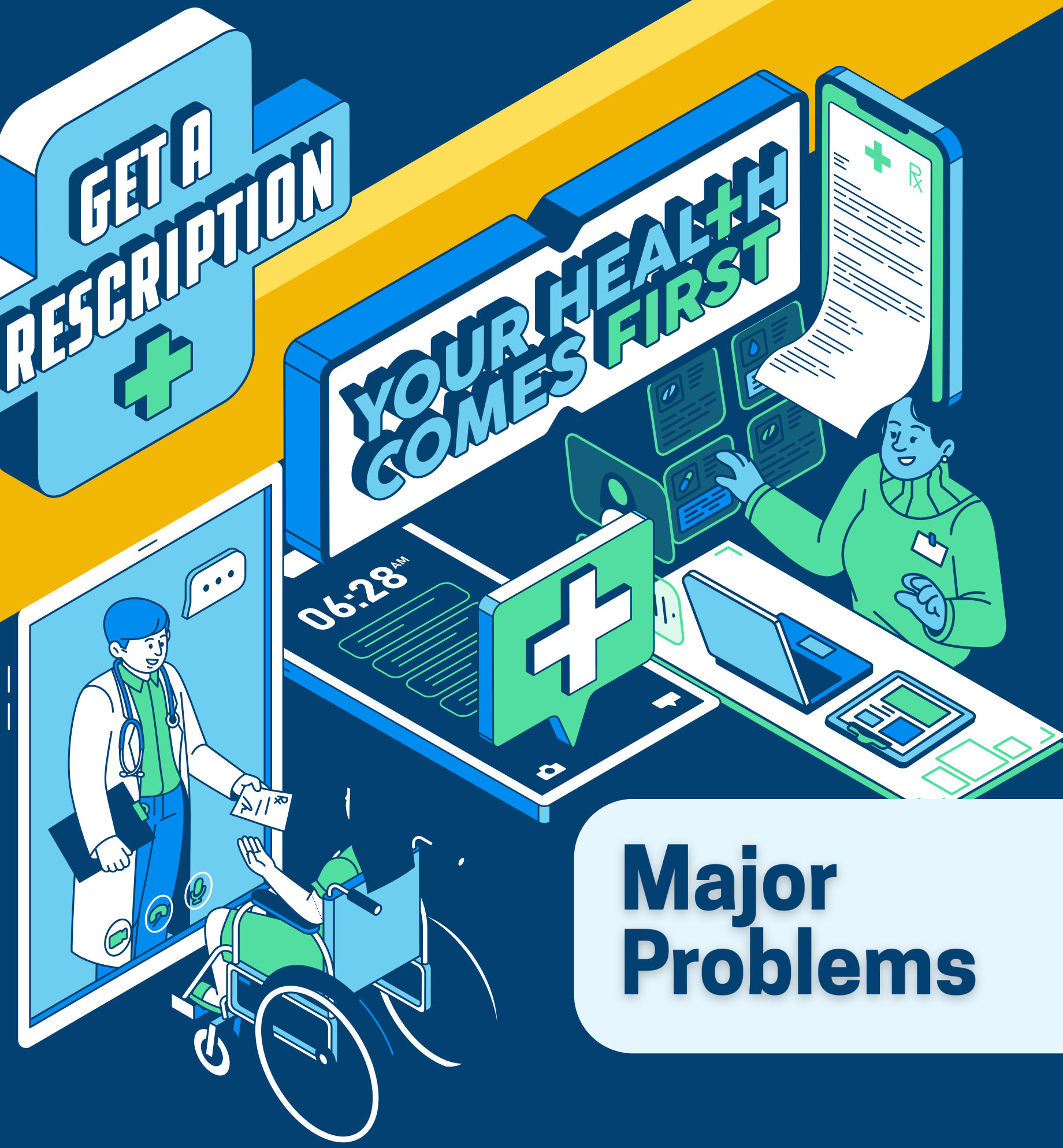
Performance Metrics

- Metrics:
 - MAE: 13.14 BPM (Best) | RMSE: 17.45 BPM
 - MAPE: 15.45% | Correlation: -0.12 (Poor)
- Bland-Altman Analysis:
 - Mean bias: -10.20 BPM (BCG underestimates HR)
 - Limits of agreement: ± 27.77 BPM

Results

- Key Plots:
 - a. Time-series comparison of BCG vs. ECG heart rates
 - b. Bland-Altman plot showing systematic underestimation
 - c. Correlation scatter plot with regression line
 - d. Histograms of BCG/ECG heart rate distributions
- Insights:
 - Noisy BCG signals during movement artifacts
 - Negative correlation suggests misalignment or flawed peak detection





Major Problems

- Timestamp Alignment: No direct overlap → heuristic alignment required
- Movement Artifacts: 19.8% of BCG data corrupted (threshold sensitivity)
- Code/Data Issues:
 - Discrepancy: Report mentions sym8 wavelet, code uses db4
 - Suboptimal default movement threshold (3.0 vs. optimal 2.0)
 - ECG-BCG physiological delay not accounted for
 - No ground truth for J-peak validation



Thank You