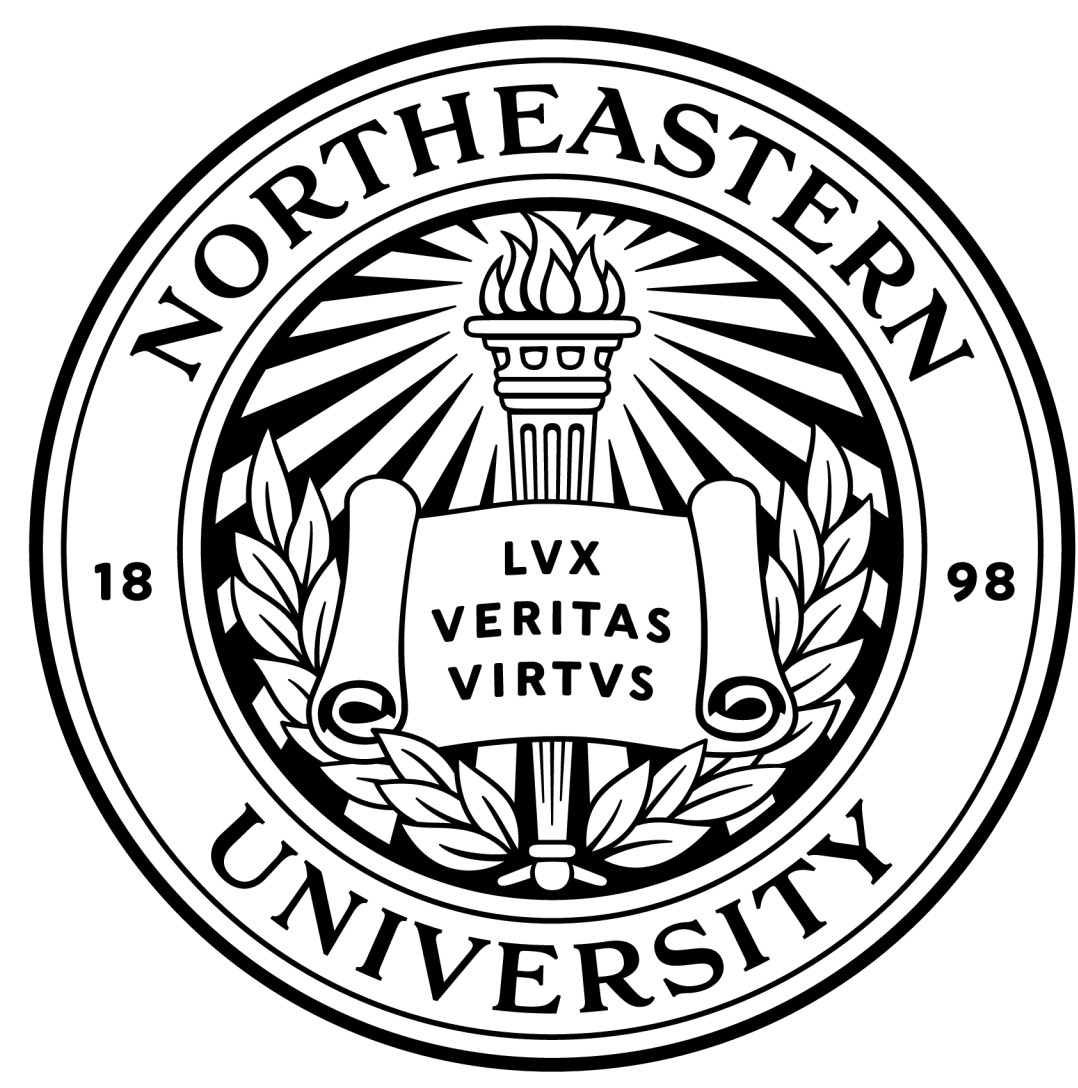
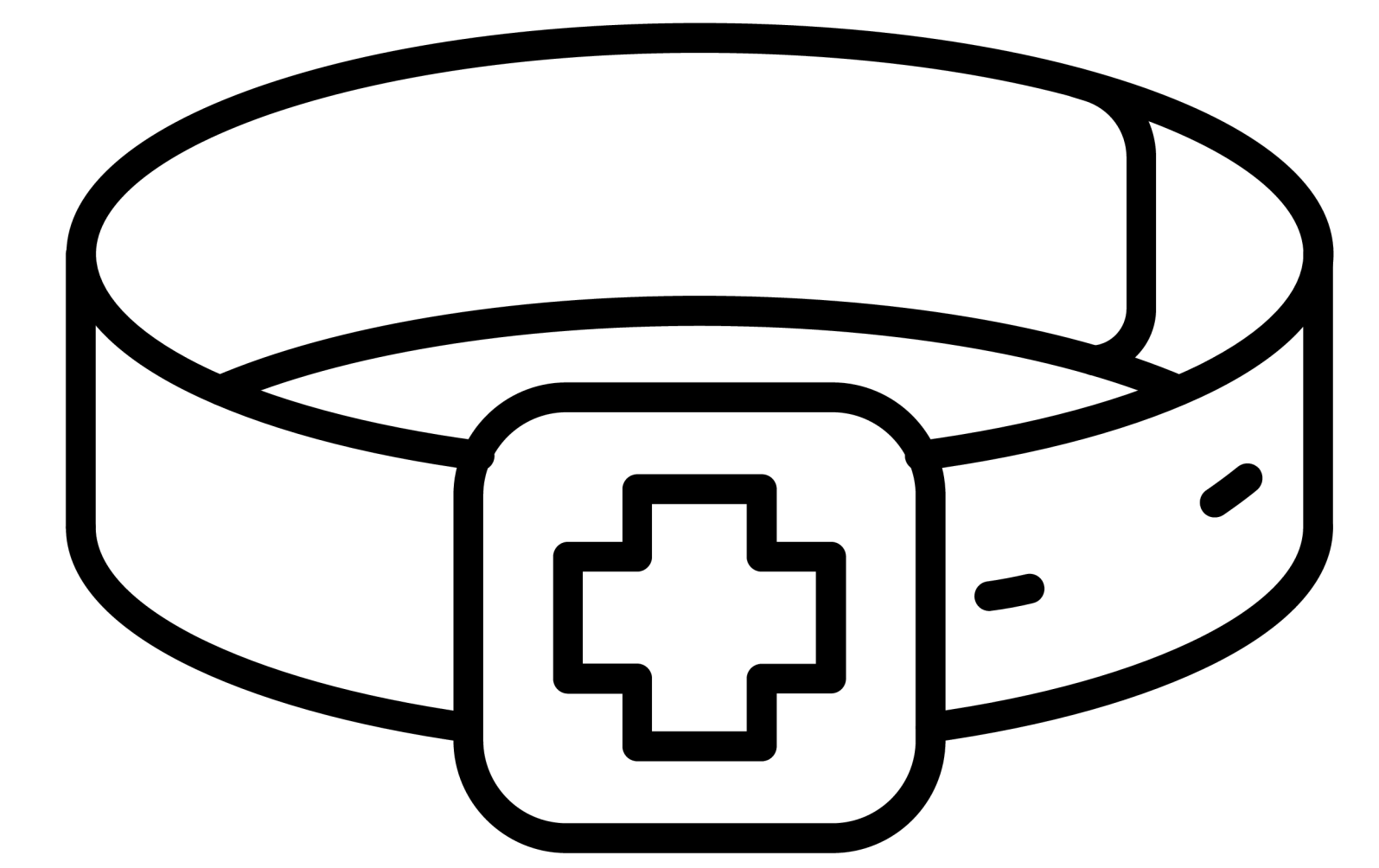




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VITALLINK

REAL-TIME EMERGENCY TRIAGE SYSTEM



(1) Overview

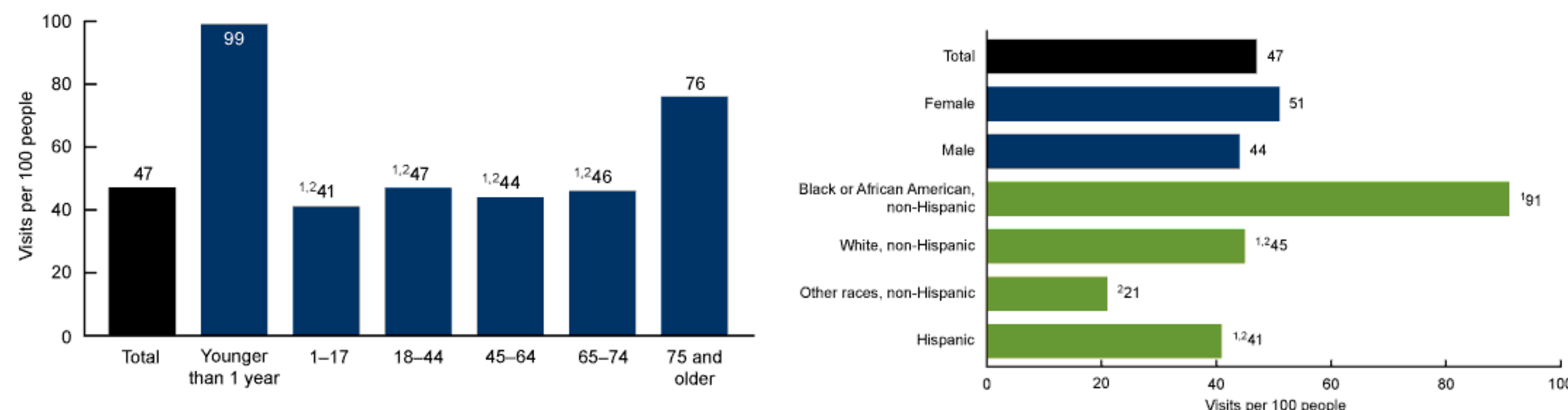
- *VitalLink* is a wearable triage system designed to reduce emergency room wait times, improve diagnostic accuracy, and provide continuous real-time vitals monitoring for every patient in the waiting room.

- The system integrates a wearable wristband, a Bluetooth Low Energy gateway, and a hospital dashboard that automatically prioritizes patients based on severity scoring to support faster and more equitable triage decisions

(2) Background

- Emergency departments face long delays, overcrowding, and inconsistent patient evaluation, especially during peak hours. Many patients wait extended periods without continuous monitoring, which leads to missed symptom changes and delayed interventions. Vulnerable groups face higher rates of misdiagnosis due to atypical symptom presentation and systemic inequities.

- *VitalLink* addresses these challenges through unbiased, continuous vitals data that helps clinicians identify high-risk cases more accurately.



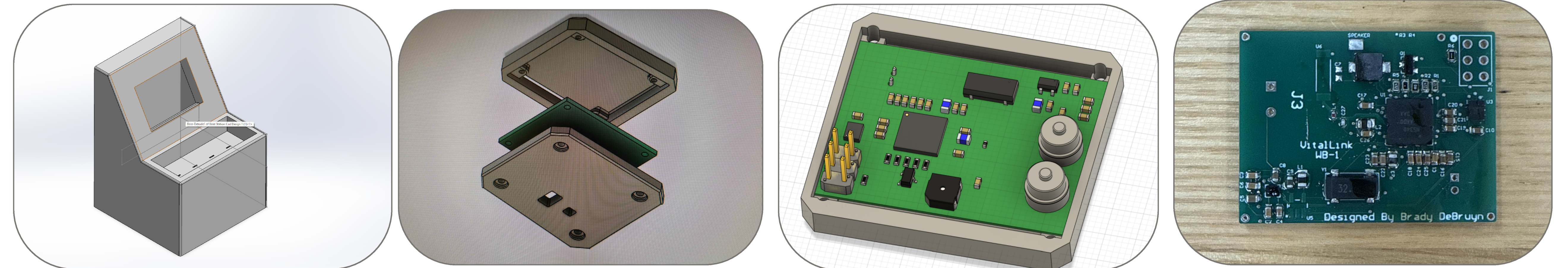
Figures 1-2: ER visitation rate by age and by sex and ethnicity, respectively

(3) System Design

VitalLink is built on a modular, real-time architecture designed for high-volume emergency settings.

- Wearable Wristband:** Continuously measures SpO₂, heart rate, temperature, and motion using compact biomedical sensors.
- Base Station Gateway:** Aggregates Bluetooth Low Energy streams from all wristbands and securely forwards data to the backend.
- Hospital Dashboard:** Displays live vitals, highlights abnormal trends, and automatically prioritizes patients using a severity-scoring algorithm.

This three-tier system provides continuous triage visibility, low latency, and seamless integration into existing hospital workflows.



Figures 3-6: Base station design, wristband design, and custom PCB used in wristband

(4) Hardware Architecture

The *VitalLink* wristband integrates medical-grade sensing, efficient power electronics, and a compact enclosure to deliver continuous monitoring in emergency environments.

Precision Sensors:

- MAX30102 optical module for accurate heart rate and SpO₂ measurements
- MAX30208 high-resolution digital temperature sensor
- LSM6DSO 6-axis IMU providing motion tracking and fall detection

Electronics & Processing:

- TI CC2652R7 Bluetooth 5.2 SoC with an FDA-cleared medical BLE profile
- Custom PCB engineered for low electrical noise and stable signal acquisition
- Optimized sampling pipeline for consistent performance during continuous operation

Power & Durability:

- Over 72 hours of battery life on a single charge thanks to ultra-low-power design
- Integrated power management and thermal stability safeguards
- Lightweight, impact-resistant enclosure designed for comfort, sanitation, and daily ER use.

(5) Backend & Triage Interface

VitalLink backend processes continuous vitals streams from every wristband and converts them into actionable triage insights.

Real-Time Data Processing: Incoming SpO₂, HR, temperature, and motion readings are timestamped and analyzed as they arrive.

Noise Reduction: Filtering algorithms smooth motion artifacts and sensor fluctuations to ensure clinically meaningful data.

Anomaly Detection: The system flags oxygen drops, tachycardia, fever events, and sudden motion changes that may indicate deterioration.

Severity Scoring: A color-coded risk model (green/yellow/orange/red) updates dynamically as vitals change.

Auto-Sorted Queue: Patients are automatically ordered by risk level so clinicians can identify the most urgent cases at a glance.

Live Visualization: The dashboard displays real-time graphs for each vital sign, along with trend indicators and alert badges.