Infection Detective Bandage: Smart Bandage Prototype

Crawford, Zynila (School: Sandy Creek High School)
LaGrande, Russell (School: Sandy Creek High School)

Wound infections remain a major challenge in healthcare, often slowing healing, raising treatment costs, and sometimes becoming life-threatening. Most infections are detected only after visible symptoms appear, such as redness or swelling. The purpose of this project was to design and test a low-cost, reusable smart bandage that can detect infection risk early through real-time monitoring of pH, temperature, and moisture. The bandage integrates three sensors connected to an Arduino Nano microcontroller, which continuously records and analyzes data. When abnormal readings are detected, a red LED and buzzer activate to warn of possible infection. The device was tested using a gelatin-agar wound phantom maintained at body temperature (37 °C). Each sensor was evaluated under different simulated conditions (normal, moisture-only, heat-only, pH-only, and combined infection risk). Data were collected for five minutes per condition and analyzed using calibration equations and statistical comparisons to evaluate accuracy and false-positive rates. Results showed that the prototype accurately detected increases in temperature and moisture, producing alerts during simulated infection conditions while avoiding false alarms during stable phases. The average readings were consistent (pH ˜ 5.9, temperature ˜ 34.7 °C, moisture ˜ 281 a.u.), confirming strong calibration and sensitivity. This research demonstrates that a multi-sensor approach can improve the reliability of early infection detection by reducing false positives by over 30 percent. The design provides an affordable, practical model for future smart wound-care systems, particularly in rural or low-resource healthcare settings.

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