Patient Identification at Scale: Assessing the Feasibility of Paper Wristbands at Leeds Teaching Hospitals NHS Trust

Dishita Agarwal, Duke University, Class of 2028
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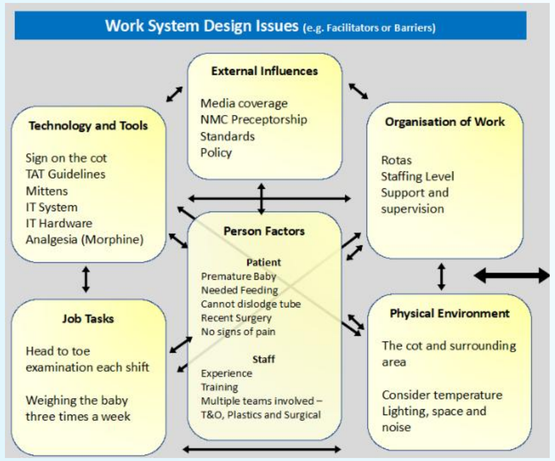
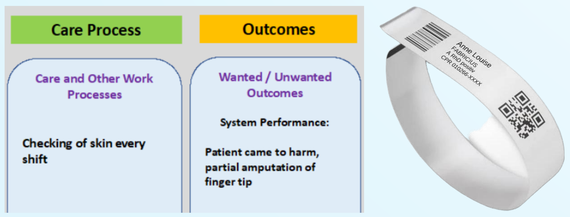
Abstract

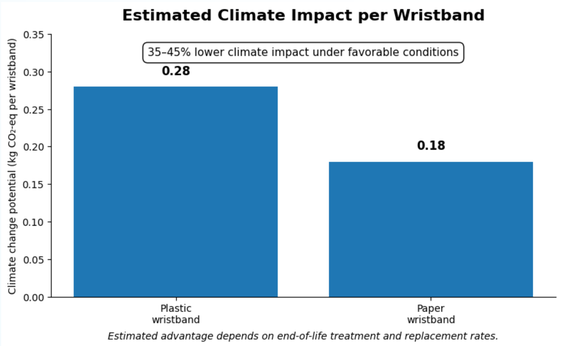
Patient misidentification is a persistent, systemic failure in healthcare that drives preventable medical errors globally. In the United States alone, 14% of medical records contain errors tied to incorrect patient information, leading to prolonged hospital stays, medication and transfusion incidents, wrong-person procedures, and even the discharge of infants to the wrong families. For over two decades, durable plastic wristbands integrated with barcode medication administration (BCMA) have been the standard of care to verify identity. However, this reliability comes with a massive environmental cost: Leeds Teaching Hospitals NHS Trust (LTHT) uses approximately one million plastic wristbands annually, most of which are worn for just 24 to 72 hours before persisting in the biosphere for decades. Following a promising informal pilot in one of the Leed Teaching Hospital's medical departments, Zebra Technologies and the Health Mechatronics Lab sought to determine if a paper-based alternative could scale trust-wide. This six-week mixed-methods feasibility assessment revealed that while paper wristbands offer a 35–45% reduction in climate change potential for short-stay patients, their viability is entirely dependent on systems-level factors. Expanding beyond one department into high-stress environments requires robust recycling infrastructure, an overhaul of BCMA scanning culture, and targeted workflow redesigns.





Methodology

Lifecycle Assessment
A lifecycle assessment (LCA) using Brightway2 compared the environmental footprint of plastic and paper wristbands from raw material extraction through end-of-life. The functional unit was defined as one patient wristband worn for a single hospital stay, assuming an average duration of two days. The system boundary included raw material sourcing, manufacturing and converting processes, transportation, use, and end-of-life treatment.
The analysis compared current practice, in which wristbands are primarily treated as clinical waste, with an alternative recycling scenario. Climate change potential, measured in kg CO_2-equivalents, was the primary environmental impact category. Sensitivity analyses examined the effects of transport distance, electricity grid carbon intensity, and end-of-life treatment.



Human Factors and Workflow Analysis
Human factors were assessed using the SEIPS 2.0 framework, examining interactions between task, organization, technology, physical environment, and person. Semi-structured interviews were conducted with 12 LTHT stakeholders, including nurses, physicians, ward managers, procurement specialists, and sustainability and infection control staff.
Clinical workflow observations were conducted across general medicine, the emergency department, and the NICU. Observations focused on wristband use, barcode scanning practices, workflow interruptions, failure events, staff workarounds, and integration with downstream medication administration systems.

Patient Experience
A 27-item questionnaire was administered to 58 patients across multiple wards. The questionnaire examined physical comfort, understanding of wristband purpose, perceived safety, and privacy concerns through quantitative and open-ended responses.

Results

Environmental Advantage is Real but Conditional
LCA modeling indicated that a paper wristband could have approximately **35–45% lower climate change potential** than a plastic equivalent under favorable conditions. This reduction was primarily associated with lower material mass and manufacturing energy requirements. However, the environmental advantage depended on several conditions. When paper wristbands were treated as clinical waste and incinerated, the estimated benefit decreased substantially. Similarly, increased replacement rates reduced the benefit of switching materials. The analysis also identified printer cartridges as a major contributor to overall environmental impact, accounting for approximately **45–50% of total climate impact per wristband**.

Performance is Highly Context-Dependent
Paper wristbands performed reliably in general medicine, where barcode scans succeeded on the first attempt in more than **95% of observed cases** and no premature failures were observed during routine workflows.
Performance was less reliable in the emergency department. Moisture exposure contributed to barcode degradation, while scanning failures introduced additional delays in time-critical workflows. Stakeholder interviews and workflow analysis also indicated that paper wristbands would be unsuitable for prolonged, high-reliability applications such as neonatal intensive care.These findings indicate that wristband performance cannot be evaluated independently of the clinical environment in which it is used.

BCMA Compliance is an Independent Safety Barrier
Barcode medication administration (BCMA) compliance was already suboptimal across wards, ranging from **15–40%**. Identified barriers included bulky equipment, slow electronic medication administration workflows, unreliable connectivity, spatial constraints, staffing pressures, and reduced staff confidence in scanning systems. This finding is important because additional wristband-related scanning failures could introduce further friction into a workflow that already experiences inconsistent compliance.

Patient Understanding Represents an Additional Opportunity
Only **52% of surveyed patients** could accurately explain the purpose of their wristband, while **41%** reported that its purpose had been explained to them by staff. Patients who understood the wristband's role reported higher perceived safety, suggesting that patient communication may represent an additional opportunity to improve engagement with the identification system.

Conclusion

Paper wristbands have the potential to reduce the environmental impact of patient identification for selected patient groups, but the findings do not support a universal replacement of plastic wristbands across all clinical settings.

Environmental benefits are dependent on effective end-of-life management, particularly recycling infrastructure, and on maintaining sufficient durability to avoid frequent replacement. At the same time, clinical feasibility varies substantially across settings. Paper wristbands were most compatible with routine, short-stay environments and less suitable where moisture exposure, prolonged wear, or time-critical identification created higher reliability requirements. The study also identified barcode medication administration compliance as a broader systems-level concern. Existing technology, workflow, and organizational barriers may have a greater effect on patient safety than wristband material alone. A material transition that increases scanning friction without addressing these underlying barriers could therefore introduce additional risks.

Future implementation should follow a staged approach. Paper wristbands should initially be evaluated through a structured multi-ward pilot in clinically appropriate settings, with continued monitoring of barcode reliability, wristband failure rates, workflow disruption, patient safety outcomes, staff acceptability, and recycling performance.

Clinical Setting	Expected Stay	Environmental Stress	Deployment Recommendation
General Medicine	3–14 days	Low	Highly Viable (>95% scan success)
Emergency Dept. (ED)	Rapid Throughput	High (Moisture, Speed)	Not Recommended (8–12% scan failure rate)
Neonatal ICU (NICU)	7–60 days	High (Moisture, Strict Protocols)	Contraindicated (Requires 7-day minimum endurance)

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