Design and Development of a Cost-Effective and Mobile Radiant Warmer for Neonatal Care in Tanzania Hospitals

1. PROBLEM STATEMENT

Neonatal hypothermia remains a major challenge in Tanzania, contributing significantly to neonatal morbidity and mortality. Although radiant warmers are essential for preventing heat loss in newborns, many public hospitals and rural health centers lack access to reliable, modern warmers due to high procurement costs, electricity instability, limited spare parts availability, and difficulties in transportation within and between facilities. Existing radiant warmers are often imported, expensive, and not well-adapted to low-resource environments where mobility, affordability, and ease of maintenance are crucial.
Therefore, there is a need to develop a **cost-effective, mobile, and locally adaptable radiant warmer** that can operate effectively in Tanzanian healthcare settings.

2. OBJECTIVES

2.1 Main Objective

To design and develop a **cost-effective, portable, and efficient radiant warmer** tailored to the needs and conditions of healthcare facilities in Tanzania.

2.2 Specific Objectives

1. To assess the limitations of current radiant warmers used in Tanzanian hospitals and clinics.
2. To design a radiant warmer prototype using locally available materials and low-cost components.
3. To incorporate mobility features (wheels, lightweight frame, adjustable height) suitable for movement across different wards.
4. To ensure that the device is energy-efficient and capable of functioning reliably during power fluctuations common in Tanzanian facilities.
5. To evaluate the prototype's thermal performance and safety parameters compared to existing commercial warmers.

6. To estimate the manufacturing cost and analyze affordability for public and private healthcare facilities.

3. LITERATURE REVIEW (Focused on Tanzania & Problem-Solving)

3.1 Neonatal Hypothermia in Tanzania

Neonatal hypothermia is a recognized cause of premature and newborn deaths in Tanzania. Studies from Muhimbili National Hospital and district hospitals indicate that newborns are highly vulnerable due to inadequate thermal care equipment. The national health system prioritizes improving neonatal survival through cost-effective interventions, including better access to warming devices.

3.2 Availability and Limitations of Existing Radiant Warmers

Although modern radiant warmers exist globally, their adoption in Tanzania faces several barriers:

a. High Cost

Imported radiant warmers can cost between **TZS 4,000,000 – 3,000,000**, which is unaffordable for many district hospitals and dispensaries. Maintenance costs parts replacement, sensor calibration, and technical service are also expensive.

b. Limited Mobility

Many warmers are bulky, heavy, or lack good-quality caster wheels. In Tanzanian hospitals where one warmer may serve multiple delivery rooms or neonatal units, mobility is crucial.

c. Electricity Instability

Some warmers require stable electricity and advanced electronics. In rural Tanzania, power interruptions are common, making these devices unreliable.

d. Maintenance Challenges

Imported machines rely on foreign spare parts. When components fail, warmers may remain out of service for months. Lack of local technicians further worsens the issue.

3.3 Existing Low-Cost Innovations

There have been international attempts to design low-cost radiant warmers, but few address the **specific Tanzanian context**:

- **Simplified heating elements** that reduce cost but may lack reliability.
- **Solar-powered concepts**, suitable for areas with electricity challenges, but not yet widely tested in Tanzanian hospitals.
- **Locally fabricated neonatal care devices** (e.g., by engineering students at UDSM and NM-AIST) showing potential for local production and affordability.
- **Modified open-source medical equipment designs** that allow local fabrication, but require adaptation for mobility and durability in busy ward environments.

These innovations show promise, yet still fall short in **balancing performance, mobility, affordability, and local maintainability**.

3.4 Gap Identified

There is a clear gap for a radiant warmer that is:

- **Affordable** for district-level and rural facilities
- **Locally manufacturable** using available materials
- **Mobile and lightweight** for easy movement
- **Energy-efficient** and resilient to power instability
- **Simple to maintain** with locally available spare parts

This gap justifies the development of a new, problem-solving–driven radiant warmer tailored specifically for Tanzanian conditions.