

**The Design, Analysis, Build and Test of a Vaccine Management and Preservation System
(VacMAPS) to Reduce Vaccine Waste in Healthcare Facilities**

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ABSTRACT

Vaccine expiration due to poor inventory management has cost health clinics in the United States over \$100 million dollars in 2015 alone. While costly hi-end inventory systems exist, these are typically only affordable for major hospitals, leaving local clinics without an accessible solution. These needs motivate a low-cost alternative capable of mechanizing and computerizing storage, inventory, and retrieval of refrigerated vaccines. The solution proposed herein is the vaccine management and preservation system (VacMAPS). VacMAPS is a modular add-in capable of integration within existing refrigeration systems. The functional design of VacMAPS was created and refined with input from medical professionals working in hospitals, clinics, and pharmacies. VacMAPS consists of a support frame, dispensing and storing mechanism, a motor, electronics for monitoring and controlling supply, and an inventory tracking software. VacMAPS accurately tracks, monitors and stores 175-300 single vaccine doses. VacMAPS was fabricated and tested for appropriate robustness, function within expected refrigeration conditions, motor performance, electronics and software operation, and functional storage and retrieval capabilities. Assessments demonstrated that VacMAPS can meet the functional and operational requirements identified through the survey of medical professionals nationwide, publishing engineering standards, and Center for Disease Control vaccine handling requirements. The results showed that VacMAPS is a feasible alternative to existing, and far more expensive, commercial vaccine tracking systems and provides an effective solution to vaccine and monetary waste issues in low-cost healthcare clinics. This study concluded that VacMAPS can be an effective, frugal solution for the monitoring and management of refrigerated vaccines in the United States and third-world markets.

KEY WORDS: Mechanical Engineering, Medical, Vaccines, Refrigeration, Inventory, Storage