



Retraction Notice

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Comment:

The Editorial Board would like to extend its sincere apologies for any inconvenience this retraction may have caused.



Cold Chain Equipment Management and Partners' Challenges in Kiribati

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Abstract

The management of cold chain equipment (CCE) in Kiribati presents unique and persistent challenges that significantly affect vaccine storage, distribution, and potency. As an archipelagic nation spread over 33 atolls and reef islands, Kiribati's health infrastructure and logistics systems are strained by geographic isolation, unreliable power supply, and limited human resource capacity. This paper explores the multifaceted challenges of CCE management in Kiribati, with emphasis on technical, operational, and coordination barriers. It also examines the role of key development partners UNICEF, the World Health Organization (WHO), Gavi, the Vaccine Alliance, and the Governments of Japan and Australia in strengthening cold chain systems. The findings reveal that while partner interventions have been instrumental in expanding equipment coverage and technical support, systemic issues related to sustainability, capacity, and coordination persist. The study calls for sustainable investment in equipment lifecycle management, improved governance and coordination mechanisms, and context-specific technology adoption to ensure the continuity and quality of immunization services in remote island settings [1]-[3].

Subject Areas

Public Health

Keywords

Cold Chain Equipment, Health System, Climate Vulnerability, Vaccine Storage

1. Introduction

The cold chain system is critical to maintaining the potency and safety of vaccines

from manufacture to administration. In small island developing states (SIDS) such as Kiribati, the cold chain plays a vital role in achieving immunization coverage targets and preventing vaccine-preventable diseases [1]. However, management of cold chain equipment (CCE) in Kiribati is hindered by logistical, infrastructural, and human resource constraints. Despite significant support from global health partners, including UNICEF, WHO, and bilateral donors, persistent technical and operational issues continue to undermine the efficiency of vaccine storage and distribution systems [2] [3].

Kiribati's dispersed geography, coupled with limited infrastructure and human resource capacity, places extraordinary strain on its vaccine delivery systems. Despite commendable support from international partners including UNICEF, WHO, and bilateral donors, the country continues to face recurring challenges in maintaining the integrity of its cold chain. Equipment failures, power instability, limited spare parts, and fragmented coordination among stakeholders often result in vaccine wastage, stockouts, or service disruptions.

2. Equipment Management Challenges

2.1. Outdated and Non-Functional Equipment

A significant portion of the CCE in Kiribati consists of outdated or weather-incompatible models prone to malfunction. Solar direct-drive refrigerators such as TCW 40 units have shown short lifespans of about three years [3]. Reliance on sub-standard vaccine carriers (e.g., Blow King models) that lose insulation efficiency over time threatens vaccine integrity during transport [4].

2.2. Maintenance, Repair, and Spare Parts Shortages

Local technical capacity for maintenance remains limited. There is a critical shortage of biomedical engineers and technicians capable of timely repairs [5]. The unavailability of spare parts results in prolonged downtime, disrupting vaccine distribution schedules. Repair work often depends on partner interventions, leading to delays that risk vaccine wastage [1].

2.3. Power Supply Instability

Frequent power outages and voltage fluctuations compromise temperature stability, especially in outer islands without grid electricity [1]. Although solar direct-drive (SDD) units and auxiliary generators supplied by Japan and Australia through UNICEF have mitigated some issues, long-term sustainability remains a challenge due to maintenance and replacement costs [2].

2.4. Inconsistent Temperature Monitoring

Temperature monitoring remains inconsistent and often paper-based. Some health facilities do not regularly share temperature logs with national supervisors, leading to undetected temperature excursions and possible vaccine wastage. The absence of real-time digital monitoring limits system visibility [6].

2.5. Storage Capacity Constraints

Kiribati faces storage capacity challenges due to mismatched equipment allocation. Small refrigerators serve large populations while oversized units are deployed in low-demand areas, reflecting inadequate forecasting [1].

3. Partners and Coordination Challenges

3.1. Geographic Dispersion and Last-Mile Delivery

Kiribati's wide geographic spread complicates vaccine delivery. Reaching outer islands often requires irregular sea or air transport, risking cold chain breaches [4].

3.2. Fragmented Logistics and Supply Chain Visibility

Multiple actors—including MHMS, UNICEF, WHO, and bilateral donors—operate without centralized coordination, causing duplication and inefficiencies [5]. Some facilities have multiple refrigerators while others remain unequipped due to fragmented planning [2].

3.3. Human Resource Gaps

A chronic shortage of trained personnel and biomedical engineers undermines CCE maintenance. Limited training opportunities and high turnover further compromise adherence to protocols [6].

3.4. Duplication and Equipment Mismatch

Uncoordinated donor procurement has led to equipment duplication and allocation mismatches [3]. This inefficiency highlights the need for a unified cold chain master plan guided by population data [1].

3.5. Coordination and Communication Barriers

While UNICEF and WHO provide procurement and training support, absence of a functioning National Logistics Working Group (NLWG) results in isolated interventions [5].

3.6. Sustainability and Lifecycle Management

Sustainability remains a pressing issue. Without recurrent national funding for maintenance, spare parts, and energy costs, the long-term viability of donated equipment remains uncertain [7].

4. Discussions

The challenges identified in Kiribati's CCE management mirror those seen in other small island developing states. Despite partner support, sustainability is undermined by limited capacity and weak governance structures [2]. Establishing an NLWG could harmonize procurement, improve accountability, and strengthen

data-driven decision-making [4] [7].

Adopting digital temperature monitoring systems and preventive maintenance plans would enhance system reliability. Long-term success will depend on local capacity-building, integrating maintenance costs into national budgets, and ensuring shared accountability among partners and government stakeholders.

5. Recommendations

- 1) Establish a National Logistics Working Group (NLWG) for partner coordination.
- 2) Develop a comprehensive CCE inventory for rational allocation.
- 3) Institutionalize preventive maintenance with local technicians.
- 4) Expand renewable energy solutions through hybrid solar systems.
- 5) Implement digital temperature monitoring linked to national dashboards.
- 6) Integrate cold chain sustainability into the national health budget.
- 7) Enhance partner coordination through shared operational frameworks [1]-[7].

6. Conclusion

Cold chain equipment (CCE) management in Kiribati faces complex challenges shaped by geography, limited infrastructure, and fragmented coordination. Although progress has been achieved through partner assistance, sustainability remains critical. A coordinated, data-driven, and context-specific strategy will ensure vaccine potency and equitable immunization coverage [1]-[7].

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Conflicts of Interest

The authors declare no conflicts of interest.

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