

Integrating Domestic Production and International Supply Chains: A Holistic Review of Kenya's Safety and Security Framework for Medical Radioisotope Transport.

Abstract.

The safe, secure, and timely transport of medical radioisotopes is fundamental to sustaining nuclear medicine diagnostic and theranostic services. In Kenya, demand for radiopharmaceuticals such as Fluorine-18 Fluorodeoxyglucose (18F-FDG), Fluorine-18 Prostate-Specific Membrane Antigen (18F-PSMA), Gallium-68 tracers (PSMA, FAPI04, DOTA), Technetium-99m (Tc-99m), and therapeutic Lutetium-177 (Lu-177) and Iodine-131/123 continues to rise.

Kenya operates three cyclotrons, with two commercial and one institutional, supporting domestic 18F production. Four hospitals rely on these cyclotrons, complemented by imported Ga-68 generators, Tc-99m and therapeutic isotopes.

The supply chain faces substantial security threats. Political volatility, youth demonstrations, and organized terrorist groups such as Al-Shabaab present major risks. Porous borders with Somalia, Ethiopia, and Sudan further enable movement of armed groups that could infiltrate Nairobi Kenya's main hub for isotope medication and transport. These realities underscore the urgency of a holistic safety and security framework.

1.0 Background

Medical radioisotope transport in Kenya sits at the intersection of expanding domestic production and continued international dependence. Local cyclotron production reduces import-related delays but intensifies internal transport risks, especially within Nairobi's volatile environment. Imports remain indispensable for Ga-68, Tc-99m, Lu-177, and I-131, yet are vulnerable to clearance delays, airport bottlenecks, and evolving terrorist threats.

2.0 Methods

This study applies a qualitative policy review methodology, analysing IAEA Safety Standards Series (SSG-26, TS-R-1) and Nuclear Security Series No. 9-G (Rev. 1) and No. 46-T, IATA Dangerous Goods Regulations and ICAO standards, the Kenya Nuclear Regulatory Authority (KNRA) Act, regulations, and guides, and National policy documents on nuclear security and emergency preparedness.

The analysis emphasizes regulatory oversight, physical protection, interagency coordination, emergency preparedness, and safety-security integration against the common practise. Comparative insights from international, and regional practices provide context for Kenya's evolving framework.

3.0 Results and Discussion

3.1 Regulatory Oversight and Security Imperatives

KNRA issues a single, integrated license for radioactive material transport embedding safety, security, and emergency response. Pre-transport risk assessments, approved routes avoiding high-risk zones, real-time GPS tracking, and armed escort requirements for high-activity sources are aligned with the national threat profile.

3.2 Strengths and Vulnerabilities in a High-Threat Environment

Domestic Production: Cyclotrons reduce international freight risks but concentrate supply in Nairobi a city prone to demonstrations, gridlock, and terrorist targeting. Transport disruptions can immobilize shipments, delay procedures, and heighten exposure risks.

Clearance Delays and Airport Vulnerabilities: Imports are frequently hindered by customs clearance and airport handling delays. These choke points increase decay risks for short half-life isotopes and expose consignments to security threats. Enhanced screening, personnel vetting, and interagency coordination remain critical.

3.3 Persistent Challenges

Interagency Coordination: Seamless collaboration among KNRA, National Police Service, Anti-Terrorism Police Unit (ATPU), intelligence agencies, and emergency responders remains limited.

Human Capacity: Specialized training is insufficient. Personnel including drivers and regulators require instruction beyond radiation safety, with emphasis on terrorism awareness and response under duress.

Adaptive Threat Assessment: Current plans risk obsolescence. Evolving threats demand continuous, intelligence-led reassessment of protocols rather than static security measures.

4.0 Conclusion and Recommendations

Kenya's medical radioisotope supply chain operates within a fragile security environment. While the KNRA framework provides a solid foundation, its resilience depends on adaptive, intelligence-driven measures. Recommendations includes; Establishment of stronger links with security agencies to enable threat-informed routing and scheduling, avoiding hotspots and volatile periods. Deployment of centralized, real-time tracking systems with duress alarms for transport vehicles. Institutionalize advanced training and realistic drills simulating hijackings, demonstrations, and ambushes to prepare stakeholders for high-stress conditions. By addressing these areas, Kenya can safeguard uninterrupted access to critical nuclear medicine services while strengthening its national nuclear security regime.

Country or International Organization

Instructions

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Track Classification: Track 3 Safety and Security during Transport Operations