Title: Transport Challenges of Radiopharmaceuticals and Other Radioactive Materials in Developing Countries: A Case Study of Kenya

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Background:
The safe and secure transport of radioactive materials is an essential element of a country's nuclear infrastructure. In Kenya, radiopharmaceuticals such as Fluorine-18 (^{18}F), Technetium-99m (^{99m}Tc), Iodine-131 (^{131}I), Lutetium-177 (^{177}Lu), and Gallium-68 (^{68}Ga) play a central role in nuclear medicine for diagnosis and therapy. Their short half-lives, specialized storage needs, and strict regulatory requirements present significant challenges in transport. In parallel, Kenya also handles other radioactive materials such as Cobalt-60 (^{60}Co), Iridium-192 (^{192}Ir), and Americium-241 (^{241}Am) used in medical, research and industrial applications. These present additional transport safety and security challenges due to higher activity levels, security risk categorization, and infrastructure demands.

Purpose:
This paper aims to identify and analyze key barriers affecting the transport of both radiopharmaceuticals and other radioactive materials in Kenya. It seeks to offer practical recommendations for building a sustainable, safe, and secure transport system in a developing country context.

Methodology:
The study adopts a qualitative, descriptive approach, including:
- A review of international guidance, IAEA Transport Regulations, published nuclear safety and security requirements and guidelines for radioactive materials and our national laws (Kenya Nuclear Regulatory Act (2019));
- Case analyses involving import and domestic distribution of ^{18}F, ^{131}I, ^{177}Lu, ^{99m}Tc, ^{60}Co, and ^{192}Ir;
- Key informant interviews with radiopharmacists, regulators, logistics companies, and radiation safety professionals;
- Examination of transport chains to public and private nuclear medicine facilities and industrial users.

Results:
Preliminary findings highlight several critical issues:
- Time-sensitive delays for short-lived radiopharmaceuticals due to customs clearance and inter-agency disconnect
- Inadequate cold chain systems and shortage of Type A/B containers
- Fragmented and lengthy licensing and authorization processes
- Security vulnerabilities, especially in the inter-city and cross-border movement of Category 1 and 2 sources
- Lack of real-time tracking systems and insufficient training of transport personnel and customs officers

Conclusion:
Addressing these challenges requires the alignment and strengthening of Kenya's legal and regulatory framework for radioactive material transport. Sustainable

solutions will involve investment in infrastructure, development of digital tracking systems, harmonized inter-agency coordination, and specialized capacity building. A robust, integrated system will not only enhance the safety and security of radioactive materials in transit, but also improve access to essential health services and support compliance with international obligations.