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# Optimizing the Medical Cyclotrons in Saudi Arabia: From Installation to Decommissioning

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I. Introduction

Medical cyclotrons (MCs) have undergone significant technological evolution since their inception. Initially large and fixed-energy systems, they have evolved into compact, high-efficiency devices tailored for hospital-based applications. In Saudi Arabia, the integration of MCs into the national healthcare infrastructure reflects this broader trend and underscores the need for sustained optimization. Optimization of the cyclotron lifecycle, from design and shielding to isotope production, maintenance, and decommissioning, is essential for safe, cost-effective, and regulation-compliant operations [3][4]. This review article aims to examine the complete lifecycle of MCs deployed in Saudi Arabia, highlighting key practices across installation, operation, optimization, and decommissioning.

II. The Life Cycle of Medical Cyclotrons in Saudi Arabia
MC facilities in Saudi Arabia follow a structured workflow comprising
II.A. Installation Phase
Involving infrastructure preparation, shielding design, regulatory approval, and commissioning. According to IAEA guidance, planning for installation must begin with clear definitions of the intended radionuclide outputs, anticipated workload, and regulatory constraints.
II.B. Maintenance and Quality Control Phase
MC facilities in Saudi Arabia must adhere to a robust maintenance and quality control (QC) regimen to ensure safety, reproducibility, and GMP compliance.
II.C. Decommissioning Phase
Decommissioning is increasingly recognized as a critical lifecycle phase requiring early planning. Exposure to secondary neutrons during years of operation leads to the activation of cyclotron vault concrete and internal metal components.

III. Clinical and Industrial Impact
Cyclotrons are vital for theranostics, enabling targeted radioligand therapy and imaging. The expansion of tracer applications in neurology and cardiology underscores the broader relevance of MCs beyond oncology.

IV. Conclusions
Medical cyclotrons are at the heart of nuclear medicine innovation in Saudi Arabia. From installation to decommissioning, their lifecycle requires multidisciplinary collaboration and regulatory alignment. Scaling up isotope production and tracer innovation is essential to support future-ready healthcare systems.

## Technical Track

Nuclear Applications and Radiation Processing

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