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The Graveyard of Donated Equipment: Shifting from Capital Expenditure to Value-Based Care in African Health Systems

Running Head: Shifting to Value-Based Care in African Health Systems

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1. Introduction: Challenging the Resource Scarcity Hypothesis

In global health discourse, the prevailing response to infrastructural deficits in low- and middle-income countries (LMICs) has often been shaped by what this essay calls the "resource scarcity hypothesis": the assumption that health systems fail primarily because they lack physical assets such as scanners, incubators, ventilators, monitors, and laboratory platforms, and that the logical remedy is the continuous injection of capital and equipment [1].

That assumption contains an important truth: many African health systems are undercapitalised and under-equipped. Yet it is incomplete. An inspection of many tertiary and secondary facilities reveals a second reality: equipment may be present but non-functional. Magnetic resonance

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imaging (MRI) machines, neonatal incubators, anaesthesia workstations, and mechanical ventilators may be immobilised by power instability, missing consumables, obsolete software, unavailable spare parts, or the absence of qualified biomedical engineering support [2-4]. The clinical problem is therefore not only the absence of hardware; it is the absence of the financing, maintenance, technical, and regulatory ecosystem required to keep hardware useful.

The current infrastructural deficit in African healthcare is thus better understood as a failure of financing architecture and technology management, not merely a failure of acquisition. For decades, the procurement of complex medical hardware in Nigeria and comparable settings has relied on two fragile routes: donated equipment from high-income settings and high-interest, debt-financed capital expenditure (CAPEX) by private providers. Both routes can expand access when well governed, but both fail when they ignore local infrastructure, maintenance capacity, foreign-exchange exposure, and tariff realities.

This paper argues that health systems should move from a narrow ownership model toward an access-and-uptime model. In practical terms, this means shifting selected categories of complex medical technology from CAPEX to operational expenditure (OPEX) through Equipment-as-a-Service (EaaS), while linking deployment to value-based care (VBC), pooled insurance purchasing, and measurable clinical uptime.

2. The Ecological Mismatch of the Donation Trap

Medical equipment is not an isolated object. It is a system-dependent clinical tool. A CT scanner, MRI suite, incubator, or anaesthesia machine assumes a functional "habitat": stable electricity, temperature and humidity control, trained operators, scheduled calibration, consumables, spare parts, biomedical engineering support, and a service chain that can respond quickly when faults occur [1,2].

When complex equipment is transferred into a low-resource environment without that habitat, failure is predictable rather than accidental. Voltage fluctuations, abrupt transitions between grid power and diesel generators, dust, heat, humidity, weak procurement planning, and thin biomedical engineering capacity may convert a clinically valuable device into an unusable asset. The result is a paradoxical form of scarcity: patients lack access to services even when the underlying machine exists in the hospital.

The evidence base should be stated carefully. Perry and Malkin reviewed 112,040 equipment items across developing-country inventories and found that an average of 38.3% of medical equipment was out of service [2]. They also noted earlier WHO-cited claims that as much as 70% of medical equipment in sub-Saharan Africa may be out of service and that only 10%-30% of donated equipment may become operational [2,3]. A later review of medical equipment donation in low-resource settings similarly emphasised poor needs assessment, weak maintenance planning, inadequate training, and lack of spare parts as recurring reasons donations fail to translate into durable clinical capacity [4].

The defensible conclusion is not that all donated equipment fails, nor that one universal percentage applies to every country, device class, or donation program. The safer conclusion is that imported and donated equipment frequently becomes unusable when procurement is not matched to local infrastructure, training, maintenance, health technology management, and spare-parts capacity. Donations without endowed service agreements, biomedical engineering

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plans, and local repair pathways can unintentionally turn hospitals into storage sites for unusable technology.

3. OEM Restrictions and Technological Sovereignty

Even when local biomedical engineers are present, repair can be constrained by original equipment manufacturer (OEM) restrictions. Modern diagnostic and therapeutic equipment often depends on proprietary software, licensed diagnostic tools, calibration keys, and locked service menus. A relatively minor fault may require an authorised service tool or software reset, which may be unavailable to the hospital or local engineer [5].

This becomes a sovereignty problem as much as a maintenance problem. If service contracts are priced in foreign currency, and if repair authorisation depends on an overseas or officially licensed technician, local facilities remain exposed to exchange-rate shocks, travel delays, and vendor lock-in. In that setting, an otherwise repairable asset can become clinically useless simply because the hospital cannot access the software or parts required to return it to service.

The policy implication is that procurement should not end at purchase price. Ministries, insurers, donors, and hospital boards should evaluate life-cycle access: availability of parts, service documentation, training, calibration rights, cybersecurity responsibilities, and reasonable right-to-repair accommodations. For LMICs, the ability to maintain equipment locally is not a secondary convenience; it is a condition of clinical continuity.

4. The CAPEX Crisis and Macroeconomic Volatility

While donated equipment exposes the weakness of philanthropic procurement, private-sector acquisition exposes the weakness of unit economics. Complex medical equipment is priced largely in foreign currency, while Nigerian providers earn revenue in naira from patients, insurers, and employers. When a hospital borrows locally to import dollar-priced equipment, its balance sheet becomes exposed to inflation, interest-rate pressure, and exchange-rate depreciation.

The Nigerian naira has depreciated substantially since 2023. A dollar that cost approximately ₦460 in early 2023 may cost around ₦1,500 under a recent stress-case scenario. That shift represents roughly a 226% increase in the naira cost of a dollar and roughly a 69% fall in naira-denominated dollar purchasing power. The implications for imported medical equipment are severe: the naira cost of purchasing a scanner, replacing a part, or renewing a service contract can rise much faster than insurance tariffs or household income.

Table 1 is therefore presented as an illustrative scenario analysis, not as a report of private hospital accounts. It combines public macroeconomic indicators, public NHIA tariff examples, and explicit author assumptions to show how foreign-exchange exposure and borrowing conditions can destabilise CAPEX-heavy medical infrastructure.

Table 1: Illustrative Scenario Analysis of CAPEX Medical Asset Depreciation

Economic Variable	Q1 2023 Historical Base	Stress-Case Scenario Assumption	Systemic Impact on Provider
Exchange rate (₦/US$)	Approx. ₦460 / US$1	Approx. ₦1,500 / US$1	226% increase in the naira cost of a dollar;

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Economic Variable	Q1 2023 Historical Base	Stress-Case Scenario Assumption	Systemic Impact on Provider
			approx. 69% fall in naira-denominated dollar purchasing power.
Capital cost of CT scanner (US$300,000)	₦138,000,000	₦450,000,000	Barrier to entry becomes prohibitive for many mid-tier facilities.
Cost of replacement part (US$5,000)	₦2,300,000	₦7,500,000	Routine maintenance can become a major financial event.
Illustrative naira commercial borrowing environment	Prime/high-grade borrowing band: approx. 18%-22%	High-cost borrower/maximum-lending stress band: approx. 25%-35%+	Debt servicing may outpace diagnostic revenue, especially for imported dollar-priced equipment.
Illustrative NHIA-covered CT/MRI tariff examples	Adult CT: approx. ₦60,000	Adult MRI: approx. ₦70,000-₦75,000	Tariffs may lag the naira cost of imported equipment, parts, and service contracts.

Note: This table is an illustrative scenario analysis. Exchange-rate assumptions are based on public CBN exchange-rate reporting and observed naira depreciation trends [6]. Lending-rate assumptions distinguish between prime/high-grade borrowing conditions and higher-cost commercial borrowing stress scenarios using CBN macroeconomic indicators as context [7]. NHIA tariff examples are drawn from publicly available fee-for-service prices for adult CT and MRI [8]. Scanner and replacement-part costs are the author's assumptions used for scenario modelling only. The table does not contain unpublished hospital, patient, or private financial data.

5. The Paradigm Shift: Equipment-as-a-Service

The central policy question is therefore not simply how to buy more machines. It is about guaranteeing functioning services. An Equipment-as-a-Service (EaaS) model shifts selected high-cost devices from CAPEX-based ownership to OPEX-based service. Under this model, an infrastructure provider installs and maintains equipment in a facility, while revenue is generated through agreed service fees, scan volumes, uptime guarantees, or revenue-sharing arrangements.

This approach changes incentives. In the ownership model, maintenance is often treated as a cost centre after the purchase has already been celebrated. In the EaaS model, the provider's revenue depends on uptime, utilisation, and continuity of service. Maintenance, spare parts logistics, power conditioning, and remote monitoring become core business functions rather than afterthoughts.

Table 2 compares the conceptual structures of the traditional ownership model and the EaaS model. It does not claim that EaaS automatically produces lower prices or better outcomes in

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every setting. Rather, it identifies the mechanism by which risk can be reallocated from hospitals to specialised infrastructure providers that are better positioned to manage equipment life-cycle costs.

Table 2: Conceptual Comparison of Traditional Ownership and Equipment-as-a-Service in LMICs

Systemic Feature	Traditional Ownership (CAPEX)	Equipment-as-a-Service (OPEX)
Financial risk bearer	Healthcare provider or government purchaser	Specialised infrastructure provider, with risk shared through service contracts
Maintenance incentive	Often treated as a recurrent cost after purchase	Central to revenue generation because uptime determines income
Technological obsolescence	The hospital may remain locked into ageing equipment	Provider has an incentive to upgrade assets to remain competitive
Monitoring model	Reactive maintenance is common	Predictive monitoring can be designed into service contracts
Potential impact on access	High tariffs may be used to recover debt and the costs of imported parts	Potential for more predictable pricing when volume and uptime are contractually aligned

Note: This table is a conceptual author synthesis comparing theoretical financing frameworks. Claims regarding predictive monitoring, cost standardisation, and access reflect intended design features of the EaaS model, not universally demonstrated empirical outcomes. The table contains no unpublished patient, clinical trial, or private financial data.

6. Synchronising OPEX with the NHIA and Value-Based Care

The transition to EaaS should not occur in isolation. It requires a financing architecture that rewards availability, quality, and appropriate utilisation. The National Health Insurance Authority Act 2022 mandates health insurance coverage in Nigeria and provides a legal platform for broader pooling, purchasing, and protection of vulnerable groups [9]. This creates an opportunity to rethink how diagnostics and high-cost services are purchased.

Nigerian health financing currently uses a mixed reimbursement architecture, including capitation and fee-for-service payments. Fee-for-service remains useful for discrete procedures, but when it is layered on top of CAPEX-heavy provider balance sheets, tariffs become a proxy for debt recovery rather than a pure reflection of clinical value. This contributes to friction between health maintenance organisations and providers: payers seek tariff stability, while providers exposed to foreign-exchange and debt pressures seek tariff increases.

Value-based care reframes the payment question around outcomes, patient value, and the efficient use of resources [10]. In an EaaS-enabled diagnostic pathway, a payer could contract for reliable clinical availability rather than indirectly subsidising hospital-owned depreciating assets. Tripartite arrangements among insurers, hospitals, and infrastructure providers could guarantee

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minimum volumes, clinical uptime, quality standards, and transparent pricing. Such contracts would not remove the need for regulation, but they could align incentives more directly than isolated equipment purchases.

This model also matters for equity. Out-of-pocket payments and catastrophic health expenditure remain major barriers to healthcare access in Nigeria [11]. If pooled purchasing can reduce the capital burden on providers and stabilise diagnostic tariffs, it may help reduce the pressure to transfer equipment-related costs directly to patients. The goal is not simply to make machines cheaper; it is to make functioning clinical services financially predictable.

7. A Strategic Roadmap for Stakeholders

The graveyard of donated equipment is not inevitable. It is a design flaw in the global health strategy that is correctable. Reversing it requires coordinated action across policy, procurement, insurance, and hospital management.

First, policymakers and ministries of health should move beyond acquisition counts as the primary measure of progress. Donated equipment should be accepted only when accompanied by needs assessment, installation planning, maintenance financing, training, spare-parts pathways, and service-level agreements. Public-private partnerships for diagnostic centres should evaluate OPEX and EaaS options alongside traditional procurement.

Second, insurers and health maintenance organisations should use pooled purchasing power to create predictable demand for high-value services. Instead of negotiating tariffs only after hospitals have already absorbed equipment debt, payers can help structure volume-based diagnostic bundles that make service deployment bankable while protecting patients from unpredictable price escalation.

Third, hospital directors should resist the prestige logic of ownership. A hospital's core competency of a hospital is clinical care, not foreign-exchange procurement or logistics for proprietary equipment. Where ownership creates unsustainable risk, hospitals should consider access models that preserve service availability without overloading the balance sheet.

Fourth, donors and manufacturers should treat maintainability as part of ethical deployment. A donated device without training, consumables, repair documentation, and local service capacity is not a completed intervention. It is an unfinished obligation.

8. Conclusion

The scientific and economic narrative of African healthcare must mature beyond a simple scarcity frame. African health systems do need more resources, but resources only become capacity when embedded in the right ecosystem. The non-functional equipment sitting in hospitals is a reminder that technology without maintenance, power, financing, and repair rights is not infrastructure; it is stranded capital.

This opinion piece has argued for a shift from ownership to uptime, from CAPEX exposure to OPEX service models, and from equipment procurement to value-based clinical availability. Equipment-as-a-Service is not a universal cure, and it requires careful regulation, transparent contracting, and outcome measurement. Yet it offers a credible path for aligning hospitals, payers, infrastructure providers, and patients around a common goal: operational services rather than symbolic assets.

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To build resilient health systems, Nigeria and comparable LMICs must stop measuring progress by the number of machines acquired and start measuring it by the services that reliably reach patients.

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