

Medical Equipment Maintenance in Cameroon

Challenges, Current Practices, and Opportunities for Improvement

A documentary analysis of publicly available procurement records and WHO guidance



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Abstract

Background

Medical equipment supports diagnosis, monitoring, treatment and emergency care, but its clinical value depends on safe and reliable operation throughout its working life. Maintenance therefore requires more than repairing a device after failure: it includes preventive servicing, corrective repair, performance and safety checks, spare-parts access, user training and maintenance records (World Health Organization, 2011).

Objective

To examine what publicly accessible Cameroonian procurement records and WHO technical guidance reveal about the organisation of medical equipment maintenance, and to identify practical priorities for strengthening healthcare technology management.

Methods

This documentary analysis reviewed a focused set of publicly available procurement notices and related institutional records from Cameroon's Public Contracts Regulatory Agency (ARMP), together with WHO technical guidance. The documentary search was conducted for this manuscript on 19 October 2026. The analysis focused on the equipment categories covered, maintenance activities specified, contracting arrangements and limits of what procurement records can establish. It was not a completed systematic or scoping review of all scientific literature.

Findings

Official notices document procurement activity for biomedical and interventional imaging equipment at Douala General Hospital in 2024; laboratory, ventilation, monitoring and related equipment in regional hospitals in 2023; and multi-facility imaging-equipment maintenance through Ministry of Public Health framework-contract tenders in 2025. The 2025 specifications included preventive and corrective maintenance, safety and quality checks, spare parts, software updates, technical training and assistance to facility maintenance teams. These records show that maintenance is formally addressed in public contracting, but do not by themselves establish service completion, equipment uptime or clinical outcomes.

Conclusion

Cameroon's maintenance agenda should connect procurement to lifecycle budgeting, competent local support, verified asset registers, risk-based preventive maintenance, measurable service-level agreements and transparent reporting of performance. Facility-level operational data are needed to determine whether contracting arrangements translate into reliable equipment availability.

Focus:

Medical equipment;
Biomedical engineering;
Preventive maintenance;
Healthcare technology management;
Cameroon;
Public procurement.

1. Introduction

1.1 Background and rationale

A medical device is useful only when it is appropriate to the clinical need, safe to use, available when required and supported throughout its working life. An ultrasound scanner may support timely diagnosis, a patient monitor may help clinicians recognise deterioration, and an oxygen concentrator or ventilator may support respiratory care. Conversely, a device that is broken, inaccurate, missing accessories or awaiting a replacement part may be physically present in a hospital without providing dependable clinical service.

The World Health Organization describes equipment maintenance as a programme combining performance inspection, safety inspection, preventive maintenance and corrective maintenance. Inventory management and computerised maintenance-management systems are also important elements of a broader management approach (WHO, 2011, 2012). A lifecycle perspective includes needs assessment, procurement, acceptance, installation, user training, maintenance, performance monitoring and eventual decommissioning.

1.2 The Cameroon-specific problem

Cameroon's health system includes central and regional hospitals, district hospitals, integrated health centres and private facilities. These settings differ in equipment complexity, access to specialist technicians, procurement capacity, power reliability, transport links and proximity to authorised service providers. A maintenance arrangement suitable for a tertiary hospital may require adaptation before it can serve a remote facility.



Acquisition is not availability

Purchasing a device creates an asset; it does not automatically create a sustainable clinical service. Maintenance contracts, consumables, calibration, software support, spare parts, reliable power and staff competence must be planned and funded.

1.3 Problem statement

Publicly accessible evidence offers only a partial view of how medical equipment maintenance is organised, implemented and evaluated across Cameroon. Procurement notices identify intended activities and institutional priorities, but operational performance must be established through contract reports, maintenance logs, equipment uptime data and independent verification.

1.4 Aim

To analyse selected public documentary evidence on medical equipment maintenance in Cameroon and identify practical, measurable opportunities to strengthen healthcare technology management.

1. Scope and analytical framework

1.5 Review questions

What do selected public procurement records reveal about the scope and organisation of medical equipment maintenance in Cameroon? What additional evidence is needed to determine whether these arrangements improve equipment reliability, availability and safety?

Scope of this article

This article is a focused documentary analysis of selected ARMP procurement notices and WHO technical guidance. It does not claim to represent all Cameroonian health facilities, all procurement activity, or the full body of peer-reviewed research on biomedical equipment maintenance. Procurement examples are treated as evidence of advertised or specified services—not as proof that the services were completed or effective.

Five linked dimensions

	Governance and accountability Clear asset ownership, defined maintenance responsibilities, contract supervision and escalation pathways.
	Technical capacity Competent biomedical engineers and technicians, suitable test equipment, manufacturer documentation and specialist support.
	Financial and supply readiness Planned operating budgets, spare parts, consumables, service agreements and predictable procurement processes.
	Facility operating conditions Power quality, environmental conditions, safe storage, accessories and appropriate user handling.
	Information and performance A complete asset register, fault reporting, maintenance history, downtime tracking and management review.

These dimensions interact. Repeated device failure may reflect wear, unstable power, user practices, delayed spare parts or a mismatch between the device and its environment. Replacing equipment without investigating contributing causes can reproduce the same problem.

2. Methodology

2.1 Design

A focused documentary analysis was undertaken to examine publicly accessible procurement records and technical guidance relevant to medical equipment maintenance in Cameroon. The method is descriptive and interpretive: it identifies what selected documents specify and considers the implications for healthcare technology management. It is distinct from a completed scoping review, which would require comprehensive database searches, deduplication, screening, data charting and transparent reporting of record counts.

2.2 Sources and selection

The primary documentary source was the ARMP public procurement platform. Selected notices were included where their titles and descriptions directly concerned preventive or corrective maintenance of medical, biomedical, imaging, laboratory, ventilation or monitoring equipment in Cameroonian health facilities. WHO technical guidance was used to frame maintenance as a lifecycle management function rather than a repair-only activity.

2.3 Analysis

For each notice, the analysis recorded the publishing institution and date, the facility or geographic scope, equipment categories, maintenance activities specified, procurement or contracting mechanism, and any stated estimated budget or duration. The interpretation distinguished between an invitation to tender, a framework-contract tender and a published award decision. Where the document described planned services, the analysis did not infer that those services had been delivered.

2.4 Transparency and limitations

!	Evidence boundary The source set is deliberately described as a focused documentary sample. No national prevalence estimates, failure rates, uptime rates, repair-time averages or total number of included scientific studies are reported because these were not established by the documents reviewed.
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The search date for this manuscript was 19 October 2026. Future systematic work should preserve full search strings, dates, record counts, exclusion reasons and a source-extraction table, in line with recognised scoping-review guidance (Peters et al., 2020; Tricco et al., 2018).

3. Documentary findings

3.1 Maintenance is explicitly included in hospital procurement

On 6 May 2024, ARMP published a Douala General Hospital notice for preventive and corrective maintenance of biomedical and medical imaging/interventional equipment. The notice stated an estimated cost of FCFA 98,000,000, financed through the hospital’s 2024 operating budget, and a seven-month execution period from notification of the service order (ARMP, 2024).

	What this establishes The notice documents a planned, budgeted procurement for maintenance services, including biomedical and imaging/interventional equipment. The estimated amount is not necessarily the final contract value or the amount paid, and the notice does not itself demonstrate completion or value for money.
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3.2 Maintenance needs span several equipment categories

A Ministry of Public Health tender published in June 2023 covered laboratory equipment, ventilation and monitoring systems, medical furniture and other equipment at the regional hospitals of Bafoussam, Ebolowa and Garoua (ARMP, 2023). The breadth of the listed categories matters because laboratory analysers, patient monitors and ventilation systems have different maintenance, calibration, consumable and specialist-support requirements.

3.3 Maintenance requires workforce capacity

The Douala General Hospital tender included qualification criteria for experienced biomedical or related engineering personnel, illustrating that public contracting can specify technical staffing requirements. Such requirements can support quality assurance, but their practical value depends on the qualifications and availability of personnel assigned, access to tools and parts, and verification of work delivered (ARMP, 2024).

3. Documentary findings (continuation)

3.4 Framework arrangements broaden the geographic scope

In July 2025, the Ministry of Public Health published a tender for framework agreements covering preventive and corrective maintenance of medical imaging equipment and related equipment across regional hospital centres and hospitals. The notice described four lots and an estimated three-year programme cost of approximately FCFA 1.435 billion (ARMP, 2025a). These are estimates in a procurement notice, not proof of final expenditure or completed maintenance.

A further notice published in September 2025 specified maintenance of imaging equipment at the Hôpital de Référence de Sangmélina, Hôpital Jamot de Yaoundé and a range of regional hospitals. The required activities included scheduled preventive maintenance, corrective maintenance, safety and quality checks, spare-parts provision, software updates, technical staff training and assistance to facility maintenance services (ARMP, 2025b).

3.5 Procurement includes a potential oversight function

A December 2025 ARMP publication records an award decision concerning framework agreements for maintenance of medical imaging equipment in central and regional hospitals (ARMP, 2025c). Read alongside the tender notices, this demonstrates that the public record can contain multiple stages of a procurement process. It still does not substitute for contract execution reports, equipment-level service records or independent assessment of results.

3.6 What the records do not establish

- The proportion of medical equipment that is functional or non-functional nationally.
- National equipment downtime, mean time to repair or preventive-maintenance compliance.
- Whether each tendered service was completed to specification and on schedule.
- Whether maintenance activity reduced clinical delays, equipment failure or patient harm.
- The distribution of biomedical engineers and technicians across all facility levels.



Central finding

The available procurement records show institutional recognition of maintenance as a contracted service. They do not measure the effectiveness of maintenance delivery.

4. Discussion

4.1 From equipment purchase to sustained clinical service

The central implication is that equipment acquisition and maintenance should be planned together. Total cost of ownership includes installation, electricity, accessories, consumables, user training, calibration, software, maintenance, spare parts and eventual disposal. A lower purchase price may not represent good value if the device lacks dependable local support or relies on parts that are difficult to obtain.

Procurement documents should therefore require a lifecycle support plan: the proposed maintenance model, local response arrangements, parts availability, training commitments, warranty coverage, maintenance budget and post-warranty support. Equipment should not be treated as ready for clinical use merely because it has been delivered; acceptance testing, installation, documentation and user training must also be completed.

4.2 Workforce and service geography

Biomedical engineers and technicians need clear responsibilities and a practical escalation system. Clinical users should conduct authorised routine checks and report faults; technicians should perform tasks within their competence; biomedical engineers should coordinate risk-based planning, testing and technical decisions; and specialist providers should handle complex interventions when necessary.

Geography can affect service response. Travel, transport and access constraints may extend downtime when specialist support is far from a facility. Regional maintenance hubs, mobile teams, scheduled preventive visits, remote triage where appropriate and framework contracts may form part of a workable model, but the best combination should be assessed against actual response and restoration data.

4.3 Power and operating conditions

Power quality, grounding, surge exposure, temperature, humidity, dust and ventilation should be considered alongside maintenance logs. Where failures cluster after power interruptions or voltage fluctuations, repeated component replacement without investigating the operating environment may be wasteful. The documentary records reviewed here do not establish the national prevalence of power-related failures; this is an empirical question for facility-level research.

4. Discussion (continuation)

4.4 Spare parts, software and vendor support

Repairs can remain incomplete when parts are unavailable, unaffordable or subject to long supply lead times. Contracts should define which parts are included, which are chargeable, how obsolete components are handled and what happens when a device is no longer supported. Software updates and access to technical documentation are increasingly important for imaging and digitally enabled equipment.

4.5 User training and shared responsibility

Equipment reliability is not solely an engineering issue. Inadequate cleaning, incorrect accessories, poor handling, skipped start-up checks and failure to report early warning signs can contribute to damage or unsafe use. Device-specific induction and refresher training should cover permitted user checks, cleaning, warning indicators, fault reporting and tasks that must not be attempted by unqualified users.

4.6 Contract performance and accountability

A contract should be evaluated by measurable service outcomes, not merely by whether a provider visited a facility. Useful indicators include response time, time to restore service, completion of scheduled preventive maintenance, first-time fix rate, repeat failure, parts availability and completion of required safety checks. Facility sign-off and independent sampling can help verify that the work reported was performed.



From procurement to accountability

The next analytical step is to connect procurement records to award decisions, signed contracts, service reports, payment records, equipment uptime and post-repair verification. Publishing anonymised performance indicators would allow comparison between intended services and delivered results.

4.7 Patient safety and equity

An unavailable device may delay diagnosis, require referral or increase workload. An inaccurate device may be more dangerous than one that is visibly broken because it can continue to be used while producing unreliable results. Smaller or remote facilities may also face longer travel times and fewer specialist resources. Maintenance priorities should therefore consider equipment criticality, patient-safety risk and facility context. This article does not attribute specific patient harm to any named facility.

5. Recommendations



5.1 Policy and governance

- Establish clear national and facility-level responsibilities for equipment maintenance and contract supervision.
- Link procurement planning to lifecycle budgets, warranty arrangements and post-warranty support.
- Publish contract awards, equipment coverage, completion reports and anonymised performance summaries where legally permissible.



5.2 Asset management and preventive maintenance

- Maintain a verified asset register with unique asset ID, location, model, serial number, clinical criticality, warranty, provider, service history and current status.
- Use risk-based preventive-maintenance schedules informed by manufacturer guidance, use intensity, environment and failure history.
- Document acceptance testing, calibration where required, safety checks and decisions to retire equipment.



5.3 Workforce and service delivery

- Strengthen training and retention of biomedical engineers and technicians.
- Provide device-specific user training and clear fault-reporting pathways.
- Assess regional hubs, mobile maintenance teams and shared specialist services for facilities that cannot sustain every technical specialism locally.



5.4 Contracting and supply chains

- Define response and restoration targets, parts coverage, post-repair testing, repeat-failure handling and escalation procedures in service-level agreements.
- Track spare-parts lead time and clarify responsibility for software updates and obsolete components.
- Require evidence of work and facility sign-off before payment approval.



5.5 Facility environment and monitoring

- Investigate power and environmental conditions where fault patterns suggest a contributing factor.
- Track uptime, downtime, preventive-maintenance compliance, repair time, repeat failures, safety-test completion and maintenance expenditure.
- Use performance data to prioritise support and inform replacement decisions.

6. Proposed performance indicators

The indicators below are proposed for future facility-level studies and management reporting. They are not current national estimates.

Indicator	Operational definition	Use
Equipment availability / uptime	Time equipment is available for clinical use ÷ planned service time.	Shows whether the asset can support care when needed.
Preventive-maintenance compliance	Scheduled tasks completed within the defined window ÷ tasks due.	Measures planned prevention, not only emergency repairs.
Mean time to repair	Elapsed time from validated fault report to restored and verified service.	Captures the operational burden of failure.
First-time fix rate	Faults resolved without a repeat visit for the same fault within a defined period ÷ faults repaired.	Signals repair quality and parts readiness.
Repeat-failure rate	Repaired devices with a similar failure within a specified period ÷ repaired devices tracked.	Can reveal incomplete repairs or unresolved root causes.
Safety-test completion	Relevant repairs followed by required safety/performance checks ÷ relevant repairs.	Supports safe return to clinical use.
Asset-register completeness	Sampled assets with all required fields verified ÷ sampled assets.	Supports planning, budgeting and accountability.
Maintenance cost per asset	Maintenance expenditure per asset or asset category over a defined period.	Supports lifecycle budgeting and comparison.
Spare-parts lead time	Elapsed time between an approved parts request and parts availability at the facility.	Identifies supply-chain delays.

For comparability, facilities should define denominators, time windows, device categories and exclusions consistently. Results should be disaggregated where possible by facility level, region, equipment type and clinical criticality.

7. Limitations and conclusion

7.1 Limitations

This article analyses a focused set of publicly accessible procurement records and WHO technical guidance. It is not a completed search of all planned scholarly databases and institutional sources, and it does not report a PRISMA-ScR flow diagram or a comprehensive evidence map. Public procurement notices describe planned or tendered services; an award decision documents a procurement outcome, but neither alone proves service completion, service quality, equipment uptime or patient benefit.

The analysis cannot estimate national equipment-failure prevalence, maintenance performance, staffing levels or the distribution of functional devices. These questions require facility-level asset registers, maintenance logs, contract-performance reports, technical audits and, where feasible, interviews with relevant staff. The findings should be interpreted as documentary evidence of institutional activity and specified requirements, not as a nationally representative assessment.

7.2 Conclusion

Medical equipment maintenance should be treated as a core component of healthcare quality, safety and public investment management in Cameroon. Public records from 2023 to 2025 document procurement activity for biomedical, laboratory, ventilation, monitoring and imaging equipment, including framework-contract approaches and specifications covering preventive and corrective maintenance, parts, safety checks, software and technical support.

The practical priority is to connect procurement to measurable performance. Verified asset registers, risk-based preventive maintenance, competent local users and technicians, responsive specialist support, suitable operating conditions and transparent contract monitoring can provide a foundation for improvement. The effectiveness of these arrangements must be tested against actual maintenance delivery, equipment availability, repair time, repeat failures and safety verification.

Research priority

A subsequent full scoping review should complete reproducible English- and French-language searches and report actual screening counts. Facility-level research should then measure equipment uptime and contract performance across different regions and levels of care.



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