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Clinical Medical Physics Capacity in Zimbabwe: Workforce, Equipment Functionality, and Service Coverage

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ABSTRACT

Zimbabwe's clinical medical physics service capacity was assessed using facility questionnaires, national radiotherapy equipment-inventory data, and CQMP workforce-profile data as of June 2026. The analysis focused on three radiotherapy service sites: PGH, Mpilo, and Oncocare. Six CQMPs and six installed linacs were identified nationally; however, only two linacs were functional, and public-sector radiotherapy capacity was fragile because PGH remained the main active public RT provider while Mpilo EBRT and HDR brachytherapy were inactive. HDR brachytherapy and NM capacity were present nominally, but functional capacity was limited: public HDR service was mainly PGH, PGH nuclear medicine was closed due to staffing, and Mpilo nuclear medicine was non-functional. One functional CT simulator was reported at each assessed RT centre. Nominal capacity therefore overstated effective clinical capacity. Effective capacity was limited by non-functional equipment, training/supervision burden, weak retention, reliance on visiting international service engineers, inactive nuclear medicine services, limited implementation of advanced RT techniques, and weak public-sector/geographic redundancy.

DEFINITIONS

Nominal capacity: available / installed capacity.

Functional capacity: equipment or service reported usable.

Effective clinical capacity: practical service capacity after staffing, functionality, QA, maintenance, supervision, and redundancy constraints.

ABBREVIATIONS

3DCRT = 3D conformal radiotherapy
AAA = anisotropic analytical algorithm
AHPCZ = Allied Health Practitioners Council, Zim.
Brachy = brachytherapy
CQMP = Clinical Qualified Medical Physicist
CT = computed tomography
DR = diagnostic radiology
EBRT = external-beam radiotherapy
HDR = high-dose-rate
MoHCC = Ministry of Health and Child Care
MRI = magnetic resonance imaging
NM = nuclear medicine
PET = positron emission tomography
PGH = Parirenyatwa Group of Hospitals
QA = quality assurance
RT = radiotherapy
SPECT = single-photon emission CT
TPS = treatment-planning system

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Effective clinical capacity in Zimbabwe's radiation-medicine services is constrained by equipment downtime, limited CQMP staffing, retention challenges, delayed repairs, limited redundancy, and limited implementation of advanced RT techniques. Recent public-sector procurement of 4 linacs and 2 CT simulators is a significant step toward restoring radiotherapy service capacity.

INTRODUCTION

Clinical medical physics capacity is not determined by staff or equipment counts alone. Radiation-medicine services require trained personnel, functional and commissioned equipment, QA/dosimetry tools, maintenance support, radiation-protection systems, and integrated clinical workflows. In Zimbabwe, personnel and infrastructure exist across public and private service sites, but effective capacity is constrained by equipment functionality, staffing, maintenance, and service redundancy. This assessment evaluated Zimbabwe's deployed clinical medical physics workforce, infrastructure functionality, and service coverage, with emphasis on the gap between nominal capacity and effective service delivery.

METHODS AND MATERIALS

This descriptive service-capacity assessment examined PGH, Mpilo, and Oncocare using facility questionnaires, national equipment-inventory data, and CQMP workforce-profile data. Equipment functionality was assessed as of June 2026. Domains included workforce, CQMP production & retention, equipment, maintenance, and service redundancy. Equipment domains covered EBRT, brachytherapy, CT simulation, TPS, diagnostic imaging, and NM. Indicators included CQMP density, linac availability, CQMPs per linac, and installed-versus-functional capacity.

DISCUSSION

Nominal capacity should not be equated with clinical readiness. Zimbabwe's main challenge is ensuring that installed radiotherapy and imaging equipment can be used consistently and sustainably in routine clinical care. Diagnostic-imaging downtime further weakens cancer care by limiting staging, treatment planning, response assessment, and follow-up. Workforce findings suggest a fragile service model. Low CQMP density, reliance on few personnel, supervision duties, and post-registration attrition limit commissioning, QA sustainability, and implementation of advanced techniques. This may explain why IMRT/VMAT and in vivo dosimetry are not routinely translated into practice despite equipment availability at some sites. Dependence on PGH as the main active public EBRT/HDR provider limits resilience, especially while Mpilo remains inactive and private-sector capacity may not ensure equitable public access. Recent linac and CT-simulator procurement is a significant step; however, long-term impact will depend on CQMP retention, creation of formal internship posts, guaranteed engineer/spare-parts response, and structured vendor training.

CONCLUSIONS

Effective clinical capacity in Zimbabwe's radiation-medicine services is constrained by equipment downtime, limited CQMP staffing, retention challenges, delayed repairs, limited redundancy, and limited implementation of advanced RT techniques. Recent public-sector procurement of 4 linacs and 2 CT simulators is a significant step; however, long-term impact will depend on CQMP retention, formalized internship capacity, reliable service support, and structured vendor training before routine clinical use.

RESULTS

- **CQMP workforce:** Zimbabwe has 6 AHPCZ-registered full-time CQMPs across PGH, Mpilo, and Oncocare.
- **Training output:** ~1 site-trained CQMP per site/year; Mpilo often reports no output during prolonged RT downtime since 2021. Supervised clinical training is site-based, with no dedicated MoHCC-funded medical-physics intern posts.
- **Retention:** PGH and Mpilo both report poor post-registration retention after physicists obtain practicing certificates.
- **EBRT functionality:** Only 2 of 6 linacs are functional (Fig. 1); Mpilo EBRT is inactive, although a new linac is being installed there.
- **Capacity indicators:** Zimbabwe has 0.35 CQMPs per million and 0.12 functional linacs per million. The 3.0 CQMPs per functional linac ratio reflects low functional linac availability, not staffing adequacy.
- **Treatment capability**: Treatment is currently limited to 3DCRT ± electrons; no IMRT/VMAT capacity is reported (Table 1).
- **Public-sector fragility:** PGH remains the main active public EBRT/HDR provider, while Mpilo EBRT/HDR is currently inactive; private Oncocare capacity provides limited public-sector access (Fig. 2).
- **NM/SPECT**: Gamma cameras exist at PGH and Mpilo, but not functionally active at either site; no PET-CT reported.
- **Imaging/simulation:** Each assessed RT centre has 1 functional Toshiba Aquilion CT simulator. Diagnostic CT, MRI, and mammography were documented across the assessed sites, but CT/mammography functionality was limited at public sites (Table 2).
- **Recent government procurement:** New PGH/Mpilo linacs and CT simulators indicate public-sector expansion, including planned Mpilo restoration, but are excluded from functional capacity pending commissioning.

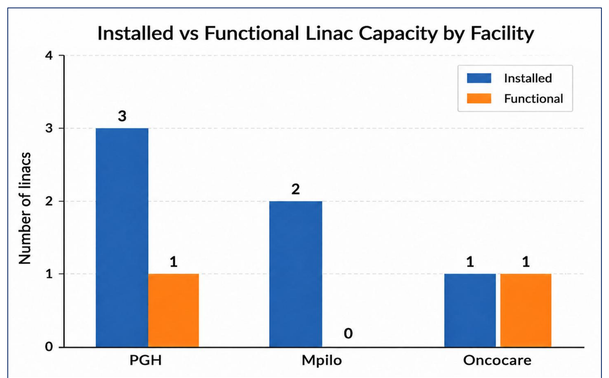

Fig 1. Installed vs. functional national linac capacity. Six linacs exist nationally, but only two were functional.

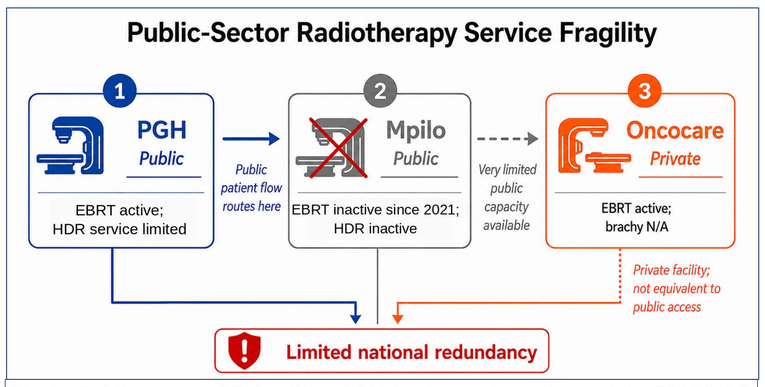

Fig 2. Public-sector RT fragility. PGH is the main active public EBRT/HDR provider; Oncocare adds private EBRT capacity with limited public access.

Table 1. EBRT inventory at RT sites. As of June 2026, only PGH and Oncocare had functional linac capacity; Mpilo EBRT was inactive.

Facility	Linacs installed	Models	Functional status	Capabilities	TPS / algorithm	Patient Capacity (per day)	Waiting time
[a]PGH	3	Varian DMX 2300C; Unique; 600C	1 functional DMX. All outdated	3DCRT, electrons	Eclipse / AAA	60 on DMX; 60 on Unique; 5 on 600C	Up to 1 month
[a]Mpilo	2	Varian DMX; Varian Unique	0 functional; outdated; frequent breakdowns	3DCRT, electrons	Eclipse / AAA	~40/day	1–3 days
[b]Oncocare	1	Elekta Synergy	Functional	3DCRT, electrons	Mosaic / pencil beam	Not reported	Not reported

[a]public; [b]private. No Co-60 teletherapy units reported at any site. Capacity & capabilities refer to reported potential service if systems are operational. PGH reported linacs under service contract since Oct 2023; Mpilo reported servicing once or twice per year and limited engineer availability. Recent government procurement includes 4 new linacs and 2 CT simulators for PGH and Mpilo, with each site expected to receive 1 low-energy linac, 1 multi-energy linac, and 1 CT simulator. Low-energy linac installation has been completed at PGH, with commissioning pending (Fig. 3), while installation is ongoing at Mpilo.

Fig. 3. Newly installed LinaTech low-energy linac at PGH; clinical use pending commissioning and QA.

Table 2. Nominal vs. effective clinical capacity. Staffing and functionality constraints reduce effective capacity, especially for EBRT, brachy, and NM.

Domain	Nominal Capacity	Capacity constraint	Effective capacity
Workforce	6 CQMPs	Attrition	Fragile
EBRT	6 linacs	Extended downtime	2 functional
CT Sim	3 CT sims	Linac-dependent [a]	3 functional
Brachy	2 HDR systems	Mpilo HDR inactive	Mainly PGH
NM	2 Gamma Cameras	Both inactive	No active NM
DR	2 CT; 2 MRI; 2 Mammo, 1 Mobile mammo	CT and Mammo downtime	MRI + mobile mammo

[a] Functional, but clinical use depends especially on active linacs.

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