Image-Guided Radiation Therapy Practices in Low- and Middle-Income Countries: A Multi-Institutional Survey and Initial Findings

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INTRODUCTION

As radiotherapy access expands in Low- and Middle-Income Countries (LMICs), maintaining stringent safety standards is paramount.
This study evaluates two critical pillars of safe radiotherapy delivery: **Pre-treatment Physics Plan Quality Assurance (QA)** and **Image-Guided Radiotherapy (IGRT) practices**.
While these technologies are vital for precision treatment delivery, systemic barriers often limit their clinical optimization in resource-constrained settings. To address this knowledge gap, we developed a cross-sectional online survey mapping the global availability, utilization, and clinical application of these tools. By identifying specific operational barriers, this work aims to define scalable best practices that enhance treatment precision and safety.

METHODS AND MATERIALS

A 28-question survey was developed using Qualtrics, structured into four domains:

- Institutional demographics and equipment inventory
- Available IGRT modalities
- Site-specific and treatment delivery–specific use of IGRT
- Physics safety and plan review practices

The complete study protocol, including the final survey draft, electronic consent form, and recruitment materials, were submitted for Institutional Review Board (IRB) for ethical review and approval. Following IRB approval, the survey was distributed to 3 physicists to test functionality, clarity, and estimated completion time. Feedback was reviewed, and minor final adjustments were made to the survey flow or wording to enhance participant understanding. The survey was distributed via professional societies and social media. Sample responses within 5 months of deployment were analyzed.

RESULTS

Geographic Representation:
A total of 19 responses were received across 15 different countries: Jordan, Lithuania, Uganda, Brazil, India, Indonesia, Latvia, Libyan Arab Jamahiriya, Mexico, Nepal, Nigeria, Pakistan, Philippines, Turkey, Ukraine

Technology & Equipment Availability:
C-arm LINAC: Available at 16/19 institutions
Brachytherapy: Available at 17/19 institutions
MR-Linacs: Available at 2 institutions
Cobalt-60 Units: 0 units reported across all participating sites

RESULTS

Clinical Workload & Staffing Levels:
Daily Throughput: Median of 70 fractions per machine, per day
Staffing Infrastructure (Median values per site): 5 Radiation Oncologists, 6 Medical Physicists, 12 Radiation Therapist, 0 Medical Dosimetrists.

Physics safety and plan review practices
Across the 16 unique institutions, IGRT quality-assurance practices were generally strong at the front end but thinned out downstream. Nearly all institutions performed end-to-end testing for new IGRT procedures (93%, 14/15), and most maintained a routine QA program for their IGRT systems (80%, 12/15) and had established IGRT documentation protocols (79%, 11/14). Governance of daily practice was weaker: only half reported an established action plan for large shift corrections (50%, 7/14), and daily setup shifts were most often approved by a radiation therapist or technician (67%, 10/15) rather than a radiation oncologist (40%) or physicist (27%). The most commonly cited barriers to IGRT use were a lack of available technology (7 institutions) and a lack of funding (6), followed by gaps in guidelines/education and QA equipment (4 each). Physics plan review showed a clear drop-off across the workflow: 87% (13/15) reviewed the plan before transfer to the record-and-verify system, but only 53% (8/15) did so after transfer and before treatment. These were not independent groups — every institution that reviewed after transfer also reviewed before it — so the 8 institutions performing an after-transfer check represent those doing both, while 5 of the 13 that review before transfer omit the post-transfer secondary check, marking that step as the most frequent gap in the plan-review chain.

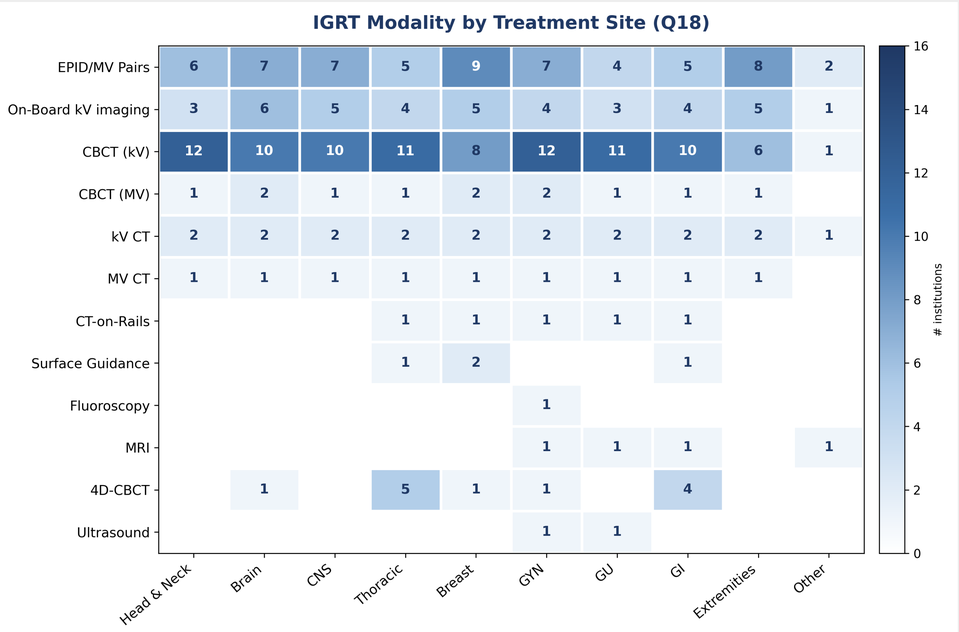

Figure 1. IGRT modality use across treatment sites. Cell values indicate the number of institutions using each modality (rows) for each site (columns)

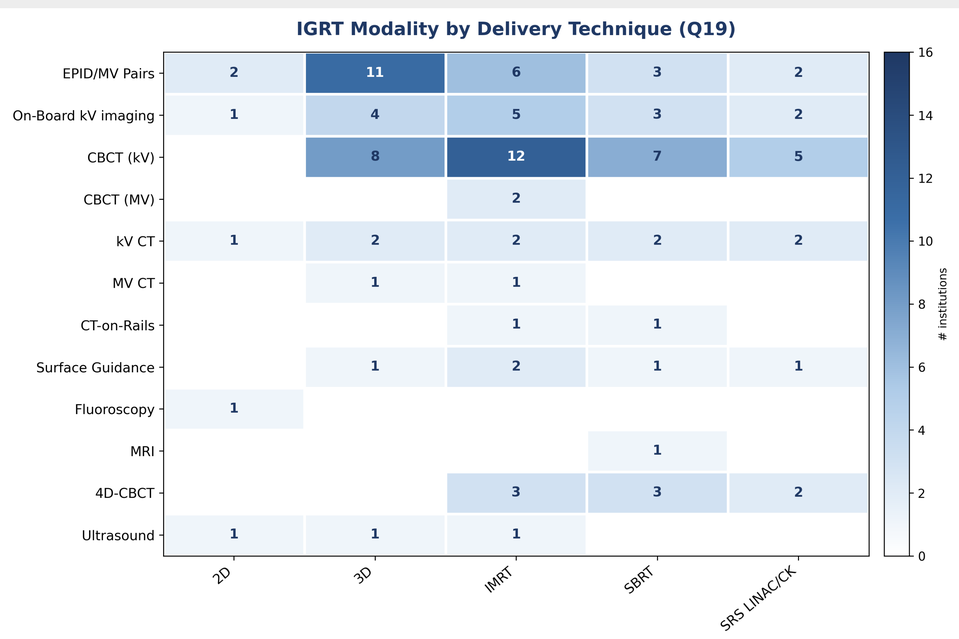

Figure 2. Pairing of IGRT modalities with delivery techniques. Cell values indicate the number of institutions using each modality (rows) with each delivery technique (columns)

IGRT Techniques (Q16)

Multi-select. Denominator = 16 unique institutions. % sums to >100%.

IGRT technique	# institutions	% of 16
CBCT (kV)	13	81.3%
EPID / MV pairs	12	75.0%
On-board kV imaging	8	50.0%
4D-CBCT	6	37.5%
Surface guidance	2	12.5%
MRI	2	12.5%
Ultrasound	2	12.5%
CBCT (MV)	2	12.5%
kV CT	2	12.5%
CT-on-rails	1	6.3%
MV CT	1	6.3%
Fluoroscopy	1	6.3%
PET / PET-CT	0	0.0%
EM transponders (Calypso)	0	0.0%
Do not use IGRT prior to delivery	1	6.3%

CONCLUSIONS

Early results demonstrate adoption of core IGRT practices across LMICs, alongside variability in QA standardization.

These findings highlight opportunities for targeted guidance and education to support safe, scalable IGRT implementation.

Take our Survey!

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