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Barriers and Success of Interventional Radiology Training in Nepal

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Background

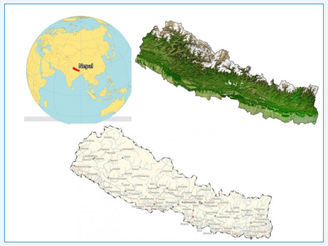
- Interventional Radiology (IR) uses minimally invasive, image-guided techniques to diagnose and treat disease. Core procedures include fine needle aspiration cytology (FNAC), core biopsy, and percutaneous drainage.[1]
- Advances in imaging have expanded IR to transjugular intrahepatic portosystemic shunt (TIPS), embolization, and thrombectomy, making it essential across oncologic, vascular, and emergency care.
- In the United States, IR is involved in **7.8%** of hospital admissions (2.3M cases) and is available in most hospitals.[2]
- IR patients are higher acuity, with greater severity of illness and resource utilization.[2]
- Despite high upfront cost, IR improves efficiency through lower morbidity, shorter length of stay, and reduced Intensive Care Unit (ICU) needs.[2]
- Access disparities persist: IR specialists are present in only 15.5% of U.S. counties, leaving ~31% of the population without local access.3

Comparison of IR Capacity in the United States and Nepal

Metric	United States	Nepal
Population	330M	30M
IR physicians	2,989	15
DSA machines	Thousands	4
MDCT scanners	>6,000	5
Radiologists	~30,000	~150

- Nepal (~30M population) faces major constraints including limited infrastructure, workforce shortages, and economic barriers.[4]
- IR capacity is extremely limited (**~15** physicians, minimal advanced imaging), restricting access to life-saving procedures.[3,5]
- Stroke highlights the gap: high disease burden but limited access to interventions like thrombectomy leads to significant preventable mortality.[6,7]

Maps of Nepal[4]



Methods

- **Design**: Historical review of IR development in Nepal and comparable Lower- and Middle-Income Countries (LMICs).
- **Sources**: Peer-reviewed literature, training records, global health reports, and organizational documents. Anecdotal evidence was also added from conversations between the radiology staff at the University of Colorado Hospital (UCH) and Tribhuvan University Teaching Hospital (TUTH)
- **Databases**: PubMed, Google Scholar, and regional medical journals.
- **Keywords**: "interventional radiology Nepal," "IR LMIC," "global IR development," plus related subspecialty implementation terms.
- **Ethics & sustainability**: Reviewed global health training and capacity-building literature.
- **Inclusion criteria**: IR procedures, training pathways, institutional milestones, system barriers, comparable specialties, and ethical considerations.
- **Analysis**: Thematic coding (training, technology, workforce, infrastructure, partnerships, ethics) with chronological synthesis and cross-validation.
- **Other**: No IRB required; searches updated through February 2026.

Historical Analysis - Results

Timeline of IR Development in Nepal[5,8-11]

1990's
- Manual film processing
- TUTH only site with mammography/ angiography
- Patients in remote areas carried on backs to reach imaging services

Early 2000's
- Gradual increase in imaging but most equipment 2nd hand and >20 years old
- Some hospitals with a single radiographer

2013
- National count: 5 MDCT scanners, 4 DSA machines
- Most IR-type care consists of basic biopsies and aspirations

2014-15
- RAD-AID Radiology Readiness Assessment
- Massive earthquake marks a key moment in international partnerships

2017-2019
- First aneurysm coiling program
- First mechanical thrombectomy

2022-26
- PACS installed at TUTH
- Expansion of IR to tumor ablation, embolotherapy, TIPS/BARTO
- Fall 2026, anticipated start of IR fellowship level training program at TUTH

Lessons from IR Development in Other LMICs

- **Severe workforce shortages limit IR development:**
  - Sub-Saharan African countries lack even a single interventional radiologist leaving over a billion people with no IR access[12,13]
  - Relatively resourced South Africa workforce is still inefficient (73 IR physicians/ 62 million people)[13]
- **Infrastructure and supply-chain constraints:**
  - Equipment failures, unreliable procurement of IR consumables, limited access to advanced imaging, frequently interrupt service[12]
  - Reliance on external donations to function limits capabilities[12]
- **Successful models show promise for the future:**
  - The Road2IR Tanzania program demonstrated sustain international partnerships and frequent on-site mentorship with a step-wise approach focused on high-yield procedures to build local expertise[12,16]
  - Continued barriers: clinical awareness and trainee pipelines after program establishment[17,18]
- **IR expansion challenges:**
  - IR is widely practiced in urban centers within India, resulting in rapidly increasing procedural volumes[19]
  - Access remains limited – fewer than 1% of hospitals are quipped with IR facilities19
  - Innovative strategies, including simulation-based education, offer additional opportunities to strengthen training and expand capacity in resource-limited settings.[20]

Lessons from Other High-Technology Specialties

- **IR development challenges parallels those of high-technology specialties** such as cardiac electrophysiology (EP) and cardiothoracic (CT) surgery, which require specialized expertise and advanced equipment.[21,22]
- **Workforce disparities in specialty fields are profound:**
  - Several LMICs report pacemaker implantation rates of <1 per 100,000 people compared to 62 per 100,000 in the United States[22,23]
  - Estimations show up to six billion people lack access to cardiac surgical care.[22,23]
  - Growth of these specialties is further hindered by fragile supply chains, high costs of consumables, and insufficient supporting infrastructure.[24]
- **EP and CT surgery have successfully advanced care in LMICs**, providing a valuable framework and proof of concept for the continued development of IR.[21,22]

Comparison of IR Capability of Nepal with Select LMICs[12-18]

COUNTRY	POPULATION	IR PHYSICIANS	IR SUITES	SCOPE OF PROCEDURES	SUPPLY CHAIN & RELIANCE ON DONATIONS	MAJOR BARRIERS
NEPAL	30 million	15 (all trained abroad)	Very few dedicated suites; many procedures done in cardiac cath labs	US/CT-guided biopsies, drainages; emerging neuro-IR, aneurysm coiling; limited oncology IR	High reliance on external donations; consumables intermittently available	Lack of training programs, uneven geographic access
TANZANIA	65 million	11 (all from Road2IR). Graduating ~3 per year.	1-2 functional suites	Biopsies, abscess drainage, nephrostomy/ ureteric stents, biliary drainage/stenting, thoracentesis, PICC lines, foreign body retrieval, uterine fibroid embolization.	Very high reliance on donated equipment; frequent consumable shortages and procurement delays that halt cases.	New service awareness; nationwide access; early-stage training pipeline
CAMEROON	28 million	None with formal degree. Few radiologists performing limited IR	4 (Only 5.7% of centers had any IR suite)	"Simple" procedures only (biopsy, drainage); no complex vascular IR	Moderate–high reliance on external support; severe shortages of basic consumables such as catheters and guidewires.	Workforce shortages
SOUTH AFRICA	62 million	73 physicians	Several dedicated IR units in major cities; none in most rural provinces	Full range of IR but restricted to select tertiary centers (oncology IR, neuro-IR, vascular IR)	Low–moderate reliance on episodic external support in the public sector; availability varies, adequate in cities, limited in rural hospitals.	Lack of qualified personnel outside major cities; inequitable distribution of services
INDIA	1.4 billion	ISVIR has 600+ members (mix of trainees & IRs; true IR specialists likely fewer)	>75 tertiary centers performing complex IR; <1% of 40,000 hospitals have IR facilities	Full spectrum: biopsies, drainages, angioplasty, TACE, RFA, neuro-IR, vascular-IR	Low reliance on donations; some consumables (e.g., drainage catheters, biopsy guns) manufactured locally, but most endovascular hardware imported and often in short supply.	High cost of hardware, low public awareness, limited training seats, IR specialists overworked due to small workforce

PICC= Peripherally inserted central catheter, ISVIR= Indian Society for Vascular and Interventional Radiology, TACE=transarterial chemoembolization, RFA=radiofrequency ablation

Role of International Partnerships and the CU–Nepal Connection

- International collaborations have been central to advancing IR in Nepal. RAD-AID conducted a Radiology Readiness Assessment in 2014 and has since partnered with TUTH, including supporting disaster response after the 2015 earthquake through implementation of trauma imaging protocols and infrastructure assessments.[4,25] Over the past decade, RAD-AID and academic partners, such as UCH, have contributed to capacity building through PACS installation, workforce training, and expansion of subspecialty education.
- These efforts have culminated in the development of Nepal's first in-country IR training pathway, a Doctorate of Medicine (DM) program at TUTH, representing a critical step toward building a sustainable domestic IR workforce.[26] TUTH anticipates recruiting its first IR DM candidate in the Fall of 2026.

Ethics Review

- Ethical and structural challenges shape IR development in Nepal, where limited access to basic healthcare, particularly in rural areas, risks widening disparities with the introduction of high-technology services.[22,25] Short-term global health initiatives may exacerbate inequities through power imbalances and insufficient local capacity for follow-up care.[27,28] In contrast, longitudinal partnership models that emphasize sustained mentorship and local leadership offer a more equitable approach.

Discussion/Limitations

- Nepal's IR development follows a typical LMIC trajectory and is at a critical inflection point for expansion with targeted investment.
- Stroke highlights the stakes: lack of IR (e.g., thrombectomy) contributes to preventable morbidity and mortality.
- Key dilemma: prioritize broad-access thrombolytics vs. high-impact thrombectomy, both requiring system-level support.
- IR expansion must balance equity, cost-effectiveness, and feasibility to avoid benefiting only urban populations.
- Training is the primary bottleneck: reliance on short international fellowships limits workforce growth.
- Development of Nepal's DM-IR program at TUTH is a pivotal step toward a sustainable national workforce.
- Nursing specialization is essential; IR-trained nursing support is needed for safe procedural and post-procedural care.
- Persistent barriers include fragile supply chains, equipment downtime, limited imaging access, and infrastructure gaps.
- IR growth depends on parallel system strengthening (imaging, anesthesia, information technology, and biomedical support).
- India provides a scalable model, demonstrating long-term success through training expansion, professionalization, and system investment.
- Ethical implementation requires avoiding widened disparities and ensuring IR develops alongside foundational health services.
- Limitations: data is fragmented, comparisons across LMICs are approximate, and lack of national registries and stakeholder input limits precision.

Conclusion

- IR in Nepal has progressed from fragmented, improvised beginnings to a field capable of delivering complex neurovascular and oncologic therapies. Yet its growth remains constrained by the same structural barriers seen across many LMICs: limited imaging infrastructure, fragile supply chains, and a small workforce trained abroad. Evidence from regional and global comparators demonstrates that these challenges are surmountable when countries invest in domestic training pathways, build reliable procurement systems, and integrate IR into broader emergency and specialty-care networks.
- Nepal's forthcoming DM-IR program represents the most promising step toward long-term self-sufficiency, but its success will depend on parallel development of nursing, technical, and diagnostic capacity. Sustained partnerships, ethical program design, and careful alignment with national health-system priorities will be essential. With coordinated investment and continued collaboration, Nepal is well positioned to transform IR from a limited, urban-centric service into a durable, equitable national specialty.

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