Scientific Research Publishing

Open Journal of Radiology, 2025, 15(3), 77-90
https://www.scirp.org/journal/ojrad
ISSN Online: 2164-3032
ISSN Print: 2164-3024

Empowering Minimally Invasive Care: Training, Equipment, and Practice of Interventional Radiology in Cameroon

Guegang Goujou Emillienne[1,2], Guea Ngbwa Ghislain[1], Hamidou Alioum[1,2], Gonsu Fotsin Joseph[1,2]

[1]Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon
[2]Department of Medical Imagery and Radiology, University of Yaoundé I, Yaoundé, Cameroon
Email: ghislainngbwa@gmail.com

How to cite this paper: Emillienne, G.G., Ghislain, G.N., Alioum, H. and Joseph, G.F. (2025) Empowering Minimally Invasive Care: Training, Equipment, and Practice of Interventional Radiology in Cameroon. *Open Journal of Radiology*, **15**, 77-90.
https://doi.org/10.4236/ojrad.2025.153008

Received: June 18, 2025
Accepted: August 15, 2025
Published: August 18, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

Background: Interventional radiology (IR) has revolutionized patient care worldwide, yet its adoption and practice in sub-Saharan Africa remain inadequately characterized. Cameroon, with its growing radiology workforce, offers a unique opportunity to evaluate IR capacity, practitioner engagement, and predictors of procedural implementation. **Materials and Methods:** We conducted a cross-sectional survey of radiologists and senior radiology residents in Cameroon between. Eligible participants included radiologists and fourth-year residents across all major referral hospitals. Data collected encompassed demographic characteristics, IR training and qualifications, years of IR experience, availability of imaging modalities and IR suites, types and frequencies of IR procedures performed, and continuing education participation. All analyses were performed using SPSS version 23. **Results:** Seventy practitioners (61 radiologists, 9 senior residents; 39 males, 31 females) with a mean age of 38.2 (SD 5.0) years participated. None held a formal IR degree, and 61.4% reported ≤5 years of IR experience. Ultrasound was the most widely available modality (95.7%), while only seven practitioners (10.0%) had access to a dedicated IR suite. Overall, 39 participants (55.7%) performed IR procedures; however, all were classified as simple per Société Française de Radiologie criteria, and none performed vascular interventions. The most frequently performed procedures were exploratory puncture (87.2%) and collection evacuation (79.5%). In multivariable analysis, engagement in continuing IR education ($p = 0.048$) was the sole predicting factor and availability of advanced imaging equipment ($p = 0.051$) presented a borderline level of significance. **Conclusion:** Our findings reveal that while basic IR services are being adopted in Cameroon, significant gaps persist in advanced training, infrastructure, and procedural scope. Expansion of formal IR training programs and investment in dedicated IR suites

and advanced imaging modalities are imperative to broaden the spectrum of minimally invasive treatments and improve patient outcomes. These insights should inform national health policy and international collaborative efforts to strengthen IR capacity in resource-limited settings.

Keywords

Interventional Radiology, Advanced Imaging Equipment, Continuing Education, Developing Countries

1. Introduction

Interventional radiology (IR) has emerged as a cornerstone of modern medicine, offering minimally invasive alternatives to conventional surgical procedures and thereby reducing patient morbidity, shortening hospital stays, and lowering overall healthcare costs. Globally, the IR market was valued at USD 28.66 billion in 2023 and is projected to grow to 49.72 USD billion by 2031, reflecting a compound annual growth rate of 7.13 percent as healthcare systems increasingly adopt image-guided therapies for a broad spectrum of clinical indications, from oncology to vascular disease [1]. Despite these advances, the translation of IR into low- and middle-income countries has been uneven, hindered by limited subspecialty training, inadequate infrastructure, and scarcity of dedicated IR suites.

In sub-Saharan Africa, radiology sub-specialization—including IR—remains in its infancy. A recent review highlighted that only a handful of African nations offer formal IR fellowships, with South Africa, Tanzania, and Kenya being the sole countries with established training programs as of 2024 [2] [3]. The Society of African Interventional Radiology and Endovascular Therapy (SAFIRE) currently counts approximately 100 practicing IR physicians across the continent, underscoring both the nascent state of the specialty and the potential for rapid growth through targeted capacity-building initiatives [2] [4].

Cameroon exemplifies these challenges: despite a growing cadre of diagnostic radiologists, no formal IR degree programs exist, and research infrastructure is scant, with no dedicated radiology research institute and minimal global health-oriented imaging initiatives [5]. Ultrasound represents the most ubiquitous imaging modality, yet only a minority of centers possess dedicated IR suites, and the procedural scope is largely restricted to simple interventions such as exploratory puncture and fluid collection evacuation. Vascular and advanced oncologic interventions remain absent from routine practice.

Despite global recognition of IR's potential to transform patient care through minimally invasive, image-guided therapies reducing morbidity, shortening hospital stays, and lowering costs, comprehensive data on Cameroon's IR landscape remain scarce. The absence of formal IR fellowship programs, limited access to dedicated suites and advanced imaging modalities, and the unknown interplay

between practitioner education and procedural adoption represent critical knowledge gaps. Elucidating these determinants is therefore of paramount importance for resource-limited settings, where strategic investments must be guided by robust evidence. A clearer understanding of training pathways, infrastructure capacity, and barriers to IR practice will equip policymakers, academic institutions, and international partners to design targeted capacity-building initiatives such as formal curricula development, establishment of dedicated IR suites, and procurement of advanced equipment that can expand the spectrum of minimally invasive care, optimize resource utilization, and ultimately elevate patient-centered radiologic services in Cameroon.

2. Materials and Methods

Study design and setting

We conducted a national, cross-sectional study of practicing radiologists and senior radiology residents in Cameroon between November 2022 and September 2023. Cameroon's health system is organized into ten regions, each served by referral hospitals that provide imaging services across the public, private, and faith-based sectors. This study targeted all radiologists and fourth-year radiology residents affiliated with major referral centers in each region, ensuring geographic representation of urban, peri-urban, and rural practice environments.

Participants and sampling

Eligible participants were (1) diagnostic radiologists and (2) fourth-year radiology residents, reflecting the anticipated point of exposure to interventional radiology (IR) rotations. A comprehensive list of practicing radiologists and residents was obtained from the Cameroonian Society of Radiology and the Ministry of Health. We employed a census approach, inviting all 85 eligible practitioners to participate via email and telephone. Of these, 70 (82.4%) consented and completed the survey.

Survey instrument

We developed a 30-item, self-administered questionnaire in English and French, informed by existing IR capacity assessment tools and guidance from the World Health Organization's imaging availability survey. The instrument included the following domains:

- Demographics and professional background: age, sex, years since radiology certification or years of residency training, and possession of a formal IR degree or fellowship.
- Training and continuing education: participation in IR-focused workshops, short courses, or webinars within the last three years.
- Imaging equipment and infrastructure: on-site availability of ultrasound, standard radiography, computed tomography (CT), mammography, magnetic resonance imaging (MRI), and access to dedicated angiography or IR suites.
- IR procedural practice: types and frequencies of procedures performed in the preceding 12 months, categorized according to the Société Française de Radi-

ologie (SFR) classification into simple, intermediate, and advanced vascular or oncologic interventions [6].

- Barriers and facilitators: self-reported obstacles to performing IR procedures (e.g., lack of equipment, insufficient training) and institutional supports.

The draft questionnaire was pre-tested with five radiologists at a tertiary hospital outside the sampling frame to assess clarity, content validity, and completion time. Feedback led to refinement of question wording and response options.

Data collection

Between November 2022 and September 2023, we disseminated the final questionnaire electronically via a secure, password-protected online platform. Two reminder emails and up to three phone calls were made to non-respondents over a six-week period. Participation was voluntary, and informed consent was implied by completion of the survey. No incentives were provided.

Data management and variables

Survey responses were exported into a password-protected spreadsheet and cleaned for completeness and logical consistency. Key variables were defined as follows:

- Primary outcome: any performance of IR procedures (yes/no) within the preceding 12 months.
- Predictor variables: (a) participation in ≥1 IR continuing education event in the last three years (yes/no), and (b) availability of advanced imaging equipment (CT, MRI, or dedicated IR suite; yes/no).
- Covariates: age (continuous), sex (male/female), professional status (attending radiologist/resident), years of IR practice (<5, 5 - 10, >10 years), and possession of a formal IR degree (yes/no).

Statistical analysis

We conducted descriptive analyses to summarize participant characteristics, training backgrounds, equipment availability, and procedural practices. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. To identify independent predictors of IR procedural practice, we used multivariable logistic regression, entering all predictor variables and covariates with $p < 0.05$ in univariable analysis into a final model. Only predictors with at least 10 events per group and who showed significance on univariate analysis were consider for multivariate logistic regression. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) and two-sided p-values are reported; statistical significance was set at $\alpha = 0.05$. All analyses were performed using SPSS version 23.

Ethical considerations

The study protocol was approved by the Faculty of Medicine and Biomedical Science of University of Yaoundé I Ethics Committee for Research in Human Health. Participation was voluntary and anonymous; no personal identifiers were collected.

Reporting

We adhered to the Strengthening the Reporting of Observational Studies in Ep-

idemiology (STROBE) guidelines for cross-sectional studies throughout study design, conduct, analysis, and reporting.

3. Results

Participant characteristics

Of 85 eligible practitioners, 70 completed the survey (response rate 82.4%). Respondents comprised 61 board-certified radiologists (87.1%) and 9 fourth-year radiology residents (12.9%). There were 39 male (55.7%) and 31 female (44.3%) participants, with a mean age of 38.2 years (SD 5.0). No participant held a formal interventional radiology (IR) degree Table 1.

Table 1. Baseline characteristics of study participants.

Variable	Category	n	%
Professional status	Radiologist	61	87.1
	4th-year resident	9	12.9
Sex	Male	39	55.7
	Female	31	44.3
Age, years	Mean (SD)		38.2 (5.02)
Region of practice	Centre	39	55.7
	Coastline	18	25.7
	Others	13	18.6
Professional experience in radiology (years)	[0 - 5[	43	61.4
	[5 - 10[	7	10
	[10 - 15[	19	27.1
	More than 15	1	1.4
Level of radiology equipment available	Basic		
	Advanced		
Imaging equipment available	Sonography	67	95.7
	X-ray	60	85.7
	X-ray scanner	39	55.7
	Mammography	28	40
	MRI	17	24.3
	Angiography room	7	10
	Interventional radiology suite	4	5.7
Interventional radiology degree	Yes	0	0
	No	70	100
Continuing education in IR	Yes	32	45.7
	No	38	55.3
Years of IR practice	≤ 5 years	32	82.1
	5 - 10 years	6	15.4
	10 - 15 years	1	2.6

Continued

Imaging modalities used for IR	Standard radiography	22	56.4
	Sonography	39	100
	CT-scan	3	7.7
	MRI	0	00
Type of IR procedure performed	Vascular procedure	0	00
	Non-vascular procedure	39	100
Purpose of the IR procedure	Diagnosis	15	38.5
	Therapeutic	2	5.1
	Both	22	56.4

Training and IR experience

Overall, 39 practitioners (55.7%) reported an IR experience. Among them, 32 practitioners (82.1%) reported ≤5 years of IR practice, 6 (15.4%) had 5-10 years, and 1 (2.6%) had >10 years; the remaining 31 participants (44.3%) had not performed any IR procedures to date. Thirty-2 participants (45.7%) had attended at least one IR-focused continuing education event (e.g., workshop or webinar) within the previous three years Table 1.

Imaging equipment and infrastructure

Ultrasound was nearly universal, available to 67 participants (95.7%), followed by standard radiography in 60 (85.7%), computed tomography in 67 (95.7%), mammography in 39 (55.7%), and magnetic resonance imaging in 28 (40.0%). Only seven respondents (10.0%) had access to an angiography room and four (5.7%) to a dedicated IR suite Table 1.

IR procedural practice

Thirty-nine practitioners (55.7%) performed at least one IR procedure in the preceding 12 months. All reported procedures were classified as "simple" per Société Française de Radiologie guidelines; no intermediate or advanced (including vascular) interventions were undertaken. Among those performing IR, the most common procedures were exploratory puncture (n = 34; 87.2%) and fluid collection evacuation (n = 31; 79.5%) Figure 1 **and** Table 2.

Predictors of IR practice

In bivariable analyses, participation in IR continuing education (p = 0.044) and availability of advanced imaging equipment (CT, MRI, or dedicated IR suite; p = 0.039) were associated with performing IR procedures. In multivariable logistic regression adjusting for age, sex, professional status, and years of IR experience, continuing education participation remained significant (p = 0.048) and availability of advanced equipment presented a borderline statistically significance (0.051) Table 3 and Table 4**.**

No significant associations were observed for age, sex, professional status (attending vs. resident), or years of IR practice once continuing education and equipment availability were accounted for.

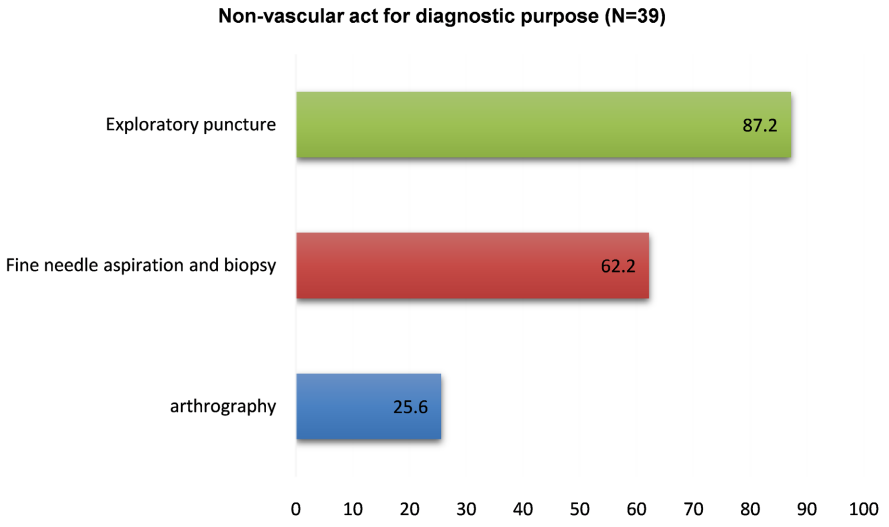

Figure 1. Illustration of the non-vascular act for diagnostic purpose.

Table 2. Non-vascular acts performed for therapeutic purpose.

Variable	Effectif	Percentage
Drainage of a collection	31	79.5
Musculoskeletal		
Intraarticular infiltration	12	30.8
Treatment of intra-articular calcification	4	10.3
Intra-discal infiltration	2	5.1
Urinary tract		
Suprapubic catheterization	6	15.4
Others		
Foreign body removal	1	2.7

Table 3. Bivariable analysis.

Variable	IR-No (%) (n = 31)	IR-Yes (%) (n = 39)	OR (95% CI)	p-value
Sex				0.895
Female	14 (45.2)	17 (43.6)	1 (0.4 - 2.7)	
Male	17 (54.8)	22 (56.4)		
Status				0.992
Radiologist	27 (87.1)	34 (87.2)	0.9 (0.2 - 4.1)	
Resident	4 (12.9)	5 (12.8)		
Professional experience				
<5 years	20 (64.5)	23 (59)	0.9 (0.3 - 2.8)	0.950
5 - 10 years	1 (3.2)	6 (15.4)		
10 - 15 years	9 (29)	10 (25.6)	0.2 (0.1 - 1.8)	0.151
≥ 15 years	1 (3.2)	0		

Continued

Continuing education	10 (32.3)	22 (56.4)	2.7 (1.1 - 7.3)	**0.044**
Material				
Echography	30 (96.8)	37 (94.9)	0.6 (0.1 - 7.1)	0.696
Standard radiography	24 (77.4)	36 (92.3)	3.5 (0.8 - 14.9)	0.077
Mammography	9 (29)	19 (48.7)	2.3 (0.8 - 6.3)	0.095
X-ray scanner	13 (41.9)	26 (66.7)	2.8 (1.1 - 7.3)	**0.039**
MRI	7 (22.6)	10 (25.6)	1.2 (0.4 - 3.6)	0.767
Angiography suite	1 (3.2)	6 (15.4)	5.4 (0.6 - 47.9)	0.092
Interventional radiology suite	1 (3.2)	3 (7.7)	2.5 (0.2 - 25.3)	0.424
Equipment level				
Advanced material	13 (41.9)	26 (66.7)	2.7 (1.1 - 7.3)	**0.039**
Basic material	30 (95.8)	37 (94.9)	0.6 (0.1 - 7.1)	

Table 4. Multivariate logistic regression.

Variable	OR (95%CI)	p-value
Continuing education	2.7 (1.01 - 7.24)	**0.048**
Equipment level	2.9 (0.99 - 8.55)	**0.051**

4. Discussion

Global Context of IR Practice

This national survey reveals an embryonic stage of IR practice in Cameroon, characterized by relatively young practitioners (mean age of 38.2 years) lacking formal IR specialization. None of the radiologists or senior residents surveyed had completed a dedicated IR fellowship or degree, reflecting the absence of local IR training programs. Among those who perform IR procedures, 82.1% had ≤5 years of IR experience, indicating that IR is a newly adopted practice for many. These findings align with broader trends in sub-Saharan Africa, where IR training opportunities are scarce or non-existent in most countries [7]. Of 54 African nations, only about 18 even have well-established diagnostic radiology residency programs, and only a handful (approximately 8) report any formal subspecialty fellowships—with the first IR fellowship on the continent introduced recently in 2002 in South Africa [8]. In contrast, high-income countries (HICs) have long-established IR pathways. For example, in the United States and Europe's countries, IR is an essential subspecialty with board-certified IR physicians routinely performing a wide range of complex vascular and non-vascular interventions. The stark disparity in IR capacity between HICs and LMICs has been explicitly recognized. Our results underscore that Cameroon exemplifies this gap—IR is present, but at a very basic level, akin to many resource-limited settings where only the simplest procedures are done [9].

Gaps in Training and Equipment

Crucially, we found that 55.7% of participants had performed at least one IR procedure in their practice, but these were exclusively simple, minor procedures according to the French Society of Radiology (SFR) classification. The vast majority were performing diagnostic or palliative interventions such as exploratory needle punctures (87.2%) and fluid collection drainages (79.5%), typically under ultrasound guidance. No respondent reported performing any vascular IR procedures. This highlights a complete absence of advanced IR services. This limitation is unsurprising given the infrastructure constraints: while almost all radiologists had access to basic imaging tools like ultrasound (95.7%), only 10% reported access to a dedicated IR suite. A prior country assessment by RAD-AID similarly noted that IR in Cameroon was essentially confined to ultrasound-guided biopsies and drain insertions [9]. The net effect is that many conditions routinely managed via IR in higher-resource settings cannot be addressed with minimal invasive cares in Cameroon.

The implications for patient care are significant. The absence of locally available vascular and advanced IR procedures means that patients with certain illnesses either undergo more invasive surgical treatments or receive no definitive treatment at all. Many life-threatening yet treatable conditions may thus result in unnecessary morbidity or mortality. For example, trauma patients with solid organ injuries or gastrointestinal hemorrhage in Cameroon currently have no access to life-saving transarterial embolisation, which in HICs is a standard of care to control bleeding without open surgery [10]. Cancer patients cannot benefit from interventional oncology techniques that improve outcomes in liver, kidney, or bone lesions [11]. Even relatively common problems like symptomatic uterine fibroids or benign prostatic hyperplasia have no minimally invasive treatment alternative available, leaving patients to either undergo surgery or suffer without intervention.

One illustrative case is the management of intra-abdominal abscesses. In HICs, percutaneous abscess drainage under imaging guidance has largely replaced open surgical drainage for most patients, given its far lower risk and comparable efficacy [12]. Our data show Cameroonian radiologists do perform abscess drainages as a simple IR procedure, but where IR services are limited, many abscesses likely still end up in the operating theater. The difference in outcomes between these approaches can be stark. A recent study from Tanzania vividly demonstrated this: patients treated with image-guided percutaneous abscess drainage had a 100% technical success rate and zero procedure-related complications, whereas those who underwent open surgical drainage had only 65% success and a 32% 30-day mortality rate [12]. In other words, one in three patients in the surgical group died, compared to none in the IR group which is a striking outcome disparity attributed to the invasiveness of surgery and the critical delays or risks it entails. While patient populations and case complexity can differ, the message is clear: limited access to IR in Cameroon likely translates into avoidable adverse outcomes

for patients. This is tragically exemplified by reports from similar environments. For instance, in East Africa, children have died from liver abscesses that would have been readily treatable by percutaneous drainage if IR services were available [13]. Such scenarios underscore that the gaps identified in training and equipment are not abstract as they have direct consequences on healthcare quality, safety, and equity.

Beyond acute life-threatening cases, the lack of IR also impacts the efficiency and cost of care. Without IR options, patients who could be treated as outpatients or with short hospital stays might instead undergo surgical procedures requiring general anesthesia, longer recovery, and higher expense. This places additional strain on operating theaters, surgical wards, and healthcare budgets. In sum, the current limitations in Cameroon's IR capacity likely lead to a greater burden on conventional surgical services and less optimal patient outcomes. Bridging these gaps could therefore yield improvements not only in survival and complication rates, but also in healthcare system efficiency and patient experience.

Role of Continuing Education and Training Initiatives

A key finding of our survey is the association between continuing education and IR practice. On bivariate analysis, participation in IR-related continuing medical education (CME) or training was significantly linked with whether a radiologist actively performed IR procedures ($p = 0.044$). In multivariate logistic regression, continuing education emerged as the only significant independent predictor of IR practice (adjusted OR = 2.7, 95% CI 1.01 - 7.24; $p = 0.048$). In practical terms, radiologists who had engaged in ongoing IR education were nearly three times more likely to incorporate IR into their practice compared to those who had not. This suggests that exposure to IR techniques, through workshops, short courses, conferences, or other training empower physicians to overcome barriers such as lack of confidence or skills and begin offering minimally invasive procedures. It is an encouraging insight that even in the absence of formal specialist qualifications, education can catalyze the adoption of IR.

This observation is consistent with global experience. A recent worldwide survey of IR professionals identified education and training as top priorities for expanding IR services. Across regions, respondents emphasized the need for more dedicated IR training programs and greater access to educational resources; in fact, establishing training programs and providing access to online education were among the top three recommended actions to strengthen IR globally [14]. Our findings provide local evidence for the same principle. In Cameroon, where no respondent had formal IR credentials, those who sought out any form of additional IR learning were the ones actually practicing IR. Conversely, the lack of structured training is a well-recognized hurdle as international IR societies note that limited training opportunities are a fundamental barrier holding back IR in LMICs [13]. The implication for policy and professional bodies is that investments in training yield tangible returns. Supporting radiologists to attend IR workshops, hands-on courses, and may quickly increase the number and scope of IR proce-

dures offered to patients.

In the longer term, continuing education could not a substitute for formal training pathways. The complete absence of IR fellowship-trained specialists in our cohort highlights an urgent need to establish a sustainable IR training program for residency. This could involve several strategies: integrating IR rotations into existing radiology residency curricula, creating dedicated post-residency fellowships or Master's programs in IR, and leveraging online learning platforms for didactics and case-based learning. The successes seen in other African countries offer a roadmap. For example, Tanzania, Rwanda, and Uganda had virtually no IR specialists a few years ago. However, today, thanks to the Road2IR training consortium (a partnership of local universities with international experts), these countries have begun graduating their first IR fellows and expanding IR services rapidly [12] [13] [15]. The Road2IR model emphasizes high-frequency, hands-on training and mentorship, and it demonstrates that with concentrated effort, it is possible to build a cadre of IR professionals even in resource-constrained settings [13]. Cameroonian radiology could benefit from similar collaborations—for instance, partnering with established IR centers in Africa or beyond, to send trainees for experience and to bring expert mentors to Cameroon for on-site training. In addition, professional exchanges and scholarships supported by international bodies (RSNA, CIRSE, SIR, etc.) and NGOs (e.g., RAD-AID's IR initiatives) can be scaled up to nurture local champions of IR. Our data underscore that those who learn will practice; hence, lowering the barriers to learning is a critical step in empowering minimally invasive care.

Infrastructure and Policy Implications

Parallel to human capital development, the IR's infrastructure must be addressed. Our study found that only 5.7% radiologists had access to a dedicated IR suite. The remainder are essentially limited to using ultrasound or occasionally CT for guidance, which precludes most vascular and advanced interventions. Even basic procedures could be challenging without appropriate tools. The logistic regression showed a strong trend suggesting that access to advanced equipment markedly increases the likelihood of practicing IR (aOR = 2.9; p = 0.051). This highlights the that no matter how skilled or motivated a physician is, certain procedures simply cannot be done safely without the right technology. Limited access to IR equipment is a widespread challenge in LMICs, often cited alongside training gaps as a major barrier [16]. In Cameroon's context, the near-ubiquity of ultrasound availability is a strength that has enabled the current modest IR practice (e.g., biopsies and drainages are conducted under ultrasound guidance). However, the scarcity of fluoroscopy units, angiographic suites, and modern endovascular tools is a critical barrier that confines IR to a narrow scope.

Addressing this equipment gap will require strategic investment and planning. Given finite resources, it may not be feasible in the short term to equip every regional hospital with a full IR suite. A more realistic approach is to designate a few centers of excellence to receive initial investments in IR infrastructure. These cen-

ters could be outfitted with digital subtraction angiography units, interventional CT or hybrid suites, and stocked with essential IR consumables. They would then serve as referral units for complex procedures from across the country and as training sites for radiologists and technologists. Over time, as the benefits are demonstrated and expertise grows, additional centers could be upgraded. Such phased capacity-building has precedent in global health as it mirrors approaches taken for developing cardiac catheter labs, radiation therapy units, and surgical specialties in LMICs.

In sum, our study's findings carry a clear message: bridging the gaps in IR training and infrastructure is both a medical and a policy imperative. The benefits have been well-demonstrated in high-resource settings and small-scale LMIC projects. It is time to translate those benefits to Cameroon through deliberate investment and collaborative action.

5. Limitations

Like all research, this study has limitations. First, as a cross-sectional survey of practitioners, it provides a snapshot of IR practice and perceptions at one point in time; it cannot establish causality for the associations observed. For example, while we found a statistically significant correlation between continuing education and IR practice, we cannot definitively say that education caused increased practice—it may also be that those inclined to practice IR seek more education. Second, the data are self-reported by respondents. This introduces potential biases as individuals might overestimate their procedural experience or access to resources due to optimism or professional pride, or conversely under-report due to modesty or recall bias. We did not independently verify responses (such as cross-checking actual procedure logs or inventories of equipment), so there is room for inaccuracy in the reported figures. Additionally, with a relatively small sample, some potentially important predictors of IR practice might not have reached statistical significance (as seen with advanced equipment access narrowly missing the significance threshold). Finally, our study focused on providers and systems, not on patient outcomes. We did not collect data on how the limited IR services impact patient-level metrics (e.g., complication rates, length of stay, mortality in relevant conditions). We also did not qualitatively probe the reasons why respondents do not perform certain procedures, which could have provided richer insight into specific barriers (be it lack of training, fear of complications, administrative constraints, etc.). These limitations mean our conclusions should be interpreted with appropriate caution. Nonetheless, the study fills an important gap by systematically documenting the status quo of IR in Cameroon—information that is critical for planning improvements.

6. Conclusion

In conclusion, our study reveals a significant gap in the availability and complexity of interventional radiology services in Cameroon. The identified predictors of IR

practice—continuing education and equipment availability—offer clear targets for intervention. To truly empower minimally invasive care and improve patient outcomes, a concerted effort involving policy changes, increased funding, and international collaborations is urgently needed to establish robust training programs, ensure access to essential equipment, and ultimately integrate interventional radiology as a vital component of healthcare delivery in Cameroon. The global emphasis on the crucial role of medical imaging, including interventional radiology, in improving diagnosis and treatment worldwide reinforces the urgent need to prioritize its development in Cameroon. Aligning efforts with the vision of the Society of African Interventional Radiology and Endovascular Therapy (SAFIRE) to advance the field across the continent provides a framework for collaborative progress. By addressing the identified limitations and pursuing the suggested avenues for future research, we can work towards a future where the benefits of minimally invasive care are accessible to all patients in Cameroon, contributing to improved health outcomes and a reduction in healthcare disparities.

Funding Statement

This Cross-sectional study received no specific grant from any institution in the public, commercial, and not-for-profit-sectors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Vivanco-Suarez, J., Dibas, M., Lopes, D.K., Hanel, R.A., Martínez-Galdámez, M., Rodriguez-Calienes, A., *et al.* (2024) Safety and Effectiveness Assessment of the Surpass Evolve (SEASE): A Post-Market International Multicenter Study. *Journal of Neurointerventional Surgery*, **17**, 277-283. https://doi.org/10.1136/jnis-2024-021503

[2] Iyawe, E.P., Idowu, B.M. and Omoleye, O.J. (2021) Radiology Subspecialisation in Africa: A Review of the Current Status. *South African Journal of Radiology*, **25**, a2168. https://doi.org/10.4102/sajr.v25i1.2168

[3] Imanzadeh, A., Pourjabbar, S. and Mezrich, J. (2020) Medicolegal Training in Radiology; an Overlooked Component of the Non-Interpretive Skills Curriculum. *Clinical Imaging*, **65**, 138-142. https://doi.org/10.1016/j.clinimag.2020.04.002

[4] Malley, G. (2022) Policy Priorities of the Royal College of Radiologists. *Clinical Radiology*, **77**, 1-2. https://doi.org/10.1016/j.crad.2021.10.002

[5] Perchik, J.D., Larrison, M.C. & Feudjio, G. (2021) Finding Meaningful Opportunities during the COVID-19 Crisis: Developing an International Radiology Elective in Cameroon. *Journal of Global Radiology*, **7**, 3. https://doi.org/10.7191/jgr.2021.1108

[6] Mellouk Aid, K., Tchala Vignon Zomahoun, H., Soulaymani, A., Lebascle, K., Silvera, S., Astagneau, P., *et al.* (2017) Mortality and Infectious Complications of Therapeutic Endovascular Interventional Radiology: A Systematic and Meta-Analysis Protocol. *Systematic Reviews*, **6**, Article No. 89. https://doi.org/10.1186/s13643-017-0474-y

[7] Sharma, S. and Ganga, K. (2019) Establishing IR in Emerging Countries—A Skill Development Initiative. *Journal of Vascular and Interventional Radiology*, **30**, 956-960.

https://doi.org/10.1016/j.jvir.2018.12.728

[8] Laage Gaupp, F.M., Solomon, N., Rukundo, I., Naif, A.A., Mbuguje, E.M., Gonchigar, A., *et al*. (2019) Tanzania IR Initiative: Training the First Generation of Interventional Radiologists. *Journal of Vascular and Interventional Radiology*, **30**, 2036-2040. https://doi.org/10.1016/j.jvir.2019.08.002

[9] Kwaye, M.P., Bendfeld, J. & Anglani, N. (2015) Assessment of Renewable Energy Resources in Cameroon and Special Regards on Energy Supply. 2015 5*th International Youth Conference on Energy* (*IYCE*), Pisa, 27-30 May 2015, 1-7. https://doi.org/10.1109/IYCE.2015.7180807

[10] Swierz, M.J., Storman, D., Riemsma, R.P., Wolff, R., Mitus, J.W., Pedziwiatr, M., *et al*. (2020) Transarterial (Chemo)Embolisation versus No Intervention or Placebo for Liver Metastases. *Cochrane Database of Systematic Reviews*, 3, CD009498. https://doi.org/10.1002/14651858.cd009498.pub4

[11] Lastrucci, A., Iosca, N., Wandael, Y., Barra, A., Lepri, G., Forini, N., *et al*. (2025) AI and Interventional Radiology: A Narrative Review of Reviews on Opportunities, Challenges, and Future Directions. *Diagnostics*, **15**, Article 893. https://doi.org/10.3390/diagnostics15070893

[12] Ukweh, O.N., Alswang, J.M., Iya-Benson, J.N., Naif, A., Chan, S.M., Laage-Gaupp, F., *et al*. (2023) Comparative Analysis of Percutaneous Drainage versus Operative Drainage of Intra-Abdominal Abscesses in a Resource-Limited Setting: The Tanzanian Experience. *Annals of Global Health*, **89**, Article 35. https://doi.org/10.5334/aogh.4070

[13] Alswang, J.M., Mbuguje, E.M., Chan, S.M., Ak, M., Naif, A., Rukundo, I., *et al*. (2024) Creating a Sustainable Foundation for IR Services and Training in Sub-Saharan Africa: 5-Year Update on the Road2ir Initiative. *Journal of Vascular and Interventional Radiology*, **35**, 1049-1056. https://doi.org/10.1016/j.jvir.2024.03.015

[14] Jamil, H., Tariq, W., Ameer, M.A., *et al*. (2022) Interventional Radiology in Low- and Middle-Income Countries. *Annals of Medicine and Surgery*, **77**, Article 103594.

[15] Musa, B., Ashraf, N., Gandhi, A., Alswang, J.M., Mbuguje, E.M., Naif, A., *et al*. (2024) An International Collaboration in Interventional Radiology Training: Cultivating Knowledge and Fostering Interest among Radiology Residents in East Africa. *CardioVascular and Interventional Radiology*, **47**, 517-519. https://doi.org/10.1007/s00270-024-03665-5

[16] Papalouka, V., Kilburn-Toppin, F., Gaskarth, M. and Gilbert, F. (2018) MRI-Guided Breast Biopsy: A Review of Technique, Indications, and Radiological-Pathological Correlations. *Clinical Radiology*, **73**, 908.E17-908.E25. https://doi.org/10.1016/j.crad.2018.05.029