



COUNTRY REPORT

The State of Interventional Radiology in Myanmar: A National Report

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Abstract

Purpose: Radiology global outreach programs have increased in recent years but progressed more slowly than other specialties. Establishing radiology services is increasingly recognized as a priority in resource-limited settings. Myanmar has a tremendous disease burden that is treatable with interventional radiology (IR) techniques, and aims to grow and effectively integrate this service into its public healthcare sector. Through collaborations between Asia Pacific Society of Cardiovascular and Interventional Radiology (APSCVIR) and Myanmar Radiological Society (MRS), the field of IR has grown exponentially over recent years. This study aims to provide a Myanmar national IR report on the current trends and future challenges.

Methods and materials: Descriptive variables across five domains (facility and equipment, workforce, supplies, infrastructure, and casemix) from the four public sector hospitals with IR capability were obtained between 2016-2019. The four hospitals were Yangon General Hospital (YGH), Yangon Specialty Hospital (YSH), Mandalay General Hospital (MGH), and Defense Services General Hospital (DSGH). Data were analyzed to demonstrate progress in IR and the differing casemix.

Results: There are currently four IR-capable hospitals and nine interventional radiologists across Myanmar's public healthcare sector. IR case volumes tripled from 514 cases in 2016 to more than 1,500 cases in 2019. The three most common procedures performed were trans-arterial chemoembolization (TACE, 63%), bronchial arterial embolization (BAE, 7.7%), and drainages (7.7%). Significant challenges to the growth and adoption of IR services span the domains of infrastructure, equipment and supplies, workforce, and IR awareness, among other clinical specialties.

Conclusion: Myanmar's healthcare priorities, coupled with international radiological outreach programs, have led to rapid growth of IR. The exponential growth in case volumes is promising for Myanmar and other developing countries. But to widen the scope of practice and integrate the service within local clinical workflows, a holistic effort that addresses multiple domains is needed in the future.

Introduction

Myanmar is a country in Southeast Asia bordered by Bangladesh, India, China, Laos, Thailand and the Andaman Sea. It has an area of 261,288 square miles, a population of 54 million, and a population growth rate of 0.85% (1). It has a tropical climate with a population concentrated along coastal regions, and urban areas accounting for roughly one third of its total population. The largest city, Yangon, is located near the southern coast and has a population of 5.3 million. The second largest city, Mandalay, located in the country's central region, was a former economic center

prior to British rule and has a population of 1.4 million (2). The current life expectancy is 67 years. The GDP per capita is \$6,674 USD, with major economic contributions to GDP coming from agricultural and oil and gas sectors (3).

Economy

After gaining independence from British rule in 1948, Myanmar was plagued by nearly 15 years of ethnic conflict that saw its economy and healthcare system stagnate. While under military control over the next five decades, Myanmar experienced minimal growth with its isolated economy

Figure 1. Map of Myanmar No. 4168 Rev 3.

Retrieved From Wikimedia Commons, the free media repository. Available from <https://www.un.org/Depts/Cartographic/map/profile/myanmar.pdf> (4).



(2). Since its reform period in 2011 and opening up of trade with the rest of the world, Myanmar has become one of the fastest growing economies in Southeast Asia.

Healthcare goals

Despite having abundant natural resources, Myanmar ranks as a low-income country with a Human Development Index of 0.483 in 2011, ranked 149 out of 187 countries globally (5). With renewed desire for globalization and democracy since its free elections in 2015, Myanmar has made significant progress across various sectors, with healthcare among the top priorities. The country has made great effort and received international assistance in addressing the millennium development goals (MDGs) – specifically improving on MDG 4 (malnutrition and child mortality), MDG 5 (maternal health), and MDG 6 targets (HIV, Malaria, and Tuberculosis) (6). While these disease-specific, community-oriented programs have yielded promising results, there is increasing recognition of the need to strengthen institutional healthcare delivery to address the growing non-communicable disease (NCD) burden (7). The

healthcare system in Myanmar includes a large mixture of public and private facilities. As of 2014 there are 4 general, 50 specialty, and 55 state/district hospitals (8). In a recent review of Myanmar's healthcare system, two key recommendations include increasing funds allocation to improve health services, and expand health services in the public facilities, including radiological sciences, to address the growing burden of NCDs (9).

Radiology environment

Progress in the fields of diagnostic and interventional radiology has been significantly slower than in other areas. The World Health Organization (WHO) found that two thirds of the world population lacked access to basic medical imaging (10). In recent years there have been calls for a more coordinated effort to address the need for improved medical imaging and image-guided intervention in developing countries (11). Along this front, initiatives coordinated by the Asia Pacific Society of Cardiovascular and Interventional Radiology (APSCVIR) and Myanmar Radiological Society (MRS) and involving the Cardiovascular

Table 1. Interventional radiology capacity in four public sector hospitals across four domains.

	YGH	YSH	DSGH	MGH
FACILITY and EQUIPMENT				
IR service available	2004	2018	1990	2004
Approximate population size served (million)	5.0	1.0	5.0	5.0
Number of beds	2000	500	1000	1500
Number of Angiography Suite with C-Arm	1	1	1	1
Magnetic Resonance Imaging	2	1	N/A	2
Computed Tomography Scanner	3	2	1	3
WORKFORCE				
Interventional Radiologist	3	3	1	4
Interventional Radiology Nurses	3	2	N/A	3
Technicians	2	4	5	2
SUPPLIES				
Availability of Sedation	Yes	Yes	Yes	Yes
Availability of Antibiotics	Yes	Yes	Yes	Yes
Availability of Needles, Catheters, and Guidewires	Limited	Limited	Limited	Limited
INFRASTRUCTURE				
Mini PACS ^β for image viewing	Yes	Yes	No	Yes
PACS for reporting	Limited	Limited	No	No
Availability of electronic medical record system	No	No	No	No
Estimated power outages / month	3	0	2	5-10
Angiography suite downtime / month	2	0	<1	<1

^β Picture archiving and communication system

Figure 2. Interventional radiology casemix trend in public sector hospitals from 2016-2019 for Yangon General Hospital (YGH).

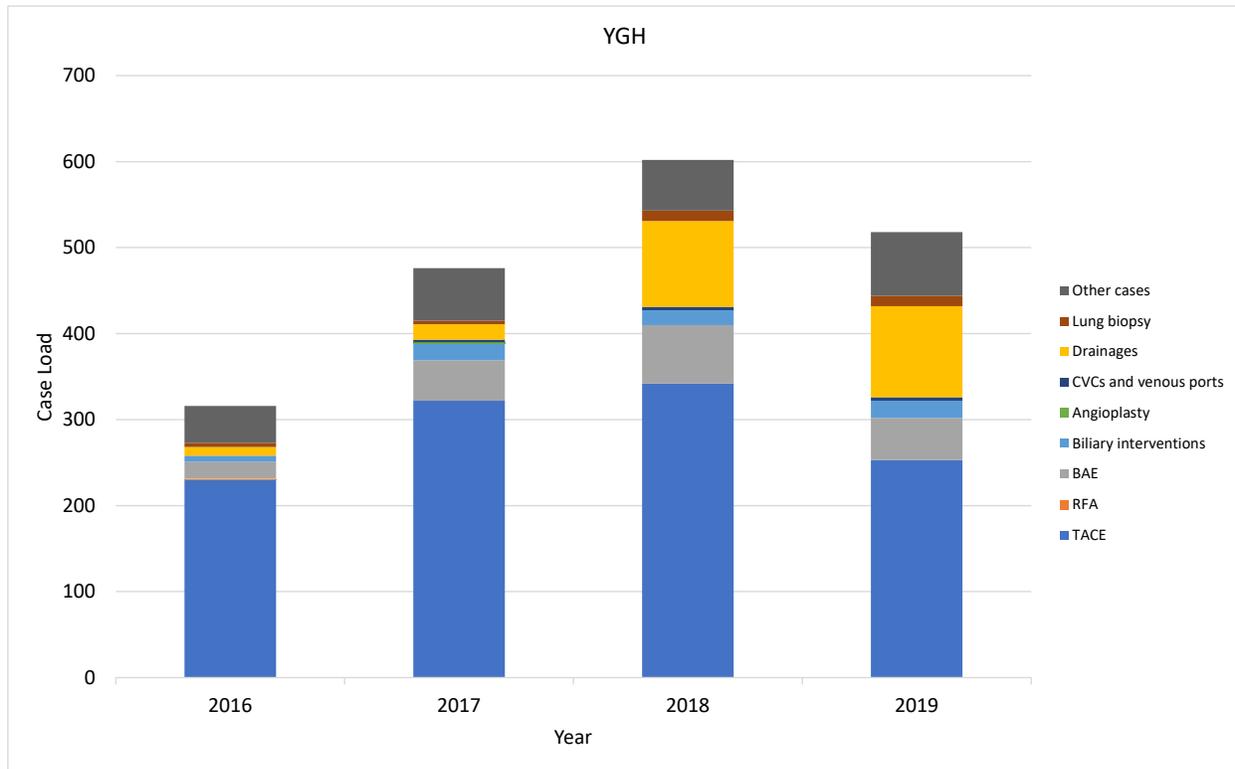
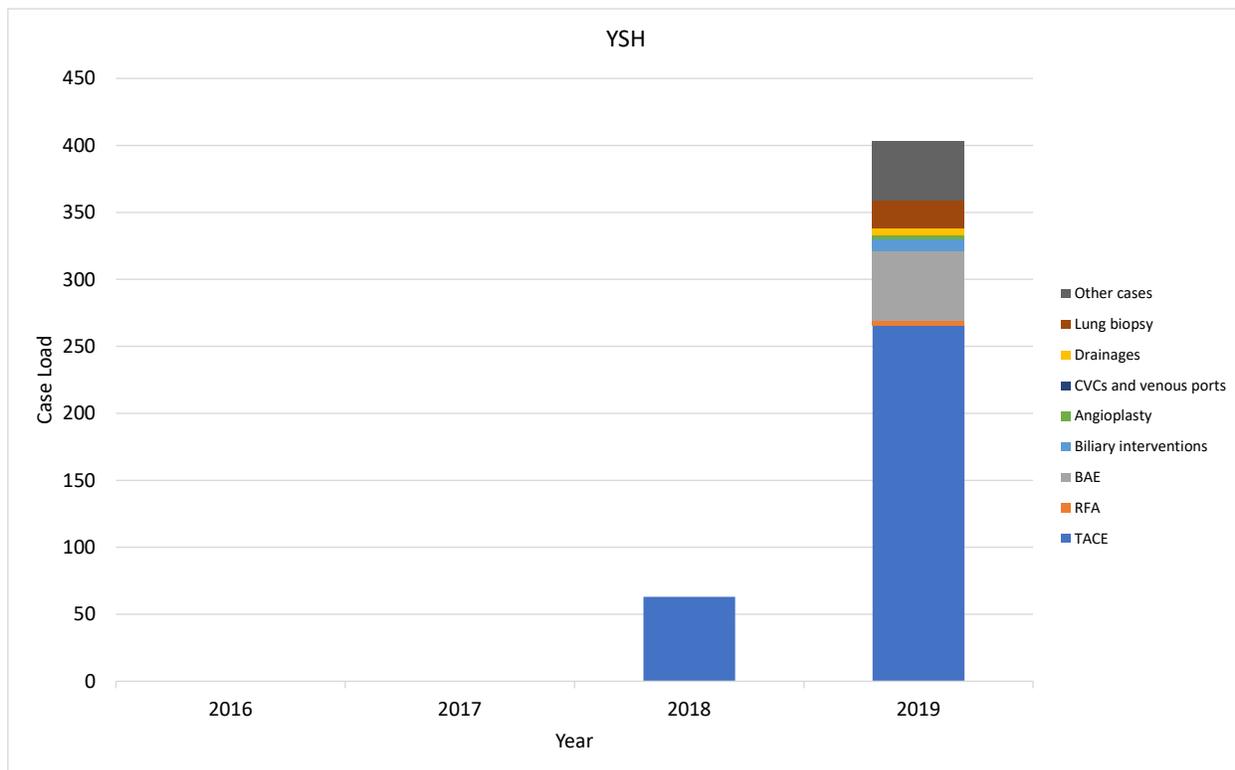


Figure 3. Interventional radiology casemix trend in public sector hospitals from 2016-2019 for Yangon Specialty Hospital (YSH).



and Interventional Radiological Society of Europe (CIRSE) and Society of Interventional Radiology (SIR) have included annual IR outreach programs to Myanmar and Cambodia since 2016 (12–14). These initiatives have consisted of on-site workshops, educational lectures, live case demonstrations, and 12-month fellowship programs for Myanmar radiologists to be trained overseas in South Korea and Singapore.

This review aims to provide a national report on the current trends of interventional radiology (IR) within Myanmar's public sector since the established initiative coordinated by APSCVIR and MRS. To our knowledge, this will be the first report on IR capacity and casemix in Myanmar. We further set out to describe some challenges unique to the country, and propose the need to further develop this specialty to meet Myanmar's growing clinical needs.

Methods and materials

Data within the following domains were collected to provide a general understanding of the current capability, challenges, and opportunities for IR in the public sector: 1) Facility and Equipment, 2) Workforce, 3) Supplies, 4) Infrastructure, and 5) Casemix. Casemix breakdown by each hospital from 2016–2019 was obtained to demonstrate the progress in IR and disease burden trends. Data were obtained via clinical charts from the four public hospitals with IR service: Yangon General Hospital (YGH), Yangon Specialty Hospital (YSH), Mandalay General Hospital (MGH),

and Defense Services General Hospital (DSGH).

Results

Yangon General Hospital (YGH)

YGH is a 2,000-bed public facility built in 1899, and it began IR service in 2004. With the largest IR capacity in the country, it has one angiography suite with C-Arm fluoroscopy, two magnetic resonance imaging (MRI), and three computed tomography (CT) scanners. There are three interventional radiologists all trained overseas (one in Singapore, and two in South Korea), three specialized IR nurses, and two in-department technicians. IR-related supplies are limited, which often contributes to procedural delays. A mini picture archiving and communication system (PACS) is available for image viewing; however, there is currently no electronic medical record system. The department experiences approximately three power outages and two angiography suite downtimes each month (Table 1). The predominant IR casemix includes trans-arterial chemoembolization (TACE, 48.9%), bronchial arterial embolization (BAE, 9.5%), and drainages (20.5%, Figure 2). No radiofrequency ablation (RFA), central venous catheters (CVCs), venous ports, or angioplasty were performed over the past four years. The caseload drop experienced from 2018 to 2019 was due to the sharing of IR cases with the new neighboring hospital YSH in 2019.

Figure 4. Interventional radiology casemix trend in public sector hospitals from 2016–2019 for Defense Services General Hospital (DSGH).

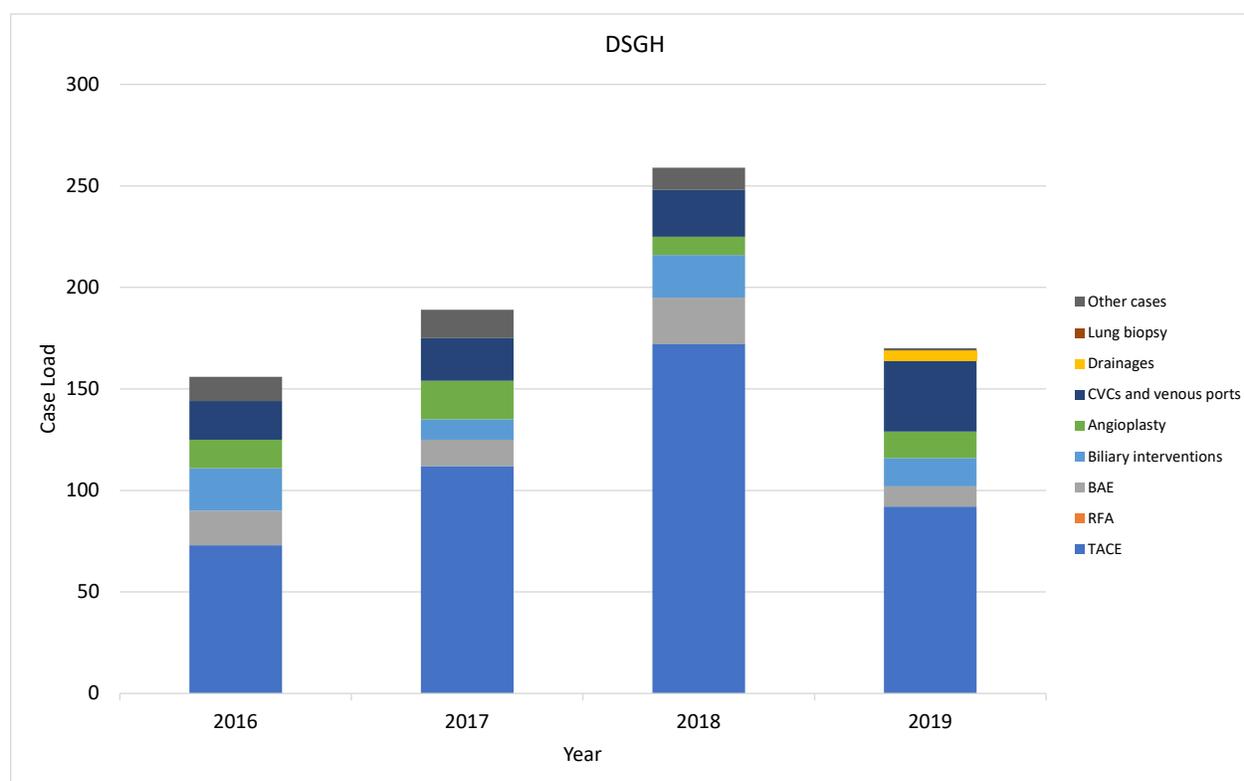
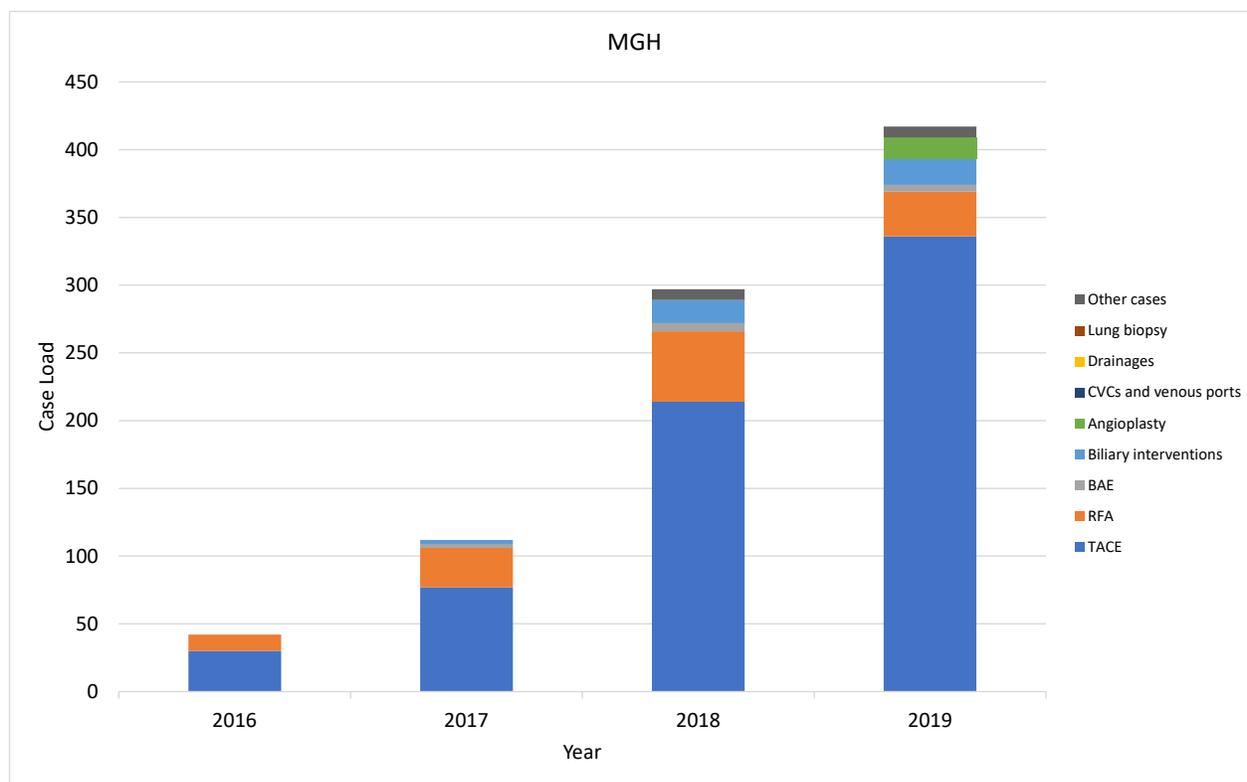


Figure 5. Interventional radiology casemix trend in public sector hospitals from 2016-2019 for Mandalay General Hospital (MGH).

Yangon Specialty Hospital (YSH)

YSH is a 500-bed public facility built in 2014. It is the country's premier liver and renal transplant center. Additionally, it has a wide range of specialized services (urology, hepatology, rheumatology, pulmonology, and interventional radiology) to complement YGH. Its IR service started in June 2018, initially supported by visiting IR consultants from YGH and DSGH. Its caseload in 2018 was 63 cases, all of which were TACE. Currently there are three interventional radiologists (trained in Singapore and South Korea), two IR nurses, and four technicians. Due to manpower constraints, the IR staff from YSH (radiologist, nurse, and technicians) have both diagnostic and interventional duties. Mini PACS for image viewing is available, but there is no electronic platform for clinical care and storage (Table 1). At the time of writing, YSH has not had any power outages or IR suite downtimes during its first year of operation. The casemix at YSH is similar to that of YGH, with TACE (66%) and BAE (13%) accounting for 318 of 484 procedures in 2019 (Figure 3).

Defense Services General Hospital (DSGH)

DSGH is a 1,000-bed military hospital servicing Myanmar's armed forces. Its IR service started in 1990. There is one angiography suite and one CT scanner. There is currently one interventional radiologist servicing DSGH's IR department on a part-time basis. Prior to 2019 there were two interventional radiologists (trained in Singapore) who were subsequently reassigned to other centers. PACS is not available and all

images are viewed and stored on DVDs. The predominant casemix includes TACE (54%) and CVCs and venous ports (20.5%), which accounted for 127 out of 170 cases in 2019 (Figure 4). The drop in caseload in 2019 was due to manpower redistribution.

Mandalay General Hospital (MGH)

MGH is a 1,500-bed public facility servicing Mandalay and its surrounding region. Its IR service started in 2004, initially performing fewer than 10 TACE procedures each year until a service interruption from 2014 to 2016 due to unrepaired equipment. Since the installation of new angiography equipment in 2016, its caseload and casemix have grown consistently. MGH has one angiography suite with C-Arm fluoroscopy, two MRI, and three CT scanners. There are currently four interventional radiologists (two trained in South Korea, two trained locally), three specialized IR nurses, and fifteen technicians that rotate on a daily basis to service the radiology department, with two daily rostered IR technicians. The predominant casemix includes TACE (80.6%), RFA (8%), and percutaneous transhepatic cholangiography (PTC, 4.5%), accounting for 388 out of 417 cases in 2019 (Figure 5). No CVCs, other drainages, or biopsies were performed at MGH in the past four years.

Myanmar IR casemix trends

There were approximately 1,508 IR cases performed across the Myanmar public sector hospitals in 2019 with fluoroscopy-guided procedures accounting for more than three quarters of cases (Figure 6). These were predominantly

angiographic procedures consisting mostly of TACE (63%) and BAE (7.7%). Non-angiographic fluoroscopy procedures were mostly biliary interventions. Ultrasound-guided procedures represented 18% and consisted predominantly of non-lung biopsies, drainages, and RFA. Lastly, CT-guided procedures represented only 2% of all cases and consisted mostly of lung and mediastinal biopsies. The main institution where RFA procedures were performed was MGH. The main institutions where drainages and biopsies were performed were YGH and YSH, and the main institution where CVCs and angioplasties were performed was DSGH.

Discussion

IR growth and capacity in Myanmar's public sector

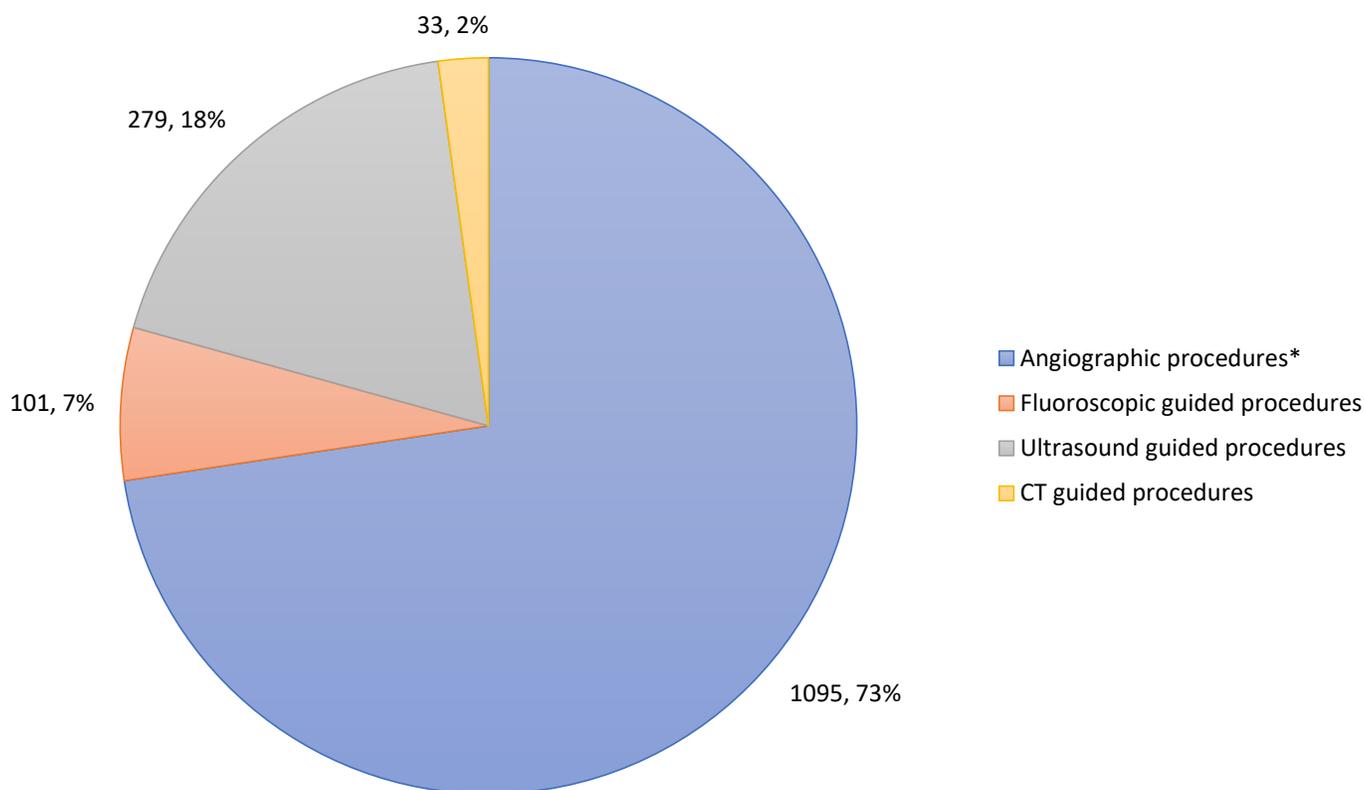
Interventional radiology across Myanmar's public sector has seen a tripling of caseloads – from 514 cases in 2014 to 1,508 cases in 2019 – as a result of growth in facility, workforce, equipment, and workflow integration. While the increase in IR volume is promising as the service establishes itself in tertiary hospitals, there remains significant opportunity to

widen the scope of procedures performed. The majority of cases were angiographic procedures guided by fluoroscopy, which reflect the unique disease burden in Myanmar. The management of underlying hepatocellular carcinoma (HCC) and tuberculosis (TB) with TACE and BAE represented more than 70% of all cases.

The literature on IR in Southeast Asia is varied and limited. While there are no countrywide reports on the IR casemix and trends in this region, most of the available IR studies were from Thailand, with TACE treatments published as early as 2000 (15). The available literature on IR in Thailand was predominantly on fluoroscopic-guided angiographic procedures, with TACE being the most prevalent (16), and very limited findings on other procedures such as vascular access, non-hepatic embolization, and CT-guided biopsies (17–19).

Despite the significant cost and challenges associated with establishing IR service in developing countries, the call for such service is increasing, and particularly for the treatment for HCC (20). HCC severity is of particular interest given its wide prevalence, advance presentation, and recently

Figure 6. Image-guided interventions in 2019 across four public sector hospitals in Myanmar by imaging modality.



Case volume denoted by number and proportion denoted by percentage.

*Angiographic procedures consisted predominantly of TACE and BAE, fluoroscopic-guided non-angiographic procedures consisted mostly of biliary interventions, ultrasound-guided procedures consisted mostly of drainages, RFA, and CT-guided procedures consisted predominantly of lung and mediastinal biopsies.

declared effort to screen and treat early in Myanmar (21,22). As health screening and follow-up programs improve, early HCC presentations will become more prevalent, further increasing the caseload for this disease group. In recognizing potential treatment options for advanced HCC, a recent study in Bangladesh by a hepatologist initiated TACE treatments for the first time (23). More research evaluating HCC severity and its corresponding TACE response would help to shed light on the utility and cost savings of disease-specific IR procedures, which is of increasing importance in developing countries.

Myanmar is among the global list of 30 developing countries with a high MDR-TB burden, which has continued to increase in recent years (24). Correspondingly, significant diagnostic and treatment delays are further contributing to the rise in tuberculosis-related hemoptysis (25). As a result, IR service across the country has been performing more BAE to meet this unique regional need. However, in resource-limited settings, this has likely come at the expense of further delays in other elective cases.

Differing expertise and IR casemix across public institutions

While the predominant procedures for all four public sector hospitals include TACE and BAE, significant differences were evident in the remaining casemix. Within the public sector, MGH had more than 90% of the entire country's RFA procedures, and yet it had no CVCs, drainages, or venous ports. Within the public side, YGH accounted for more than 90% of the country's drainages, however it had negligible CVC, angioplasty, and RFA procedures. YSH is the premier liver and renal transplant center in the country, and yet biliary procedures accounted for less than 4% of its casemix. Similarly, within the public sector, DSGH performed 90% of the country's CVCs and most of the angioplasty cases over the past four years. The diversity in casemix across the public sector stems from differences in expertise, referral practices, equipment, vendor support, and awareness of IR capability by other medical specialties.

At MGH, the interventional radiologists have adequate vendor interest and support, and abundant exposure to RFA techniques during their overseas training. Currently, it is common practice across the country that renal biopsies and nephrostomies are performed by urology surgeons. CVCs and venous ports are routinely performed by anesthesiologists, except in DSGH, where the first interventional radiologist established an expertise reputation for these procedures in 1990. Lack of IR awareness and referrals are likely primary reasons for the few drainages performed at most of the public sector hospitals. At YGH and YSH, the lack of RFA procedures for the IR department is multi-factorial. Currently, most RFA procedures at Yangon are performed by the hepatobiliary surgeons, and the referral workflows for such cases are not as well delineated as at MGH. There are also differing skill sets and experience among interventional radiologists within the private and the public sectors, which may contribute to the diverse casemix observed. While not well described, the private sector has experienced

rapid IR growth over the years. In particular, RFAs are commonly performed at private centers in Yangon by both interventional radiologists and hepatobiliary surgeons.

Challenges and future initiatives

The common themes underscoring the challenges to growing IR in Myanmar revolve around infrastructure, equipment and supplies, manpower and expertise, and local workflow practices. Each of the four public hospitals with IR service has only one angiography suite with an office-hour operational window. This limits the potential to address many hemorrhage emergencies secondary to trauma, medical complications, and advanced oncology illnesses that are more prevalent in developing countries. In resource-limited settings, IR service that is prepared, available, and effective has demonstrated the ability to improve the care of trauma-related outcomes significantly (26). Additionally, there are increasing calls for establishing IR service for postpartum hemorrhages and other urgent indications (27,28). Future efforts to grow IR in Myanmar should strive to optimize the balance between upscaling to provide emergency 24-hour services and having the infrastructure to support elective cases without significant delays. In addition to expanding service infrastructure, further skill set training is needed, particularly in neurointervention, which is severely lacking in the public sector. The neurological disease burden ameliorated by IR procedures remains poorly characterized, and further research is needed to better evaluate this need. Only about 10 to 20 neurointerventions are currently performed each year by neurointerventional radiologists visiting from overseas (29).

Equipment breakdown and lack of supplies pose a significant challenge for the practice of IR and across many other developing countries. The lack of supplies such as embolization coils, angioplasty balloons, and micro-catheters in Myanmar limits the scope of procedures that can be performed. Additionally, poor equipment servicing contributed to the two-year IR service downtime in MGH between 2014 and 2016.

The four public hospitals with IR service have only one to four interventional radiologists and limited support staff. Many of the IR nurses and radiographers have duties outside of IR in diagnostic and medical settings due to manpower constraints. This challenges the ability to develop equipment and workflow familiarity, and ultimately predisposes the departments to service disruption and reduced safety, and efficacy.

IR is dependent on a multidisciplinary approach. The public sector hospitals face the challenge of integrating their service within the established workflow of other medical specialties. The level of acceptance of interventional radiologists by medical and surgical specialties has varied. It was only within the past five years that referral workflows were established for the treatment of advanced HCC with TACE at MGH, which corresponded to the significant increase in case volume. The integration of IR treatment options such as TACE and RFA for HCC at MGH occurred gradually,

with joint bi-monthly meetings with oncology staff and weekly clinical rounds with hepatobiliary (HPB) surgical and medical services. Additionally, YGH's IR department, which had an established referral program for TACE, shared its integrated workflows. This, along with studies calling for the adoption of diverse treatment options for HCC in resource limited countries, led to further uptakes in referrals (20). There is ongoing effort to better integrate and increase referrals in other medical and surgical specialties. This includes CT-guided procedures, which were predominantly lung and mediastinal biopsies accounting for only 2% of all caseloads in the public sector. The minimal case volume stems from few referrals from medical specialties due to lack of awareness of IR capability and dedicated workflows at MGH and DSGH. At YGH, there is a selection of cases favoring only the lowest risk mediastinal biopsy cases, due to infrastructural factors limiting IR capabilities. Currently the CT equipment at YGH lacks the CT fluoroscopy function that would enable CT-guided biopsies to be performed more efficiently. Furthermore, the thoracic surgical/medical wards are not in YGH but in the adjacent YSH, thereby limiting adequate post lung biopsy monitoring. At YSH, due to its relatively new IR service, many clinical frameworks do not include IR referrals and may explain the low number of biliary and RFA procedures despite having a liver transplant center. MGH faces a similar low referral workflow with drainage and CVC procedures. Future outreach, workshop, and training initiatives should not only aim to improve the skill set of local radiologists, but also aim to raise awareness of IR capability among other medical specialties to improve referral networks. As IR continues to grow across Myanmar and other developing countries, these initiatives should target the social, infrastructural, logistical, and administrative domains (30). This holistic approach would serve to up-skill the workforce and better address the contextual challenges specific to different cultural and local medical practices.

Conclusion

Myanmar has seen tremendous growth in its IR service across its public healthcare sector. The predominance and exponential growth of TACE and BAE procedures suggest the clinical need for more robust IR services to meet this growing demand. Outreach programs such as the annual workshop sponsored by the APSCVIR in collaboration with SIR and CIRSE play a pivotal role in the growth of IR in Myanmar. Future initiatives should be holistic and concerted, in order to improve the integration and sustainability of IR service across Myanmar's public sector.

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Conflict of interest

The authors report no conflict of interest.

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