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GLOBAL VISION

Interventional Radiology Readiness Assessment Tool for Global Health

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Abstract

The Interventional Radiology Readiness Assessment Tool for Global Health is a new tool to methodically evaluate the environment of a medical institution for interventional radiology services given an existing infrastructure. Global health provides a meaningful opportunity for interventional radiology to impact health outcomes. A systematic and thoughtful approach to integrating interventional radiology services in the health care institutions of resource-poor areas is needed in order to maximize global health efforts and outcomes.

Introduction

Through partnerships with the World Health Organization (WHO), non-profit organizations, professional societies, academic institutions, the private sector, and other entities, some progress has been made to recognize, define, and begin to address the disparities in global radiology (1). With cardiovascular and noncommunicable diseases, such as cancer, projected to increase proportionally by WHO, it has been suggested that radiology will be in increased demand for the diagnosis and treatment of patients around the world (1,2). In fact, the International Atomic Energy Agency states that for cardiovascular diseases, medical imaging is "extremely important in that it offers strategic advantages in both diagnostic and therapeutic decision-making (3)". Additionally, to address the issues in WHO emerging epidemiologic data, the Cancer Moonshot initiative was established by the United States federal government, in association with the National Cancer Institute, to focus on the prevention, diagnosis, and treatment of cancer (4). Interventional radiology (IR) is a subspecialty of radiology focusing on minimally invasive, targeted techniques which are guided by medical imaging, such as X-ray, CT, or ultrasound, to diagnose and treat internally. As noted by the Society of Interventional Radiology, "Today many conditions that once required surgery can be treated less invasively by interventional radiologists. IR treatments offer less risk, less pain and less recovery time compared to open surgery (5)." As interventional radiology is a key service in the treatment of vascular conditions and cancer, the question can be raised regarding the emergence of IR's role in the global health setting.

Interventional radiology in global health

There is little literature on IR and global health or IR in low-income countries (as defined by the World Bank). It is unclear whether IR is not frequently performed in low-income countries or if it is performed and not frequently documented in the literature.

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However, there are some examples of IR services performed in remote locations. Ferrara described United States medical military bases' use of interventional radiology to deliver arterial embolization after trauma, as well as insertion of IVC filters, chest tubes, central venous access catheters, percutaneous abscess drains and nephrostomy tubes (6). Admittedly, the resources of a US medical base are not those of most hospitals in low-resource settings. For example, fluoroscopy equipment required for embolization and IVC filter procedures is unlikely to be available. Another example comes from Brazil, where Kisilevsky and Elkis described using a truck, C-arm and angiographic supplies to perform uterine artery embolization at multiple hospitals over a 6-week period (7), demonstrating an alternative answer to the question, "what is an angiography suite?"

In South Africa, hepatopancreaticobiliary surgeons have paired with radiologists to learn how to perform percutaneous transhepatic biliary drainage catheter placement after failed placement of bile duct stents by endoscopy in order to better treat biliary obstruction (8). To address the challenge of expense encountered in areas of healthcare access disparity, more cost-effective ways to treat disease have been described. For example, Karim et al. reported using a direct trocar puncture of the kidney for percutaneous nephrostomy tube placement in the setting of urinary obstruction (9).

Alternative solutions to better administer international medical aid have also been described by surgeons. Gosselin et al. describe the complexities of meeting surgical challenges in low-resource settings, which are akin to those encountered for more complex IR procedures, and propose creation of local training programs with a twinning of medical schools in "developed and developing countries" to their mutual benefit (10).

The department of surgery at the University of North Carolina at Chapel Hill, along with other institutions, has partnered with the Malawian Ministry of Health to analyze the need for surgery in global health. The partnership began with an assessment of resources for trauma cases; in response, the partners created a surgical residency to create a long-term, sustainable solution by training more local surgeons (11). The program utilizes an international network of surgeons who educate the Malawian surgeon trainees and encourage them to stay in Malawi after completion of their training (12).

There are less complex interventions that interventional radiologists can offer and train others to perform. One of the most beneficial procedures for low-resource areas would be the image-guided drainage of abscesses, which could be facilitated by ultrasound in many cases (13). Additionally, ultrasound-guided biopsy can help direct therapy if pathologists, oncologists and/or surgeons are members of the healthcare team.

Necessity of assessment

To create a data-driven, methodical approach, Radiology Readiness™ was developed by RAD-AID International in 2010 and was endorsed by WHO in 2012. RAD-AID International is a US-based 501(c)(3) nonprofit that promotes sustainable global health radiology initiatives. The Radiology Readiness™ assessment is a framework for implementing radiology partnerships in areas of low access to medical imaging technologies or education. At the onset of a partnership, data are collected on all aspects of the target health system. Examples include infrastructure of the community, availability and reliability of power supplies, staffing within and outside of radiology, availability of treatment resources, epidemiology, and specifics about modalities within the facility (14). This allows for the stakeholders to establish goals tailored to the site and to optimize outcomes. Planning and implementation are based on the assessment data with education and training as major components allowing for sustainability (15).

Obtaining a baseline assessment allows for preparation in partnership planning so that resources are used effectively. Additionally, the collection of these objective data allow for outcomes measurement over time, as the tool provides a standardized means for evaluating the partnership goals. If planning a global radiology partnership with specific focus, then a Radiology Readiness™ assessment can be supplemented by an additional survey. For example, if a RAD-AID partner could benefit from a picture archiving and communication system (PACS) and informatics implementation, a PACS Readiness assessment is collected (1). If creating a partnership with goals related to IR, then collecting information on existing interventional resources is necessary as a starting point. The authors propose a basic outline for an IR Readiness Assessment Tool for global health.

Interventional Radiology Readiness Assessment

An IR Readiness Assessment is a tool to methodically evaluate the environment of a medical institution for IR services. The assessment can be used to determine the scope of services that could be provided given the infrastructure. Additional consideration of the culture and politics of a medical institution should also be considered in the initial evaluation and partnership implementation. Supply chain management and technological equipment availability, maintenance, and repair will play major roles in service sustainability. The assessment will focus on technological equipment, devices, supplies, personal protective equipment, complementary medical services, and educational resources.

Assessment of technological equipment includes inventorying ultrasound machines and types of probes (e.g. superficial linear high frequency, curvilinear penetrating lower frequency probes, etc.), CT scanners with readily viewable monitors in the procedure room, fluoroscopy equipment (e.g. C-arm) and PACS for reviewing relevant prior imaging. If no PACS is available, the presence of hard copy film and view boxes should be considered.

Procedural devices and supplies will also determine the

types of procedures that can be performed. Inventory should be made of biopsy guns (gauge, length), drainage catheters (French size, length), central venous catheters (non-tunneled, tunneled, subcutaneous port) and other bio-safe tubing such as Foley tubes. Other procedural supplies to count include coaxial needles (gauge, length), short and long guidewires (0.035-inch or 0.018-inch), vascular sheaths (French size, length), peel away sheaths (French size, length), vascular catheters (end hole, flush, angled, reverse curve, microcatheter as well as French size, length).

Medical supplies to consider include ultrasound probe covers, IV contrast agents, sterile saline, saline flushes, gel foam, lidocaine, syringes, suture, needles, sterile towels, sterile drapes, and antiseptic agents (e.g. Chlorhexidine or Betadine). Assessed personal protective equipment items should include eye protection, sterile gloves, sterile gowns, masks, hair covers, and hand wash stations. Moreover, if ionizing radiation will be used, assessment of available shielding should be performed to include leaded aprons, leaded shielding such as table skirts or leaded glass, leaded eye glasses and the availability of dosimeters.

In order to provide peri-procedural care, the availability of relevant oral and/or IV medications should be evaluated. The assessment should include narcotics, benzodiazepines, non-steroidal anti-inflammatory medicines, steroids, antihistamines, anti-platelet therapy and antibiotics.

IR services will be most effective if they can naturally integrate with other hospital services. IR services may yield a biopsy specimen, but without a pathologist the specimen is of limited use. In addition, if there is a given diagnosis of cancer and no oncologist or surgeon, how does ascertaining the diagnosis help the patient? Therefore, an evaluation of the clinical pathology laboratory services (blood counts, coagulation studies, electrolytes) and medical specialties available (anatomical pathology, surgery, anesthesiology and oncology) is necessary. Surgical services may already employ supply chain management that could be used in the IR setting. Similarly, nurses and technologists who could integrate into the IR setting should be considered in the evaluation.

An IR Readiness Assessment is included in the Appendix.

Ethical and educational considerations

Ethically, it is essential to address peri-procedural management and communication with other providers as a first step in global health IR-integrated partnerships. Education for the radiology team and others providing IR services is necessary. Avenues for this learning should be assessed, such as local experts or Internet access to online resources or a trainee program—as in the case of surgery in Malawi (11). An IR knowledge base should include radiation safety, dose and image optimization, infection control and peri-procedural patient management. Local protocols regarding radiation safety and infection control should be assessed.

Analysis

The Interventional Radiology Readiness Assessment will yield data that are unique to the site. This information serves as an objective baseline for a partnership. During data analysis, one might ask: What is the scoring system for the IR Readiness Assessment Tool? Are there non-negotiable requirements or some minimal threshold criteria to start IR services? As the partners consider moving forward, it is critical to note that each assessment and action plan will be based on the local resources, needs, and stakeholders. Generalizations are inappropriate because what meets the needs of one partnership may be inadequate in another setting. Moreover, resources as well as gaps can be used as starting points from which to build. The assessment data can be written into a report form, including an executive summary, as a product for the partners to consider as they move forward together.

Conclusion

Interventional radiology bridges the specialties of radiology and surgery, allowing for minimally invasive diagnosis and management of many types of disease. However, IR procedures are not commonly performed in countries defined as low-income by the World Bank because of limited access and availability. As sustainable imaging services are implemented in a greater number of these countries, the authors believe there may be a role for interventional radiologists to partner with low-resource institutions to offer IR services. The Interventional Radiology Readiness Assessment Tool can be part of the first steps in evaluating a hospital for IR services in a thoughtful and measured way with in-country colleagues.

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Appendix

The IR Readiness Assessment Tool can be found in PDF format and as an online form at:

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Full text of IR Readiness Assessment Tool

NOTE: Answers are in free-text format unless otherwise indicated

- Describe the culture and politics of the medical institution as they relate to IR.
- Perform a brief Strengths, Weakness, Opportunities and Threats (SWOT) assessment for IR services at your institution.
- Describe the supply chain management for the department in which you work.
- How many functioning ultrasound machines are available?
- For each ultrasound machine, list the probe types (linear, curved) and MHz range of each probe.
- How many functioning CT machines are available?
- For each CT, list the number of detectors.
- How many functioning angiographic fluorocopy machines are available?
- How many functioning C-arm machines are available with monitors for live fluoroscopy?

  Answer options: Choose number: 0-8, 9 or more
- Is there a PACS workstation readily available in the procedure room?

  Answer options: Yes, No, Maybe
- Is there a view box available in the procedure room?

  Answer options: Yes, No, Maybe
- List the types of available biopsy guns, including gauge and length in centimeters.
- List the types of available drainage catheters, including French size and length in centimeters.
- List the types of available central venous catheters, including French size and length in centimeters.
- List the types of available tubes with attached balloons, including French size and length in centimeters.
- List the types of available coaxial needles, including gauge and length in centimeters.
- List the types of available guide wires, including diameter and length in centimeters.

- List the types of available vascular sheaths, including French size and length in centimeters.
- List the types of available peel-away sheaths, including French size and length in centimeters.
- List the types of available vascular catheters, including diameter (French size) and length in centimeters.
- Are there sterile disposable ultrasound probe covers?
  Answer options: Yes, No, Maybe
- What IV contrast agents are available?
- Are there sterile saline bags available?
  Answer options: Yes, No, Maybe
- Are there sterile saline flushes available?
  Answer options: Yes, No, Maybe
- Is gel foam available?
  Answer options: Yes, No, Maybe
- Is lidocaine available?
  Answer options: Yes, No, Maybe
- Is bupivacaine available?
  Answer options: Yes, No, Maybe
- Are sterile syringes available?
  Answer options: Yes, No, Maybe
- Are sterile needles available that can be attached to the sterile syringes, and if so, what gauge?
- Are there sutures with needles available? If yes, specify curved or straight and if dissolvable?
- Are there available sterile towels?
  Answer options: Yes, No, Maybe
- Are there available sterile drapes?
  Answer options: Yes, No, Maybe
- Which of the following are available: Chloraprep, iodine solution, isopropyl alcohol?
- Describe the available eye protection.
- Describe the available sterile gloves and size ranges.
- Describe the available non-latex sterile gloves and size ranges.
- Describe the available sterile gowns and sizes.
- Describe the available face masks.
- Describe the available head hair covers.
- Describe the available hand hygiene available such as wash stations.
- Describe the available leaded aprons and their millimeters of lead equivalents.
- Describe the available leaded table skirts and their millimeters of lead equivalents.
- Describe the available leaded glasses and glass panels.
- Describe the available personal dosimeters and how they are monitored.
- List the available narcotics and their routes of administration.
- List the available benzodiazepines and their routes of administration.
- List the available non-steroidal anti-inflammatory medicines and their routes of administration.
- List the available steroids and their routes of administration.
- List the available antihistamines and their routes of administration.
- List the microbe coverage of the available antibiotics and their routes of administration.
- Are there surgical pathology services available and with what specific expertise?
- Are there surgery services available and with what specific expertise?
- Are there laboratory services available to provide INR, complete blood counts, creatinine, basic metabolic panel and liver function tests?

INR	*Yes/No*
CBC	*Yes/No*
Cr	*Yes/No*
BMP	*Yes/No*
LFTs	*Yes/No*

- Are there nursing services available that can help provide procedural sedation?
- Are there radiologic technologist services or a similar substitute available that can help provide procedural assistance?
- Are there anesthesia services available that can help provide procedural anesthesia?
- What is the availability and speed of the internet at the facility (https://fast.com/)?
- What is the medical physics expertise available at the facility?