Grown from Global Roots: American Radiology and Health Diplomacy

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With Roentgen's initial discovery of X-rays in 1895, and subsequent clinical adaptations, a new era in medicine was born. The early years of medical imaging centered on global innovations originating in England, the United States, Germany, and Austria.[1,2] While initially, physicians were informally trained to interpret X-rays, the first American radiology residency was established in 1915 at Massachusetts General Hospital (MGH). As World War I began in 1917, a lack of imaging experts on the front line was bridged with a short intensive taught by US Army Medical School Professor Dr Arthur Christie.[3]

Upon the homecoming of combat physicians to civilian posts, those returning to specialize in radiology helped evolve radiology into its own specialty rather than divisions within other specialties (eg, surgery or obstetrics).[4] By 1934, a quorum of preeminent radiology departments and radiologists established the American Board of Radiology (ABR), which established radiology as the fifth medical specialty in America.[5]

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Prior to that, however, the dangers of medical ionizing radiation were noted by the German Roentgen Society, in 1913, which led to the eventual development of the United States National Bureau of Standards (now the National Council on Radiation Protection, NCRP).[6] Among their responsibilities, the NCRP facilitates standardized government inspections of laboratories and safety assessments of radiation sources.[7]

In 1928, the International Commission on Radiological Protection (IRCP) was formed as a consortium to protect healthcare workers from the hazards of occupational radiation exposure and to facilitate national radiation protection plans.[6]

Advanced through foreign military deployment, and standardized for safety by worldwide consortiums, radiology in America originated as a global specialty. However, as radiology has advanced clinically with imaging diagnostics and image-guided procedures integrating into nearly every clinical service line, these advances have not been equal around the world. However, the next era of radiology requires a refocus on equity and access for patients around the world. Especially as the United States government advances diplomacy through global health, and supports the expansion of health care delivery internationally, revisiting the importance of radiology and imaging infrastructure especially in the Global South is critical.[8,9]

US global health policy is led by the executive branch through the Department of State and the Department of Health and Human Services. The US Agency for International Development (USAID) was created in 1961 by President John F. Kennedy, combining many existing federal foreign assistance programs to create a single agency focused on economic development abroad.[8,10]

The US Congress supports foreign assistance by utilizing authorization bills, appropriation bills and resolutions as well as allocating discretionary and direct spending to set direction and policy.[8,10] While these bilateral efforts by the US represent the focus of the American agenda, much of the global health agenda is achieved through international alliances and multinational organizations such as the World Health Organization (WHO).

As the flagship health programs supported through US Global Health policy are centered on disease, radiology plays an integral supportive role in many of these programs.

With time, investment, and input from regional leaders and stakeholders, safe, sustainable, and locally staffed imaging is a possibility for all.

Programs and Pathology

Tuberculosis (TB)

The WHO declared TB a global health emergency in 1993, which was met with varied response by the global public health community.[11] USAID now implements an organization-wide global TB strategy that aims to reduce the burden of TB globally by strengthening systems for prevention, care, and treatment. This includes supporting the development and implementation of national TB control plans, improving laboratory capacity, drug supply management, and providing technical assistance to improve case detection and treatment outcomes.[12–14] The program also works to address social and structural barriers to TB care, including stigma and discrimination, and supports research to improve diagnostic tools and treatments for TB.[15]

Radiology plays a crucial role in Tb eradication programs. Imaging is commonly used to diagnose TB, determine disease extent, and monitor treatment effectiveness. In settings with limited access to cross-sectional imaging, chest X-rays can be inadequate as a diagnostic complement to bacteriologic tests. Additionally, chest X-ray interpretation can be limited by insufficient training of readers and a shortage of radiologists globally. Computer-aided detection (CAD) is an artificial intelligence tool being validated in varied use cases to provide rapid image interpretation in limited resource settings.[12,16,17] An update to the WHO guidelines on Systemic Screening recommends that screening for TB be conducted using a symptom screen, chest X-ray, or WHO-recommended rapid molecular diagnostic tests, alone or in combination. Per the guidelines, CAD software may be used *"in place of human readers for interpreting digital chest X-rays for screening and triage for TB disease."* [11,12,17–20]

Human Immunodeficiency Virus (HIV)

The President's Emergency Plan for AIDS Relief (PEPFAR) is a US government initiative launched in 2003 to combat the HIV/AIDS pandemic, primarily in sub-Saharan Africa. It is the largest commitment by any nation to combat a single disease internationally and has provided antiretroviral treatment and care for millions of people living with HIV/AIDS.[21] As TB accelerates mortality and morbidity amongst people living with HIV, regular TB screening (along with diagnostic testing and treatment) centers on radiology. Notably, the Focused Assessment with Sonography of HIV/TB (FASH) exam is a point of care ultrasound (POCUS) technique to quickly assess high-risk patients with concern for extrapulmonary TB in resource-poor environments.

The FASH exam, while not traditionally used for screening, has been validated as a complement to clinical acumen.[22] The FASH exam is used to evaluate for pericardial or pleural effusion, abdominal ascites or lymphadenopathy, and focal hepatic or splenic hypoechoic.[22]

PEPFAR's model of health delivery relies on a variety of mechanisms, including direct funding to partner or-

ganizations and governments, as well as through procurement of goods and services. This requires analysis of imaging infrastructure (eg, electricity, imaging equipment, RIS [radiology information system], PACS [picture archiving and communication system], etc.) and acquisition in partner countries. PEPFAR works closely with local partners to ensure that its assistance is integrated into national HIV/AIDS programs and is aligned with national priorities.[23–25]

Maternal and Child Health

USAID strategy for maternal and child health focuses on improving the health and well-being of mothers, newborns, and children in developing countries. This strategy involves supporting partner organizations, programs and initiatives that address the main causes of maternal and child mortality, such as inadequate access to quality health care, poor nutrition, and lack of education and awareness about health practices. This includes providing funding and technical assistance for programs and organizations with topical expertise.[26,27]

USAID's flagship program, the Maternal and Child Survival Program, utilized $540 million to work in 25 countries and establish high-impact interventions and sustainable "scale-ups" of health delivery.[28–30] Through this program, guidance surrounding expansion of obstetric ultrasound services to reflect WHO and Pan American Health Organization (PAHO) guidelines for routine sonography for pregnant women living in areas affected by Zika virus was developed.[26,27,30–32]

The global need for general maternal ultrasound continues to increase. The updated 2022 WHO recommendations now include that for all pregnancies, "*one ultrasound scan before 24 weeks of gestation is recommended for pregnant women to estimate gestational age, improve detection of fetal anomalies and multiple pregnancies, reduce induction of labor for post-term pregnancy, and improve a woman's pregnancy experience.*" [27,33–35]

Neglected Tropical Diseases

Neglected tropical diseases (NTDs) encompass a varied group of bacterial and parasitic diseases that disproportionately infect over a billion impoverished and marginalized people globally. USAID focuses on the most common pathogens considered to have cost-effective health interventions (lymphatic filariasis, soil transmitted helminths, onchocerciasis, blinding trachoma, and schistosomiasis).[36,37] These NTDs predominate in low resource areas, as limitations in sanitation and access to clean water create endemic environments for infection, leading to further reduced economic activity, reduced intellectual development, and decreased school enrollment.

The key objectives of USAID include control and elimination of disease, strengthening scientific evidence base, and supporting local partners. While imaging is not uniformly integrated into the screening of these diseases, diagnostic tests and imaging findings can help confirm a diagnosis or evaluate burden of disease. Ultrasound can be utilized to evaluate pathology, including- onchocercal nodules, scrotal swelling and lymphedema secondary to filariasis, and schistosomal calcifications in bowel. With further investment in infrastructure, imaging will continue to clinically impact diagnosis and management of NTDs.[37,38]

COVID-19

As COVID-19 continues to challenge individuals, healthcare systems, economies, and governments around the world, it represents the most recent stress test on US global health policy. With response originating from the White House (across two administrations), USAID was the center of international outreach by the US, generally aligning with WHO and working with other geopolitical alliances.[39]

Like many respiratory illnesses, COVID-19 clinical care often centers on medical imaging. To increase access, programs were created to solve capacity and infrastructure shortcomings.[40–42] One such program was uniquely implemented in remote districts in Vietnam where COVID-19 outposts converged with modern TB screening due to the high burden of multi-drug resistant TB in these areas. Rapid diagnostic machines (TrueNAT) as well as ultraportable X-ray machine were implemented in these healthcare outposts.[19,42,43] Computer aided software helped with imaging evaluation in areas where radiographs were not accessible by a radiologist. Rapid detection of COVID-19 and TB served to support the health of the people of Vietnam and their national health strategy.[19,41,41,43–46]

The importance of radiology in a global pandemic was cemented by COVID-19. While telemedicine emerged as an access option in certain areas without adequate staffing, implementation is limited by the available infrastructure. Considerations for teleradiology in low/middle income settings involve access to reliable electricity and the internet, PACS systems and digital imaging equipment (eg, radiography, ultrasound, etc.), on top of the clinical and technical support. While COVID-19 necessitated urgency in implementing programs based on assumptions of need, true operational considerations must be evaluated on a site-by-site basis with thorough needs assessment.[47]

Health Diplomacy, Radiology, and the Future

While any review on global health would be remiss without a discussion of the roots in colonialism and historic disenfranchisement of certain populations, this critique deserves a larger scope than can be provided in this review.[49]

Nearly two-thirds of the world population does not have access to diagnostic imaging, and even fewer to cross-sectional imaging and image-guided procedures.[33] While many academic radiology societies have advanced care and techniques, these collaborations have generally excluded improving access to imaging in the developing world. During the pandemic, the global effects of pathology and policy as well as the importance of access to basic imaging were highlighted. As US global health programs expand and focus on disease processes, radiology is a crucial pillar.

Where applicable, allocating specific resources within aid programs to grow sustainable imaging infrastructure globally should become a formal strategic mission integrated into the US health diplomacy agenda. Interest in global service from radiology trainees to retirees can be the first step in supporting imaging care globally.[48] With time, investment, and input from regional leaders and stakeholders, safe, sustainable, and locally staffed imaging is a possibility for all. Furthermore, with increased attention to global imaging needs, innovations improving access to imaging infrastructure and equipment, as well as developments in autonomous imaging evaluation, the medical landscape in once remote places is quickly shifting. With clinical and technical expertise, Radiologists should be more engaged in programmatic development and collaborations with burgeoning partner sites.

Conclusion

American radiology as a specialty has grown and evolved on the world stage; however, global health delivery in low resource settings has been insufficient. United States diplomacy has focused immense resources towards healthcare around the world without adequate focus on the critical role of imaging services. With renewed reflection on the value of imaging by governments, agencies, clinical societies, and individuals alike in the era of the pandemic, working together towards humanitarian objectives can transform the landscape of care throughout the world.

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