Imaging inequality: Exploring the differences in Radiology between high and low income countries

Introduction

According to the 2019 data published by the Organisation for Economic Cooperation and Development (OECD), there are approximately 10 CT scanners per 1 million population in the United Kingdom[1]. Vanuatu, a Lower Middle Income Country in the Pacific Ocean[2], does not have a single one. What does that mean for daily work 'on the shop floor'?

A young man was brought into the Vila Central Hospital in Vanuatu as a major trauma call following a boating accident. He sustained complex cranial vault fractures, intracranial injuries and soft-tissue body injuries. With limited availability of diagnostic imaging and no specialist neurosurgical care the patient did not regain consciousness and was managed palliatively…

Just over 10 000 miles away, in a tertiary hospital in the United Kingdom, a similarly injured patient underwent a full body CT scan within minutes of arriving in the Emergency Department. The head scan detailed complex cranial vault fractures and confirmed a mass effect from an intracranial haematoma. This was subsequently evacuated by the neurosurgical team with the patient making a satisfactory neurological recovery…

The Importance of Priorities

Medical imaging has a central role in well-functioning health systems, integrated into the World Health Organisation's Six Building blocks of a Health System[3, 4]. As such its adoption is crucial among both high- and low and middle-income (LMI) countries. Broadening adoption of medical imaging could impact several of the Indicators of Sustainable Development Goal 3 (Good Health and Well-Being), including improvements in prenatal care, earlier diagnosis of TB, complications of malaria and non-communicable diseases[5]. Despite this role, widespread use of medical imaging remains the domain of heavily-industrialised countries. The World Health Organisation estimates that approximately two-thirds of the global population still lacks access to appropriate diagnostic medical imaging[6, 7].

The most obvious cause for such imaging inequality, (sometimes termed 'radiology divide'[8]) is the high, upfront cost of acquiring and running advanced imaging units such as CT, MRI and PET. Suppliers in the US, quote purchase prices of up to 2.5 million USD for new CT scanners with operating costs in the region of 100 thousand USD per annum[9]. In a world where even high-income economies, such as Canada with a GDP of over 2 trillion USD[10], struggle to keep their equipment updated[11], there is little chance that countries like Vanuatu (GDP of just under 1 billion USD[10]) will be able to afford the latest technology. In addition to the running costs, taking full advantage of diagnostic imaging requires availability of highly specialised medical personnel. Treatment of severe head injuries such as those in scenarios above, requires input from experienced neurosurgical and critical care teams. For Vanuatu, the closest neurosurgical centre is in Australia, some 1300 miles away, across the sea. Even if the patient did undergo a full trauma CT scan and the injury was identified, it would be unlikely to alter the clinical management.

Aside from costs and other services' availability, a further contributor to diagnostic imaging inequality, is the relative lack of technologies developed with LMI countries in mind[12]. As pointed out by the World Health Organisation (WHO), manufacturers of medical equipment tend to prioritise the healthcare needs of high-income countries, which offer much higher and reliable profits[13]. Until recent years, the market for imaging devices in LMI countries has been quite sparse. The healthcare needs in those settings revolved primarily around treating the complications of malnourishment, poor sanitation, with a limited role of diagnostic imaging. While these issues are still relevant, they increasingly give way to tackling infectious and non-communicable diseases[14]. This shift puts provision of diagnostic technology, at a more central position in global health and brings the needs of LMI countries closer to those of their industrialised counterparts. While the healthcare needs are rapidly evolving, the supply of reliable devices, producing high-quality images in a resource-limited setting, is lagging. The increased demand for imaging services caused the WHO to redefine its stance on donation of imaging technologies to LMI countries from a peripheral and supplementary role in early 2000s[15], to a more recently regulated endeavour suited to local needs[16].

Improved understanding of different challenges facing imaging departments of LMI and high-income countries has led to a growing concern about the suitability of philanthropic initiatives[16]. Higher-income countries focus on the needs of aging populations and exploit marginal health gains using sophisticated diagnostic imaging[17, 18, 19]. This approach helps with earlier detection and treatment of non-communicable diseases and importantly, is underpinned by decades of development in healthcare infrastructure. Given that the majority of the global population has no access to radiological imaging, it is unlikely that an overnight leap to a Western model of healthcare will be possible. It is therefore inadvisable to extrapolate the lessons learned from healthcare provision in high-income countries to the rest of the globe. In fact, the WHO stipulates that the most effective intervention in LMI countries includes widespread adoption of good quality basic X-ray and ultrasound imaging and establishment of reliable digital imaging infrastructure. These interventions are robust, can immediately improve patient management and build foundations for further work[12].

Given the vast differences of priorities between high-income and LMI countries, generally available equipment is simply not suited for the latter. Issues such as complex maintenance, lack of replacement parts, staff needed to run it, adverse environmental conditions and limited access to electricity, require a different design and testing of such machines. The magnitude of this issue is illustrated by the fact that in the late 1990s and early 2000s, 70% of medical equipment in Sub-Saharan Africa laid idle due to mis-deployment[15]. With 80% of all equipment acquired from international aid, this makes uncoordinated, unsolicited donation efforts highly inefficient[13]. These issues triggered the WHO to produce specifications for equipment suitable for use in underserved areas (World Health Imaging System for Radiography- WHIS-RAD), where a single radiological unit can be reliably used to support a population of 50 000 in a place where no prior service exists[12].

Maybe Not So Different After All?

As part of the paradigm shift in provision of medical imaging in under-represented areas, organisations, such as Rad-AID, (a non-profit organisation helping to bring radiology to LMI countries) developed tools to assess the most appropriate ways of addressing local imaging needs. The RAD-AID Radiology Readiness tool[8] aims to deliver a structured assessment of

local infrastructure and systems, to maximise the positive impact of imaging. Despite use of different criteria, the core principle of health needs assessment and service evaluation tools is not dissimilar in the healthcare systems of high-income countries, such as the United Kingdom. While in the high-income countries one rarely worries about a functioning power supply or availability of replacement parts for imaging equipment, other aspects, such as adequate staffing, availability of specialist teams, fulfilling a pre-existing service need and long-term financial viability, do remain a significant concern.

Despite demonstrated differences between high-income and LMI countries, a more in-depth analysis of their health service needs does reveal some parallels. Given the global, exponential increase in demand for diagnostic imaging services, both high- and low-income countries face a shortage of specialist radiologists. The recent Royal College of Radiologists workforce censuses reported that between 2013 and 2018 there has been a 54% increase in demand for cross-sectional CT imaging, with a further 5% per annum increase up till 2022 [20, 21]. This rapidly rising workload is outstripping the current provision of services with more than 1700 additional radiologists needed to meet the current demand[21]. While reliable data is difficult to extract for LMI countries, estimates suggest that to bring service availability in Sub-Saharan Africa to a level comparable with that of high-income countries, each Sub-Saharan country would need to train on average 1400 more radiologists[22, 23]. While their starting points are of course different, the challenge of an ever-increasing demand for services is ubiquitous among economies of all sizes. One needs to be aware, however, that apart from the absolute number of radiologists, the geographical distribution of diagnostic services plays an equally important role in populations being able to access them. This pattern of inequality frequently leaves rural populations underserved with poorer health outcomes seen in both high-income and LMI countries[24, 25].

Conclusion

Both scenarios presented in the introduction are based on the real patients I looked after during my medical career. Having fad first-hand experience of the impact of imaging inequality on my patients certainly adds a personal, emotional degree to this highly important issue. It is tempting to rush into action and help bring cutting-edge technological advancements to underprivileged areas of the world. While this would be a well-meaning endeavour, the differences in Radiology are multi-faceted and could not be solved by donating a few CT scanners to countries in need. More in-depth exploration of the differences (and similarities!) between high-income and LMI countries reveals that while facing some similar challenges related to growth of radiology as a specialty, their fundamental needs and service constraints are very different, and it will likely take decades of coordinated and well-designed efforts to address them.

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