The Imaging Gap - A life-threatening shortage of diagnostic imaging

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Introduction

Over the last few decades, the demand for medical imaging has increased enormously, alongside the improvements in the field. The marked improvement in the quality of plain X ray imaging has been overshadowed by the development of entirely new technologies such as CT, MRI, Ultrasound and Nuclear Medicine systems, including PET and PET CT. Even within the scope of individual technologies, new examinations have been devised. The Imaging department today looks very different from the one of half a century ago and its diagnostic powers are orders of magnitude greater.

The combination of all this, each with its own range of specialist techniques, and an increasingly well-informed and demanding population has been relentlessly driving demand for more and more imaging. Add to this the impact of populations living longer and manifesting the diseases associated with longevity and the consequent increase in incidence of malignancies and the scale of the problem is clear. Doctors, of course, understand the extent to which modern imaging expands their own diagnostic capabilities and guides their treatments and so, in turn, want to offer more and more of it.
As a consequence, demand has massively increased and continues to grow exponentially to the point that it is now no exaggeration to suggest that the Imaging Department is one of the most important in any hospital.
The global medical imaging market size was valued at USD 20.13 billion in 2017 and is expected to expand (1). Factors such as an increasing demand for early-stage diagnosis, rising aging demographics and giving accessibility to underequipped communities are expected to boost the growth.

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There is a remarkably variable distribution of the modern technologies across even the developed world (2). This reference illustrates the situation very well showing that CT scanners per million of population ranges from 6 to 64 machines. This variability of provision does not reflect differences in need or demand but rather economic and political factors. So, even in many of the richer countries, it is the case that demand is running ahead of supply - most developed nations to some degree lacking sufficient resources to meet the demand.

Cost: driving the mismatch of supply and demand

The most important reason, obviously, is the cost of modern imaging technology. In public health care systems spending is constrained by budgetary factors. In private healthcare systems it is also restrained, not so much by a lack of potential patients but by a lack of sufficient numbers of patients with adequate insurance or ability to pay out of pocket. Of course, even in an almost exclusively non-public health care system such as in the United States, there is a tax payer factor operating through insufficiently funded Medicare and Medicaid systems. It equally obviously follows that if the costs of imaging systems were to be radically reduced, this would be a game-changing event.

Imaging Market Size and Exponential Growth of Demand

A snapshot of annual imaging activity in the UK may be of interest: 42.7 million imaging tests were reported in England specifically in the 2017-2018 financial year, compared with 42.1 million in the previous financial year, an increase of 1.4%.

Plain Radiography (X-ray) had the biggest share of all tests performed during the year, with 22.9 million (53.6%) X-rays reported. The next most common procedures were Ultrasound (9.51 million, up 1.5% from 2016/17), CT scans (5.15 million, up 6.9%) and MRI Scans (3.46 million, up 3.1%), and additional imaging procedures in smaller scales. (3). The continuing importance of plain X rays is seen.

These trends are paralleled on a global scale. A research report published by 'Infinium Global Research1' (4) also found that X-ray devices dominated the global medical imaging market. Simple X-ray imaging is the oldest form of medical imaging, though, of course, it has evolved considerably and in so doing has enhanced its diagnostic potential and reliability and achieved an enormous continuing importance.

Another report form "Omdia" (5) shows how the huge revenue from medical imaging equipment sales is distributed between modalities. The report finds that the global medical imaging market has immense growth opportunities in both developed and developing regions. The market in the developed countries is seeing an increased adoption of medical imaging systems for high-quality imaging, screening and diagnosis due to improved access and encouragement from the government and other healthcare institutions. While in the developing countries we witness a significant demand for imaging systems as a part of reliable medical services.

As a result, Diagnostic imaging is one of the major industries in healthcare, which is continuing to grow consistently.Nor should we fail to consider the future of interventional radiology; Early detection is essential for early intervention which may then follow immediately if using appropriate imaging support.

Where is imaging needed?

Imaging is needed in a variety of places, to mention a few:

- Hospitals
- A&E/ER, Trauma Center
- GP/FP facilities
- Physio and Chiro offices
- Dental Surgeries
- Orthopaedic and sports clinics

There is a huge demand for ambulatory imaging which is expected to drive the ambulatory care centres (1) urgent care units which are not linked to a specific hospital and remote clinics (Government initiatives to expand the reach of advanced care in rural areas is one of the prime drivers).

Ambulatory Care

Ambulatory care refers to medical services performed on an outpatient basis, without admission to a hospital or other facility. It is provided in settings such as:

- Offices of physicians and other health care professionals
- Hospital outpatient departments
- Ambulatory surgical centres
- Specialty clinics or centres, e.g., dialysis or infusion
- Urgent care clinics

It can undoubtedly be a confusing term. ‘Ambulatory’ simply means any patient walking into an outpatient department of a hospital or into a Family Practitioner’s office. However, it is used generally today to indicate a new idea of a facility separate from hospitals, Family Practices, etc., where a variety of diagnostic and therapeutic services are provided. As regards diagnostic services, these may be provided alone or as part of a wellness or treatment programme. They may include Imaging and laboratory and blood tests.
The potential for such centres, dedicated to imaging, for relieving pressure on hospitals is self-evident.

Patients Groups Needing imaging

- Acute illness or injury
- Follow up of known conditions or injury
- Patients exhibiting non-acute symptoms or signs who need investigation
- Screening healthy individuals, with or without risk factors

Most patients will present spontaneously or by Family/General Practitioner referral to a hospital A&E/ER department but, to a growing extent, private FP/GP and Imaging Clinics are growing up which take self-referrals for clinical assessment and imaging investigations (see also Ambulatory Care above).

Although conventional hospitals with their wide range of expertise and expert facilities are likely for the foreseeable future to remain at the centre of any health care system, it is not a given that they must hold a monopoly on imaging, even for their own patients. Indeed, since they are, in most of the developed world, stretched and finding it difficult to meet the significant growing demand in a timely manner. One might even consider out-of-hospital imaging as a crucial step towards greater efficiency. With the advent of PACS and digital networks there are clearly no longer any communication difficulties with either images or reports.

Indeed, there are some obvious inefficiencies in the retention of all imaging services in the hospital. For example, consider the OP department. Some studies may get organised at on OP visit to be performed for the next visit but often a patient is sent off from OP to get a study and then returns to be seen, hopefully with a report, but this may not always be achievable. This is an obvious inefficiency.

Increasing the Throughput of Imaging

The use of Ambulatory Care facilities could play a large part in achieving efficiency improvements in terms of patient throughput. This might be achieved in a number of areas:

- Hospital OPs
- Virtually all existing condition follow-ups (combined with remote consultations in many cases)
- Non acute suspected illness
- Minor trauma
- Aches and pains, headache
- Persistent cough, haemoptysis
- Dental Evaluation

Cloud-based Radiography

A fundamental problem with organising more imaging, whether in a hospital or in any of the out-of-hospital settings suggested, is the availability of radiologists to report the imaging. While demand will inevitably drive a greater supply, a full solution to the problem of supplying sufficient radiologists to every imaging site is simply not likely.

One solution is telemedicine. University Hospital Boston uses a picture-archiving and communication system that sends CT scans to a server in Boston, which stores the images and creates an electronic medical record for radiologists in the U.S. and Canada to read. The radiologists log on twice a week to look over scans, which each take about tenminutes (7). Tele-radiology, Cloud storage and Artificial Intelligence will all contribute to the solution of this problem.

Teleradiology/A Cloud based service will allow easy distribution of examinations and radiologists can be incentivised to work in their own time to do more. In the longer term, AI is suggested to play a crucial role in providing part of the solution, at least by performing a filtering 1st reading.

The Developing World

The above discussion has been oriented toward the developed world. The developing and underdeveloped worlds are in an entirely different situation. Their problem is that there is virtually no access at all to imaging or, if there is, it is in a handful of remote cities and, since few poor countries have developed national public health services, these are totally unaffordable in any case.

The World Health Organization estimates that two-thirds of the world does not have access to basic radiology services: simple x-rays, which can show a fracture or lung infection, and ultrasounds to image the foetus, track blood flow, or guide a biopsy, for example (7). They suggest that billions of people are at risk for widespread losses and deaths that can be avoided or treated, if radiology were available.

In a 1979 detailed survey the WHO found that 1.5 billion people had no access to imaging technology and 1.1 billion had poor access and only 1.2 billion have adequate access. Sadly, during decades, the WHO states that it is essentially unchanged. (8).
This global ‘radiology gap’ is far less discussed than infectious-disease outbreaks and natural disasters, but its dangers to public health are every bit as urgent. Interestingly, 80-90% of the imaging needs in developing countries could be met by x-ray and ultrasound alone (8).
What is required for these countries is a combination of foreign aid, large company support schemes and, “the holy grail”, the availability of cheaper imaging systems (see below).

Summary

Technology Meeting Urgent Demand

The challenges of booming demands for imaging, its considerable costs, even for developed nations, and its impossible costs for poor countries, and the shortage of expert personnel need novel approaches.We have seen that The Cloud/teleradiology and AI will in time provide at least partial solutions to man-power issues.
As regards equipment costs, cheaper, versatile technology would appear to be the only solution if, in the developed world, healthcare budgets (whether public, private or some mixture) are not to balloon out of control and if, in the developing world, matters are to improve at all and to ensure the accessibility to reliable imaging devices.

The Covid-19 Crisis

The worldwide urgency for immediately accessible and affordable imaging technology is being perfectly emphasized by the Covid-19 crisis in a comprehensive and global manner. There is an on-going debate in the medical community in respect to imaging in the Covid-19 crisis: when, how (Plain x-ray/CT), costs, hospitals' overload, etc. Regardless of this debate, we see different medical systems stretched to the end of their capacity, in dealing with an overwhelming overload. This affects all stakeholders of the industry, from the pandemic patients themselves to the routine patients in need of other medical help, to the medical and non-medical staff, and to the financial burden on the health system.

In some countries the local governments instructed people not to come to the hospital under any circumstances other than a medical emergency, which ended up in a large number of both asymptomatic patients and patients with mild to moderate symptoms, spreading the virus on a large scale in addition to being limited in term of access to medical imaging and other medical services.

In other countries the medical services collapsed or nearly collapsed due to the high numbers of patients in need of treatment, among that medical imaging. In those countries, an additional problem was contamination of the examination room by Covid-19 patients, especially CT rooms, which resulted in shut-down of the contaminated room for long periods of time. Due to the fact that there is a low number of CT machines, if any at all, in each facility, a contamination of a CT room might cause severe delays in service for other patients, especially trauma, as well as the Covid-19 patients.

In any approach, accessibility to out-of-hospital imaging, has the ability to change dramatically the entire systemic methodology. It can reduce the overload of patients trying to obtain hospital imaging services if many are directed to out-of-hospital facilities, allowing the hospitals to continue the daily routine with non-Covid patients. Of course, reducing the number of Covid and suspected Covid patients arriving at the hospital will reduce risk to other patients and staff. Furthermore, out-of-hospital imaging can contribute dramatically to the measures that should be taken in order to maintain routine everyday life, as well as keeping the borders open and the global markets running, with imaging systems being stationed at airports, on cruise ships, at borders, etc.

* Nanox.ARC was cleared by the FDA for MSK imaging as adjunct to X- Ray. Other applications will be available in other markets per local regulatory approvals. ** Concept Device for educational purposes only

Nanox is uniquely poised to transform theimaging around the world

NanoX is in an excellent position to take advantage of the market demands discussed above, in terms of costs, accessibility, out-of-hospital imaging, Cloud-based technology and so on, all that thank to its exclusive and disruptive cold cathode technology and unique MSaaS business model.

It will soon be in a position to provide high quality, flexible equipment at significantly lower prices than any competitor currently, allowing the wide spread of medical imaging devices, for different needs, in every facility. This will enable a massive change in the medical world with vast out-of-hospital imaging available for all.

The NanoX technology will not only revolutionize the imaging world in terms of accessibility and affordability, but we believe that even major hospitals with conventional plain X ray equipment and conventional CT scanners will wish to augment their imaging capabilities and, as a result, the local standard of care.

Secondly, Physiotherapy and Chiropractic Clinics, Orthopaedic and Sports units Clinics, Family Practitioner offices, amongst numerous other facilities, which, up to now, have not had their own imaging equipment at the facility are expected to be very interested in expanding their clinical expertise and revenue. They will then be able to deliver a fully comprehensive service to the patient/customer without the need to send him to another clinic to perform the needed imaging. In addition, stand-alone Imaging Centres who supply services to all stakeholders in the industry are expected to be highly interested in providing better service to their customers with the NanoX machine.

Altogether, we can see that the need for a ‘game-changer’ in the medical imaging world is crucial. Imaging is a fundamental discipline in modern medicine. Surprisingly, the field suffers from a huge shortage in all aspects: devices, accessibility, high costs, and radiologists. NanoX is a promising company, holding a unique technology and business approach, that addresses this medical lacuna and holds the key to this 21st century revolution in the imaging world.

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