**Pathology in India : A call to implementation**

**State of diagnostic pathology in India**

Spread over 3.3 million km2 with a population of 1.3 billion,  India is the second most populous country of the world. Despite being vast, the trained technical, paramedical and specialist workforce makes for a robust national healthcare infrastructure which is more efficacious and productive than in some other lower middle income countries (LMIC) countries. Expertise in medical sciences and technology available at affordable costs has also drawn patients across the globe boosting Indian medical tourism, currently being handled primarily by private stakeholders (1).

The health services in India are provided by public and private run (industry attached/affiliated and corporate) hospitals, medical colleges, primary & community health centres, government dispensaries and private run medical laboratories. Though the government health care is tiered into primary, district and tertiary health care facilities, the referral system is unstructured. The disadvantages of a marginalized diagnostic healthcare as evidenced during the Covid pandemic, can be attributed to  clustering of facilities in urban areas and deficiency of infrastructure and trained manpower in rural areas where 75% of the country’s population resides (7). Under the current system,  doctors at all levels refer patients horizontally to peers or vertically to higher or tertiary care centres as needed. The tertiary care centres also receive patients directly in their outpatient departments. This creates an additional load on the public health laboratories already overburdened by the demands of increasing population and the double epidemic of communicable and non-communicable diseases. The system is further encumbered by re-opinions often requested by patients, due to variations in the quality of healthcare laboratory practices. In India, the decision of operating the healthcare system in regulation to an established quality control system is voluntary and there is no government regulation for mandatory accreditation or for participating in an external quality control. There is a pressing need for making high quality, affordable healthcare facilities accessible to the masses, especially the section which is primarily dependent on the free or subsidized government facilities.

The health laboratory workforce has a key role to play towards any country’s healthcare system as evidenced by the decreased diagnostic efficiency in the US (4) due to the decline in the absolute number of pathologists.  The pathologist-to-population ratio in the US is 3.94 per 100,000 (3,4), in Japan 1.6 per 100,000 population (6), and that in LMIC countries such as Mozambique is 0.47 per 100,000 (5). The confirmed number of pathologists in India is difficult to ascertain as is the total number of practicing doctors. The government tally rests at 13,01,319 doctors registered with state medical councils and National Medical Council (2). The Indian Medical Registry records the registration of 12,76,256 medical practitioners and started in the year 1931 (retrieved on 07/05/2022). However, this number is not the active health force as the registry was started pre-independence, and most registered then are nonagenarians now and not available for active duty.  However , data on faculty numbers in medical colleges of India  is available through the Medical Council of India. It shows that there are a total of 96649 faculty encompassing all departments, in medical colleges across India, out of which the pathology faculty number stands at 15284 (15.8%)(ref). That gives us a pathologist-to-population ratio of 1.13 per 100,000 population in medical colleges in India. As the number of medical college faculty in India is 7.57% of the total registered, this is only a small part of the workforce. Adding private practitioners and industry and corporate hospitals to this number will yield a much higher pathologist-to-population ratio and absolute number of pathologists compared to other countries (ref).

Unprecedented growth in pathological and other laboratory diagnostic modalities across the world has resulted in revision of diagnostic, treatment and prognostic classifications of diseases. Ancillary tests (like special stains, immunohistochemistry, electron microscopy, immunofluorescence, flow cytometry) and molecular studies (cytogenetics, FISH, PCR etc.), now constitute key elements to disease diagnosis, patient prognostication and therapy decisions. Keeping up with these changes, incessant training of pathologists and laboratory staff is also required to prepare for the upcoming challenges and to adopt new technologies. Although guidelines and recommendations have been established for set up and reporting of various ancillary tests, many small cities or rural areas lack the resources for the same, leaving clinicians and patients stranded.

The solution is by implementing a network of the existing laboratories to supplement diagnostic capabilities in resource-poor areas to form an  ecosystem of reliable and accurate diagnostic services that are accessible, affordable to the masses and have a  rapid turnaround time. A pathology network is a structured set-up where a plexus supported by laboratory information management system (LIMS) is established in every state under which the medical colleges act as hubs and the other diagnostic facilities in the catchment area rely for support from these hubs. Physicians across the country and worldwide will be able to upload digital images and case files for review by pathologists. The samples (biological fluids and tissue) can be sent to laboratories equipped with adequate facilities for reporting them. At the same time, results of tests done in-house by trained technicians can be sent to experts digitally, and opinions taken on the output by the pathologist. This would be successful for histopathology/cytology/hematology whole slide images, graphs and plots of flow cytometry, thromboelastography, Hb electrophoresis, HPLC etc. Pathology practices in technologically advanced regions can earn ancillary revenue from such national and intranational consultations. The network of 'subject /organ /disease /subspeciality' experts in each state/region can either be coordinated by a central secretariat or a hub and spoke model could be established in each state/district with a tertiary case center as 'hub' and all others as 'spokes'. The hubs would also request the other hubs for domain experts if not available in their region. The primary diagnosing pathologist, on whom the onus rests, can also be assisted in arriving at a decision sooner rather than later, thus promoting early management. In addition, as established in other countries (10), a standardized structured reporting pattern can be formulated and  implemented with the help of the experts in the network.

Combining resources in such a manner  would drastically reduce the cost of pathology services, enabling utilization of the healthcare budget for overall healthcare development. Development of a fully integrated LIMS will empower labs to integrate laboratory data into clinical pathways, introduce new diagnostic modalities, and to provide well-timed, evidence based disease management while facilitating appropriate use of limited and precious resources. By adopting best practices and innovative ways of working, a network would enable services to be delivered with faster turnaround times at a lower pay cost and at a distance accessible to the patient. This network will help sustain services, promote training of fresh recruits in specific domains of interest, reduce national economic burden and thus strengthen the infrastructure and make it future ready.

India can adopt and incorporate suggestions from models of pathology networks operational across the globe. The National Health Service (NHS), England established  29 networks as a measure of improvement in pathology services across nation. The vast majority of pathology services work in these network configurations, with an annual savings of 33.6 million pounds (9). NHS is a government led initiative, however, private stakeholders are also attempting the consolidation of pathology services by forming grids and meshworks. The Pathology Network Limited, a health-tech private company based in Kenya brought together pathology labs, pathologists and hospitals under a membership framework accessed through a cloud-based platform with the aim of providing every African the access to diagnostic tests. The [Pathology Network](http://www.pathcentralpro.net/), California is another such system which has created a telemedicine network incorporating digital imaging, laboratory information system, and social media. The Sazanami pathology network , is an analogous telepathology network in Japan which combines whole slide imaging and information technology to create a “ virtual pathology department” accessible to all healthcare facilities.

The government has also taken other significant initiatives to enhance the diagnostic healthcare system. The National Essential Diagnostics List (NEDL) was released in 2007, as a catalog of tests recommended to be essential at different levels of the public health system (8). This is envisioned to improve the quality  and utilization of public health resources and decrease the out-of-pocket expenditures by people on diagnostics. Many countries like the USA, Israel, Denmark, Sweden, Australia, South Korea  have taken initiatives towards creating a nationwide digital health architecture. To leverage the advances in digital technology towards universal health, India proposed The National Digital Health Blueprint (NDHB)  in 2019 (11). It lays down the SOP’s and standards to create digital electronic health records and digital health systems spanning all sectors of healthcare from preventive care to management. This would facilitate consolidation of a patient's past medical history and diagnostic test records in a digital space or cloud which can be tracked by the patient and his physician. Kerala launched the eHealth project under which each individual is given aadhar linked unique health ID. Similar initiatives on e-health have been taken by Gujarat, Rajasthan, Uttar Pradesh, Chattisgarh, Andhra Pradesh and Tamil Nadu.  However, NDHB is yet to be implemented by all states.