Conducting Research in the COVID-19 Era

Summary: Under pressure in the age of COVID-19, David Koff stresses that researchers need to maintain high standards for their offerings to have value to the medical world.

COVID-19 is the worst pandemic the world has been going through since the Spanish Influenza of 1918, which claimed the lives of millions of people. As we watch the death toll climbing above that of the dreaded 2003 SARS-CoV-2 coronavirus, we dream of a way to eradicate this virus and go back to normal life. At the moment, there is no other choice than to practice physical distancing, remain at home as much as possible in self isolation, and hope to be spared by the virus. Our admiration and respect go to the front-line healthcare workers, nurses, physicians and all those exposed in hospitals and long-term care facilities, and to those selling us food and essential products or maintaining our infrastructure.

No surprise that so many researchers want to contribute to the fight against the coronavirus and, in the absence of treatment or vaccination, all ideas are welcome to decrease the disease burden, keep people away from the hospital, improve diagnosis capabilities or help stratify the risks of adverse outcomes. Many agencies and organisations are offering grants to support hundreds of projects, researchers are rushing to apply, and many see this as a unique opportunity to get funding with hopefully a faster and better success rate than with traditional competitive grants. As always, fast tracked peer reviews will have the pressure to quickly review the grants and separate between the best and the worst.

For us in Diagnostic Imaging, these past few years have seen the most disruptive change since the adoption of PACS, with the swift development of Artificial Intelligence (AI). It was natural for this growing community of engineers to join forces with radiologists to create new solutions to better diagnose and predict the COVID-19 disease from chest X-rays and CT scanners. The assumption is that anyone with cough and fever will get imaging when access to the molecular test RT-PCR is limited, the results can take up to five days, or the sensitivity is not reliable enough.

The Role of imaging

Access to imaging is not as simple as it looks, as there is a need to ensure safety of patients and health workers with strict infection control protocols slowing down the throughput.

The most recent Multinational Consensus Statement from the Fleischner Society gives recommendations that many will comply with (Rubin et al 2020). In summary, the essentials are as follows:
• Imaging is not routinely indicated as a screening test for COVID-19 in asymptomatic patients.
• Imaging is not indicated in patients with suspected COVID-19 and mild clinical features unless they are at risk for disease progression.
• Imaging is indicated in a patient with COVID-19 and worsening respiratory status.
• In a resource-constrained environment, imaging is indicated for medical triage of patients with suspected COVID-19 who present with moderate-severe clinical features and a high pre-test probability of disease.

Prior to that, the American College of Radiology recommended (ITN 2020) on March 11, that:
• CT should be used sparingly and reserved for hospitalised, symptomatic patients with specific clinical indications.
• Portable units should be used and CXR requested only when truly necessary.

The Canadian Association of Radiologists and Canadian Society of Thoracic Radiology (CAR 2020) made similar recommendations on March 24, 2020:
• Portable radiography and ultrasound should be utilised as much as possible.
• CT and CXR findings are not specific and can overlap with other infections.
• If performed, non-contrast full dose diagnostic CT is recommended.
• Negative CT and CXR does not exclude COVID-19 infection.

Imaging Appearance

The one view chest X-ray is more often normal in early or mild phases, demonstrating bilateral airspace consolidations in more advanced phases. But findings are not specific

and overlap with other infections, including influenza.

The CT pattern may be comparable to organising pneumonia with ground glass opacities mostly bilateral, peripheral and lower lobes, and which may have a nodular or mass-like appearance. There is usually no tree-in-bud, no pleural effusion, no lymphadenopathy (Simpson et al 2020).

Artificial Intelligence in COVID-19 Imaging

There is no doubt that the fight against COVID-19 can and will benefit from AI Imaging and there are many ways for AI to contribute as it is already advanced in detection of a number of lung diseases. For example, AI is already able to recognise pneumonia as demonstrated by the RSNA/Kaggle Pneumonia Detection Challenge in 2018 in which 1,400 teams participated. The teams used a dataset of chest X-rays from the National Institute of Health annotated by volunteers from the Society of Thoracic Radiology (Kaggle 2018).

It is expected that AI will help in many capacities, including but not limited to:

- Early recognition of the COVID pneumonia on standard portable chest X-rays; this is of particular relevance for countries that don't have readily access to the RT-PCR test.
- Risk stratification for patients admitted to intensive care units, helping to prioritise allocation of ventilators and maybe give some predictive indications to outcomes, allowing for changes in treatment plan.
- Short and mid-term follow-up of patients considered as cured to detect reactivation and recurrences.

But as pressing as it may be, research must not be rushed and follow a solid methodology. It would be useless and damaging to lead research projects on wrong assumptions or with poor quality material, leading to unreliable results. Strong collaboration between engineers and radiologists is required to validate the research question on the most updated knowledge.

Researchers must comply with Research Ethic Boards and privacy requirements, in most cases fast-tracked to enable research. Data used for the developments must be of good diagnostic quality, ideally DICOM, labelled with the most relevant information, properly de-identified using a recognised anonymisation tool and annotated to help identify the region of interest. It is important for these images to be validated by a radiologist and the diagnosis confirmed as ground truth is needed.

As many cases are required to train and test the algorithms, there are a number of initiatives to provide access to as many images available as possible; among these initiatives, I would like to mention the RSNA COVID-19 Imaging Data Repository (RSNA 2020). This library is an open data repository for research and education. The RSNA is inviting institutions, practices and societies around the world to contribute their cases to this database and collaborates closely with the European Imaging COVID-19 AI Initiative. In both cases, the participants will upload images to be shared in a secure way, taking into consideration privacy and ethics; the images will all be labelled, and participants will find limited tools to annotate their images on the site. The RSNA COVID-19 Imaging Data Repository should be made available in the coming weeks.

The Road Ahead

In the worst pandemic that the world has known in a century with devastating human and economic consequences, it is of utmost importance to conduct research to help fight the disease as fast as possible. But for the outcomes to be relevant and meaningful, this research must rely on a strong collaboration between engineers and radiologists, and AI developments must use high quality curated images shared by trusted healthcare institutions all over the world. ■

🔖 Author: **Prof. David Koff**

Department of Radiology, Director Medical Imaging Informatics Research Centre at McMaster University | Hamilton, **Canada**

dkoff@mcmaster.ca | mcmaster.ca | 🐦@McMasterU

✔ Key Points

- COVID-19 is the worst pandemic the world has seen since the Spanish flu 100 years ago.

- Research into the virus and disease must follow high quality standards.

- Strong collaboration between engineers and clinicians is necessary for quality AI research.

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