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Divide and conquer: strategies to manage a nuclear medicine department during COVID-19

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Abstract

The Covid-19 outbreak was declared a Public Health Emergency of International Concern by the World Health Organisation (WHO) on 30 January 2020. Since then, the virus has spread to affect more countries worldwide. During this period, our nuclear medicine at Singapore General Hospital segregated our staff and patients either by time, space, or both, to minimise contact and prevent the spread of the virus. Necessary changes to our clinical practices and stricter infection control measures were also enforced. We share our personal experience in managing a nuclear medicine department during this epidemic.

Keywords: epidemic; COVID-19 infection; infection control

Introduction

In December 2019, China reported several cases of pneumonia of uncertain aetiology linked to the Hunan seafood market in Wuhan, China. This was later found to be due to a novel coronavirus, later named Covid-19[*1*]. Bats appear to be the reservoir of the virus, however, the intermediary host is not yet known[*2*]. Symptoms include fever, cough and breathlessness, although some patients who tested positive via reverse transcription polymerase chain reaction (RT-PCR) were asymptomatic. Transmission between humans has been confirmed, although transmission routes are still unclear. The outbreak was declared a Public Health Emergency of International Concern by the World Health Organisation (WHO) on 30 January 2020. WHO later raised the highest alert for the risk of spread and risk of impact for the disease on 28th February 2020[*3*].

The first patient detected with Covid-19 in Singapore was admitted to the Singapore General Hospital on 23 January 2020. Singapore detected its first patient with Covid-19 on 23 January 2020, who was admitted to the Singapore General Hospital[4]. Initially, all cases were imported. However, in early February, 'community cases', or positive cases did not have any recent travel to mainland China or links to the previous cases, were detected. The Ministry of Health (MOH) implemented additional precautionary measures, such as regular temperature and symptom screening at workplaces, as well as cancellation or deferment of large-scale events, to minimise the risk

of further transmission of the virus in the community[*4*]. By 9 Mar 2020, there were 160 confirmed cases with 10 critically ill in the country.

Singapore General Hospital is the largest tertiary hospital in Singapore. It also houses the largest nuclear medicine department in our country. Our department currently has 1 PET/CT scanner, 3 gamma cameras, 1 SPECT/CT, 1 ultrasound machine, 1 treadmill for cardiac stress testing and 1 bone densitometer. We provide in- and outpatient services, and both diagnostic and therapeutic nuclear medicine services. Our department also provides satellite nuclear medicine services for some of the other hospitals in our health group cluster. The challenges arise as nuclear medicine is a diverse discipline involving many groups of people including the laboratory staff, nuclear medicine technologists, administrative staff, nurses and doctors. In order to deal with this national emergency, we put measures in place to minimise the risk of disease transmission.

Materials and methods

Work processes in our institution were reviewed in order to minimise the likelihood of transmission of the virus. Based on discussions among different people of the department, we adopted various strategies to modify the usual practices in the department, yet maintaining the normal functioning as much as possible.

SEGREGATION AMONGST PATIENTS AND STAFF

Previous experience with the severe acute respiratory syndrome (SARS) outbreak in Singapore in 2003 taught us that disease transmission takes place within the hospital – radiology-related infections were seen in staff members, and visitors or outpatients to the radiology department[*5*]. Therefore, segregation is needed to differentiate people of different infection risks.

Patients were segregated according to likelihood of transmission, either by time, space, or both. Outpatients would be screened at the entrance of the hospital prior to entering the department for recent travel and symptoms. Temperature checks were done. Only one accompanying person was allowed for each patient. Two of the gamma cameras were dedicated for inpatients while the others were used for outpatients. As we only have one PET/CT scanner, outpatient scans were done first before inpatients, so that there would be minimal mixing between the different groups of patients. Patients under isolation would be done as the last case of the day, when there would be fewer patients in the department. There were also designated rooms used for holding inpatients so that they would not be in physical contact with the outpatients (Figure 1).

One of the rooms was set aside as a designated isolation room (Figure 2). Suspect Covid-19 cases would be escorted to this room with a face mask on until further assessment was done. Further management decisions were made, for example whether admission was required, with the advice of an infectious disease specialist. Time is also of importance. Patients were managed promptly, and as safely as possible, so that less time was spent in close proximity to other patients.

Staff were divided into teams and encouraged to minimise interaction to prevent contamination. The nuclear medicine technologists were assigned fixed rooms to work in. Doctors were also segregated. Cross institutional work was stopped or reduced to the minimum that is workable, and one physician was assigned to one of the other hospitals for the time being. Fellow colleagues from other hospitals helped with some of the radionuclide injections, such as sentinel node injections, while the scans were reported remotely. Nuclear medicine physicians within Singapore General Hospital were split into 2 teams. One would have patient contact while the other reported scans remotely from another office building. Duties were exchanged every fortnight to prevent physician burnout.

New applications for overseas travel were discouraged to the high risk countries and some previously booked travel plans were cancelled in a display of solidarity and in case manpower is needed. Relevant information technology platforms, such as the use of secured social media like Workplace by Facebook and Tiger Connect, were adopted to facilitate communication between staff [*6*].

Appointments for patients from high-risk countries such as China were postponed where possible. Otherwise, they were expected to fulfil a specified home quarantine of 14 days if they were symptomatic and came from affected countries. The same applied to staff who returned from high risk areas.

During this period, all student attachments and clinical postings were suspended to avoid unnecessary exposure. Doctors under training were not allowed to move to other hospitals for other rotations. Multidisciplinary tumour boards and discussions would usually physically bring together specialists from various disciplines to discuss cases and were generally discouraged - many moved to online discussions via video conferencing.

CHANGES TO CLINICAL PRACTICE

Some modifications were done for scans. For example, aerosolization was stopped for the ventilation part of the ventilation-perfusion lung scans, and we made do with perfusion only scans where necessary. Myocardial perfusion imaging was done mainly with pharmacological stress where possible. A one-day rest-stress protocol was preferred rather than our usual one or two-day stress-rest protocol as this would minimise patient transfers and duration of exposure.

It is suggested that Covid-19 pneumonia may show abnormalities on a chest CT during the subclinical phase of the disease. Special attention was paid with early review of the lungs on PET/CT or SPECT/CT images to identify any patients with possible ground-glass changes in the lungs which may indicate early infection [*7, 8*]. Patients who had

lung findings possibly secondary to Covid-19 infection were quickly isolated and admitted for further investigations after consulting the primary physician and infectious disease expert.

CONTACT TRACING

Contact tracing is an important part of trying to curb the spread of the virus[*9*]. A paper by Niehus et al used Singapore as the standard to estimate the probability of detection of cases in other countries as they considered the detection rate to reflect the highest surveillance capacity among all locations affected by the virus [*10*]. We had to play our part in the efforts for contact tracing. In our department, extra measures were put in place to facilitate contact tracing, with special care made to take note of which personnel attended to each patient.

INFECTION CONTROL

It is important to protect our frontline staff who would continue to have patient contact. More stringent infection control measures were taken and refresher courses for infection control were conducted. Staff in the clinical areas or at the counters were asked to don surgical face masks at all times. Hand hygiene techniques were emphasized. To minimise the human traffic in the department, patients who had non-urgent follow up clinic appointments were contacted - appointments were postponed if patients were deemed medically stable. Arrangements were made for prescriptions or medications to be delivered to their address to ensure that they had a sufficient supply until the next appointment. Staff temperature recording was done twice a day. Staff with a temperature reading of 37.5 degrees Celsius or more, as well as those who were unwell and had respiratory symptoms, had to seek medical attention in the staff clinic or at the emergency department. They would be granted medical leave till they were fit for return to work, and possibly tested for Covid-19 depending on their risk of exposure. Staff were also fitted with N95 masks or powered air purifying respirators (PAPR) should the need to use it arise, for instance, when coming into contact with patients from isolation wards or during aerosol generating procedures. Social distancing, or limiting the social contact and increasing physical distances between people, was deemed an important policy to reduce the risk of transmission of the virus (figure 3).

Senior management and designated infection control officers within each department embarked on a daily walkabout exercise within the different clinical areas in the division. Team members of the walkabouts went in groups of two or three personnel with at least one external auditor in each team for the place of audit while practicing safe social distancing. Observations were made and photos taken with reports generated daily to quickly correct any infection control lapses as well as safety or workflow issues.

Fomite has been widely criticised as the cause of transmission[*11*]. The imaging couch is covered with linen which is changed after every patient to prevent direct contact between the scanner and the patient. During positioning, the linen and blankets are also placed between the safety straps and the patient. Patients are imaged with their mask on to prevent droplets from contaminating the equipment. Increased frequency of cleaning of the surroundings is necessary to provide a clean and safe environment for the staff and patients as much as possible. Walls of the imaging rooms are disinfected after imaging of patients from isolation wards. Terminal cleaning which was already being done after every patient have been further emphasised during this period.

STAFF MORALE

Last but not least, the psychological well-being of the people in the department must be looked after during this stressful period. The hospital sent frequent updates about the situation and the conditions of the patients to keep everyone abreast with the latest information. Words of encouragement from the general public and the hospital administration were shared to acknowledge the hard work and efforts that staff had put in. Helplines providing psychological support were also made available.

We recognise that it is our responsibility to create a safe environment for our staff and patients. This requires team effort from all the involved parties, to cooperate against the spread of the virus.

Conclusion

We describe our personal experience in managing a nuclear medicine department during the Covid-19 epidemic (figure 4). As of today, we have not detected any transmission of the virus amongst our patients or staff which attests to the effectiveness of the measures taken. The operational measures are important to help in the control of the transmission of the virus with minimal disruption to the necessary functioning of an established nuclear medicine department.

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This article does not contain any studies with human participants or animals performed by the authors.

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References:

1. World Health Organisation. Rolling updates on coronavirus disease (COVID-19). https://who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen. Accessed March 9, 2020.
2. Lu R, Zhao X, Li J, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet*. 2020;395:565-74.
3. Centers for Disease Control and Prevention. 2019 Novel coronavirus, Wuhan, China: 2019-nCoV situation summary. https://www.cdc.gov/coronavirus/2019-nCoV/summary.html. Accessed March 9, 2020.
4. Ministry of Health. Singapore. Updates on COVID-19 (coronavirus disease 2019) local situation. https://moh.gov.sg/covid-19. Accessed March 10, 2020.
5. Lau TN, Teo N, Tay KH, et al. Is your interventional radiology service ready for SARS? The Singapore experience. *Cardiovasc Intervent Radiol.* 2003; 26:421-427.
6. Human Solidarity in a Fragmenting World. 24th Gordon Arthur Ransome Oration. George Yeo. 2020 Jan. https://www.ams.edu.sg/view-pdf.aspx?file=media%5C5230_fi_386.pdf&ofile=24th+Gordon+Arthur+Ransome+Oration.pdf
7. Shi H, Han X, Jiang N, et al. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis.* 2020; (published online Feb 24).
8. Qin C, Liu F, Yen T, et al. ^{18}F-FDG PET/CT findings of COVID-19: a series of four highly suspected cases. *Eur J Nucl Med Mol Imaging.* 2020. https://doi.org/10.1007/s00259-020-04734-w.
9. Ng Y, Li Z, Chua YX, et al. Evaluation of the effectiveness of surveillance and containment measures for the first 100 patients with COVID-19 in Singapore – January 2-February 29, 2020. *MWWR Morb Motal Wkly Rep*. 2020;69(11), 307-311.
10. Niehus R, De Salazar PM, Taylor AR, Lipsitch M. Quantifying bias of COVID-19 prevalence and severity estimates in Wuhan, China that depend on reported cases in international travellers. Preprint. Posted February 18, 2020. medRxiv.

11. Ong SWX, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. *JAMA* 2020; (published online March 4).

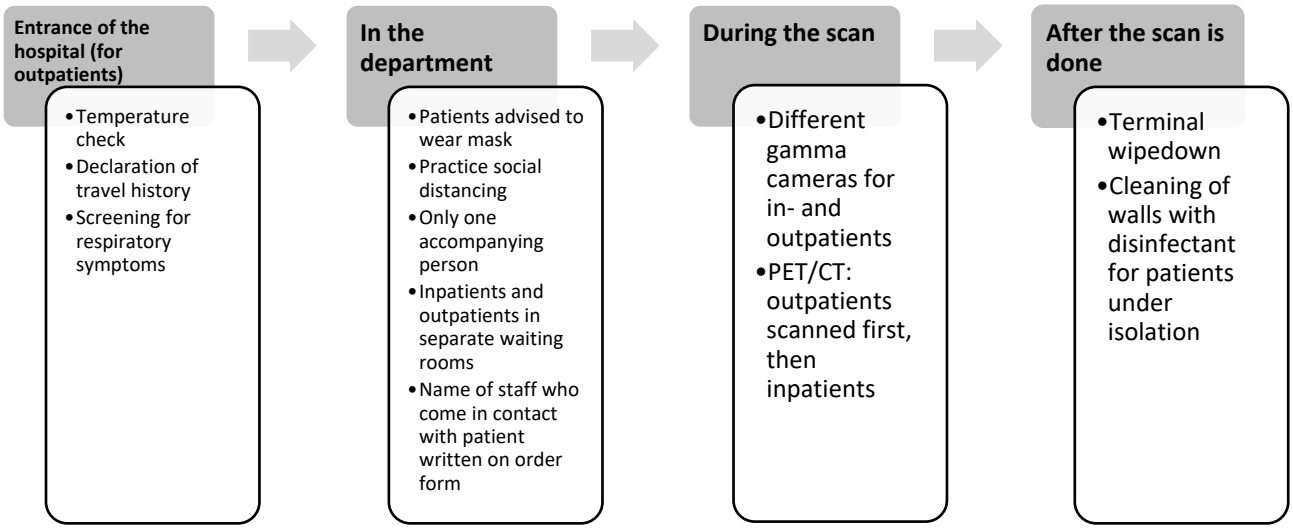

Figure 1. Flowchart for patients coming for outpatient scan appointment at nuclear medicine department

Figure 2. Isolation room in the Department of Nuclear Medicine and Molecular Imaging (DNMMI), Singapore General Hospital.

Figure 3. Waiting area in the nuclear medicine department encouraging social distancing

Take home messages

- Screen patients at the entrance
- Segregation of patients with different infection risk profiles
- Divide staff into smaller groups
- Emphasize hand hygiene and infection control
- Practice social distancing
- Modify scans to minimise risk to staff
- Have protocols in place to manage patients detected with possible infection

Figure 4. Take home messages