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## Neurosurgery Services in Dr. Sardjito General Hospital, Yogyakarta, Indonesia, During the COVID-19 Pandemic: Experience from a Developing Country

Wiryawan Manusubroto, Adiguno Suryo Wicaksono, Daniel Agriva Tamba, Paulus Sudiharto, Handoyo Pramusinto, Rachmat Andi Hartanto, Endro Basuki

■ **BACKGROUND:** Most articles describing the effect of the coronavirus disease 2019 (COVID-19) pandemic on neurosurgical services have been from developed countries. We report our experience in carrying out neurosurgical services at Dr. Sardjito General Hospital, Yogyakarta, Indonesia, during the time of the pandemic.

■ **METHODS:** To collect information on the effect of the pandemic in Indonesia and Yogyakarta, we gathered data from the Indonesian Ministry of Health's online database for the national data and local government records for the local data (including records of Dr. Sardjito General Hospital Division of Neurosurgery).

■ **RESULTS:** Compared with other countries, Indonesia has not been severely hit by the impact of COVID-19. To increase our understanding of the natural history of the pandemic, we divided the period into 4 phases: phase 1 (when there were confirmed cases in Indonesia but no cases in Yogyakarta), phase 2 (when the first case in Yogyakarta was detected), phase 3 (when the cumulative cases surpass their peak), and phase 4 (when the pandemic ends). At the time of this writing, we were still in phase 2 and in this phase, we experienced a decrease in the number of emergency surgical procedures, from an average of 4 to 2.4 per week. Moreover, the number of elective operations dropped from an average of 12 to 9 per week.

■ **CONCLUSIONS:** A pandemic, such as COVID-19, reduces both inpatient and outpatient neurosurgical activities. A comprehensive plan can improve both utilization and safety of the neurosurgical staff.

The first case of coronavirus disease 2019 (COVID-19) in Indonesia was reported on March 2, 2020.<sup>1</sup> Since then, the number of people who are infected with SARS-CoV-2 has grown exponentially, a pattern that can usually be observed in an uninhibited outbreak.<sup>2,3</sup> Some experts have stated that the number will continue to soar in the subsequent few weeks if no significant intervention is performed.<sup>4</sup> The government then announced a public health emergency on March 31, 2020.<sup>5</sup>

Following the public health emergency announcement, the Indonesian government imposed a temporary ban on all foreign travelers and also published several other regulations.<sup>6</sup> One major regulation was a guideline for large-scale social restriction (Permenkes No. 9 Tahun 2020; Pedoman Pembatasan Sosial Berskala Besar). The local governments with a high number of cases or deaths in their regions were allowed to impose such restriction with approval from the Indonesian Ministry of Health.<sup>7</sup> Such measures included banning mass gatherings, closing schools and offices, curbing nonessential businesses, and banning public transport.<sup>7</sup>

Furthermore, the Indonesian Ministry of Health selected several hospitals as the referral hospitals to handle the emerging infectious disease (KH.01.07/MENKES/169/2020). Dr Sardjito General Hospital was one of the selected hospitals located in the Special Region of Yogyakarta.<sup>8</sup> The hospital, which is also the university hospital for Universitas Gadjah Mada, was chosen because of its full-range intensive care unit and 2 isolation wards for airborne infectious diseases.<sup>9</sup> Finally, to accommodate more patients with COVID-19, the hospital also remodeled a ward as a new isolation ward.

Compared with other countries located outside the equatorial zone, the number of COVID-19 cases has been relatively small in Indonesia.<sup>10</sup> However, the outbreak is adding extra burdens on the health care system worldwide, including Indonesia.<sup>11</sup> Neurosurgical service is one of the systems affected.<sup>12</sup> Several articles have discussed how neurosurgical services should be

### Key words

- COVID-19
- Low- and middle-income countries
- Neurosurgery service
- Pandemic

### Abbreviations and Acronyms

**COVID-19:** Coronavirus disease 2019

**PPE:** Personal protective equipment

**RT-PCR:** Reverse-transcription polymerase chain reaction

Division of Neurosurgery, Department of Surgery, Universitas Gadjah Mada, Yogyakarta, Special Region of Yogyakarta, Indonesia

To whom correspondence should be addressed: Adiguno Suryo Wicaksono, M.D., M.Sc. [E-mail: adiguno.sw@ugm.ac.id]

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managed during this difficult time<sup>13,14</sup>; however, there is no specific report on neurosurgical services in developing countries. This article focuses on the neurosurgical service in Dr. Sardjito General Hospital, Yogyakarta, Indonesia, as a representative of low- and middle-income countries. Moreover, although the number of COVID-19 cases has remained rather low in Yogyakarta, we believe that hospital preparedness and contingency plans for a pandemic should be formulated, especially for neurosurgery cases, to manage the potential development of this pandemic and possible future outbreaks.

Here we review what has been done by related stakeholders to curb the impact of the disease. We also describe our hospital's policy for performing neurosurgical services during the COVID-19 outbreak and explore what can be corrected in the future, especially in the setting of low- and middle-income countries.

## METHODS

We collected information on the effect of the outbreak in Indonesia from the COVID-19 online database created by the Indonesian Ministry of Health. The government selected the National Institute of Health Research and Development (Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan [Balitbangkes]) as COVID-19 national referral laboratory. In addition, the government also selected several regional laboratories as COVID-19 diagnostic laboratories.<sup>15</sup> All facilities had to meet the Biosafety Level 2 standard and have reverse-transcription polymerase chain reaction (RT-PCR) capabilities.<sup>16</sup> By the middle of April 2020, the Indonesian government had tested more than 30,000 samples (i.e., approximately 130 tests per 1 million population).<sup>17</sup>

Furthermore, we gathered information from online COVID-19 records generated by the Yogyakarta government to assess the effect of the outbreak in the Special Region of Yogyakarta. By April 13, 2020, the Yogyakarta administration had performed 516 tests, for a rate of approximately 144 tests per 1 million people.<sup>18</sup> The data on confirmed COVID-19 cases from all laboratories throughout Indonesia were then sent to Balitbangkes to be validated and verified.<sup>15</sup> All confirmed cases, which included inpatients, recovered patients, and deaths, had been confirmed by RT-PCR.<sup>15</sup> Finally, the data were sent to the Public Health Emergency Operation Center of the Indonesian Ministry of Health.

The data on the number of neurosurgical procedures performed between February 2, 2020, and April 10, 2020, at Dr. Sardjito General Hospital were obtained from the hospital's Division of Neurosurgery. Emergency cases were defined as head tumor and cerebrovascular problems with acute deterioration, shunt malfunction, cauda equina syndrome, acute obstructive hydrocephalus, or head and spinal cord trauma. In addition, urgent cases such as non-rapid-onset hydrocephalus, head tumor (with urgency depending on history), or problems with recent onset of upper motor neuron symptoms or signs (e.g., cervical or thoracic myelopathy) were included in the elective surgical planning. Pre-operative procedures during the pandemic, including tests to detect COVID-19, are described in the Discussion section.

We included data from the previous months to help the reader differentiate the number of surgical procedures performed before and during the outbreak. Moreover, we compared the types of

neurosurgical procedures performed at our center before and after the announcement of the first COVID-19 case in Yogyakarta. Finally, we also analyzed the changes in the number of outpatients visiting Dr. Sardjito General Hospital's neurosurgical clinic.

## RESULTS

### COVID-19 in Indonesia

The number of confirmed cases in Indonesia had skyrocketed in the last few weeks. By the middle of April, the government had tested more than 30,000 samples (i.e., approximately 130 tests per 1 million population) and found more than 4800 confirmed cases, with 459 fatalities (Figure 1).<sup>17,19</sup> The highest number of death was in the capital city, Jakarta, which had 2335 infected cases and 241 deaths at the midpoint of April 2020.<sup>20</sup> Moreover, compared with other nations, Indonesia had a considerably higher case fatality rate (i.e., 9.56%).<sup>19</sup> On the other hand, the mortality rate was rather low at roughly 1 death per 588,000 people.<sup>19</sup>

### COVID-19 in the Special Region of Yogyakarta

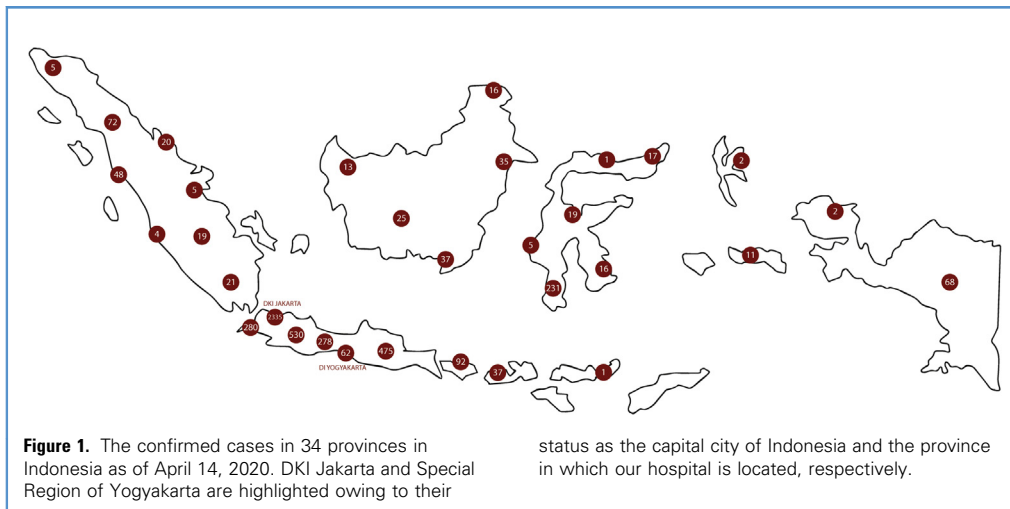
The infection rate in Yogyakarta was not as high as that seen in Jakarta. The first case was detected on March 13, 2020, in a 3-year-old child who had a history of a family trip to Depok, West Java. As of April 13, 2020, there were 55 confirmed cases, including 6 deaths.<sup>18</sup> Sleman, where our hospital is located, was the region with the highest number of positive cases (i.e., 29 cases). Moreover, Yogyakarta has not been declared as an area with local transmission.<sup>21</sup> Nonetheless, it is strongly suggested that each stakeholder remain vigilant.

### The 4 Phases of the Pandemic at Dr. Sardjito Hospital

We divided our experience during this period into 4 phases to ease the understanding of the nature of the pandemic (Figure 2). Phase 1 (March 2–13, 2020) was the period of indigency. There were confirmed cases already in Indonesia during this period; however, knowledge of the disease was limited at that time. As a result, there was no clear diagnosis, and inadequate equipment to manage it. Phase 2 is defined as the period between the initial detection of the outbreak in Yogyakarta and when the government relaxes the strict regulations regarding the outbreak. Early in this phase, the number of cases outside Yogyakarta had soared, and the Indonesian Ministry of Health and the Indonesian Medical Association had instituted several measures in an effort to curb the impact.<sup>22,23</sup> In phase 3, the transition phase, the infection rate has subsided but the end of the outbreak has not been declared. Finally, phase 4 is defined as the period after the outbreak resolved. At the time of this writing, we have not yet entered the last 2 phases; we described them here to explain our expectations of the end of the pandemic.

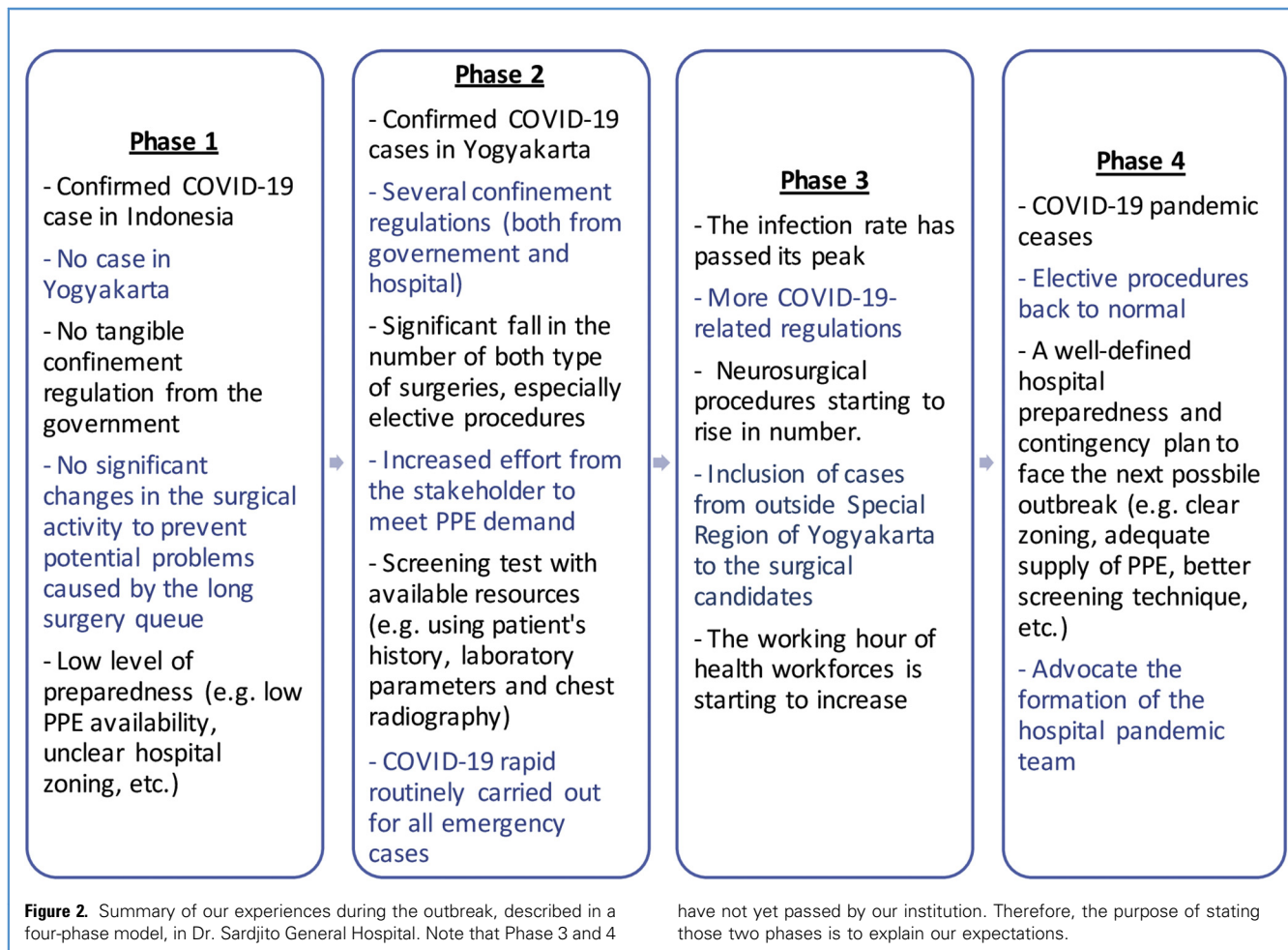
### Number of Neurosurgical Procedures Performed at Dr. Sardjito General Hospital

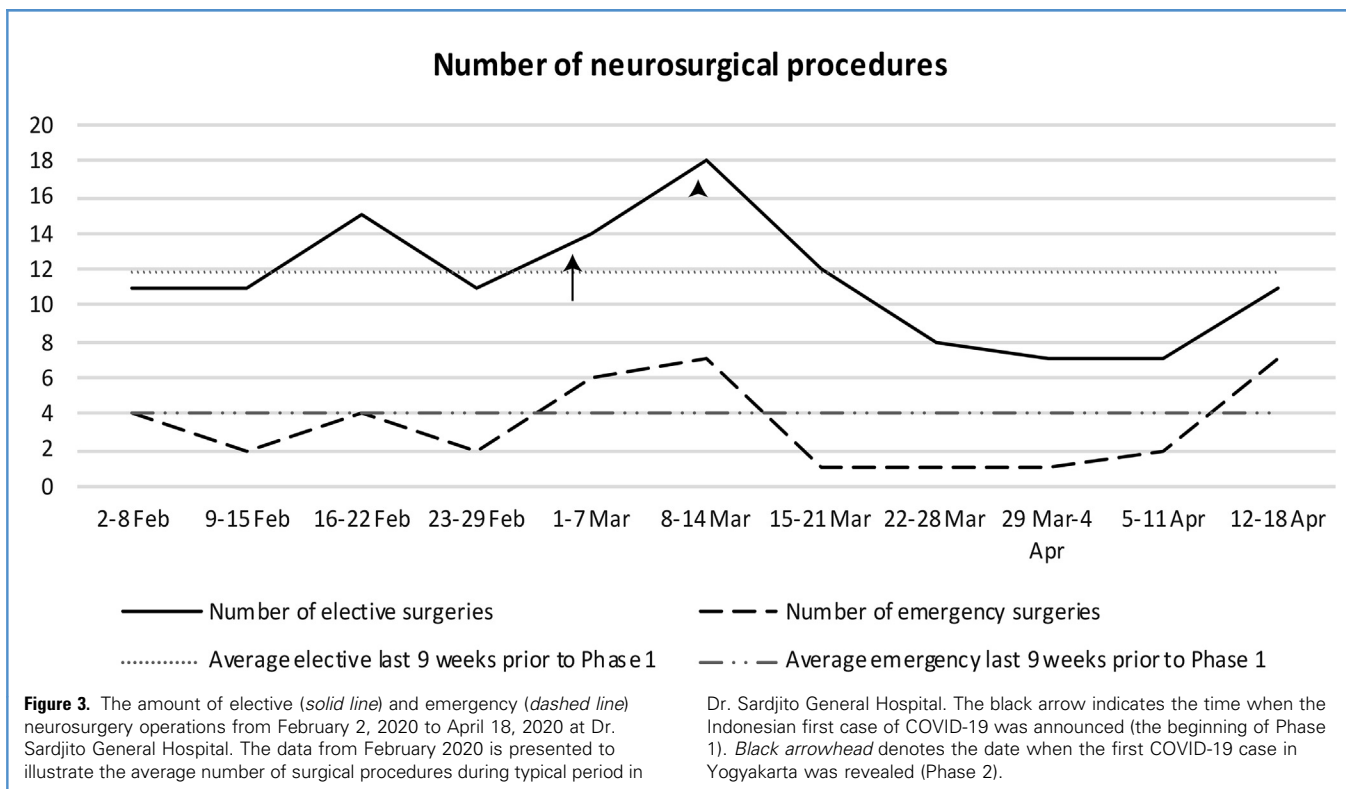
Our center's staff comprises 6 consultant neurosurgeons and 23 residents capable of performing both emergency and elective procedures.<sup>8</sup> In the last 9 weeks before the first confirmed case in Indonesia, an average of 4 emergency operations were performed each week. However, early in phase 2, there was a drop in the number of emergency operations, to an average of 2.4 per week (Figure 3).



Furthermore, an average of 16 elective operations per week were performed during phase 1 (Figure 3). However, early in phase 2, the number decreased to roughly 9 operations weekly. This was

lower than the average of 11.78 elective surgical procedures weekly performed in the last 9 weeks. Tumor resection accounted for the highest number of operative procedures, with



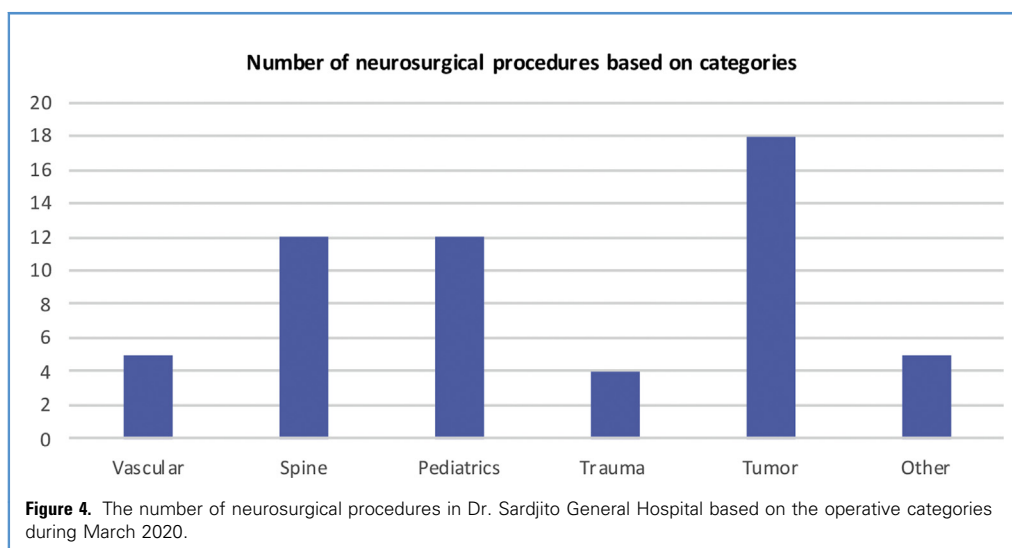


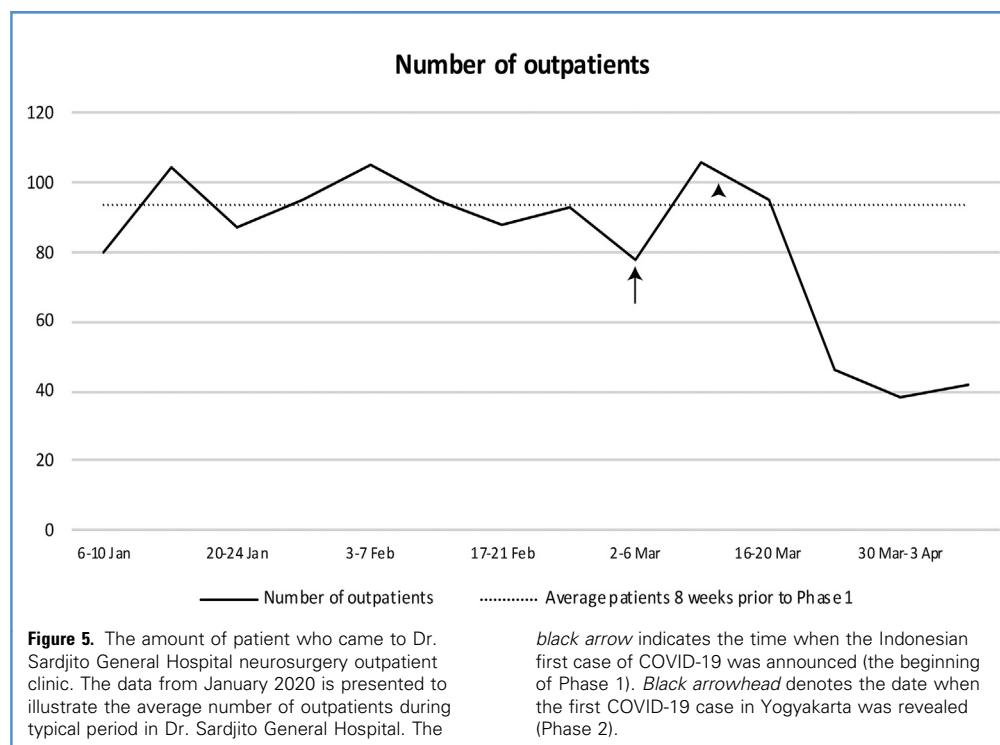
18 cases. In contrast, trauma surgery accounted for the fewest cases, with only 4 procedures (Figure 4).

**Number of Appointments in the Hospital’s Neurosurgery Outpatient Clinic**

The pattern of the number of outpatient visits was similar to that observed in the number of surgical procedures. In the last 8 weeks before phase 1, we had an average of 93.38 outpatients each week

(Figure 5). However, since early phase 2, there was a slight reduction in outpatient numbers, and since March 20, 2020, the decline has accelerated. Furthermore, we had 12 residents who were eligible (based on year of residency) to provide care in the outpatient clinic. In phase 1, we allocated 4–6 residents each day to provide care in the outpatient clinic. However, in phase 2, we reduced the number of residents to just 2 per day owing to the reduced number of outpatients.





## DISCUSSION

### The COVID-19 Test in Indonesia: The Iceberg Phenomenon

The COVID-19 pandemic in Indonesia is rather challenging. We have a high case-fatality rate yet a low mortality rate, which might reflect the “iceberg” phenomenon. Some experts believe that it is associated with Indonesia’s low testing rate.<sup>24</sup> Although the number of tests increased in phase 2 compared with phase 1, Indonesia remained among the countries with a low testing rate.<sup>25</sup>

Furthermore, evidence shows a high level of SARS-CoV-2 replication in the upper respiratory tract even before symptoms appear.<sup>26,27</sup> Consequently, people who are infected with the virus yet do not have any signs or symptoms may possibly spread the virus to others.<sup>28</sup> This might have significant epidemiologic repercussions, especially in countries with a low testing rate.<sup>19,24</sup> In such countries, asymptomatic carriers cannot be widely detected, which in turn might increase the rate of transmission.<sup>29</sup> Therefore, increasing the effort to test as many people as possible appears to be an essential strategy for reducing the impact of the pandemic.<sup>30</sup>

### Preoperative Preparation During the COVID-19 Pandemic

In phase 2, we have started to use screening tests for elective and emergency patients to detect possible COVID-19 infection in surgical candidates (Figure 2). Each test will include a patient history (e.g., previous travel, place of residence, any closed contact with a suspected COVID-19-positive individual), laboratory tests (increased neutrophil-to-lymphocyte ratio and C-reactive protein, decreased lymphocyte count), and chest radiography suggesting

COVID-19 infection (i.e., multifocal airspace opacities in the lower lung areas, perihilar and upper lobe abnormalities in the later stage).<sup>31-33</sup> If the initial tests suggest suspicion for COVID-19, a rapid test and chest computed tomography scan can be used to establish the diagnosis. The rapid test measures the reactivity of SARS-CoV-2 antibody in patients’ blood (i.e., IgG and IgM anti-SARS-CoV-2). For emergency patients, the rapid test can be directly ordered by the neurosurgeons without consulting with the COVID-19 team (i.e., the team assigned to provide specific management for patients with suspected COVID-19). A positive rapid test prompts RT-PCR analysis, the gold standard for diagnosing COVID-19.<sup>34</sup>

### Adjustment in Surgical Practices and Recent Trends at the Outpatient Clinic

Our status as a tertiary referral hospital results in a high patient load.<sup>8</sup> We have a long list of patients queueing up to undergo operative procedures. In some cases, a tumor patient can wait for up to 6 months for surgery. Consequently, we decided not to eliminate elective surgical procedures during the pandemic. We were aware that this practice is not in line with the recommendation published by the Indonesian Society of Neurological Surgeons suggesting that hospitals postpone all elective procedures.<sup>35</sup> We were afraid that such a policy would lengthen waiting periods and lead to worsening of patients’ conditions, which might further increase the patient load in the future. Later, it became clear that our policy was aligned with a recommendation from Burke et al.,<sup>13</sup> who suggested that

eliminating elective surgery is not compulsory until a hospital needs substantial aid from external institutions.

Nonetheless, early in phase 2 we reduced the number of elective surgical procedures (Figure 3). One reason for this reduction was the hospital's policy of allocating only 2 spots in the intensive care unit for postoperative neurosurgical patients. This was meant to prepare for a surge of COVID-19 critical patients. Burke et al.<sup>13</sup> recommended that a hospital reduce the number of elective surgeries by 25% when it has a total of 10–99 community cases or 7–16 COVID-19 inpatients. By the time we reduced the number of elective procedures, we had 55 cases in Yogyakarta and 3 COVID-19 inpatients.

Another significant issue affecting the number of elective procedures was the poor availability of personal protective equipment (PPE) in our hospital. It is recommended that surgeons who are performing an operative procedure for a suspected patient or confirmed cases use level-3 PPE, including N95 masks or equivalent, coverall gowns, boots, face shields, and other standard surgical protective gear.<sup>36</sup> Unfortunately, the hospital was struggling to provide sufficient PPE, especially in the early phase of the outbreak, a problem that also occurred globally.<sup>37</sup> This issue started to improve in the second week of April 2020. The government and related stakeholders increased their efforts to meet the demand. In addition, there was support from nongovernmental organization and individuals. The improved PPE availability increased the safety of the procedure, which might explain the increased number of elective surgical procedures after the second week of April 2020.

As for the emergency cases, the decline could also be seen early in phase 2 (Figure 3), possibly caused, at least in part, by the government's "stay at home" recommendation. This recommendation may cause citizens to hesitate to leave their homes, leading to a reduction in the number of traffic accidents, a cause of emergency neurosurgery.<sup>38</sup> Finally, such hesitation also might inhibit the desire to visit the outpatient clinic, resulting in the drop in outpatient visits (Figure 5). Consequently, the working hours of staff and residents were also reduced.

### Importance of a Contingency Plan for the Next Possible Pandemic

Based on a World Health Organization guideline, every hospital should develop an integrated hospital emergency risk management program. This program should include continuous risk assessment of future threats, a multihazard early warning system, and emergency simulations to prepare for an outbreak.<sup>39</sup> One

example is the creation of clear hospital zoning. By treating different groups of patients in a separate zone, the risk of transmission can be reduced.<sup>39</sup> However, there is no exclusive zone dedicated to treating related patients in our hospital. All COVID-19 clinics and wards are not located in the same zone. In phase 2, we also treated all surgical patients in the same building because of limited screening resources. This could result in increased transmission if the prevailing procedure resulted in failure to detect positive cases. Furthermore, a good signage system can also be applied to promote physical distancing and reduce the transmission rate. Therefore, hospital management must clearly plan for the development of a more appropriate infrastructure for facing future pandemics.

### CONCLUSION

COVID-19 is having a deleterious impact on the stability of global public health, including neurosurgical services. Our hospital in Yogyakarta, Indonesia has been affected by the pandemic, especially in the early phase. Several factors, such as the government's slow response, the inadequacy of PPE, and low testing rate, have hindered the management of neurosurgical patients during COVID-19 pandemic. To help us understand the extent of the impact, we used a 4-phase model of the outbreak. In phase 2, when the first case was detected in Yogyakarta, there was a decline in the numbers of both emergency and elective surgical procedures. The number of outpatients was also decreased. Using this model, we also expected to produce a clear strategy for improving the management of neurosurgical patients during the pandemic by reducing the number of surgical procedures and advocating for an adequate supply of PPE to stakeholders. In the future, a comprehensive plan can enhance both utilization and safety of the neurosurgical staff.

### CRediT AUTHORSHIP CONTRIBUTION STATEMENT

**Wiryawan Manusubroto:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing - original draft, Writing - review & editing. **Adiguno Suryo Wicaksono:** Conceptualization, Formal analysis, Methodology, Project administration, Writing - original draft. **Daniel Agriva Tamba:** Conceptualization, Data curation, Investigation, Software, Visualization, Writing - original draft. **Paulus Sudiharto:** Supervision, Validation, Writing - review & editing. **Handoyo Pramusinto:** Formal analysis, Resources. **Rachmat Andi Hartanto:** Resources. **Endro Basuki:** Supervision, Validation, Writing - review & editing.

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