

Neurosurgery residency program in Yogyakarta, Indonesia: improving neurosurgical care distribution to reduce inequality

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OBJECTIVE Educating future neurosurgeons is of paramount importance, and there are many aspects that must be addressed within the process. One of the essential issues is the disproportion in neurosurgical care, especially in low- and middle-income countries (LMICs). As stated in their report “Global Surgery 2030,” The Lancet Commission on Global Surgery has emphasized that the availability of adequate neurosurgical care does not match the burden of neurosurgical disease. A strong partnership with the local and national government is very desirable to improve the way everyone addresses this issue. In addition, international collaborative effort is absolutely essential for the transfer of knowledge and technology from a developed country to an LMIC. This paper shows what the authors have done in Yogyakarta to build an educational model that helps to improve neurosurgical care distribution in Indonesia and reduce the inequity between provinces.

METHODS The authors gathered data about the number of neurosurgical procedures that were performed in the sister hospital by using data collected by their residents. Information about the distribution of neurosurgeons in Indonesia was adapted from the Indonesian Society of Neurological Surgeons.

RESULTS The data show that there remains a huge disparity in terms of distribution of neurosurgeons in Indonesia. To tackle the issue, the authors have been able to develop a model of collaboration that can be applied not only to the educational purpose but also for establishing neurosurgical services throughout Indonesia. Currently they have signed a memorandum of understanding with four sister hospitals, while an agreement with one sister hospital has come to an end. There were more than 400 neurosurgical procedures, ranging from infection to trauma, treated by the authors' team posted outside of Yogyakarta.

CONCLUSIONS Indonesia has a high level of inequality in neurological surgery care. This model of collaboration, which focuses on the development of healthcare providers, universities, and related stakeholders, might be essential in reducing such a disparity. By using this model, the authors hope they can be involved in achieving the vision of The Lancet Commission on Global Surgery, which is “universal access to safe, affordable surgical and anesthesia care when needed.”

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KEYWORDS inequality; LMIC; neurosurgery training program; international collaboration

EVIDENCE shows that a large number of patients from low- and middle-income countries (LMICs) lack access to surgical care.^{2,16} Globally, it is estimated that more than 143 million additional surgical procedures are required to prevent mortalities and morbidities.¹⁶ Almost

half of these unmet surgical needs can be found in South and Southeast Asia, two regions where most of the countries are in the LMIC category (<https://data.worldbank.org/income-level/lower-middle-income>).¹⁶ If all dimensions of access to surgery (i.e., timeliness, capacity of workforce

ABBREVIATIONS HIC = high-income country; ISNS = Indonesian Society of Neurological Surgeons; LMIC = low- and middle-income country; MoU = memorandum of understanding.

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and infrastructure, surgical safety, and affordability) are analyzed, slightly more than 90% of the population in Southeast Asia does not have proper access to surgery.¹⁶ Even when they finally have access to surgery, they are at risk of becoming impecunious because they are not immune from the catastrophic impact of out-of-pocket payments.²³ Consequently, patients with untreated surgical conditions usually suffer disability and even death.²²

One factor that contributes to the global burden of surgical care is neurosurgical disease. The issue of disproportionate care is reported to be larger in neurosurgical care, and the difference is even higher in LMICs.^{7,20,21} In some parts of India, for instance, 1 neurological surgeon is responsible for caring for approximately 350,000 people;⁷ thus, it is evident that there is a substantial need to increase the number of neurosurgeons to solve the shortage problem.¹³

The primary aim of a neurosurgical educational program is to prepare the neurosurgeon of the future to provide service to a large number of patients where needed, without compromising the quality of care.^{4,12,25} Delivering theoretical knowledge, improving clinical skills, and keeping up with technological advances are the essential points that must be included in the curriculum by the institution.¹² It is therefore crucial for the architects of the program to have national and (perhaps) international colleagues at the table from the beginning to make sure that the training is consistent with acceptable national and international standards without being excessively strict to the point of stifling new ideas.⁴

The effort to deliver high-quality neurosurgical training is not as straightforward as one would expect. The curricula of the neurosurgery training programs remain highly varied in different parts of the world.⁶ In Europe, for example, there is no standard for neurosurgical training programs that can be applied to all regions there.⁴ Unsurprisingly, the stakeholders face a more significant challenge in creating a high-quality training program in LMICs. Issues such as lack of standardization or time work limit are often confronted in this group of countries, including Indonesia. Nonetheless, the number of studies or reports focusing on how the neurosurgery institutions deliver neurosurgical training programs in LMICs, specifically Indonesia, is low, if any. Furthermore, little is known about how neurosurgical training centers in countries such as Indonesia play a role in reducing surgical care inequality. We aim to review the practice that has been developed at our institution, emphasizing our effort to reduce the gap in neurosurgical healthcare throughout Indonesia.

Methods

To gather information on the number of neurosurgical procedures performed at every sister hospital (i.e., a developing hospital that collaborates with an established hospital for a specific program and usually has less health service capacity), we requested that our trainees keep a record of the number of surgical cases they or visiting consultants treated during a 1-month period in the sister hospital. The data had to also include the diagnosis and type of attempted procedures to treat the diseases. Data from

TABLE 1. Type of surgical cases that were performed in Undata General Hospital from September 2017 to January 2018

Type of Surgical Case	2017				2018	Total
	Sep	Oct	Nov	Dec	Jan	
Trauma	9	7	12	12	13	53
Spine	1	—	1	1	1	4
Pediatric	1	1	—	—	3	5
Tumor	2	2	3	3	4	14
Vascular	1	2	1	1	1	6
Infection	1	1	1	1	1	5
Functional	—	1	—	—	—	1
Total	15	14	18	18	23	88

all residents were then compiled by one of our staff in the Division of Neurosurgery at Dr. Sardjito General Hospital. To give perspective about the range of clinical experience received by our residents outside Yogyakarta, we present data about the type of surgical cases from Undata General Hospital in Table 1. In addition, to compare the quantity and variety of cases among the sister hospitals, we summarized the number of surgical cases treated by our team in Undata General Hospital, Yuliddin Away General Hospital, and Tengku Chik Ditiro General Hospital (Fig. 1).

We aim to present information about the disparity in neurosurgical care in Indonesia. Therefore, we gathered information about the recent number of neurosurgeons working throughout the country along with their current working locations. The data were collected from the ISNS website (http://www.ins.or.id/frontend/detail_news/20) and then compiled into a map of neurosurgeon distribution (Fig. 2). Finally, a brief description about the profile of our division and the information about the curriculum that we use here are taken from the guidebook of the Universitas Gadjah Mada Division of Neurosurgery.

Results

Surgical Cases Performed by Our Residents in Different Sister Hospitals

In 2017, Dr. Sardjito General Hospital signed a memorandum of understanding (MoU) with Undata General Hospital in Palu, Central Sulawesi, and Tengku Chik Ditiro General Hospital in Sigli, Nangroe Aceh Darussalam. In the province of Nangroe Aceh Darussalam, we built another partnership with Yuliddin Away General Hospital, Tapak Tuan, in April 2019. To contrast the number of cases in those three hospitals, data regarding the number of surgical procedures in three different hospitals are presented in this study (Fig. 1). Undata General Hospital recorded the highest monthly average of surgical procedures over the 25-month period (16.4 procedures per month), ranging from 27 procedures in June 2018 (highest) to only 6 operations in November 2018. The earthquake in September 2018 created a downward trend in terms of number of surgical procedures performed. In addition, Dr. Franklin, one of our graduates who originated from Palu, had finished his training and went back to Palu in September 2019. This graduation, which marked the end

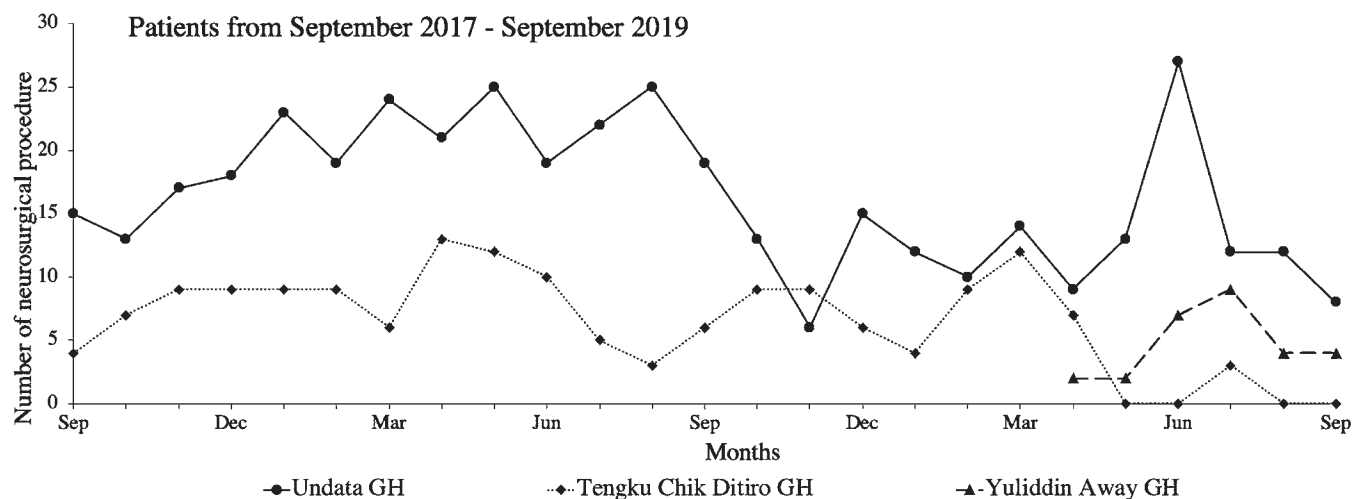
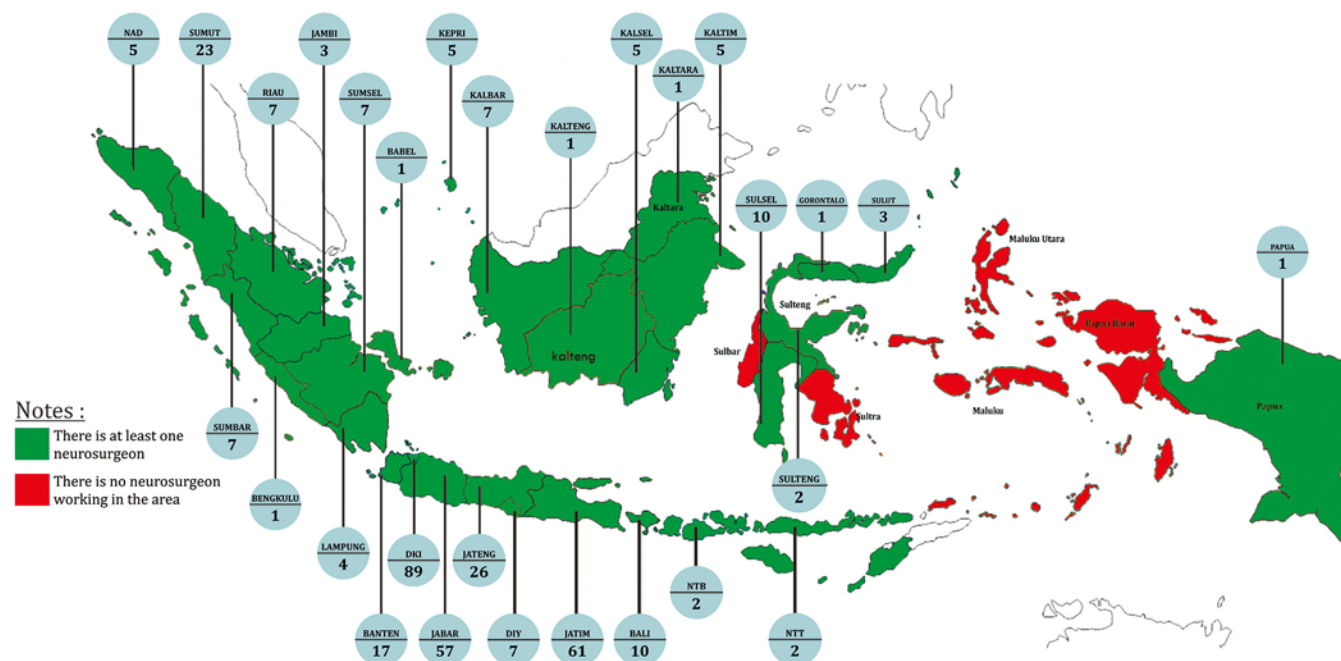


FIG. 1. Details of the number of cases performed by our trainee in Undata General Hospital (GH), Palu; Tengku Chik Ditiro General Hospital; and Yuliddin Away General Hospital, Tapaktuan.

of our agreement with Undata General Hospital, resulted in discontinuing the posting of our residents and visiting consultants.

To illustrate the types of cases performed in a particular sister hospital, data on neurosurgical procedures performed between September 2017 and January 2018 in Undata General Hospital are presented in Table 1. Most of the cases (60.2%) were trauma-related cases, followed by tumors (15.9%). Functional neurosurgery was the least

represented type of case, in which there was only 1 case during the 5-month period. Even though the types of neurosurgical cases are varied in every sister hospital, the spectrum of disorders is not as broad as in Yogyakarta; that notwithstanding, the residents learned to perform many surgical procedures independently. A total of 600 cases, including tumors, infections, pediatric, and vascular, were treated by our residents and visiting consultants (Fig. 1).



Notes:

- There is at least one neurosurgeon
- There is no neurosurgeon working in the area



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FIG. 2. Distribution of the members of ISNS in Indonesia in July 2019. Copyright Chinta Permata. Published with permission.

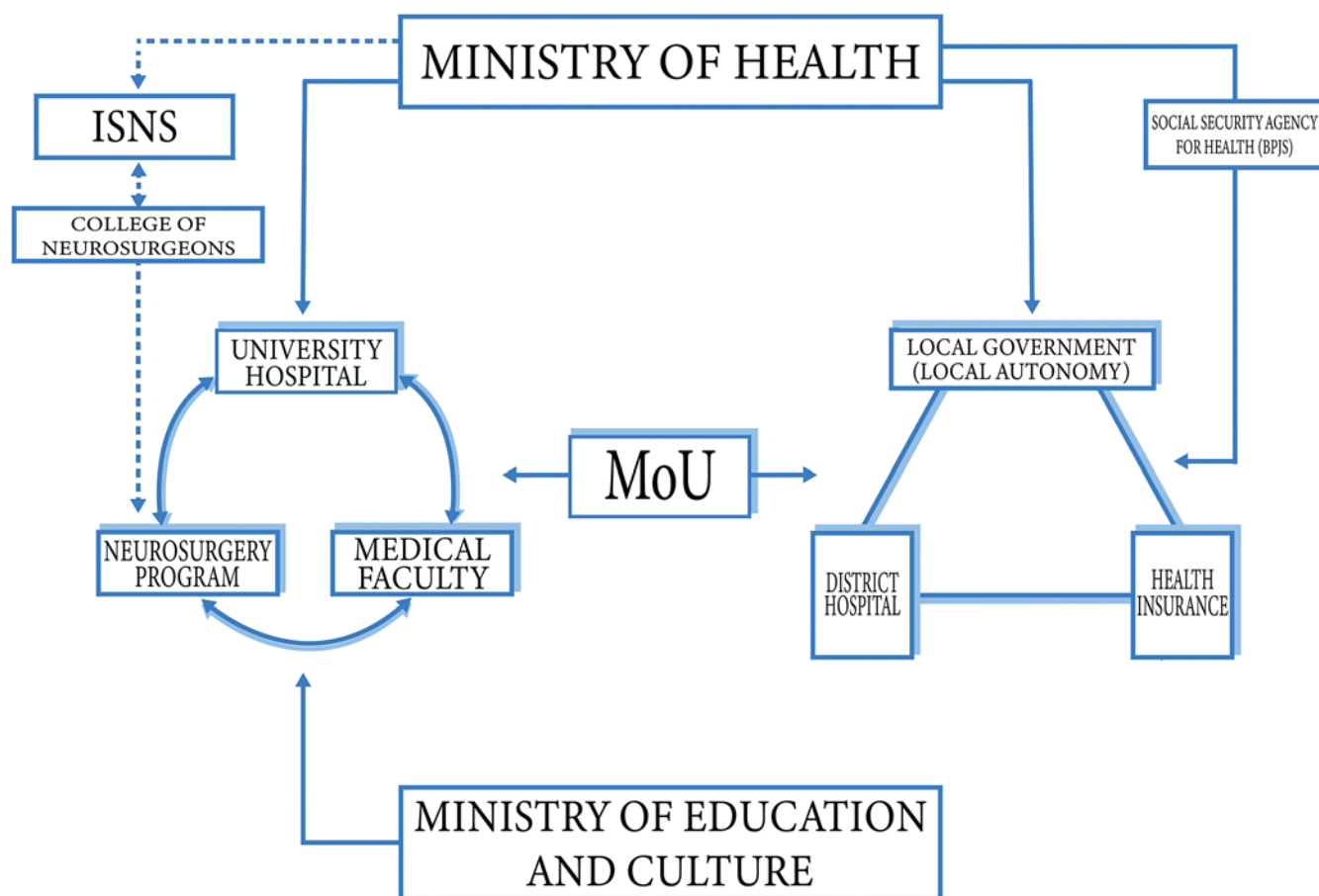


FIG. 3. The diagram of the model of collaboration. The Indonesian Ministry of Health, through the Directorate of Health Service and Board for Development and Empowerment Human Resources of Health, creates regulations that are then used by our primary hospital and local government. This set of rules is then adopted by the local government to manage the local hospital, health office, and health insurance. Likewise, our center follows guidance and regulation from both the Indonesian Ministry of Health and the Indonesian College of Neurosurgery to run the neurosurgery training program. The partnership with the local government is based on the MoU signed by the head of the related district or province.

In Nangroe Aceh Darussalam, Tengku Chik Ditiro General Hospital conducted approximately 8 operative procedures each month from September 2017 to April 2019. However, the malfunction of the CT scanner in May 2019 complicated the management of neurosurgical patients in the hospital. The unfortunate circumstance is reflected in the graph (Fig. 1) by the significant decrease in the number of surgical procedures. Currently, the hospital is not able to provide neurosurgical care. Lastly, even though it is in the early operational phase, neurosurgical service in Yuliddin Away General Hospital has shown a promising trend. During the last 5 months of this study, their monthly average of neurosurgical operations performed was 6 procedures.

Number of Neurosurgeons and Their Current Distribution

The data on the number of neurosurgeons in Indonesia and their current place of practice are presented in Fig. 2. There are 5 of 34 provinces in Indonesia with no neurosurgeon. These provinces include Sulawesi Barat, Sulawesi Tenggara, Maluku, Maluku Utara, and Papua Barat. Papua is the province with the largest disproportion between the

number of physicians and geographical area (i.e., 1 neurosurgeon covers an area of 319,000 km²). In contrast, DKI Jakarta, the capital city of Indonesia, displays the highest number of neurosurgeons, despite the small geographical area (i.e., 89 neurosurgeons).

Model of Collaboration Proposed by Universitas Gadjah Mada Division of Neurosurgery

To be actively involved in reducing inequality, we created a unique scheme for our neurosurgical training program (Fig. 3). In this scheme, we, along with the Universitas Gadjah Mada Faculty of Medicine, Public Health, and Nursing, developed a collaborative effort between our division and the government, health office, and stakeholders, especially in the region where there is no neurosurgeon. All participants in this plan of action are expected to take part in improving surgical care in underdeveloped areas (Table 2).

Resident Education

In the 7.5 years since its establishment, our division has

TABLE 2. The multiyear initiative to build the neurosurgery services in Indonesia

Multiyear Initiative of the Division of Neurosurgery: Sister Hospital Collaboration
Recruitment of local medical doctor for the candidate of neurosurgeon
MoU between our division and the sister hospital is signed
Socialization effort to the related stakeholders through seminar and teleconference
Preparation of the hospital infrastructure and health workforces
Commencing the neurosurgical services as early as possible (at least 2–3 years before the graduation of the local candidate)
Knowledge sharing via teleconference
Exit strategy at the completion of the program
Sustainable sharing of knowledge via teleconference

admitted 27 residents who originated from various locations in Indonesia. Some of them were admitted through the scheme that we noted above. Currently, there have been 6 residents who have graduated and gone back to the cities from which they originated.

The content of our curriculum is aligned with the National Curriculum of Neurosurgical Training published by the College of Indonesian Neurosurgery. By doing so, we want to provide training standardization across the country. There are three levels of competence used in our curriculum (adapted from Bloom's taxonomy³). These levels include the Enrichment Level (1st–3rd semester), Assistance Level (4th–7th semester), and Self Level (8th–11th semester). As the residents enter their 7th semester, they will be posted at various sister hospitals, where they will spend a month treating neurosurgery patients. To ensure the safety of each patient surgically treated by our residents, we will supervise the whole process by using two methods of supervision: direct visitation (i.e., once a month) and telemedicine. During our visit, we usually conduct an elective surgery that is rarely, if ever, performed by our resident. Conversely, in the case of telemedicine, the resident will contact the consultant on duty and present the patient's condition and the suggested operative or nonoperative management via phone call; this can also be conducted via video call using WhatsApp or a teleconference session.

Finally, we usually stop sending residents and visiting consultants to a sister hospital when we are satisfied that a viable neurosurgical unit has been established in the hospital. An example of a success story is that we have not sent residents to Papua since 2017. This is because our Papua-born neurosurgery resident completed his residency in Yogyakarta, and has been back practicing neurosurgery in his home province of Papua.

Discussion

General Information on the Universitas Gadjah Mada Division of Neurosurgery

In 2011, the Division of Neurosurgery of Universitas Gadjah Mada was formally established and became

the fifth neurosurgical training center in Indonesia, with Dr. Wiryawan Manusubroto as the head of the division. Currently, we have a total of 6 neurosurgeons acting as teaching staff. Our primary hospital is Dr. Sardjito General Hospital, a tertiary care referral facility for patients originating from the Special Region of Yogyakarta and the south side of Central Java Province. The type of neurosurgical cases that we treat in this hospital are highly varied due to its status. To accommodate the variety of patients and to advance our knowledge and surgical skills in specific neurosurgery cases, we have developed subspecialty units. The 5 subspecialties among the current 6 neurosurgeons include tumor, infection, vascular, pediatric, and spine. In a single week, we usually perform 10–15 surgical procedures.

Healthcare in Indonesia: The Need to Reduce the Gap in Neurosurgical Care

The call to implement social equality, including health service, for all Indonesians, is documented in several legal documents in Indonesia. In Pancasila (i.e., the Indonesian state philosophy), social justice is written in the fifth point. Moreover, Article 28H, section 2, and Article 34, section 3, of the Constitution of the Republic of Indonesia of 1945 mentions that each citizen has the right to health service. Consequently, our government created a specialized agency that regulates national health insurance, namely the Social Security Agency for Health (or Badan Penyelenggara Jaminan Sosial Kesehatan). This agency engages in the effort to protect all Indonesians from the catastrophic effect of out-of-pocket expenses (Law of the Republic of Indonesia no. 40 of 2004 and no. 24 of 2011).

However, financial ability is not the sole factor that determines healthcare accessibility.² Another critical factor is the health workforce. In 2013, the needs-based shortage of health workers was at 17.4 million around the world, where approximately 40% of the deficit occurred in the Southeast Asia Region.²⁶ Occupied by more than 269 million inhabitants, Indonesia has not been able to maintain an adequate number of medical doctors.¹¹ The World Health Statistics 2019 reported that Indonesia has an average of 0.38 physicians per 1000 persons.²⁷ The ratios are still below those recommended by the WHO (i.e., 1 physician for every 1000 persons).¹⁵

Furthermore, the distribution of physicians is also concerning.¹⁷ Indonesia is an archipelagic country with more than 17,700 islands scattered around its region. Such geographic factors bring challenges to the effort to provide the standard number of healthcare providers. Physicians are less motivated to work outside Java or other developed regions due to several factors, including primitive infrastructure, remote islands, and the spatial distance.¹ Also, inadequate policy to prevent the unusual amount of incentives from private hospitals to physicians who work in private sector and dual practices (i.e., working in state and private facilities) contribute to the human resources disproportion in healthcare.¹⁷ More than 19,500 medical doctors work in Jakarta (the capital city of Indonesia), especially in the private sector. This creates an average of 1.87 doctors per 1000 persons, the highest ratio in the country.^{18,19} In contrast, there are fewer than 10% of physi-

cians working in rural regions, where almost half of the Indonesian population lives.¹ Sulawesi Barat, one of Indonesia's undeveloped provinces, has the lowest ratio of physicians to population, with only an average of 0.11 physicians per 1000 persons.^{18,19}

In addition to the inadequate number of physicians, the disparate number and distribution of the neurosurgeons is also an essential issue in LMICs.⁹ A report by the US government in 1975 suggested that the recommended neurosurgeon to population ratio should be 1:100,000.²⁸ Data from the Indonesian Society of Neurological Surgeons (ISNS, Perhimpunan Spesialis Bedah Saraf Indonesia) showed that there are only 371 neurosurgeons spread across the country, with a neurosurgeon to population ratio of 1:725,000 (Fig. 2).¹⁰ Even the ratio of neurosurgeons to population in a metropolitan city such as Jakarta (i.e., 1:116,300) cannot satisfy the suggested ratio that was mentioned above.²⁸ The deficit is even larger in most of the eastern parts of Indonesia. The absence of neurosurgeons in provinces such as Maluku Utara, Maluku, and Papua Barat exacerbates the condition. There is still a considerable disparity to be resolved in the neurosurgery services.

Role of the Universitas Gadjah Mada Division of Neurosurgery to Improve Care Distribution: Collaboration Between the Sister Hospital, Local Health Office, and Local Government

We attempt to implement the scheme displayed in Fig. 3 in several ways. We designed a point-based admission system that gives a point boost for applicants coming from marginal regions (i.e., regions that do not have a neurosurgeon) around Indonesia. To be able to acquire the extra points, candidates are required to show proof that they will go back to the place from which they originated. The evidence can be in the form of a letter of recommendation, agreement letter, or other legal document signed by both the hospital director and a district official or a governor stating the applicant's commitment to practice in that area.

The next approach is that we, through Dr. Sardjito General Hospital, make an agreement with the hospital in the region from which the trainee originates. The hospital is then called our "sister hospital." Legally, regulation no. HK.02.02/MENKES/390/2014 of the Ministry of Health mandates the need to implement the sister hospital system. The process can be more straightforward if the related hospital already has adequate infrastructure to perform standard neurosurgical procedures. Nonetheless, the absence of robust infrastructure is not a contraindication to our mission. As long as the local government demonstrates a clear commitment to improving their facilities, which can be expressed in the MoU, the agreement can still be feasible.

We also use teleconferencing, which is held every Tuesday using the Google Hangouts program, to guide our trainees. Throughout the videoconference, our residents are required to give a thorough report regarding their clinical activities in the previous week and in-depth analysis of what they have been doing. They must include the number of operative procedures (both emergency and elective), inpatient and outpatient visits, and consulted patients in the report.

Impact of Our Model: Positive Impact and Room for Improvement in the Future

A model of collaboration that utilizes local doctors and provides them chances to become neurosurgeons will never be fruitless. The efforts of Dr. Roy Selby, a neurosurgeon from the US, might provide the best example. Dr. Selby sent several Malaysian doctors to be trained as neurosurgeons in several medical schools in the US and Canada. Later, some of those doctors came back to Malaysia and served their country.¹⁴ The same concept was also applied in Uganda by some fellow neurosurgeons from Duke University.⁸ We hope those examples can inspire us to locally build neurosurgical capacity.

Furthermore, we believe that our effort could be an impetus for future development of neurosurgical services in a wider area than the ones we have served right now. The impact of our service might hopefully spread regionally, persuading other governments from other areas to put more investment in neurosurgical equipment. Currently, two more local governments have already been in a negotiation phase with our division to build new neurosurgical services in their cities.

Also, it is obvious that our graduates have become neurosurgical leaders, at least in their native cities. They are able to provide neurosurgical care to patients who would never be able to receive such care before. In addition, their presence would reduce the number of referral cases.

Neurosurgical services need extensive involvement from other professionals (such as nurses, intensivists, nutritionists, etc.) to provide standard care for neurosurgery patients. In the future, extensive interprofessional collaboration is needed for improvement.

The Importance of International Collaboration to Reduce Inequality

In the last 2–3 decades, there has been an increased awareness to reduce inequality in surgical care.^{5,20,24} This led to the 2015 Lancet Commission on Global Surgery and the publication of their report, "Global Surgery 2030."¹⁶ The purpose of the initiative is to reduce the gap between high-income countries (HICs) and LMICs, as well as to encourage international partnerships (bilateral or multilateral) to tackle the imbalance. Because Indonesia is in the LMIC bracket, we believe that building such international collaboration may help us to reduce the disproportionate neurosurgical care within our country.

In 2012, we started to build a great partnership with Prof. Chris Ekong from the University of Saskatchewan College of Medicine, Canada. Since then, he has come on several occasions to the university, mainly giving lectures about spinal cord injury and its management. In his last visit, we arranged a program that lasted for a week. In this program, Professor Ekong gave his talk about what he has accomplished in Regina, Canada, for the management of spinal and spinal cord injury. On the last day, we held a panel discussion focusing on pain management. An anesthesiologist and a neurologist were also invited to present their perspectives of treating pain with nonsurgical approaches.

Professor Ekong has visited Indonesia on many occasions between 2013 and 2019. He gave lectures at the Universitas Gadjah Mada, and at national and World

Federation of Neurosurgical Societies meetings during those visits. In addition, Dr. Handoyo Pramusinto went to Regina, Canada, as a visiting neurosurgeon for 2 weeks in 2013. Dr. Wiryawan Manusubroto and his senior resident visited Canada in 2018. Dr. Manusubroto spent part of the time in Regina in the operating room, interacting with Regina neurosurgeons and medical leaders. He also attended the annual meeting of the Canadian Neuroscience Federation in Halifax, during which he and Professor Ekong made a joint presentation about the challenges of a neurosurgical residency program in an archipelago country such as Indonesia. The resident spent 1 month in the Division of Neurosurgery in Regina. This partnership, which originates from Regina, Canada, now includes live 90-minute videoconference rounds with general interest neurosurgeons and those with subspecialty interests (such as trauma, spine, vascular, tumor, and neuromodulation) in Canada and Malaysia every 3 months.

Conclusions

Like most LMIC countries, Indonesia has a low supply of surgical and neurosurgical services. The available services are unevenly distributed among its provinces. Such inequality may threaten the well-being of its population. The demand for an adequate supply of neurosurgeons is a vital issue to address. Our center aims to become a center of excellence in neurosurgical training, without abandoning our focus to improve the distribution of neurosurgeons within the country. Our unique approach to the selection process of residents, partnerships with provincial authorities and hospitals in remote parts of the country, and the use of inexpensive technology for videoconferencing are helping us with the supply of neurosurgeons in remote islands. International partnerships through live Internet rounds, international site visit exchanges, and joint academic projects are essential in boosting our endeavors as a center of excellence in neurosurgical training. We plan to increase the number of partnerships with provincial governments and remote hospitals in Indonesia. The new collaborations will hopefully increase the number of neurosurgeons who return to those regions over the next several years. We are also intensifying our international collaboration by sharing our experiences so that other countries (LMICs or HICs) can learn from each other.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Wicaksono, Tamba, Manusubroto. Acquisition of data: Wicaksono, Tamba. Analysis and interpretation of data: Wicaksono, Manusubroto. Drafting the article: Wicaksono, Tamba. Critically revising the article: Sudiharto, Basuki, Pramusinto, Hartanto, Ekong, Manusubroto. Reviewed submitted version of manuscript: Sudiharto, Basuki, Pramusinto, Hartanto, Ekong, Manusubroto. Administrative/technical/material support: Tamba, Sudiharto, Basuki, Pramusinto, Hartanto, Manusubroto. Study supervision: Manusubroto.

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