

REMOTE MEDICAL EDUCATION IN INDONESIA: ANALYSIS OF 10 YEARS OF ACTIVITIES

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Abstract

Introduction: With ongoing development of technology, and especially amid the current COVID-19 pandemic, there is rapidly increasing need for remote communications, including in the field of medical education. This study aimed to evaluate our telemedicine activities between Japan and Indonesia. **Methods:** We retrospectively analysed the data acquired for the period 2010–2019 inclusive, looking at number of programmes, content, participating sites, and videoconferencing systems. We also digitally sent questionnaires to attendees to request their evaluation of image quality and programmes. **Results:** There were a total 135 programmes, with 29 participating institutions in Indonesia. The number of programmes increased rapidly in 2017, following a rapid increase of participating sites in 2016. Programmes included endoscopy (50 programmes, 37%), neurology (25, 19%), and dentistry (12, 9%). Between 5 and 10 sites connected with 81 programmes (60% of all), and more than 10 sites with 33 (24%). The most commonly used videoconferencing system was Vidyoo (108, 80%), followed by Zoom (15, 11%). Participating institutions were located among 19 cities on the five major islands. Image quality received a favourable evaluation from 98% (504/516) of questionnaire respondents, with 100% (400/400) holding a favourable view of the programmes. **Conclusion:** Remote medical education expanded in Indonesia in the 10 years under review. This expansion is expected to continue to foster more specialists and it is anticipated to improve medical care nationwide.

Keywords: telemedicine; medical education; distance learning; Indonesia; videoconferencing

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Introduction

The Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 are a collection of 17 global targets for the world's people to achieve by 2030.¹ “Good Health and Well-being” and “Quality Education” are the two SDGs to which remote medical education can most substantially contribute. Inclusiveness is a key theme in the SDGs, implying that no one should be left behind in these achievements.

The COVID-19 pandemic accelerated the need for remote education, amid many countries and major cities implementing lockdowns for months, with people obligated to stay at home and/or keep distance from one another. On-

line teleconferencing and videoconferencing sharply increased in daily life, in both business and casual settings, and many scientific communities also adopted virtual modes of communication.²⁻⁶ Meanwhile, remote education became the only solution that enabled continual provision of classes for students. Telemedicine, for its part, typically offers time and cost benefits for healthcare providers by eliminating the needs for provider or patient to physically change locations, especially beyond geographic borders. Yet it also aids efficiency and scalability because it easily can be used repeatedly and with large numbers of people.⁷ Recently, telemedicine's additional benefit of reducing the carbon footprint, owing to decreased physical movement, has been discussed.^{8,9}

Indonesia is the world’s fourth most populous country, with more than 250 million people. The country comprises more than 10,000 islands across over 5,000 km from east to west. Given these circumstances, remote medical education and telemedicine would appear to be an excellent tool for achieving the two abovementioned SDGs. The Telemedicine Development Centre of Asia at Kyushu University Hospital, Japan, has collaborated with academic hospitals worldwide since 2002, and with those in Indonesia since 2006.^{10,11} In this study, we review our remote medical education and telemedicine activities in Indonesia to study how they have evolved from 2010 to 2019.

Methods

We retrospectively analysed our database for the 10 years spanning January 2010 to December 2019, inclusive. Medical education programmes over that decade included teleconferences of lectures or case discussions using slides and videos, and live demonstrations of medical techniques. (Figure 1)



Figure 1. A videoconferencing view in neurology, connecting four university hospitals in Indonesia and Kyushu University Hospital in Japan.

Each year, the number of programmes, programme content, number of connecting sites, teleconferencing systems, and participating institutions were analysed. The videoconferencing systems used were “digital video transport system”,¹² Vidyio (Hackensack, NJ, USA), and Zoom (San Jose, CA, USA), along with H.323 equipment such as that used by Polycom (Santa Cruz, CA, USA) or Cisco (San Jose, CA, USA). When two systems were used together via a gateway, the one with more connecting sites was reported as the main system. We also added one-way streaming functionality for those who only wanted to view the conference but not join the discussion. The Join-View system (Unixon Systems Co., Ltd., Fukuoka, Japan) was used when annotation with lines and arrows during presentations and discussions was needed to aid explanations.

We distributed questionnaires on image quality and on the programmes. When a programme finished, participants

were provided with a URL they could access to input their feedback. There were four possible responses: very good, good, poor, or very poor.

Results

Programmes and new institutions

A total of 135 programmes were performed in coordination with Indonesian medical institutions. The numbers were low through 2013, but increased to 15 in 2014. (Figure 2) Notably, there was a steep increase to over double the number of programmes in 2017, and this remained above 20 per year for the following three years.

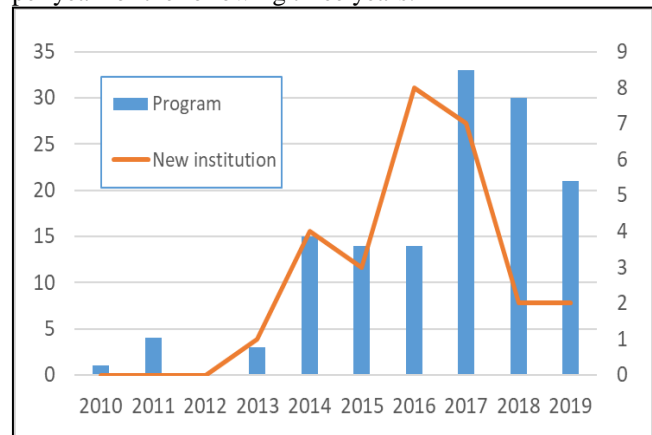


Figure 2. Numbers of programmes (left y-axis) and new institutions (right y-axis).

A total of 29 medical institutions took part in our remote medical programmes, though two had joined before the studied period – one in 2006 and one in 2007. The number of newly joining institutions substantially increased in 2016 and 2017, and then dropped markedly in 2018. The growth trend was quite similar for the two metrics (programmes and institutions), as they showed similar movement for the first 6 years. They diverged, however, over the next 4 years. The highest peaks for new institutions were in 2016 and 2017; a year earlier than for programmes (2017 and 2018).

Programme content

By medical fields, programmes on endoscopy numbered the highest, at 50 (37%), followed by neurology (25, 19%), and dentistry (12, 9%). (Figure 3) Other major programmes included paediatrics, surgery, obstetrics, and medical technology. Endoscopy began in 2010 and remained the highest represented over the entire 10 years. Neurology and dentistry both began in 2014 and rapidly increased from 2017.

Teleconference of lectures or case discussions was the primary mode of transmission among all activities (125, 92.6%), and live demonstration numbered 10 (7.4%). Live demonstration began in 2011, and six (60%) of these programmes were for endoscopy.

Connecting sites

Figure 4 shows the number of connecting sites for each

programme, grouped into four categories. In total, the majority were in the 5–10 group, with 81 (60%) programmes, followed by 11–20 (33, 24%), 3–4 (12, 9%), and two (9, 7%), with no programmes connecting to over 20 sites. Only in 2016 were programmes with 11–20 sites the most represented, with 11 (79%) of 14 programmes.

Systems used

Vidyo was the most popular videoconferencing system, and used for 108 (80.0%) of programmes, followed by Zoom (15, 11%) and H.323 (9, 7%). Notably, use of Zoom rapidly increased over the most recent 2 years (Figure 5).

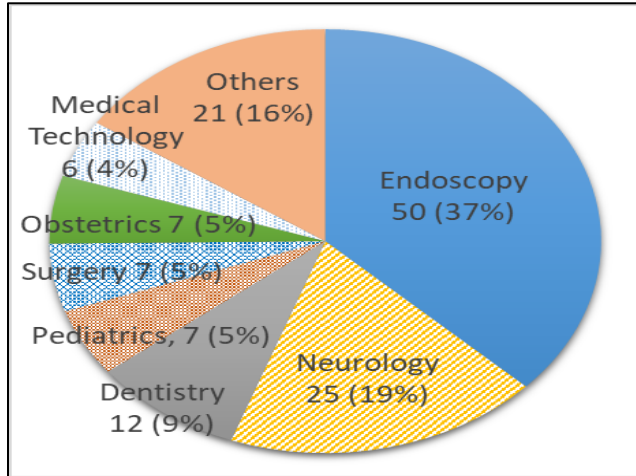


Figure 3. Programme contents.

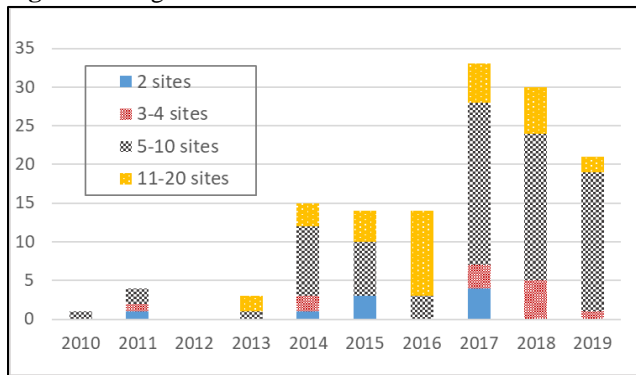


Figure 4. Number of connecting sites.

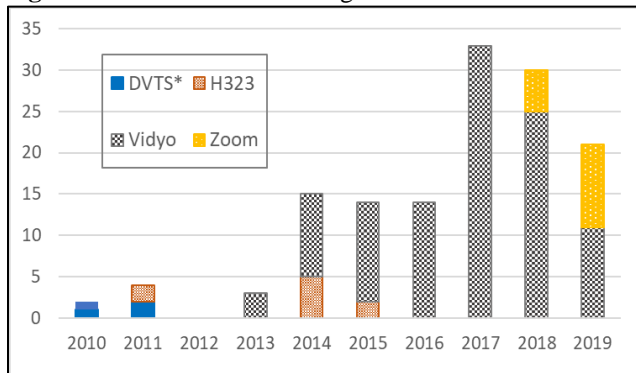


Figure 5. Main systems used. DVTS: digital video transport system

Other systems were combined with the main system in 47 programmes: 45 (96%) used H.323, of which 41 (91%) were used with Vidyo and the remaining four (9%) were used with Zoom. A streaming system was additionally used in 26 (19%) programmes from 2014, 21 (81%) of which were used with Vidyo. Join-View was used in eight (6%) programmes from 2015, all used with Vidyo.

Geographic distribution

The institutions that participated were in 19 cities across the country’s five major islands. Seventeen (66%) institutions were in eight (42%) cities on Java, followed by five institutions (17%) in five (26%) cities on Sumatra. (Table 1)

The table also shows the number of programmes participated in within each region. Seven institutions in Jakarta participated in a total of 167 programmes, followed by one institution in Malang with 71 programmes and two in Surabaya with 65.

Table 1. Geographic distribution of participation in programmes.

Island (n=5)	City (n=19)	Number of institutions (n=29)	Number of programmes joined (n=543)
Bali		(n=2)	(n=14)
	Denpasar	2	14
Java		(n=17)	(n=452)
	Bandung	3	34
	Jakarta	7	167
	Jember	1	1
	Malang	1	71
	Semarang	1	23
	Surabaya	2	65
	Surakarta	1	45
Kalimantan		(n=2)	(n=2)
	Banjarmasin	1	1
	Samarinda	1	1
Sulawesi		(n=3)	(n=39)
	Makassar	1	15
	Manado	1	23
	Palu	1	1
Sumatra		(n=5)	(n=36)
	Banda Aceh	1	2
	Medan	1	10
	Padang	1	1
	Palembang	1	21
	Pekanbaru	1	2

Evaluation of image quality and programmes

A total of 516 questionnaires were returned for the evaluation of image quality, with 400 evaluating the programmes. The majority reported that image quality was either good (310, 60%) or very good (194, 38%). All evaluations of the programmes were either very good (244, 61%) or good (156, 39%), with no unfavourable replies.

Discussion

In terms of number of programmes and participating institutions, remote medical education in Indonesia, provided through the Telemedicine Development Centre of Asia's network, grew in activity during the 10 years studied, until 2019. By number of programmes, activity seemed to be separated into three phases: (1) up to 2013, when activity was limited, (2) in 2014–2016, with a moderate increase, and (3) from 2017, when there was a substantial surge, dropping off in 2019. We speculate that the biggest reason for the first increase in 2014 was Internet expansion in Indonesia.¹³ Only three institutions participated through 2013: the Institute of Technology Bandung, University of Indonesia, and Airlangga University. Only these selected universities were capable of taking advantage of advanced Internet capabilities under a research and education network that provided widespread, stable access for academic purposes such as remote medical education.¹⁴ Image quality could be preserved only with this specially designed Internet infrastructure. From 2014, commercial Internet access that was open to the general public and made widely available showed considerable development. Bandwidth grew, speed increased, and costs reduced so that other universities and major hospitals could afford to join our programmes, reflecting a previously reported trend.¹⁵

We strongly believe the second surge in 2017 occurred as a result of the first telemedicine workshop, organised in August 2016 in Jakarta.¹⁶ We selected 11 major universities across the country and from each we invited a doctor and a technology engineer, together with medical and technology experts as panellists. The 2016 workshop was aimed at strengthening cooperation between doctors and engineers, and sharing the needs and problems among these personnel and universities. In the workshop, we organised and arranged a regular endoscopy case teleconference, with the first one starting 2 months later. The doctors' team leader asked that the participating medical personnel organise a programme, and the engineers' leader began technical preparations with evaluation and technical refinement of the Internet service and equipment at each university. Accompanying these efforts, the participants initiated a successful and educational teleconference in October 2016. Seven of the eight newly joining institutions in 2016 joined immediately after this workshop, and seven more joined the following year. The number of programmes rapidly increased in 2017, owing to this regular teleconference.

Certain characteristics of the content of major programmes warrant consideration. The first important point regards medical needs in Indonesia. There are still low numbers of specialists in endoscopy, neurology, paediatrics, and cardiac surgery; therefore, continuing medical education can be a highly practical and helpful tool for educating local doctors and increasing the number of specialists.¹⁷⁻²⁰ With our programmes, Japanese specialists could provide high-standard lectures, commentary, and advice for their Indonesian counterparts. Another issue is achieving satisfactory image quality for remote participants. For example, recognition of a subtle change in mucosal structure is essential in endoscopy for proper diagnosis of early-stage cancers, while patients' movement, such as with their fingers, gait, or facial appearance, are key factors in neurology. It is therefore vital to avoid low resolution or slow image transmission, and to appropriately select systems, secure robust Internet infrastructure, and make careful technical preparations for each programme.

Regarding systems, Vidyo emerged as a major solution during the 10 years. A possible reason for this is its sufficient image quality, especially when sending videos, though costly hardware equipment does need to be purchased in at least one central institution—Kyushu University in this case—to preserve quality in both resolution and frame rate. Thus a related advantage of Vidyo was that no satellite institutions in Indonesia needed to invest in expensive equipment since the platform worked using only a consumer-grade personal computer with a simple web camera and microphone connecting via a server at the central institution. The recently emerging Zoom platform also offered certain advantages, including sound quality. Feedback often indicated poor sound quality with Vidyo, while Zoom seemed to provide better quality, and stabler sound. Zoom also has a more user-friendly interface with convenient functions such as showing the microphone mute status of all participants. A third, and highly important, point is that Zoom is a cloud-based system, which keeps cost low for all users, as there is no need to provide expensive hardware, even at a central location. One drawback, however, is Zoom's poorer video quality compared with that of Vidyo using hardware. However, as technology is continually improving, this can be expected to improve.^{15,21}

Certain technical difficulties when organising teleconferences among multiple sites warrant mention. As the number of participating sites increases, so too do the number of potential technical difficulties. For our programmes, 5–10 sites were the most common, and about one quarter had more than 10 sites; for the latter technical preparations were accordingly more challenging than when connecting only a few stations. Groups of participants are also more difficult to accommodate than single attendees. This is because personal headphones with microphones can easily resolve audio issues such as echo, but microphones and speakers for group use must be carefully prepared so as to

avoid such problems.²² It is therefore highly important for the chief engineer responsible for technical preparations to communicate with all connecting sites, because satellite engineers need individual consultation to resolve possible technical problems, before and during the sessions. Adequate training programmes are essential for developing these leaders, as well as the remote engineers, to properly facilitate the entire activity.^{23,24}

Through our collaborations with Indonesia in remote medical education, we are pleased this activity was not limited to Jakarta but in fact expanded to many cities on the major islands nationwide. This differs considerably from experience in Thailand, where 93% of such activity was reported only in Bangkok.²⁵ Successful geographical expansion in Indonesia seems to have been aided by the important role of the Indonesian workshop in 2016. This invited major university hospitals nationwide, as mentioned above. Another reason seems to be the continual training of local engineers in various medical institutions in Indonesia, organised by domestic engineering leaders to improve skills and realise provision of capable technical support at each location. Engineering personnel who could master sufficient skills were able to assist doctors across different programmes, leading to overall expansion. Other countries have also encountered limitations in expanding telemedicine and remote medical education, but the similar emphasis on the importance of education is notable.²⁶⁻²⁹

Conclusion

Based on experience, the authors believe there are three essential factors for making remote medical education successful: access, needs, and skills.³⁰ Access is achieved through infrastructure. A sufficient level of Internet availability and quality is a fundamental requirement. The so-called digital divide must be resolved for practical remote medical education and to work effectively in every region. Doctors' needs are the primary needs. Telemedicine starts with demand from medical personnel; therefore we should more greatly publicise the benefits of remote medical education in the digital era and for a sustainable society. Requisite skills are those of engineers at each medical institution and hospital. Without such skills, a level of quality that satisfies healthcare providers cannot be guaranteed. Hopefully remote medical education will continue to expand in Indonesia and around the world, and also expand more into rural regions where a variety of medical problems remain in need of resolution.

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