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About the Journal

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Editorial Office

Faculty of Medicine and Health Sciences,

Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia

Phone: (6)088-320 000 Fax: (6)088-321 377

Email: bej@ums.edu.my

BORNEO EPIDEMIOLOGY JOURNAL | BEJ

EDITORIAL Open Access

Impact of COVID-19 Lockdown on Medical Education in India and its Scope on Distance Learning

Kondeti Madhavi,[1,2,*] Pasupuleti Visweswara Rao[3,4]

[1]*Department of Biochemistry, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India*

[2]*Multidisciplinary Research unit, Sri Venkateswara Medical College, Tirupati, Andhra Pradesh, India*

[3]*Department of Biomedical Sciences and Therapeutics, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Kota Kinabalu, 88400, Sabah, Malaysia*

[4]*Department of Biochemistry, Faculty of Medicine and Health Sciences, Abdurrab University, Jl Riau Ujung No. 73, Pekanbaru 28292, Riau, Indonesia*

*Corresponding author: madhavikondeti467@gmail.com

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The year 2020 was frightened with fight against unprecedented Coronavirus Disease-19 (COVID-19) pandemic situations which impacted extreme changes in everyone's lives. Particularly healthcare system was not ready to tackle public health emergency on immediate declaration of COVID-19 outbreak by World Health Organization (WHO), later the lockdown situations have helped a lot to tackle the situations worldwide. Coming to the medical education in India, there are 272 government medical colleges with teaching hospitals and 260 private medical colleges including deemed universities in India, a good asset to India. Total of 76,928 of Bachelor of Medicine, Bachelor of Surgery (MBBS) students were getting admitted in to the colleges every year with an average intake of 150-250 students per college and per year. The COVID-19 pandemic has strengthened distance & e-Learning worldwide. Distance & e-Learning is defined as application of computer technology to deliver training, including technology-supported learning either online, offline, or both (Shivangi, D. 2020). This technology has also helped a lot to the medical education across the world including India.

Medical Council of India (MCI), which has renamed now as National Medical Council (NMC) has implemented many improvements with new curriculum and new regulations as Competency Based Medical Education (CBME) from 2019, just before the COVID-19 outbreak. CBME made many modifications and improvements in all levels of health care system, faculty training courses, workshops that are being conducted in all the institutes to improve medical education to make Indian medical graduate competent globally by introducing competency based medical education in India.

All these trainings are mandatory as per Basic Course Workshop (BCW) and Revised Basic course workshop (RBCW) guidelines. In addition to these faculties are trained with Attitude, Ethics, and Communication skills (AETCOM) modules that were implemented in MBBS curriculum (Raman, K.S., 2018). Online assignments like education strategies, teaching learning methods, feedback, medical ethics, research methodologies, curriculum design, assessments, and program evaluations were also framed as a part of the curriculum to assess the learning efficiencies (NEP, 2020).

Nationwide, CBME guidelines were implemented for MBBS curriculum starting from year 2019. Admissions were done in September 2019. As per new curriculum, teaching started overriding many hurdles in each institute. It was noticed that delay in official strategy planning to prevent the spread leading to dramatic effect on human lives. Also identified that there was anxiety, fear, dilemma, unpreparedness, economic crisis, food chain supply was tethered, a huge dearth of personal safety masks, aprons made an emotional and mental agony in workplace and families, which has shown a great effect epidemiologically on the families as well as society. Hence, all educational institutions have been closed as well as educational activities including clinical medical education have been suspended on the 25th of March 2019. As a result, distance e-learning has been emerged as a new era of teaching in India to maintain the continuity of medical education during the COVID-19 pandemic, as followed by the other countries in the world (NEP, 2020).

After a long break of lockdown situations, Dr. NTR University of Health Sciences instructed all medical colleges to start online teaching to MBBS students from August 2020. But on the other hand, both the faculty and students are used to have traditional face to face learning in general and the new method of distance/ online/ e-Learning has been initiated during these times to propagate the academic programs. Also there was network, digital library and computer systems to start online teaching. These unprecedented and unprepared situations have mobilized the teaching faculties and medical students to takeover according to their personal, institutional and even national needs.

The sensitizations were explained for the entire faculty about e-Learning platforms and strategies to go ahead. The situations in India have limited to have the services of WhatsApp, Zoom, Google meet which are providing charge-free services. Here, faculty were able to prepare PowerPoint presentations, videos to post in the group according to schedule planned (India Report, 2020). The main hindrance was poor network connections, reliability of the content of topics, attendance of students. Mainly practical lab work is affected totally, only instructions of lab procedures could be given online and this was a big lacuna in practical training of students. Monitoring of students work in active learning and its assessments became another big task to deal (NEP, 2019).

In online sessions the lesson teaching and online attendance were made entered on time and during the session to make students interactive the chance of questionnaire by posing different sets of brief questions to answer in a particular time of interval. An academic study performed this type of follow-up have revealed that the students were able to follow and make use of the questionnaire and discussions and well as demonstrations. In next level the online counselling has been clearly helped to become attentive for the academically poor students. It is also noticed that students were proactive after counseling and improved their learning methodology.

The next important hurdle identified was to conduct assessments, which requires a strict monitoring to prevent malpractices. Conducting online examination without monitoring is not advised. But with limited resources it was identified as a difficult and time consuming task. Students couldn't do better in online exams due to many technical and personal problems (Selvaraj, A. *et al.,* 2021). Another important challenge against distance learning is the reluctance and avoidance of educators to engage in new technologies and applications because of their limited knowledge or lacking proper training in these fields (Arshi, S., *et al.,* 2021).

In overall the pandemic lockdown has taught so many lessons to the students that preparation is mandatory mentally, physically, emotionally, professionally, for facing unprecedented situations. Students always believe that Nature is mightier and more powerful than what mankind poses. A Well-known quote saying "Man proposes, and God disposes" has been proven once again with COVID-19 pandemic (Gupta, S. *et al.,* 2021). Satisfaction of distance learning is strongly linked to students experience previously in distance learning as well as instructor's experiences and interactions. Technical and infrastructural resources reported as a major challenge for implementing distance learning. Understanding technological, financial, institutional, educators, and student barriers are essential for the successful implementation of distance learning in medical education. According to the 2030 Sustainable Development Goals (SDGs) for health including good health well-being and quality of education, effective and affordable educational strategies need to be addressed critically especially in Low and Middle-Income Countries (LMIC) Adopting Distance E-Learning in different fields of knowledge in LMIC can add a great benefit to achieve 2030 SDGs. Hence, the Online/ Distance/ E-Learning concept in medical education in India is identified as a mere successful task that was propagated during the COVID-19 pandemic times and anticipated that will be sure successful in future endeavours.

References

Arshi, S., Yajur, A., Monica, G. (2021). Impact of COVID-19 on Medical Undergraduate Student's Academics and its Ramifications, *Indian J Med Sci.*, 73(1), 26-29. https://dx.doi.org/10.25259%2FIJMS_404_2020

Gupta, S., Dabas, A., Swarnim, S., Mishra, D. (2021). Medical Education During COVID-19 Associated Lockdown: Faculty and Student's Perspective. *Med. J. Armed Forces India*. 77(Suppl 1), S79-S84. https://doi.org/10.1016/j.mjafi.2020.12.008

India Report - Digital Education, Remote Learning Initiatives across India, June 2020, Ministry of Department of Education & Literacy, Ministry of Human Resource Development, Government of India https://www.education.gov.in/sites/upload_files/mhrd/files/India_Report_Digital_Education_0.pdf

National Education Policy 2019, Ministry of Human Resource Development, Government of India https://innovate.mygov.in/wp-content/uploads/2019/06/mygov15596510111.pdf

National Education Policy 2020, Ministry of Human Resource Development, Government of India. https://niepid.nic.in/nep_2020.pdf

Raman, K.S., (2018). Medical Education in India. *TAPS*, 3(2), 55-57. https://doi.org/10.29060/TAPS.2018-3-2/PV1060

Selvaraj, A., Radhin, V., Ka, N., Benson, N., Mathew, A.J. (2021). Effect of Pandemic Based Online Education on Teaching and Learning System, *Int. J. Educ. Dev.* 85, 102444(1-11). https://doi.org/10.1016/j.ijedudev.2021.102444

Shivangi, D. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis, *J. Educ. Technol. Syst.* 49(1), 5-22. https://doi.org/10.1177%2F0047239520934018

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REVIEW Open Access

Public Health Informatics in Global Health Surveillance: A Review

Puteri Nureylia Amir, Mohd Fazeli Bin Sazali*, Loganathan Salvaraji, Nafsah Dulajis, Syed Sharizman Syed Abdul Rahim, Richard Avoi

Abstract

Background: Surveillance is the backbone for effective public health practice. Traditionally, surveillance system relies on the collection of information regarding health-related events through healthcare facilities, disease notification system from the physician, syndromic notification networks, selected sentinel healthcare facilities, or by event-based data. However, there are several limitations in using conventional surveillance.

Methods: With the advancement of technology and computer science, overcoming those limitations and complementing the traditional method has been recommended. Three leading emerging technologies are applied in public health surveillance: the internet of things, artificial intelligence, and blockchain.

Results: Application of informatics in public health surveillance could raise several issues including accessibility and affordability of innovations; public health informatics' experts, law, and regulation to protect patients' information; social and ethical considerations, norms, and standards of implementing new technologies; data ownership; privacy and sharing of information; biosecurity; biosafety; and cybersecurity.

Conclusion: This article aimed to review several applications of informatics system in public health surveillance practice and its several issues related to the use of technology. Several applications of informatics could be useful for incoming challenges in public health. However, application of informatics can pose significant issues and must be taken into consideration in public health practice.

Keywords: Public health informatics, Surveillance, Event-based surveillance, Web-based surveillance.

*Correspondence Email: drmohdfazeli@gmail.com

Department of Public Health Medicine, Faculty of Medicine and Health Science, Universiti Malaysia Sabah, Jalan UMS, 8840, Kota Kinabalu, Sabah, Malaysia

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Introduction

Public health surveillance is the backbone for effective public health practice. The first concept of surveillance was first introduced in 460 B.C. by Hippocrates when he introduced the term endemic. It provided the concept of collecting data regarding the place, environment and people's behavior (Choi B.C.K., 2012). Afterwards, the component of surveillance that includes an ongoing and systematic data collection, analysis, interpretation and timely dissemination of health-related data had been applied and gone through historical evolvement until what is presented today (Choi B.C.K., 2012 & CDC, 2014).

Informatics is generally can be used by other fields such as business, security, social science, and others. It can also be applied to public health. It can be used to enable effective monitoring and surveillance, to support improved decision-making, promote health, preventing disease and injuries, and to improve the health of the population (Aziz, H.A., 2016 & PHII, 2020). In the scope of public health, public health informatics is defined as a systematic application of information using computer science and technology into public health practice (CDC, 2014). The public health practice that utilizes informatics includes surveillance, prevention, preparedness, health promotion, research and learning (Aziz, H.A., 2016 & CDC, 2014). As modern days has approached, computer technology has becoming an essential tool to enhance the use of public health surveillance system nowadays (Aziz, H.A., 2016 & McNabb, S.J.N. *et al.,* 2017). Even though informatics has been widely used in many industries, its application in public health was limited in literature. This article aimed to review several applications of informatics system in public health surveillance practice and its several issues related to the use of technology.

Application of Public Health Informatics in Surveillance

Traditionally, surveillance system relies on the collection of information regarding health-related events through healthcare facilities, disease notification system from the physician, syndromic notification networks, selected sentinel healthcare facilities, or by event-based data. It is one of the core functions in public health as it can provide an early warning system for disease outbreaks or disasters, served as an advocacy tool for informing public health policy and strategies, evaluate the effectiveness of an intervention, and set the priority of the intervention in a cost-effective manner (WHO, 2020).

However, there are several limitations in using conventional surveillance. Under-reporting, time-consuming, delay in reporting and subsequent public health intervention, expensive, poor integration, and lack of representativeness are among various challenges in public health surveillance (Mandyata, C.B. *et al.,* 2017 & CDC, 2012). With the advancement of technology and computer science, the technology has been increasingly recommended in overcoming those challenges and serves as complementary method to the traditional way of surveillance activity (Jayatilleke, K., 2020).

Emergence of New Technology in Surveillance

With the increasing amount of public health data, together with the growing importance of public health informatics, it is undeniable that public health officials need to better understand on current trend of technology and its impact. A paradigm shift is critical to be adopted by public health practitioner to integrate emerging technology innovation in public health. For greater impact of utilization of these technologies, public health practitioner needs to have

good relationship and collaboration with the experts in computational science. Greater understanding in technology in health can guide in future training and continuous education in public health program. Previous literature review identified three main emerging technologies that are applied in public health surveillance activity, namely Internet of Things, Artificial Intelligence, and Blockchain (Huang, J., 2019).

i. Internet of Things

Internet of Things (IoT) refers to the concept where the systems are interrelated and internet-enabled connections that are able to collect and transfer data between objects without human intervention (What is IoT?). It is becoming an emerging paradigm that allows wireless communication between electronic devices and sensors to facilitate human daily activities. It provides innovative solution to various challenges, especially in public health surveillance. There is big potential of IoT considering that currently there are 10 billion IoT devices in 2020 and it was projected to increase to 25 billion in 2025, and the data generated is expected to reach 3.1 ZB (zettabytes) by year 2025 (45 Fascinating IoT Statistics for 2021). IoT has been emergently used in healthcare industry. For example, wearable sensors can be used to identify individuals with COVID-19 infection by remotely monitoring clinical parameters (oxygen, temperature, heart rate, and blood pressure) and subsequently can be integrated with the special hardware and smartphone application devices (Mukhtar, H. *et al.,* 2021).

ii. Artificial Intelligence

Artificial intelligence (AI) is generally referring to ability of digital technology to perform task that is typically associated with intelligent being. AI can be defined as science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence (Mccarthy J., 2007). In the simpler form, AI is a computer science approach to create intelligent machines. One of important subset of AI is machine learning. Machine learning refers to the ability of the machine to learn from the past data without being explicitly programmed. Application of AI and machine learning enable the decision making and action become faster. It has been widely applied in public health especially in identification of emerging threats (e.g., COVID-19), enable detailed and up-to date understanding of population disease and risk factors distribution, disease incidence forecasting, guiding for targeted approach in intervention, assessment of effectiveness of intervention, as well as advocacy tool for policy changes (Zeng, D., 2021). Data aggregation system, such as Global Public Health Intelligence Network (GPHIN) and Program for Monitoring Emerging Diseases (ProMED) are among the most common example of application of AI and machine learning to crowdsource, process, and filter online data (Budd, J. *et al.,* 2020).

iii. Blockchain

Blockchain is basically referring to the decentralized, publicly distributed digital ledgers that consist of records that is called blocks to record transaction across multiple computers (How IoT, AI, and blockchain will revolutionize business, 2018). One of the special features is that transactional record cannot be retrospectively altered, without the alteration of other subsequent blocks. The main advantage of applying this blockchain is the process is faster, visible in real-time manner, and reduced operational cost. In healthcare context, blockchain has been used to promote patient-centered care by sharing patient data for remote monitoring and management (Bhattacharya, S. *et al.,* 2019). In public health context, blockchain is being used

in terms of sharing of genomic data (Friedrich, M.J., 2019). One of example of usage of blockchain is during E. coli outbreak in Denmark which it involved the sharing of DNA data of the bacteria between Denmark, German, and Spanish scientists to identify the source of epidemic (Bellod, C.J.L., 2018). The importance of blockchain, especially in global health can no longer be denied, as we learnt from Nipah virus epidemic and influenza virus pandemic (How One Man Saved his Country, 2017).

Example of Technology Application in Surveillance

i. Event-Based Surveillance (EBS)

Different from the indicator-based surveillance that systematically collects information from the official reports, EBS is a surveillance method that collects and analyses the unstructured data from various source of information such as news reporting, social media, and internet-based searches (Balajee, S.A. *et al.,* 2021). Typically, disease reporting is conducted through disease notification by physician. This requires the patient to self-aware their need to see the physician upon experiencing the symptoms. In COVID-19 infection, one fifth of the patients are asymptomatic (Kim, G.U. *et al.,* 2020) and among those who are symptomatic, only 46.8% of them seek medical care (Meng, H. *et al.,* 2016). This might cause under-reporting of disease and missing the cases in which healthcare is not sought. Therefore, identifying undetected cases could be enhanced using digital technology to elucidate the magnitude and characteristics of the outbreak and reduce transmission of the disease.

It was documented that majority of initial data (60%) that were collected for surveillance activities were originated from unofficial informal sources, including those obtained from social media, internet, and mainstream media (WHO, Epidemic Intelligence, 2020). Therefore, digital technology is one of the important tools to improve the surveillance system and has been used to utilise this informal information for rapid identification of events with potential epidemic. This is in particularly important especially when there is an ongoing global pandemic of COVID-19 which recorded 166 million cases with more than 3 million deaths, by May 2021 (WHO Coronavirus (COVID-19) Dashboard, 2021).

One of the most important event-based surveillance systems using this digital approach is the Global Public Health Intelligence Network (GPHIN). GPHIN is a network that systematically scans all the multilingual informal sources such as online news sites, social networks, web searches, participatory longitudinal community cohorts, and other data aggregation systems (eg. ProMED-mail) solves unusual events and rumors by using natural language processing and machine learning processes. Typically, there were approximately 7000 articles and news feeds into GPHIN for analysis, and there were almost 3000 feeds contain duplication or irrelevant data. All the data will undergo data processing and analyst assessment that consist of several activities such as deduplication, metadata, categorization, translation, and relevancy scoring. In the final analysis, there was only 5-10 feeds were included in the daily report (Blench, M., 2008). GPHIN has been used in collaboration with WHO since 1997 and it has been used as part of the WHO's Global Outbreak Alert and Response Network (GOARN). Utilisation of GPHIN is able to meet the requirement of International Health Regulation 2005 core capacity, to provide early warning system to all WHO country members, enable reporting of unusual events, and for dissemination of information to public health officials all over the world in time-sensitive manner (Kamradt, S.A., 2019).

Use of informal source of information provides several advantages over the formal source of information. In the evaluation of Avian influenza surveillance, informal information source reported cases 2.3 days earlier than WHO reports (Brownstein, J.S., 2008). Meanwhile, in another study found that among 111 outbreaks reported, formal source of information has delay in reporting by 1.26 day (p=0.002) compared to informal information (Bahk, C.Y. *et al.,* 2015). This shows that the unstructured information might be valuable in surveillance system. However, the use of informal information needs to be conducted with caution, as previous study found that even though it was found to be superior in term of timeliness, but it has problem with sensitivity (only 44%) (Brownstein, J.S., 2008). This problem was arising because most of systems that used informal source of information accumulate large amount of information in a wide variety of illnesses, leading to difficulty in extracting important information from the data (Magid, A. *et al.,* 2018). This limitation can be overcoming by data processing and analyst assessment to filter out irrelevant and duplicated information (Blench, M., 2008).

The other commonly used event-based system including ProMED-mail (ProMED-mail), which is using sophisticated data processing and text mining to filter and classify the emails, articles, and news in the internet. The system is a largest publicly accessible system that is mainly conducting the infectious disease outbreak worldwide. The system is adopting one health approach, where the information obtained by the system will be filtered and analyzed by a multidisciplinary team representing various fields such as epidemiology, virology, parasitology, veterinary, and plant disease. The contribution of ProMED in changing the global surveillance landscape has been recognized as among the first system that alerted global community regarding infectious disease outbreak that have pandemic potential such as Severe Acute Respiratory Syndrome (SARS) in Guandong, China in 2003, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in Saudi Arabia in 2012, and numerous additional outbreaks of Zika, Nipah, Ebola, and other terrifying diseases (Whitelaw, S., 2020). Ongoing COVID-19 pandemic also has been successfully reported by ProMED with 109 entries reported between February 29, 2000 and January 22, 2020 (Bonilla, A.D.K. *et al.,* 2020). Other widely used event-based system that provide useful tool in surveillance including Argus (Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System) (ARGUS-IS), HealthMap (Flu & Ebola Map, Virus), EpiSPIDER (Semantic Processing and Integration of Distributed Electronic Resources for Epidemics [and disasters]), and BioCaster. All of these different systems might have some overlap in their function, but those systems intended to be complementary to the conventional type of surveillance, as they are differs in term of their way of data collection, source of information, language used, degree of automation, data analysis and interpretation, and how the data was visualized for information dissemination (Magid, A. *et al.,* 2018).

ii. Online Real Time Surveillance

a. Symptom Reporting

Google Flu Trend (GFT), Flu near you, and Influenza Net are among the well-known online surveillance system that has been developed to support the conventional surveillance. GFT was one of the first web-based systems for tracking influenza activity in real time. The initial motivation of GFT development was to be able to predict the influenza disease activity early and respond immediately to reduce the impact of influenza infection. The GFT was proposed to supplement the surveillance system through prediction of influenza outbreak with 1-2 weeks earlier than the official report by United States Centre for Disease Control and Prevention

(CDC). The estimation is based on the study that the number of people searching for influenza related information in website is strongly correlated with the number of people who having influenza like illness (ILI) symptoms and seeking care in hospital (Klembczyk, J.J. *et al.,* 2016). Early Google publication on the GFT ability to predict influenza infection were 97% accurate compared with CDC data (Ginsberg, J. *et al.,* 2009).

The GFT has been performed well since its development in 2008 and was adopted by 29 countries. However, subsequent report of GFT has been documented its questionable accuracy. Study conducted in eight Latin America countries found that GFT are inaccurate in predicting influenza activity especially in tropical countries with irregular influenza seasonality, but more accurate in countries with more regular influenza seasonality (Pollett, S. *et al.,* 2017). The GFT system was found to be over-estimating the influenza incidence, where in one interval from 2012 to 2013 during flu season, it predicted influenza incidence was two times higher than the actual emergency department visit for influenza related illness (Butler, D., 2013). Inaccuracy in estimation by GFT was assumed to be confounded by the impact of extensive media coverage and changes in health seeking behaviour that was triggered by the declaration of a public-health emergency by local authority to anticipated rise in influenza infection (Butler, D., 2013). Even though the web based real time surveillance has been limited its usability due to lack of evidence of its accuracy, a number of more advanced linear and nonlinear techniques to ILI modelling have been suggested, which shows promising results (Lampos, V. *et al.,* 2015).

iii. Wearables and sensors

Other than using the web-based surveillance, the other approach is using several tools that is decentralized and connected with online system. Case identification using sensors, including thermal imaging camera and infrared sensors, are widely used with the basis to identify individuals with febrile illness. The instrument is commonly deployed in the areas with high population mobility, such as in airports, shopping malls, and public buildings. The data that is captured from the sensors are then will be connected to a centralized system and geospatially tracked to identify areas with emerging cluster of infection where the targeted public health intervention can be conducted, as being conducted in Singapore (Singapore's COVID-19). Meanwhile, John Hopkins researcher has launched a mobile application to study the geographical areas with COVID-19 infection as well as using some prediction modelling to predict the disease activity in an area using machine learning and spatial analytics (Johns Hopkins Team).

In addition, to cover the remote areas with large population density as well as poor internet connectivity, drones or unmanned aerial vehicles (UAV) might be useful. The tool is used to collect the data similar with the thermal sensor. The tool also can be used to monitor people's adherence to social distancing and application of face mask (Kumar, A. *et al.,* 2021). However, utilization of thermal sensors is not without its limitation. There are large proportions of COVID-19 patients are asymptomatic (20% asymptomatic patients in South Korea and 35.5% in Petaling District, Selangor, Malaysia) (Kim, G.U. *et al.,* 2020 & Rama K.S. et al., 2021), use of antipyretics, people's movement variability, and practical issues (variability of body temperature in response to climatic changes, building temperature, device accuracy) might potentially affect the reliability of thermal sensors (Wright, W.F. *et al.*, 2021). Utilization of these tools, if it being considered should be linked with the ongoing public health surveillance system, so that it can be monitored, followed by appropriate intervention including isolation of cases and quarantine of contacts.

ISSUES AND CHALLENGES RELATED TO PUBLIC HEALTH INFORMATICS USE IN SURVEILLANCE

Advancement in innovations and technologies will create the pace of change and new opportunities, inversely, possibly aggravate existing divisions and disparities. Big data and automation pose the several risks to the world (Davis, E., 2017).

Accessibility and Affordability

There are deliberate concerns that innovations will increase expenses in healthcare system. A syndrome surveillance system was established by Boston Public Health Commission (BPHC), in collaboration with the Centre for Disease Control and Prevention (CDC), and the Massachusetts Department of Public Health. The total cost of developing system was nearly $450,000 (Kirkwood A. *et al.,* 2007).

Purchasing innovations may be costly and return of investment will take time. Especially among low- and middle-income countries where there is a lack of mechanism to systematically collect, analyze and use these data. Lack of sufficient and reliable data collecting health information system has been reported as one of the major barriers for effective public health action at country level (Mathers, C.D. *et al.,* 2005). In addition, due to lack of comprehensive and quality local data, major donors are in doubt to provide financial support for innovative solutions, such as computer-based modelling (Butler, D., 2017). Resource-limited countries such as Africa, Asia, and other parts of the world struggling to build a healthcare facility acquired with information system. Hence, these countries constrain for adequate domestic disease detection or response capabilities (Hitchcock, P. *et al.,* 2007).

Although International Health Regulation (IHR) 2005 provides a legal framework for global surveillance and response to communicable disease, yet fund for the program was not highlighted. At the country level, strategy plan was not available to raise the financial resources to implement preventive measure as mentioned in the revised IHR 2005. The Global Outbreak Alert and Response Network's (GOARN) operating budget seems to be not part of WHO's core budget (Baker, M.G. *et al.,* 2006).

Not all health information system is costly to assess the full impact of information systems and informatics interventions. Several authors relate to the impact of systems in the quality of care. A study to evaluate the electronic health records (EHR) and investigates on the quality and efficiency of patients presenting to emergency departments. The system proves to be associated with salutary outcomes and prolongation of emergency length of stay (Connelly, D.P. *et al.,* 2012). In Louisiana, the public health informatics team implemented an integrated electronic medical record (EMR) for HIV/AIDS. This system successfully reduces critical opportunities to intervene with defaulter, vast number of information collected solely for public health purposes (Herwehe, J. *et al.,* 2012).

Workforce

Since not many experts in the field of public health informatics, it is impossible to effectively implement and adopt workforce right person for right job. New innovations and technologies have essential workforce implications. Recognizing the nature of the workforce of the future will be different from the workforce of present. Some job tasks by human may be negatively affected if certain considerations are not reviewed. Probably some working opportunity will be

diminished while others will be transformed. Recent study on Public Health Information course available in the world highlighted the average number of credits and the study costs required were much higher in private as compared to public institutions. Hence, the study proposes the need for online contextual and cost-effective PHI training programs exists to occupy the increasing needs of professionals to improve public health in their respective countries (Joshi, A. *et al.,* 2012).

To manage new data and new technologies, public health professional should lead best practice of advancement of technology. Integrated committee should be established (e.g., government, academia and not for profit public health institutions) to ensure that the technologies commonly developed at academic institutions make it to primary health units and public health organizations able to capture reliable data for improve of public health measures (McNabb, S.J.N. *et al.,* 2017).

The role of policymakers and other stakeholders, such as professional organizations, will need to pre-plan about the consequences and implications for education and training. The evolvement of teaching and knowledge has to be updated for those entering the workforce. Continuous retrain the existing workforce to align with evolving technologies and labor trends should be intensified.

Regulation

Regulation ensures patients are protected from emerging technologies. Especially those that enter the market before reliable evidence is available to ensure this are the case. Data protection laws differ from countries; require designated organization of where data is stored. European countries such as Spain, France or Italy denied storage of patient data in the cloud. Nevertheless, some cloud providers allow obligatory data storage in a specific geographic location (Health Management).

We need to investigate the way evidence is collected and evaluated. The major challenge of data quality that comes from vast number of unchecked data can be lessened somewhat by innovations in PHI. Automatic systems can be set up to monitor data quality of incoming data at regular intervals and deliver alerts when an aberration is detected.

Politicians in each country must be transparent in data sharing and mechanism of generating public health information. The process must consensus to rapid law and regulation transformation time to time. Strong top-down leadership and champions of change are essential to move a country for better future in public health management.

Ethics, Equity and Social Considerations

New advances in technology also have an indirect impact in several social and ethical considerations. Ensuring the distribution of risks and benefits of new advances should equitable and less culture sensitive. Certain technologies will have important implications for societal structures, religious belief, and cultural practice. Innovation potential to use genome-editing technology for enhancement raises concerns about creating worries for individuals, especially those with comorbidities. The effects of such a scenario closely related to public policy in the concern of reduction in the frequency of birth defects. Disabilities will be led to weaker public support for accommodating the needs of people for economy and workforce development.

Three ethical issues was highlight relating to health information for public health surveillance (Kostkova, P., 2018):

a) Sharing data across various early warning tools to support risk assessment.

b) Legal frameworks for public health data sharing to unlock the potential of population-level datasets for research with no impact on citizen's privacy.

c) Strict regulation of the IT industry with regards to manipulating user data.

A study on implementation of information systems conducted among employees in public health sector of developing countries. In the result, the study reported behavioral intention influenced by perceived need, perceived information sharing, and effort expectancy. Meanwhile, perceived awareness had a negative impact behavioral intention (Mukred, A. *et al.,* 2017). Ethical concerns are paramount in the creation and innovation of technologies as the policymakers work to enact new governance frameworks, attention to potential social and culturally sensitive factors. Dialogue session and participation of patients and the public in the process of developing policy should be embedded consistently.

Norms, Standards, Responsible Conduct

Ethical norms and standards to govern behavior differ across the countries. A scientific community comprising stakeholders of various categories like public and social, ethical, and religious groups requisite to develop norms and standards for implementation of new technologies that distinguish between acceptable and unacceptable behavior. Different society group should play role to consider the implications of new advances in the context of local diverse historical, cultural, and social characteristic. Thus, specific regulatory or legal frameworks will differ from country to country. Ethical principles for emerging technologies should be strictly consider in policy making, especially outlined for human genome editing.

Data Ownership, Privacy and Sharing

Data ownership, privacy and sharing remain global threat in the world. Patients have a right to own their data and control over it. Regulatory systems and other protocols must be in place to protect patients' rights regarding their data and to ensure that patients feel comfortable sharing their personal health information. Guarding bias is challenging as big data and analytics and AI become more perceived in healthcare. Software and algorithms of AI remain subjective and wide range of grey areas. Computer hackers are extremely searching for this data underground. Selling patient information data to organizations become an unseen market and big scam nowadays.

A systematic review study on the public health informatics data highlighted the issue of healthcare data and ownership in the context of big data is poorly researched. There is lack of consistency and integrity. Subsequently, this has impacted the policy decisions and the necessary legal regulations. The authors urge for future research to investigate on the issue of ownership as a core research question. In interim, researchers need to increase the body of knowledge regarding the development of big data management with adequate policies and relevant legal frameworks in compliance with ethical standards (Mirchev, M. et al., 2020).

Biosecurity and Biosafety

Unintentional misuse or deliberate malicious use of research raise concerns in new biotechnologies and scientific advances. National security and biotechnology communities reported that genome editing had become a global danger for the world. Harmful biological agents or products can be used improperly as biological terrorism. Subsequently, infectious might spread around the world and cause devasting health impact to living nature. World Economic Forum also highlighted transformation of biological risk in their reports. Another concern in emerging technologies for new biological threats is manufacturing and releasing of agents into the environment. This not only include healthcare laboratories but also in areas of chemicals, fuels, electronics, and others. In agriculture industry, stakeholders have sufficient knowledgeable of biosecurity risks and had established network connections. However, they expressed a less interest in or unwilling to report a potential biosecurity threat (Curnock, M. *et al.,* 2017). Despites benefits to the world; it is necessary to manage the risks through rigorous transparency and oversight requirements.

Most of the time "Real-time" surveillance is impossible in the systems like the French communicable diseases computer network and the European influenza surveillance scheme only able to collect and analyze data at least once per week. Meanwhile, the QFLU programs have shown capability of daily reporting in the 2006 influenza season. Unfortunately, the system applied depersonalized data collecting method from electronic health records, a data source which is unavailable in most countries (Hitchcock, P. *et al.,* 2007).

Cybersecurity

According to survey in 2016, healthcare was the fifth most targeted industry by the computer hackers. Nearly 16 million patient's databases were stolen from healthcare organizations related bodies (Why has Healthcare become Such a Target). In future, this threat is only likely to exaggerate with cyberattacks becoming increasingly sophisticated. Hospitals and health systems are vulnerable place to cyberattacks that jeopardy patient information. These issues range from malware that suppress the integrity of systems and privacy of patients and disrupt facilities ability to provide patient care. There is possibility of overtaking infrastructure security, such as the electric grid, could threaten hospitals from functioning and safety. Besides that, medical device linked to a network possess extreme risk from being manipulated and exploited by hackers. In Singapore, nearly 13,000 data of individuals was stolen and published online in 2016. The health authority had apologized and strengthens their block access to confidentiality of the data (Watts, J.M. *et al.,* 2019).

The both parties, health systems and individuals will need to become more aware of their vulnerability to cyberattacks and start taking necessary measures to protect themselves. Policymakers can take vigilant efforts by enacting policies and more stringent control over privacy and data security.

Conclusion

In the past two decades, public health surveillance has evolved from non-automated to electronic-based surveillance and from infectious diseases to non-infectious conditions. Considering this widened surveillance lens, we must be open to new data sources and methods and preserve the essential systems in place. Given the proliferation of data systems, unique workforce needs, and new tools and technologies, we must be open to a new way of doing surveillance. Training and

revolutionizing the way epidemiologists and public health professionals get, transfer, and use data when there are limited institutions to provide formal education, specifically in public health informatics, is one of the challenges we need to address. Transforming public health surveillance through open public health information has gained significant attention recently. Community demands on transparency and accessibility of health surveillance have both supporting and opposing opinions from the practitioners. When it is needed, restricted and constrained public health information could delay public health efforts to prevent or control an outbreak as soon as possible. However, ethical, security, and privacy issues must be considered before sharing essential and potentially sensitive public health information, affecting the risk communication process. Guiding principles to navigate the complex privacy, communication, and security are needed to ensure that collaboration and sharing occur in a manner that is ethically and socially just, efficient, and equitable.

Public health surveillance has evolved that it involves different stakeholders form various discipline. This multi-sectoral nature of public health surveillance demands for integration as to reduce unnecessary variation in the conduct of surveillance. By doing this, health surveillance involving various sectors such as those involved in one health approach can be further enhanced to ensure effectiveness and efficiency. However, challenges in the form of limited resources need to be addressed in order to transform this idea into reality. Public private partnership, academic sectors contribution and strengthened collaboration between stakeholders is the only way forward for sustainable development in public health surveillance. It may take time, but the sum of our efforts is greater than the parts.

Conflicts of Interest

The authors would like to declare there is no conflict of interest.

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References

45 Fascinating IoT Statistics for 2021, The State of the Industry, [cited 2021 May 26]. https://dataprot.net/statistics/iot-statistics/

ARGUS-IS (Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System). Persistent Surveillance, BAE Systems, United States. https://www.baesystems.com/en-us/product/autonomous-realtime-ground-ubiquitous-surveillance-imaging-system-argusis

Aziz, H.A. A Review of the Role of Public Health Informatics in Healthcare. (2016). *J. Taibah Univ. Med. Sci.*, 12(1), 78-81. https://doi.org/10.1016/j.jtumed.2016.08.011

Bahk, C.Y., Scales, D.A., Mekaru, S.R., Brownstein, J.S., Freifeld, C.C. (2015). Comparing Timeliness, Content, and Disease Severity of Formal and Informal Source Outbreak Reporting. *BMC Infect. Dis.,* 15(1), 135 (1–6). https://doi.org/10.1186/s12879-015-0885-0

Baker, M.G., Fidler, D.P. (2006). Global Public Health Surveillance under New International Health

Regulations. *Emerg. Infect. Dis.,* 12(7), 1058-1065. https://doi.org/10.3201/eid1207.051497

Balajee, S.A., Salyer, S.J., Greene, C.B., Sadek, M., Mounts, A.W. (2021). The Practice of Event based Surveillance: Concept and Methods. *Glob. Secur. Heal. Sci. Policy.*, 6(1), 1–9. https://doi.org/10.1080/23779497.2020.1848444

Bellod, C.J.L., Møller A.F., Lund, O. (2018). Public Health Surveillance using Decentralized Technologies. *Blockchain Health Today*, 1(1), 1–14. https://doi.org/10.30953/bhty.v1.17

Bhattacharya, S., Singh, A., Hossain, M. (2019). Strengthening Public Health Surveillance through Blockchain Technology., *AIMS Public Heal.,* 6(3), 326-333. https://doi.org/10.3934/publichealth.2019.3.326

Blench, M. (2008). Global Public Health Intelligence Network (GPHIN). AMTA 2008 - *8th Conf. Assoc. Mach. Transl Am.*, 299–303. https://aclanthology.org/2008.amta-govandcom.2

Bonilla, A.D.K., Holguin, R.Y., Cortes, B.I., Cardona, T.M.C., García, B.A., Bedoya, A.H.A., (2020). Coronavirus Infections Reported by ProMED, February 2000 - January 2020. *Travel Med. Infect. Dis.* 35, 101575(1-5). https://doi.org/10.1016/j.tmaid.2020.101575

Brownstein, J.S., Freifeld, C.C. (2008). Evaluation of Internet-Based Informal Surveillance for Global Infectious Disease Intelligence. *Int. J. Infect. Dis.,* 12(S1), e193–e194. https://doi.org/10.1016/j.ijid.2008.05.481

Budd, J., Miller, B.S., Manning, E.M., Lampos, V., Zhuang, M., Edelstein, M., Rees, G., Emery, V.C., Stevens, M.M., Keegan, N., Short, M.J., Pillay, D., Manley, E., Cox, I.J., Heymann, D., Johnson, A.M., McKendry, R.A. (2020). Digital Technologies in the Public-Health Response to COVID-19, *Nat. Med.*, 26(8), 1183-1192. http://dx.doi.org/10.1038/s41591-020-1011-4

Butler, D. (2013). When Google Got Flu Wrong, *Nature*, 494(7436), 155-156. https://doi.org/10.1038/494155a

Butler, D. (2017). World's Foremost Institute on Death and Disease Metrics Gets Massive Cash Boost. *Nature,* 542(7639), 1. https://doi.org/10.1038/nature.2017.21373

CDC (Centers for Disease Control and Prevention). (2012). Principles of Epidemiology: Lesson 5, Appendix E, Appendix E. Limitations of Notifiable Disease Surveillance and Recommendations for Improvement, Self-Study Course SS1978. https://www.cdc.gov/csels/dsepd/ss1978/lesson5/appendixe.html

CDC (Centers for Disease Control and Prevention). (2014). Public Health 101 Series: Introduction to Public Health Surveillance. Atlanta, GA: U.S. Department of Health and Human Services. https://www.cdc.gov/training/publichealth101/surveillance.html

Choi B.C.K. (2012). The Past, Present, and Future of Public Health Surveillance. *Scientifica (Cairo)*, 2012, 875253 (1-26). https://doi.org/10.6064/2012/875253

Connelly, D.P., Park, Y.T., Du, J., Theera, A.N., Gordon, B.D., Bershow, B.A., Gensinger, R.A.Jr., Shrift, M., Routhe, D.T., Speedie, S.M. (2012). The Impact of Electronic Health Records on Care of Heart Failure Patients in the Emergency Room. *J. Am. Med. Inform. Assoc.,* 19(3), 334-340. https://doi.org/10.1136/amiajnl-2011-000271

Curnock, M., Farbotko, C., Collins, K., Robinson, C.J., Maclean, K. (2017). Engaging with Risk (or not): Shared Responsibility for Biosecurity Surveillance and the Role of Community Gardens. *Geogr. Res.,* 55(4), 379-394. https://doi.org/10.1111/1745-5871.12231

Davis, E. (2017). The Problems of Big Data and What to do About Them. *World Economic Forum*. https://www.weforum.org/agenda/2017/02/big-data-how-we-can-manage-the-risks

Flu & Ebola Map, Virus & Contagious Disease Surveillance [cited 2021 May 25]. https://healthmap.org/en/

Friedrich, M.J. (2019). WHO's Top Health Threats for 2019. *JAMA*, 321(11), 1041 (1-15). https://doi.org/10.1001/jama.2019.1934

Ginsberg, J., Mohebbi, M.H., Patel, R.S., Brammer, L., Smolinski, M.S., Brilliant, L. (2009). Detecting Influenza Epidemics Using Search Engine Query Data. *Nature*., 457(7232), 1012-1014.

https://doi.org/10.1038/nature07634

Health Management. Radiology Management, ICU Management, Healthcare IT, Cardiology Management, Executive Management. https://healthmanagement.org/c/hospital/event/ehma-2020-annual-conference-european-health-management-association

Herwehe, J., Wilbright, W., Abrams, A., Bergson, S., Foxhood, J., Kaiser, M., Smith, L., Xiao, K., Zapata, A., Magnus, M. (2012). Implementation of An Innovative, Integrated Electronic Medical Record (EMR) and Public Health Information Exchange for HIV/AIDS. J *Am. Med. Inform. Assoc.*, 19(3), 448-452. https://doi.org/10.1136/amiajnl-2011-000412

Hitchcock, P., Chamberlain, A., Van, W.M., Inglesby, T.V., O'Toole, T. (2007). Challenges to Global Surveillance and Response to Infectious Disease Outbreaks of International Importance. *Biosecur. Bioterror.*, 5(3), 206-227. https://doi.org/10.1089/bsp.2007.0041

How IoT, AI, and blockchain will revolutionize business. (2018). Transformational Technologies: Today, Oracle. https://www.oracle.com/a/ocom/docs/transformational-tech-wp.pdf

How One Man Saved his Country from A Nightmare Virus Called Nipah: Goats and Soda : NPR. [cited 2021 May 26]. https://www.npr.org/sections/goatsandsoda/2017/02/25/515258818/a-taste-for-pork-helped-a-deadly-virus-jump-to-humans

Huang, J., Loschen, W. (2019). Potential Applications of Emerging Technologies in Disease Surveillance. *Online J. Public Health Inform.,* 11(1), e340 (1-2). https://doi.org/10.5210/ojphi.v11i1.9821

Jayatilleke, K. (2020). Challenges in Implementing Surveillance Tools of High-Income Countries (HICs) in Low Middle Income Countries (LMICs). *Curr. Treat. Options Infect. Dis*., 12(3), 191–201. https://doi.org/10.1007/s40506-020-00229-2

Johns Hopkins Team Launches Temperature-Tracking Study and App to Map and Monitor Potential COVID-19 Cases [cited 2021 May 26]. https://hub.jhu.edu/2020/04/30/johns-hopkins-covid-temperature-tracking-app/

Joshi, A., Perin, D.M.P. (2012). Gaps in the Existing Public Health Informatics Training Programs: A Challenge to the Development of A Skilled Global Workforce. *Perspect. Health Inf. Manag*., 9, 1-13. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3510646/pdf/phim0009-0001c.pdf

Kamradt, S.A. (2019). The International Health Regulations (2005), International Organizations Law Review, 16(2), 242-271. https://doi.org/10.1163/15723747-01602002

Kim, G.U., Kim, M.J., Ra, S.H., Lee, J., Bae, S., Jung J, Kim., S.H. (2020). Clinical Characteristics of Asymptomatic and Symptomatic Patients with Mild COVID-19. *Clin. Microbiol. Infect.*, 26(7), 948.e1-948.e3. https://doi.org/10.1016/j.cmi.2020.04.040

Kirkwood A, Guenther E, Fleischauer AT, Gunn J, Hutwagner L, Barry MA. (2007). Direct Cost Associated with the Development and Implementation of A Local Syndromic Surveillance System. *J. Public Heal. Manag. Pract.,* 13(2), 194-199. https://doi.org/10.1097/00124784-200703000-00017

Klembczyk, J.J., Jalalpour, M., Levin, S., Washington, R.E., Pines, J.M., Rothman, R.E., Dugas, A.F. (2016). Google Flu Trends Spatial Variability Validated Against Emergency Department Influenza Related Visits. *J. Med. Internet Res.* 18(6), e175(1-11). https://doi.org/10.2196/jmir.5585

Kostkova, P. (2018). Disease Surveillance Data Sharing for Public Health: The Next Ethical Frontiers. *Life Sci. Soc. Policy*., 14(1), 16(1-5). https://doi.org/10.1186/s40504-018-0078-x

Kumar, A., Sharma, K., Singh, H., Naugriya, S.G., Gill, S.S., Buyya, R. (2021). A Drone-Based Networked System and Methods for Combating Coronavirus Disease (COVID-19) Pandemic. *Future Gener. Comput. Syst.*, 115, 1–19. https://doi.org/10.1016/j.future.2020.08.046

Lampos, V., Miller, A.C., Crossan, S., Stefansen, C. (2015). Advances in Nowcasting Influenza-Like Illness Rates Using Search Query Logs. *Sci Rep*., 5, 12760(1-10). https://doi.org/10.1038/srep12760

Magid, A., Gesser, E.A., Green, M.S. (2018) The Role of Informal Digital Surveillance Systems before, During and After Infectious Disease Outbreaks: A Critical Analysis. p. 189–201. Radosavljevic V., Banjari I., Belojevic G. (Eds.) In: Defence Against Bioterrorism. *NATO Science for Peace and Security Series A: Chemistry and Biology.* Springer, Dordrecht. https://doi.org/10.1007/978-94-024-1263-5_14

Mandyata, C.B., Olowski, L.K., Mutale, W. (2017). Challenges of Implementing the Integrated Disease Surveillance and Response Strategy in Zambia: A Health Worker Perspective. *BMC Public Health*., 17(1), 746(1-12). https://doi.org/10.1186/s12889-017-4791-9

Mathers, C.D., Fat, D.M., Inoue, M., Rao, C., Lopez, A.D. (2005). Counting the Dead and What they Died From: An Assessment of the Global Status of Cause of Death Data. *Bull. World Health Organ*., 83(3), 171-177. https://apps.who.int/iris/handle/10665/269355

Mccarthy, J. What is Artificial Intelligence? 2007, 1–14. http://www-formal.stanford.edu/jmc/whatisai/

McNabb, S.J.N., Tyland, P., Sylvester, J., Shaikh. A. (2017). Informatics Enables Public Health Surveillance. *J. Heal. Spec.,* 5(2), 55-59. http://dx.doi.org/10.4103/jhs.JHS_28_17

Meng, H., Liao, Q., Suen, L.K.P., O'Donoghue, M., Wong, C.M., Yang, L. (2016). Healthcare Seeking Behavior of Patients with Influenza like Illness: Comparison of the Summer and Winter Influenza Epidemics. *BMC Infect. Dis.* 16(1), 499 (1–9). https://doi.org/10.1186/s12879-016-1821-7

Mirchev, M., Mircheva, I., Kerekovska, A. (2020). The Academic Viewpoint on Patient Data Ownership in the Context of Big Data: Scoping Review. *J. Med. Internet Res.,* 22(8), e22214 (1-20). https://doi.org/10.2196/22214

Mukhtar, H., Rubaiee, S., Krichen, M., Alroobaea, R. (2021). An IoT Framework for Screening of COVID-19 Using Real-Time Data from Wearable Sensors. *Int. J. Environ. Res. Public Health.*, 18(8), 4022(1-17). https://doi.org/10.3390/ijerph18084022

Mukred, A., Singh, D., Safie, N. (2017). Investigating the Impact of Information Culture on the Adoption of Information System in Public Health Sector of Developing Countries. *Int. J. Bus. Inf. Syst*., 24(3), 261-284. https://doi.org/10.1504/IJBIS.2017.082036

PHII (Public Health Informatics Institute). (2020). Define Public Health Informatics. Decatur, Georgia. https://phii.org/how-we-do-it/defining-public-health-informatics/

Pollett, S., Boscardin, W.J., Azziz, B.E., Tinoco, Y.O., Soto, G., Romero, C., Kok, J., Biggerstaff, M., Viboud, C., Rutherford, G.W. (2017). Evaluating Google Flu Trends in Latin America: Important Lessons for the Next Phase of Digital Disease Detection. *Clin. Infect. Dis.,* 64(1), 34-41. https://doi.org/10.1093/cid/ciw657

ProMED - ProMED-mail. [cited 2021 May 25]. https://promedmail.org/

Rama K.S., Lavanyah, S.A.A.R. (2021). Descriptive Epidemiology of the First Wave of COVID-19 in Petaling District, Malaysia: Focus on Asymptomatic Transmission. *Western Pacific Surveill. Response J.,* 12(2), 82-88. https://doi.org/10.5365/wpsar.2020.11.4.001

Singapore's COVID-19 Temperature Scans and Tracking Leading the Way. [cited 2021 May 26]. https://thenewdaily.com.au/news/national/2020/03/19/singapore-coronavirus-temperature-scans/

Watts, J.M., Venkat, P.R. HIV Status of More Than 14,000 People Leaked in Singapore Data Breach - WSJ. The Wall Street Journal. 2019. https://www.wsj.com/articles/hiv-status-of-more-than-14-000-people-leaked-in-singapore-data-breach-11548679969

What is IoT? Defining the Internet of Things (IoT), Aeris, [cited 2021 May 26]. https://www.aeris.com/in/what-is-iot/

Whitelaw, S., Mamas, M.A., Topol, E., Van, S.H.G.C. (2020). Applications of Digital Technology in COVID-19 Pandemic Planning and Response. *Lancet Digit. Heal.,* 2(8), e435-E440. http://dx.doi.org/10.1016/S2589-7500(20)30142-4

WHO (World Health Organization). (2020). Public Health Surveillance for COVID-19: Interim Guidance. https://www.who.int/publications/i/item/who-2019-nCoV-surveillanceguidance-2020.8

WHO Coronavirus (COVID-19) Dashboard with Vaccination Data, [cited 2021 May 24]. https://covid19.who.int/

WHO, Epidemic Intelligence - Systematic Event Detection. (2020). [cited 2021 May 24]. http://www.who.int/csr/alertresponse/epidemicintelligence/en/

Why has Healthcare become Such a Target for Cyber-Attackers? https://theconversation.com/why-has-healthcare-become-such-a-target-for-cyber-attackers-80656

Wright, W.F., MacKowiak, P.A. (2021). Why Temperature Screening for Coronavirus Disease 2019 with Noncontact Infrared Thermometers Does Not Work. *Open Forum Infect Dis.*, 8(1), ofaa603(1-3). https://doi.org/10.1093/ofid/ofaa603

Zeng, D., Cao, Z., Neill, D.B. (2021). Chapter 22: Artificial Intelligence Enabled Public Health Surveillance from Local Detection to Global Epidemic Monitoring and Control. p. 437-453. In: Artificial Intelligence in Medicine, Lei, X., Maryellen, L.G., James, K.M. (Eds), Academic Press. http://dx.doi.org/10.1016/B978-0-12-821259-2.00022-3

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REVIEW ARTICLE Open Access

Use of Effect Size Measures along with *p*-Value in Scientific Publications

Sandheep Sugathan*, Lilli Jacob

Abstract

Background: To describe various measures for estimation of effect size, how it can be calculated and the scenarios in which each measures of effect size can be applied.

Methods: The researchers can display the effect size measures in research articles which evaluate the difference between the means of continuous variables in different groups or the difference in proportions of outcomes in different groups of individuals. When p-value alone is displayed in a research article, without mentioning the effect size, reader may not get the correct pictures regarding the effect or role of independent variable on the outcome variable.

Results: Effect size is a statistical concept that measures the actual difference between the groups or the strength of the relationship between two variables on a numeric scale.

Conclusion: Effect size measures in scientific publications can communicate the actual difference between groups or the estimate of association between the variables, not just if the association or difference is statistically significant. The researchers can make their findings more interpretable, by displaying a suitable measure of effect size. Effect size measure can help the researchers to do meta-analysis by combining the data from multiple research articles.

Keywords: Effect size, *p*-Value, Research Publication, statistical concept.

*Correspondence Email: drsandheep@gmail.com

[1]*Community Medicine, Quest International University, Perak, Malaysia*

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Introduction

The researchers can display the effect size measures in research articles which evaluate the difference between the means of continuous variables in different groups or the difference in proportions of outcomes in different groups of individuals. Effect size is a statistical concept that measures the actual difference between the groups or the strength of the relationship between two variables on a numeric scale.

> The effect size measures represent the actual magnitude of the relationship between the independent variable and dependent variables (Sullivan, G.M. *et al.,* 2012).
>
> "You should describe the results in terms of measures of magnitude –not just, does a treatment affect people, but how much does it affect them" - *Gene V. Glass (Kline, R.B., 2004).*
>
> "The primary product of a research inquiry is one or more measures of effect size, not P values." - *Jacob Cohen (Cohen, J., 1990).*

When p-value alone is displayed in a research article, without mentioning the effect size, reader may not get the correct pictures regarding the effect or role of independent variable on the outcome variable. In many of the research publications, effect size measures are not represented as the p-value is presented. Purpose of this review article is to describe various measures for estimation of effect size, how it can be calculated and the scenarios in which each measures of effect size can be applied.

Methods

Absolute measures of effect size

The effect size can be presented as the raw difference between group means or absolute effect size, as well as the standardized measures of effect, which are calculated to transform the absolute effect size to an easily understood scale. Absolute effect size measure is useful when the variables under study have intrinsic meaning (for example, if we are estimating the number of hours of sleep or the difference between mean hours of sleep among individuals from different groups).

Standardized measures of effect size

Standardized measures of effect size are useful when the measurements have no intrinsic meaning, such as the raw scores on a Likert scale; or when the studies used different scales so no direct comparison is possible; or when effect size is examined in the context of variability in the population under study.

The effect size measures differ based on the type of comparison.

For example,

- When two means are compared, the effect size displays the actual difference in means divided by the standard deviation. That is known as standardized mean difference.
- When two means are compared, the effect size displays the actual difference in means along with 95% confidence interval of the difference in means.

- When two proportions are compared, the effect size displays the actual difference in proportions along with the 95% confidence interval of the difference in proportions.
- When studying the linear relationship between two continuous variables, the effect size is represented by the correlation coefficient (r).
- Comparing the odds of exposure or outcome in different groups – using odds ratio and 95% confidence interval of odds ratio.
- Incidence of disease among exposed group and incidence of disease in the non-exposed group can be displayed.
- Relative risk or risk difference can be calculated by dividing the incidence of disease among exposed group by the incidence of disease in the non-exposed group.

In statistics analysis, the effect size is usually measured in three ways: standardized mean difference, odds ratio or correlation coefficient (Complete Dissertation by Statistics Solution).

Advantages of Effect Size Measures

Effect size can tell you:

- How large the difference is between groups.
- The absolute effect (the difference between the average outcomes of two groups).
- The standardized effect size for an outcome.

An example of absolute effect size could be: patients taking a drug for depression might see a mean improvement on a depression test (like Beck Depression Inventory) by 10 points. Standardized effect sizes are estimated in a way that some scores are standardized using z-scores; it makes the result more interpretable and comparable to those research articles using another measure for data collection.

How to Present Effect Size in Publications

According to the 7th edition of Publication manual of American Psychological Association, it is highly recommended to include measures of effect size along with a confidence interval for each effect size in the Results section for the readers to appreciate the magnitude or importance of a study's findings. Confidence interval for each effect size is used to display the precision of the effect size measures (Publication Manual of the American Psychological Association).

Effect sizes may be expressed in the original units.

- Actual mean number of questions answered correctly along with 95% confidence intervals of mean.
- Difference in mean values between groups along with 95% confidence intervals of difference in mean.
- Actual increase in the value of dependent variable for each unit increase in the value of independent variable – whenever presenting a logistic regression result.

It is valuable to also report an effect size in some standardized or units-free or scale-free unit (e.g., Standardized mean difference, Cohen's d, Hedge's g, Glass's Δ, Cohen's f, Somer's d, f^2, R^2, Phi and Cramer's V).

As commonly used effect size measures with the scenarios, it continues to go through the commonly used effect size measures.

a. Standardized Means Difference:

Standardized mean difference is used as a measure of effect size, when a research study is based on the population mean and standard deviation.

The effect size of the difference in the subgroups in the population can be known by dividing the mean differences in the sub-populations or subgroups by their standard deviation in the whole population.

$$\theta = \frac{\mu_1 - \mu_2}{\sigma}$$

b. Cohen's d:

Cohen's d is known as the difference of two population means and it is divided by the standard deviation from the data. It can be applied for independent samples t test, one sample t-test and paired t-test (Effect Size in Statistics).

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s}$$

Numerator is the difference between means of the 2 groups. 's' is the pooled standard deviation which can be calculated using the following formula

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2}}$$

n_1 = number of samples in group 1 and n_2 = number of samples in group 2.

c. Pearson Correlation Coefficient:

Pearson correlation coefficient is a measure on effect size which shows the strength of linear relationship between two continuous variables and the direction of linear relationship.

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

Pearson correlation coefficient can also calculated using the following formula

$$r = \frac{\text{Covariance between x and y}}{(\text{Standard deviation of x}) * (\text{standard deviation of y})}$$

d. Point-Biserial Correlation Coefficient:

It is used to measure the strength and direction of the association that exists between one continuous variable and one dichotomous or binary variable. It can be used for independent samples t-test since the independent variable is dichotomous.

e. Hedge's g Method:

This method is the modified method of Cohen's d method

$$\text{Hedges' } g = \frac{M_1 - M_2}{SD}$$

Numerator: difference between means of 2 groups. SD: pooled & weighted standard deviation

Pooled and weighted standard deviation for 2 groups can be calculated using the following formula (Effect Size in Statistics).

$$SD^*_{pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$$

Pooled and weighted standard deviation if there are 3 or more groups (consider that k groups are present)

$$s_{\text{pooled}} = \sqrt{\frac{(n_1 - 1)s_1^{\,2} + (n_2 - 1)s_2^{\,2} + \ldots + (n_k - 1)s_k^{\,2}}{n_1 + n_2 + \ldots + n_k - k}}$$

If sample sizes are equal in multiple groups, pooled and weighted standard deviation can be calculated as

$$s_{\text{pooled}} = \sqrt{\frac{s_1^{\,2} + s_2^{\,2} + \ldots + s_k^{\,2}}{k}}$$

Interpretation of Cohen's d and Hedge's g

A 'Hedge's g' of 1 indicates the two groups differ by 1 standard deviation, a g of 2 indicates they differ by 2 standard deviations, and so on. Standard deviations are equivalent to z-scores (1 standard deviation = 1 z-score). Hedges' g and Cohen's d are similar. Both have an upwards bias in results of up to about 4%. When sample sizes are below 20, when Hedges' g is better measure of effect size compared to Cohen's d. So Hedges' g is therefore sometimes called the corrected effect size. For very small sample sizes (<20) choose Hedges' g over Cohen's d and for sample sizes >20, the results for both statistics are roughly equivalent (Stephanie, G., 2017).

f. Glass's Δ or Glass's Delta (Complete Dissertation by Statistics Solution)

Glass's Delta is a measure for effect size, when standard deviations are significantly different between groups. Glass's delta uses only the control group's standard deviation (SDC).

$$\Delta = \frac{\bar{x}_1 - \bar{x}_2}{s_2}$$

Numerator is the difference between means of the 2 groups; S_2 is the standard deviation in the control group.

g. Cohen's f statistic

Cohen's f statistic is used as a measure of effect size in ANOVA and ANCOVA. The statistic gives an estimate of the proportion of variance explained by the categorical variable. Cohen's f is a ratio between two interim sums of squares: the treatment sum-of-squares and error-sum-of-squares (The proportion of variance explained by the analysis model relative to the proportion of variance not explained by the analysis model). Cohen suggested the following interpretation for f when used in ANOVA / ANCOVA: 0.10 = Small effect size, 0.25 = Medium effect size, 0.40 = Large effect size, When f = 0, that's an indication that the population means are all equal. As the means get further and further apart, f will grow indefinitely larger.

h. Somers' Delta (Somers' D)

Somers' Delta (Somers' D) is a measure of agreement between pairs of ordinal variables. Ordinal variables are ordered, like highest to lowest or smallest to greatest (the Likert scale is one of the more popular ordinal scales.)
A measure of agreement tells you something about how two pairs of variables are connected. This connectivity is defined by concordance and discordance. Concordant pairs "match" while discordant pairs don't "match".

Effect size measures which can be used for (simple and multiple) linear regression are f^2, R^2 and adjusted R^2 (Stephanie, G., 2018)

> R^2 can be used as the measure of effect size (for entire model) – is the coefficient of determination. It is the proportion of the variation in the dependent variable that is predictable from the variation in the independent variable in simple linear regression.
> R^2 is the proportion of the variation in the dependent variable that is predictable from the variation in the combination of independent variables added to the model in multiple linear regression.
>
> f^2 can be used as the measure of effect size for entire model and for individual predictor variable.

f^2 can be calculated using the following formula

$$f^2 = \frac{R^2_{inc}}{1 - R^2_{inc}}$$

$\mathbf{R^2_{inc}}$ is the increase in R^2 value while adding the independent variable to the model as compared to the model which is not having the particular independent variable added. When only one predictor variable is added in the linear regression model, R^2_{inc} will be $R^2 - 0 = R^2$

Effect size measures for Chi square test

There are three ways to measure effect size: **Phi (φ), Cramer's V (V), and odds ratio (OR).**

a. Phi (φ)

Phi is calculated as $\varphi = \sqrt{(X^2 / n)}$.

X^2 is the Chi square value and n is the sample size.

It's appropriate to calculate φ only when you're working with a 2 x 2 contingency table (i.e. a table with exactly two rows and two columns).

A value of **φ = 0.1** is considered to be a small effect, 0.3 a medium effect, and 0.5 a large effect.

b. Cramer's V (V)

Cramer's V is calculated as $V = \sqrt{(X^2 / (n*df))}$

where X^2 is the Chi-Square test statistic, n = total number of observations and
df = degree of freedom for Chi square test = (no. of rows - 1) * (no. of columns - 1)

It's appropriate to calculate V when you're working with any table larger than a 2 x 2 contingency table.

Degrees of freedom	Small	Medium	Large
1	0.10	0.30	0.50
2	0.07	0.21	0.35
3	0.06	0.17	0.29
4	0.05	0.15	0.25
5	0.04	0.13	0.22

c. Odds Ratio (OR) and 95% confidence interval of odds ratio

Odds Ratio can be calculated for a 2 X 2 contingency table as follows

Exposure categories	Success (frequency)	Failures (frequency)
Treatment group (exposed)	A	B
Control group (not exposed)	C	D

Odds of success among exposed group (treatment group) = A / B

Odds of success among not exposed group (control group) = C / D

Odds ratio of success = Odds of success among treatment group / Odds of success among control group

= (A / B) / (C / D) = AD / BC

If odds ratio of success is higher than 1 and the 95% confidence interval of Odds ratio is not including 1, the treatment is having a higher odd of success.

If odds ratio of success is lower than 1 and the 95% confidence interval of Odds ratio is not including 1, the treatment is having a lower odd of success.

Odds Ratio can be calculated for a case control study design as follows.

Exposure categories	Diseased individuals (cases)	Not diseased individuals (controls)

Exposed to risk factor	A	B
Not exposed to risk factor	C	D

Odds of exposure to risk factor among cases = A / C

Odds of exposure to risk factor among controls = B / D

Odds ratio = Odds among treatment group / Odds among control group
= (A / C) / (B / D) = AD / BC

d. relative risk or risk difference

Relative risk can be calculated by dividing the incidence of disease among exposed group by the incidence of disease in the non-exposed group

Relative risk can be applied for a 2 X 2 contingency table

Exposure categories	Success (frequency)	Failures (frequency)
Treatment group (exposed)	A	B
Control group (not exposed)	C	D

Incidence of success among the exposed group (treatment group) = A / (A+B)

Incidence of success among the not exposed group (control group) = C / (C+D)

Relative risk or Risk ratio of success among exposed group as compared to the not exposed group = Incidence of success among the exposed group / Incidence of success among the not exposed group
= [A / (A+B)] / [C / (C+D)]

If relative risk of success among exposed group is higher than 1 and the 95% confidence interval of relative risk is not including 1, the treatment or exposure is having a higher risk of success.

If relative risk of success among exposed group is lower than 1 and the 95% confidence interval of relative risk is not including 1, the treatment is having a lower risk of success.

Conclusion

Effect size measures in scientific publications can communicate the actual difference between groups or the estimate of association between the variables, not just if the association or difference is statistically significant. The researchers can make their findings more interpretable, by displaying a suitable measure of effect size. Effect size measure can help the researchers to do meta-analysis by combining the data from multiple research articles.

References

Cohen, J. (1990). Things I have Learned (So far). *Am. Psychol.,* 45(12), 1304-1312. https://psycnet.apa.org/doi/10.1037/0003-066X.45.12.1304; Devroye, L. (1986). Non-

Uniform Random Variate Generation. Springer, New York, NY. https://doi.org/10.1007/978-1-4613-8643-8

Complete Dissertation by Statistics Solution. (2021, August 2), Effect size. Statistics Solutions (Retrieved November 29, 2021). https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/effect-size/.

Effect Size in Statistics - Ultimate Guide. (2021). SPSS Tutorials. https://www.spss-tutorials.com/effect-size/

Kline, R. B. (2004). Beyond Significance Testing: Reforming Data Analysis Methods in Behavioural Research Washington, DC: *Am. Psychol. Assoc.,* 2004, 336, (ISBN 1-59147-118-4). https://www.apa.org/pubs/books/4316031

Publication Manual of the American Psychological Association (6th ed.). (2010). Washington, DC. *Am. Psychol. Assoc.* https://apastyle.apa.org/products/publication-manual-7th-edition

Stephanie, G. (2018). "Hedges' G: Definition, Formula." https://www.statisticshowto.com/hedges-g/

Stephanie, G., (2017). Pooled Standard Deviation, In: Elementary Statistics for the Rest of Us! https://www.statisticshowto.com/pooled-standard-deviation/

Sullivan, G.M., Feinn, R. (2012). Using Effect Size-or why the P Value is Not Enough. *J. Grad. Med. Educ., 4*(3), 279-282. https://doi.org/10.4300/jgme-d-12-00156.1

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RESEARCH ARTICLE Open Access

The Public Health Intervention for International Students at University Malaysia Sabah, Malaysia

Hazeqa Salleh, Nicholas Tze Ping Pang*, Mohammad Saffree Jeffree, Helen Lasimbang, Syed Sharizman Syed Abdul Rahim, Azizan Omar, Mohd Amiruddin Bin Mohd Kassim, Farhana Harzila bt Mohd Bahar, Syaza Putri Binti Zainudin, Assikin Bin Muhamad

Abstract

Background: COVID-19 pandemic that started in Wuhan, Hubei Province, China, has spread globally, and Sabah is one of the states in Malaysia that is affected by it. The outburst in social media on discrimination against the people from China impacted the international students from China. Thus, University Malaysia Sabah (UMS) had to play a role in mitigating the COVID-19 pandemic and protecting its students. This article aimed to describe the actions taken by UMS for its international student from China during the early phase of the COVID-19 pandemic.

Methods: This study used a cross-sectional design where all 379 students from China in UMS were screened from February 2020 until March 2020 during the early phase of COVID 19.

Results: During this study period, 0.5% of the students were classified as Persons under Investigation (PUI), while 99.5% were classified as Person under Surveillance (PUS).

Conclusion: The public health interventions included surveillance, contact tracing, monitoring, quarantine, isolation, social distancing, mental health support, and mental health intervention activities. These actions to control the pandemic reduce the state health department's health burden and help the students in need.

Keywords: Mitigating activities, Covid-19, Students from China.

*Correspondence Email: nicholas@ums.edu.my

[1]*Faculty of Medicine and Health Sciences, University Malaysia Sabah.*

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Introduction

As of 17th March 2020, there were 1,79,111 confirmed cases globally, with 7,426 deaths reported by WHO (World Health Organization) (WHO, 2020). In Malaysia, the first case of COVID-19 reported was on 25th January 2020 in Johor, where three Chinese nationalities who had closed contact with a patient treated in Singapore were found positive (The Borneopost, 2020), while the first Malaysian found positive was reported on 4th of February 2020 where he attended a conference in Singapore around two weeks before that (Bernama, 2020). The COVID-19 was announced as a pandemic on the 11th March 2020 by WHO (WHO, 2020). These resulted in changes in the operative dynamics for the medical facilities and the higher education centers. This is because colleges and universities act as an international hub that is home to internationally mobile students. The risk of COVID-19 cases spreading could occur here in Sabah. At University Malaysia Sabah, a large proportion of international students that come to study here came from China. Therefore, actions need to be taken to manage this matter since this pandemic is rapidly evolving. If no strategies are in place, imported infection of COVID-19 could occur inside the college itself.

In February 2020, the federal government of Malaysia had imposed travel restrictions to delay the spread of infection. However, these travel restrictions did not encompass students from China who had valid Malaysian student residency permits. Hence, the university had to go above and beyond the federal and state government procedures by introducing a surveillance program to monitor international students entering the campus from affected regions to prevent the importation of cases. Due to high-density living environments at the university level, the importation of one stray point could have catastrophic consequences. Hence, the higher education center had to communicate health services and plans for international students regarding travel restrictions and re-entry. Multi-sectoral planning procedures were also established early on to coordinate the entry of China students back into university with clear home quarantine, alerting, and sampling requirement standard operating procedures (SOP). Therefore, this article will concentrate on the preventive measures and actions taken by the University of Malaysia Sabah (UMS) for its international students from China returning to Sabah during the alert phase.

Methods

This study used a cross-sectional study design involving all the international students from China. There were 379 students, including those still in the state and those who had just returned to Sabah from China. COVID-19 screening was done through active and passive case detection. These international students were required to self-declare their travel history overseas or upon returning to Sabah, and they were then referred to the health clinics on the campus where they were screened for COVID-19. A liaison officer was then assigned to each student and followed-up up daily for two weeks virtually to check for signs and symptoms of the virus. All the student's details, information, and follow-up details are kept in the line-listing. These secondary data collected from the UMS COVID-19 Preparedness and Response Centre from February 2020 till March 2020 were then analyzed descriptively.

Results

A total of 379 international students from China were screened & there was a 100% response rate towards surveillance and monitoring action done. 61.2% of them were in Sabah, while 38.8% were those flying in from different parts and provinces of China, as seen in **Figure 1**. The students mainly flew from Beijing, Chengdu, and Guanzhou, where 15% of the students traveled from Beijing, 10.6% traveled from Chengdu, and 2.6% from Guangzhou, China.

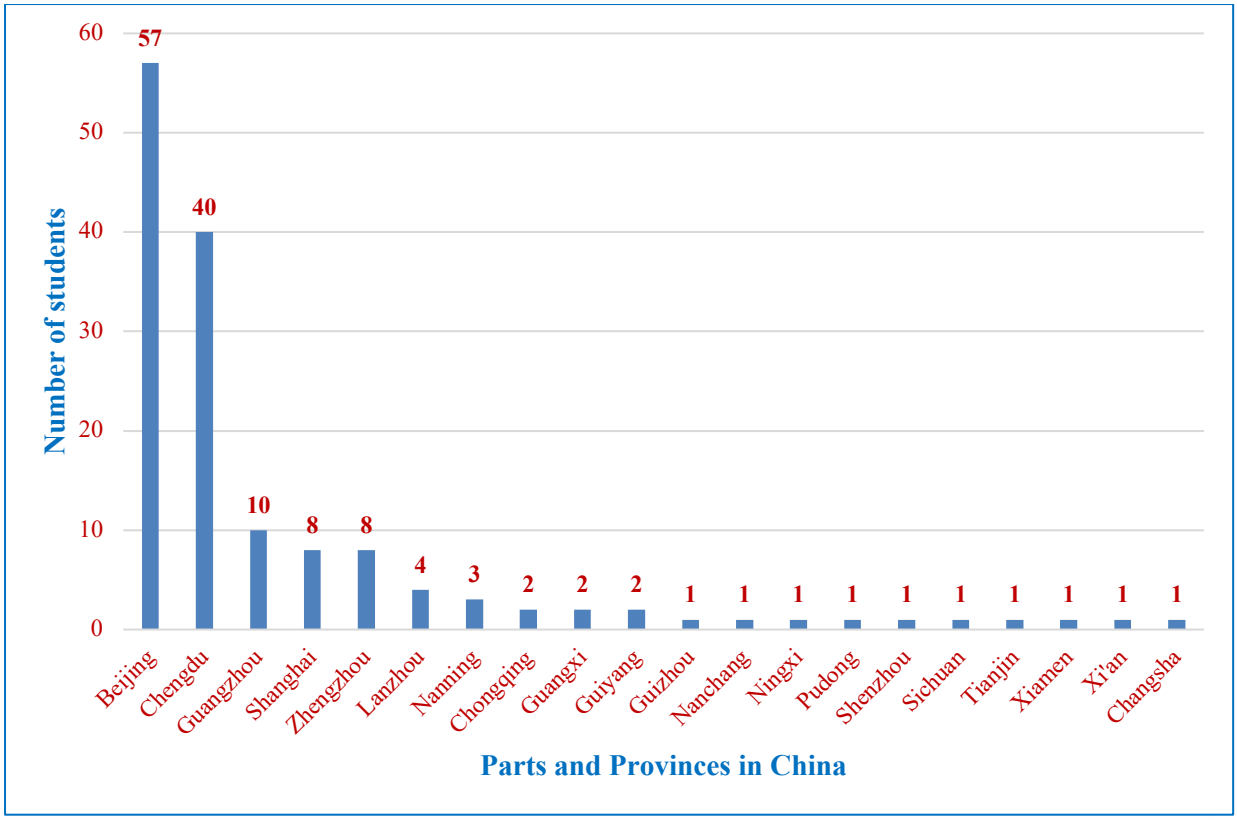

Figure 1: The Number of Students Flying into Sabah according to their Original Flight from February 2020 to March 2020

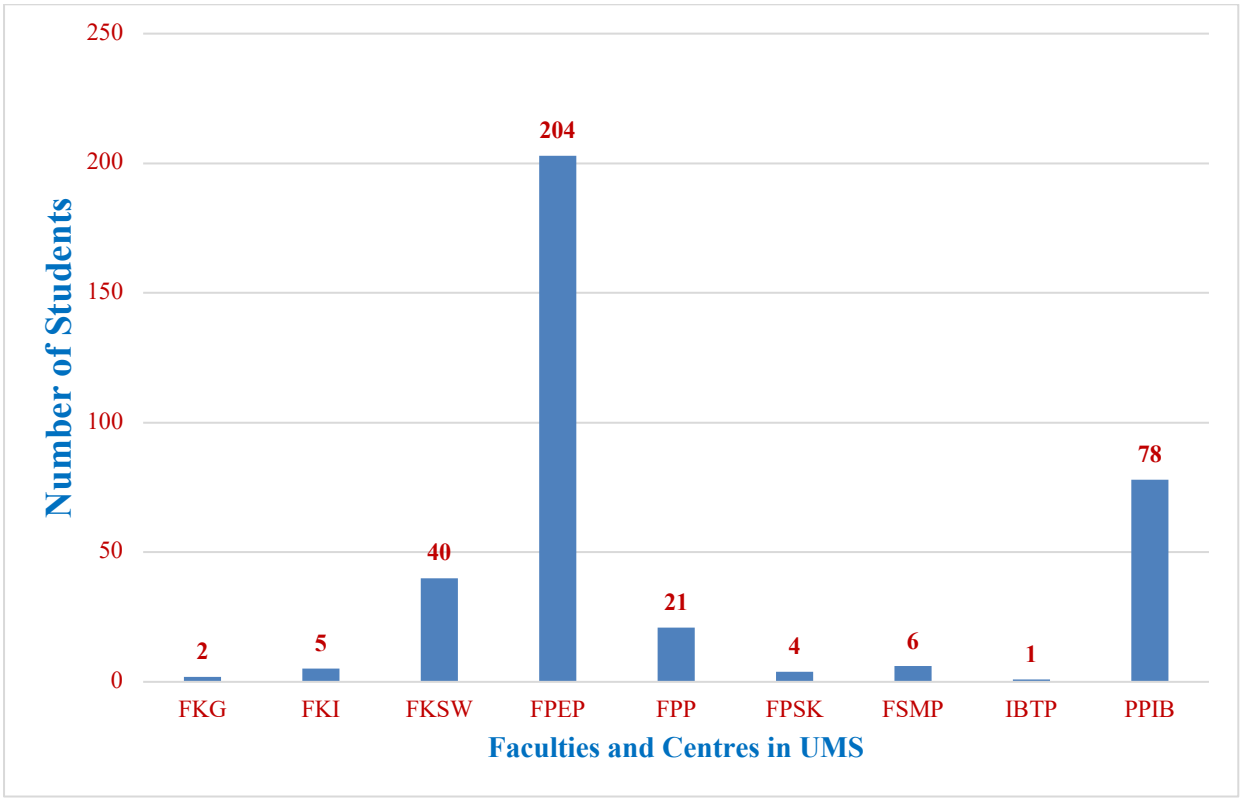

Figure 2: The Number of International Students from China according to Faculty and Centers in UMS from February 2020 to March 2020

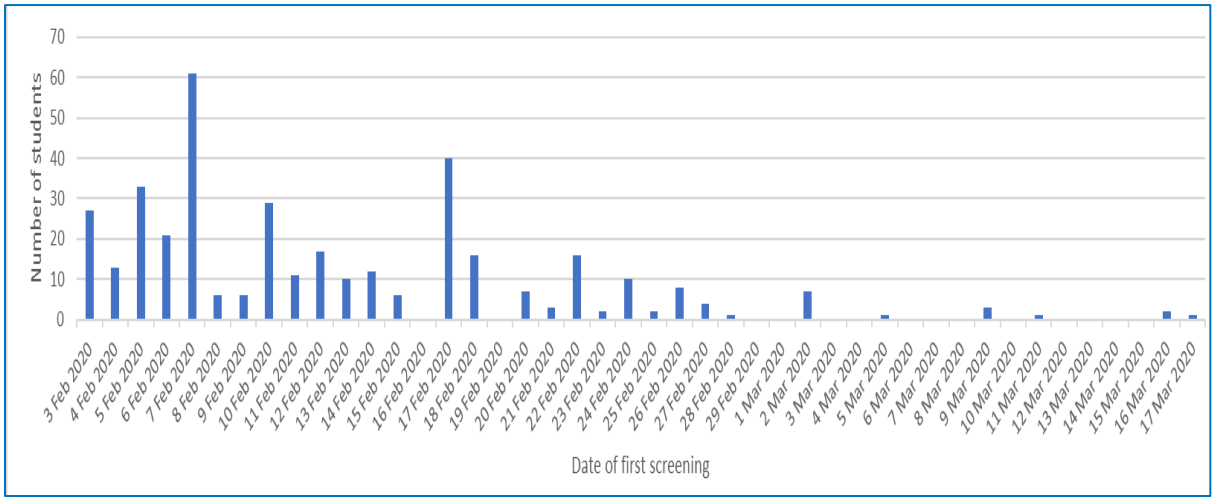

Figure 3: The Number of students from China screened for COVID-19 from February 2020 until March 2020.

All these students that came to UMS came to study in different faculties, as seen in **Figure 2**. From this table, 204 students studied at the Faculty of Business, Economics, and Accountancy (FPEP); 78 students studying at the Centre for The Promotion of Knowledge and Language Learning (PPIB); 40 students studying at the Faculty of Humanities, Art, and Heritage (FKSW); 21 students from the Faculty of Psychology and Education; six students studied at the Faculty of Food Science and Nutrition (FSMP); five students studied at Faculty of Computing and Informatics (FKI); four from the Faculty of Medicine and Health Sciences (FPSK); two from the Faculty of Dentistry (FKG), and one from the Institute for Tropical Biology and Conservation (IBTP). However, 17 students did not mention which faculties they were. All these international students lived outside the university campus but within the district of Kota Kinabalu.

From February 2020 to March 2020, the 2nd version of the COVID-19 guidelines for Malaysia was employed, so person under investigation were all individuals from China with symptoms suggestive of COVID-19. All of them had been contacted and followed up daily. From the surveillance, contact tracing, and monitoring activity, two (0.5%) of the student was classified as Person Under Investigation (PUI) due to having symptoms and were isolated at home, requiring two negative RT-PCR COVID-19 throat swabs to be discharged from home quarantine. 374 (99.5%) students were classified as Person Under Surveillance (PUS) and were quarantined at home for two weeks without taking throat swabs. **Figure 3** shows the trend of international students from China that have been screened while on campus or upon returning to Sabah.

Discussion

Since the emergence of the novel coronavirus COVID-19, news about it has been widely circulated. It has been a hot topic in social media, and the images linked to it were of people from China in quarantine and confinement. Since then, there has been an increase in discrimination and wariness towards Chinese people, and in Malaysia, this includes tourists and international students. Research shows there is a positive association between media exposure and prejudice towards foreign nationalities (Sorokowski, P. *et. al.,* 2020). Due to this, international students may face many stressors, including fear of infection, despair, boredom, and stigma (Duan, L. *et. al.,* 2020). Some may seek information from social media, and

exposure to social media is associated with a higher prevalence of anxiety and depression (Gao, J. *et. al.,* 2020). Some mitigation actions like social distancing can help slow the pandemic, but people crave social connection since it can help them cope with stress during this crisis (Jetten, J. *et. al.,* 2017). Hence, distancing may increase loneliness, depression, and anxiety for these international students, negatively affecting their health (Hawkley, L. C. *et. al.,* 2010). The effect of people who are subjected to quarantine and self-isolation also include anger and confusion (Brooks, S. K. *et. al.,* 2020).

Therefore, UMS had increased their preparedness, alert, and response in identifying and controlling the COVID-19 pandemic within the appropriate scale of the university level as in WHO advice (WHO, 2020). Communicating information is essential in creating trust and preventing people from seeking it from an unreliable source. Thus, messages are tailored according to the language the target people can understand (Berger, Z. D. et. al., 2020). Online interaction can also increase a sense of connection, and it is advantageous psychologically to those who received help and the one giving it (Doré, B. P. et. al., 2017). The educational concept done by UMS is by utilizing social media campaigns that are reachable to the students. However, there is still a risk of people misunderstanding the information and taking the precautions less seriously. Hence, UMS ensures that only trained counselors and psychologists are assigned to these students who may need it.

In University Malaysia Sabah (UMS), surveillance of international students from China had started in early February 2020. Both active and passive surveillance methods were used. Students who had just returned from China were contacted daily for two weeks to update their daily conditions for active surveillance systems. For passive surveillance, university health clinics notified the operation room if any cases of COVID-19 were identified. Rumor surveillance was also established by monitoring social media for signs of mental breakdown among students. Lecturers as well as appointed staff monitored Whatsapp and Facebook and took necessary action as needed. From these actions, the data collected were the demographies of the students, their addresses in Sabah, contact numbers, COVID 19 screening tests, their results, and their daily COVID 19 symptoms follow-up. A line listing was then made to monitor the students who have returned from China and ensure they are supported throughout this pandemic.

In public health, contact tracing is done to track down those who might have been in contact with a person diagnosed with this disease. It is imperative to ensure the contacts are located and quarantined to prevent further spread. It has been shown in a study in Taiwan that vigorous contact tracing followed by quarantine and social distancing is an effective strategy in preventing widespread community transmission of COVID-19 (Cheng, H. Y. et. al., 2020). In UMS, contact tracing and monitoring procedures were created in preparation for any COVID 19 cases among the students who had just returned from China. Liaison officers consisting of lecturers and academicians were appointed to take care of 10 students each. They were tasked to contact the identified person and provide them with education, information, and support to understand the need to separate themselves from others who are not exposed. With the help of the liaison officer, the students are monitored for illness symptoms, made to understand the possibility and the risks that they could spread the infection to others even though they were asymptomatic, and reinforce the need for social distancing and home quarantine upon return from travel.

Contact tracing is an arduous task, but this is to prevent the resurgence of COVID-19 disease (Hellewell J. et. al., 2020). Thus, UMS collaboratively worked with the state health

department to stop the transmission of COVID-19 within the campus itself. In UMS, all contract tracers were well trained with a public health background. Apart from that, for the contacts, their privacy is of the utmost importance. When they were called, their identity and details were private to the contact tracer and themselves only. The methods used to contact them were through phone calls, emails, and social media messaging. It is also known that the media stereotyped those from China as the potential carrier of the virus. This affected those of China nationalities where some were refused services like Grab car because of the negative (Rzymski P. et. al., 2020). So, to avoid these prejudices, the contact tracers were trained to be professional and sensitive while communicating with the students.

Currently, for the COVID-19 pandemic, there remains no an effective medicine or vaccines available to treat or prevent it. In February, students from China were considered to have the risk of transmitting COVID-19, although the pandemic was not announced yet by the WHO. Regardless, restrictive public health measures were used to reduce transmission of COVID-19, and quarantine has been proven to be advantageous since it has been demonstrated to reduce the disease spread by nearly 80% (Chinazzi, M. et. al., 2020). Hence, in the UMS, quarantine, isolation, and social distancing were the key measures used.

The students were explicitly requested to undergo quarantine at their homes for 14 days after returning from their travel. Those who had fever were discussed with infectious disease specialists for possible hospital isolation. For home quarantine, they were advised to stay at home for 14 days, check temperature daily, keep the distance (2 meters) between themselves and others, watch out for signs and symptoms such as fever, cough, and shortness of breath, get medical assistance if students develop any symptoms or symptoms worsening, stay calm, cooperate with the authorities and, wear a face mask if going out.

Moreover, UMS administration enforced quarantine and isolation to ensure the students' health within the campus and control the spread of infectious disease. A rapid review done by Cochrane entitled “Quarantine alone or in combination with other public health measures to control COVID-19 using 29 studies suggested that quarantine of people exposed to confirmed cases can reduce infections and deaths (Nussbaumer S.B. et al., 2020). Furthermore, UMS maintained transparency which is essential to ensure students understood the need for quarantine and isolation without developing fear and panic. Moreover, combining quarantine with other control measures like travel restriction, social distancing, and school closure effectively reduced transmission and critical cases.

COVID-19 pandemic presented as a potential stressor to vulnerable communities. International college students are uniquely vulnerable to everyday stressors and severe mental illness during this pandemic. There are many reasons why these students encounter challenges and stressors. Students experienced stress due to the uncertainty of abrupt disruption of the semester caused by university closures. Many have to cease their research projects, experience delays in their course timeline and graduation, and struggle with the cost of returning home and managing their belongings. There is also fear of infection and transmission of COVID-19 among their family members. The social isolation that the students had to face during quarantine can result in many mental health issues which can affect even an ordinary person, like acute stress disorder, irritability, insomnia, mood disorders, fear, panic, and anxiety (Hellewell, J. et. al., 2020).

UMS understood the importance of supporting these students and providing their health, education, and safety needs while considering social distancing. Hence, UMS

transitioned to an online platform to provide psychological counseling services. Every student had a liaison officer to provide psychosocial support, as brief virtual interventions are efficacious for those experiencing distress related to COVID-19 (Cheng, H. Y. et. al., 2020). To those who wanted it, there was also a broad provision of online forums and group chats with counselors where students can share their high and low points and describe how they are feeling using Zoom and google meeting platforms. This will increase their psychological mindedness, which has been shown in recent studies to be a mediator that can significantly affect the relationship between dysfunctional coping styles and depressive symptoms (Qadri F. et al., 2005).

Apart from that, to make sure there is a sense of normality, remote education through online classes was also done continuously throughout the alert phase and home quarantine. These online classes could also simultaneously act as a tool for the lecturers to reach out and identify students who might need mental health support. Communication is also vital; therefore, the international students in UMS were regularly updated on the COVID-19 pandemic. They were also regularly updated about national government initiatives, using social media as well as online sessions. The students were also clearly informed on the impact of exams, assignments, placements, and the mitigating measures taken by the university administration. COVID-19 education materials were also continuously updated in the UMS online portal. All these actions aimed to increase students' control over what they perceived during this crisis, improving their psychological well-being (Yau, E. K. B. et. al., 2020).

Hence, UMS was dedicated to helping the students be aware of their mental health needs, cope with their stress and concerns, and empower them to seek help to stay well physically, mentally, and spiritually during this pandemic. A sense of connection was what the students needed to feel supported and encouraged.

Regardless, there are still more that could be improved on as the period of COVID 19 phases advanced. For the international students, the support services should cover counseling, mental health support, and fast referral services to the healthcare providers. It should also include access to COVID 19 vaccination and other welfare services like funding and financial assistance in the future. Therefore, it is best to get feedback from these students to understand their needs during the pandemic to improve the actions further if similar scenarios were to happen in the future.

Conclusion

In response to the COVID-19 pandemic, University Malaysia Sabah provided timely, appropriate mitigating action to ensure that the disease did not spread within the college through surveillance, contact tracing, monitoring, quarantine, isolation, and social distancing. At the same time, care and support are given to the students from China for their mental health needs. Nevertheless, the university will continuously evaluate its plan and action to ensure effectiveness while combating this biological disaster.

Conflicts of Interest

This study is approved by the Medical Research Ethics Committee, Faculty of Medicine and Health Science, University Malaysia Sabah, JKEtika 3/20(10), and there is no conflict of interest in this study.

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References

Berger, Z.D., Evans, N.G., Phelan, A.L., Silverman, R.D. (2020). Covid-19: Control Measures Must be Equitable and Inclusive. *BMJ*. 368, m1141(1-2). https://doi.org/10.1136/bmj.m1141

Bernama. (2020). First Case of Malaysian Positive for Coronavirus. https://www.bernama.com/en/general/news_covid-19.php?id=1811373.

Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J. (2020). The Psychological Impact of Quarantine and How to Reduce It: Rapid Review of the Evidence. *The lancet*, 395(10227), 912-920. https://doi.org/10.1016/s0140-6736(20)30460-8

Cheng, H.Y., Jian, S.W., Liu, D.P., Ng, T.C., Huang, W.T., Lin, H.H., Taiwan COVID-19 Outbreak Investigation Team. (2020). Contact Tracing Assessment of Covid-19 Transmission Dynamics in Taiwan and Risk at Different Exposure Periods Before and After Symptom Onset. *JAMA Intern. Med.*, 180 (9), 1156-1163. https://doi.org/10.1001/jamainternmed.2020.2020

Chinazzi, M., Davis, J.T., Ajelli, M., Gioannini, C., Litvinova, M., Merler, S., Pastore, Y., Piontti, A., Mu, K., Rossi, L., Sun, K., Viboud, C., Xiong, X., Yu, H., Halloran, M.E., Longini, I.M. Jr., Vespignani, A. (2020). The Effect of Travel Restrictions on the Spread of The 2019 Novel Coronavirus (COVID-19) Outbreak. *Science*, 368 (6489), 395-400. https://doi.org/10.1126/science.aba9757

Doré, B.P., Morris, R.R., Burr, D.A., Picard, R.W., Ochsner, K.N. (2017). Helping Others Regulate Emotion Predicts Increased Regulation of One's Own Emotions and Decreased Symptoms of Depression. *Pers. Soc. Psychol. Bull.*, 43(5), 729-739. https://doi.org/10.1177/0146167217695558

Duan, L., Zhu, G. (2020). Psychological Interventions for People Affected by the COVID-19 Epidemic. *Lancet Psychiatry*. 7(4), 300-302. https://doi.org/10.1016/s2215-0366(20)30073-0

Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H.,Dai, J. (2020). Mental Health Problems and Social Media Exposure During COVID-19 Outbreak. *Plos one*, 15(4), e0231924 (1-10). https://doi.org/10.1371/journal.pone.0231924

Hawkley, L.C., Cacioppo, J.T. (2010). Loneliness Matters: A Theoretical and Empirical Review of Consequences and Mechanisms. *Ann. Behav. Med.*, 40(2), 218-227. https://doi.org/10.1007/s12160-010-9210-8

Hellewell J., Abbott, S., Gimma, A., Bosse, N.I., Jarvis, C.I., Russell, T.W., Munday, J.D., Kucharski, A.J., Edmunds, W.J. (2020). Feasibility of Controlling COVID-19 Outbreaks by Isolation of Cases and Contacts. *The Lancet Glob. Health*, 8(4), e488-e496. https://doi.org/10.1016/s2214-109x(20)30074-7

Jetten, J., Haslam, S.A., Cruwys, T., Greenaway, K.H., Haslam, C., Steffens, N.K. (2017). Advancing the Social Identity Approach to Health and Well-being: Progressing the Social Cure Research Agenda. *Eur. J. Soc. Psycho.*, 47(7), 789-802. https://doi.org/10.1002/ejsp.2333

Nussbaumer, S.B., Mayr, V., Dobrescu, A.I., Chapman, A., Persad, E., Klerings, I., Wagner, G., Siebert, U., Christof, C., Zachariah, C., Gartlehner. G. (2020). Quarantine Alone or in Combination with Other Public Health Measures to Control COVID-19: A Rapid Review. *Cochrane Database Syst. Rev.*, 2020 (4), CD013574 (1-45). https://doi.org/10.1002/14651858.CD013574

Ping, N.P.T., Shoesmith, W.D., James, S., Hadi, N.M.N., Yau, E.K.B., Lin, L.J. (2020). Ultra Brief Psychological Interventions for COVID-19 Pandemic: Introduction of A Locally-Adapted Brief Intervention for Mental Health and Psychosocial Support Service. *Malays. J. Med. Sci.*, 27(2), 51-56. https://doi.org/10.21315/mjms2020.27.2.6

Ping, P.N.T., Masiran, R., Tan, K. A., & Kassim, A. (2020). Psychological Mindedness as A Mediator in the Relationship between Dysfunctional Coping Styles and Depressive Symptoms in

Caregivers of Children with Autism Spectrum Disorder. *Perspect. Psychiatr. Care*, 56(3), 649-656. https://doi.org/10.1111/ppc.12481

Qadri F, Chowdhury MI, Faruque SM, Salam MA, Ahmed T, Begum YA, et al. (2005) Randomized, controlled study of the safety and immunogenicity of Peru-15, a live attenuated oral vaccine candidate for cholera, in adult volunteers in Bangladesh. *J Infect Dis.* :192(4):573-9.

Qadri, F., Chowdhury, M.I., Faruque, S.M., Salam, M.A., Ahmed, T., Begum, Y.A., Saha, A., Alam, M.S., Zaman, K., Seidlein, L.V., Park, E., Killeen, K.P., Mekalanos, J.J., Clemens, J.D., Sack, D.A. Peru-15 Study Group. (2015). Randomized, Controlled Study of the Safety and Immunogenicity of Peru-15, A Live Attenuated Oral Vaccine Candidate for Cholera, in Adult Volunteers in Bangladesh. *J. Infect. Dis.* 192(4), 573-579. https://doi.org/10.1086/432074

Rzymski, P., Nowicki, M. (2020). Preventing COVID-19 Prejudice in Academia. *Science*, 367(6484), 1313. https://doi.org/10.1126/science.abb4870

Sorokowski, P., Groyecka, A., Kowal, M., Sorokowska, A., Białek, M., Lebuda, I., Dobrowolska, M., Zdybek, P., Karwowski, M. (2020). Can Information About Pandemics Increase Negative Attitudes Toward Foreign Groups? A Case of COVID-19 Outbreak. *Sustainability*, 2020(12), 4912(1-10). https://doi.org/10.3390/su12124912

The Borneopost. (2020). First Coronavirus Cases in Malaysia: 3 Chinese Nationals Confirmed Infected, Quarantined in Sungai Buloh Hospital. https://www.theborneopost.com/2020/01/25/first-coronavirus-cases-in-malaysia-3-chinese-nationals-confirmed-infected-quarantined-in-sungai-buloh-hospital/

World Health Organization (WHO). (2020). Coronavirus Disease 2019 (COVID-19) Situation Report–57. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200317-sitrep-57-covid-19.pdf?sfvrsn=a26922f2_4

World Health Organization (WHO). (2020). Critical Preparedness, Readiness and Response Actions for COVID-19: Interim Guidance. https://www.who.int/publications/i/item/critical-preparedness-readiness-and-response-actions-for-covid-19

World Health Organization (WHO). (2020). WHO Director General's Opening Rremarks at the Media Briefing on COVID-19, 11 March, 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Yau, E.K.B., Ping, N.P.T., Shoesmith, W.D., James, S., Hadi, N.M.N., Loo, J.L. (2020). The Behaviour Changes in Response to COVID-19 Pandemic within Malaysia, *Malays. J. Med. Sci.*, *27*(2), 45-50. https://doi.org/10.21315/mjms2020.27.2.5

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Post-COVID-19 among Iraqi Population: Symptoms and Duration

Hasanain Faisal Ghazi[1,*], Taqi Mohammed Jwad Taher[2], Sumayah Al-Mahmood[3], Shaimaa Ahmad Hassan[4], Rana Talib Al-Nafakh[5], Shaymaa Abdul Lateef Alfadhul[6], Tamathir Abbas Hamoudi[7], Tiba Nezar Hasan[8], Ahmed Alaa Al-Temimi[9]

Abstract

Background: Earlier studies focused on description of clinical presentations of patients in the acute phase of Coronavirus disease 2019 (COVID-19). Recently, records have emerged that some patients continue to suffer from symptoms related to COVID-19 after the acute phase of infection. Yet, there is no clear definition for this condition, and different terminology has encompassed such as "post-acute COVID-19 syndrome", "post-COVID syndrome" and "long COVID". This study aimed to identify the prevalence of Post-COVID-19 symptoms among the adult population in Baghdad city.

Methods: A cross-sectional study was conducted among 341 Iraqi adults during the period from January to February 2021. All participants are confirmed and recovered cases of COVID-19. An online self-administered questionnaire was used for data collection. The questionnaire includes information about socio-demographic characteristics, presence of co-existing conditions, details about COVID-19 infection, in addition to frequency, type, and duration of symptoms.

Results: The results showed that the mean age of the participants was 30.41 years old and females represented about 65.1% of them. They suffer more frequently from symptoms of depression (6.7%), anxiety (6.2%), and peripheral neuropathy (6.2%) after 12 weeks after the acute phase. Feeling of fatigability was the most frequent symptom mentioned by (12.3%) of the patients that persist for more than 3-4 weeks beyond recovery followed by cognitive impairment in (11.7%) and loss of taste and/or smell in about (11.4%) of them.

Conclusion: The majority of the patients suffered from persistent symptoms of COVID-19 following recovery, some of these symptoms continue for more than 3-4 weeks whereas others persist for longer than 12 weeks.

Keywords: Post-COVID, Iraq, Symptoms, Long COVID.

*Correspondence Email: hasanain.f@albayan.edu.iq

[1]*College of Nursing, Al-Bayan University, Baghdad, Iraq*
[2]*Family and Community Medicine Department, College of Medicine, Wasit University, Iraq*
[3]*Department of basic sciences, College of Dentistry, Al-Iraqia University, Iraq*
[4]*College of remote sensing & Geophysics, Alkarkh University of Science, Iraq*
[5]*Department of Pharmacology and Theraputics, Faculty of Medicine, University of Kufa, Iraq*
[6]*Department of Community and Family Medicine, Faculty of Medicine, University of Kufa, Iraq*
[7]*Department of Chemistry, College of Medicine, Ninevah University, Iraq*
[8]*Department of Dentistry, Al-Turath University College, Baghdad, Iraq*
[9]*School of Pharmacy, Monash University Malaysia, Bandar Sunway, Selangor, Malaysia*

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Introduction

Worldwide, the coronavirus disease 2019 (COVID-19) has identified as a pandemic. That first became apparent in Wuhan, Hubei, China, in early December 2019 with clinical presentations greatly resembling viral pneumonia. This disease has affected most of the countries in the period of 2 months itself. The outbreak of COVID-19 has been declared a pandemic by World Health Organization (WHO), now infecting millions all over the world (WHO, 2019). The clinical and pathological features of infection have been extensive, with a wide spectrum of disease seen, from asymptomatic infection to mild self-limiting symptoms to acute respiratory failure and the need for invasive mechanical ventilation (Zhou, F. *et al.,* 2020).

The severity increases with the presence of comorbidities like hypertension, chronic kidney disease, obstructive sleep apnoea, and metabolic diseases like diabetes and obesity (Tian, S. *et al.,* 2020). The so-called "Post-COVID Syndrome" (PCS) includes persistent symptoms for weeks or months after the infection has gone, that could be related to residual inflammation, organ damage, non-specific effects from the hospitalization or prolonged ventilation, social isolation (Garg, P. *et al.,* 2021). According to the British Thoracic Society Guidance on respiratory follow-up of patients with a clinical diagnosis of COVID-19 pneumonia, those with severe conditions have a high prevalence of post-viral lung fibrosis, pulmonary thromboembolism, and attendant functional impairment (BTS, 2020).

In COVID-19, cardiac complications can precede and can occur in the absence of pulmonary and other complications. Myocardial inflammation and myocarditis, as well as cardiac arrhythmias, have been described after SARS-CoV-2 infections (Madjid, M. *et al.,* 2020). Deep vein thrombosis (DVT), venous thromboembolism, pulmonary embolism (PE) and cor pulmonale, systemic and pulmonary arterial thrombosis and embolism, ischemic stroke, and myocardial infarction (MI) are reported.

In Neurologic, SARS-CoV-2 can penetrate brain tissue via viremia and also by direct invasion of the olfactory nerve, leading to anosmia. To date, the most common long-term neurologic symptoms after COVID-19 are headache, vertigo, and chemosensory dysfunction (anosmia and ageusia). Although stroke is a serious albeit, uncommon consequence of acute COVID-19, encephalitis, seizures, and other conditions such as major mood swings and "brain fog" has been reported up to 2 to 3 months after initial illness onset (Zubair, A.S. *et al.*, 2020).

COVID-19 skin manifestations resembling other viruses and chronic inflammatory diseases like acne, eczema, psoriasis, and rosacea. Vascular problems associated with skin manifestations can be neurogenic, microthrombotic, or immune complex-mediated (Darlenski, R. *et al.,* 2020).

Long-term follow-up studies on persistent symptoms, lung function, physical, and psychological problems of discharged patients are urgently required (Yelin, D. *et al.,* 2020). For which it is necessary to know the short, medium, and long-term scope of the possible physical and psychological consequences post-COVID, including in these questions, if the times set for social isolation are sufficient (Wang, J. *et al.,* 2020). Our study aims to find out the prevalence of Post COVID-19 symptoms among the adults' population in Baghdad city.

Methods

An internet-based study was done among 341 Iraqi adults who recovered from COVID-19 infections. The respondents were selected by using invitation links in the WhatsApp groups and Facebook using non-probability convenience sampling. The questions were distributed to

respondents by using Google Forms. The respondent when opening the invitation link needs to agree to participate in research and upload a picture of their COVID-19 test to make sure that they are a confirmed case of COVID-19 before answering the questions. The inclusion criteria include adults aged 18 to 65 years old, living in Baghdad city, and a confirmed case of COVID-19. The questionnaire was adapted from a previous study (Peghin *et al*. 2021). It consists of 4 parts, which part 1 concerns socio-demographic data (age, gender, educational level, working status, weight, and length). Part 2 included questions to clarify whether if the respondent has any chronic diseases like (diabetes, Hypertension, Heart disease, Kidney disease). Part 3 includes a set of questions regarding COVID infection, which month the infection happened, how many days did the virus lasted, did the patient used antibiotics and treatments during the period of infection, did the patient need to use oxygen supplements while contracting the disease, also Part 3 included a set of questions about the symptoms that appeared during the period of COVID-19 and up to 12 weeks after recovery from COVID-19. The last part of the questionnaires includes a set of questions about daily hygiene, protection practices, and the daily routine that respondents followed to prevent a second infection with the virus. Data were analyzed using SPSS version 24. Mean and standard deviations were used for numerical variables, while frequency and percentages were used for categorical variables. The Chi-square test and the independent t-test were used to test the significance of the association between variables. Participation in the study was on a voluntary basis and all participants agreed to participate before answering the questions. A full explanation of the purpose of the study was placed at the beginning of the questionnaires and the authors assured participants that all data will be used for scientific purposes only.

Results

The result of this study was depending on the analysis of data obtained from all 341 filled questionnaires. These data show that the mean age of the participants was 30.41 years old, and females represented about 65.1%. The majority 220 (64.5%) were with University degrees and near half (49.3%) work in governmental jobs (**Table 1**).

Table 1: Sociodemographic characteristics of the respondents

Variables	**Analytical Data**			
Age	**Min**	**Max**	**Mean**	**SD***
	18	62	30.41	11.40
Gender	**Number**		**Percentage (%)**	
Male	119		34.9	
Female	222		65.1	
Working Status	**Number**		**Percentage (%)**	
Unemployed	150		44.0	
Government Worker	168		49.3	
Private Sector	23		6.7	
Educational level	**Number**		**Percentage (%)**	
Primary school	13		3.8	
Secondary school	108		31.7	
University degree and above	220		64.5	

*Standard Deviation

Table 2 revealed that 302 (88.6%) of the patients were never smoked during their lives. The most frequent comorbidity that exists among those patients was hypertension (10%) followed by renal problems which represented only (6.5%) of the whole sample.

Table 2: Presence of co-existing conditions among the participants

Questions	Number	Percentage
Do you smoke?		
Never smoke	302	88.6
Ex-smoker	25	7.3
Current smoker	14	4.1
Do you have Hypertension?		
No	307	90.0
Yes	34	10.0
Do you have Diabetic Mellitus?		
No	328	96.2
Yes	13	3.8
Do you have Renal diseases?		
No	319	93.5
Yes	22	6.5
Do you have heart problems?		
No	327	95.9
Yes	14	4.1

Table 3 shows the frequency distribution of issues regarding COVID-19 acute infection. The mean duration of acute illness among patients in this study was (13.83) days and one-quarter of patients (25%) were diagnosed with COVID-19 during September. Even though 238 of the patients (69.8%) mentioned taking medications for the treatment of COVID-19 infections, which is similar to the percentage of patients who took antibiotic drugs and only 79(23.2%) mentioned anticoagulants drugs. For severe cases that required hospital admission or oxygen supply, the percentages were 2.9% and 5.6% respectively. Forty-five (13.2%) of the participants have had at least one of their relatives die from COVID-19.

The majority of the patients suffered from continuous symptoms of COVID-19 even they recovered and got their negative PCR, some of these symptoms continue for more than 3-4 weeks and others may persist for longer than 12 weeks. The most frequent symptoms which they suffer from after 12 weeks were symptoms of depression (6.7%), anxiety (6.2%), and peripheral neuropathy (6.2%). No one has delirium for more than 12 weeks as it is shown in **Table 4**. Feeling of fatigability was the most frequent symptom mentioned by (12.3%) of the patients that persist for more than 3-4 weeks beyond recovery followed by cognitive impairment in (11.7%) and loss of taste and/or smell in about (11.4%) of them. A lot of symptoms had never been reported by patients even during the acute COVID-19 infection like delirium which never presented among 289 (84.7) followed by ear symptoms like earache (82.7%) and tinnitus (81%).

Table 3: Frequency distribution of the issues related to COVID-19 infection

Questions	Analytical Data			
How many days your acute symptoms last?	**Min**	**Max**	**Mean**	**SD**
	1	30	13.83	6.54
In which month you got infected with COVID19	**Number**		**Percentage (%)**	
March	4		1.2	
April	3		0.9	
May	4		1.2	
June	25		7.3	
July	53		15.5	
August	54		15.8	
September	85		25.0	
October	59		17.3	
November	29		8.5	
December	25		7.3	
Did you require to be admitted to the hospital?	**Number**		**Percentage (%)**	
No	332		97.4	
Yes	9		2.6	
Did you use any medications for COVID-19?	**Number**		**Percentage (%)**	
No	103		30.2	
Yes	238		69.8	
Did you take Anticoagulant?	**Number**		**Percentage (%)**	
No	262		76.8	
Yes	79		23.2	
Do you take Antibiotics?	**Number**		**Percentage (%)**	
No	103		30.2	
Yes	238		69.8	
Did you require oxygen?	**Number**		**Percentage (%)**	
No	322		94.4	
Yes	19		5.6	
Do you still wear a mask after recovery?	**Number**		**Percentage (%)**	
No	114		33.4	
Yes	227		66.6	
Do you still wash hands regularly after recovery?	**Number**		**Percentage (%)**	
No	78		22.9	
Yes	263		77.1	
Any family members died of COVID19?	**Number**		**Percentage (%)**	
No	296		86.8	
Yes	45		13.2	

Table 4: Frequency distribution of symptoms presented by the participant patients

Symptoms	During the acute infection	After 3-4 weeks of recovery	After 12 weeks of recovery	Never
Shortness of breath	131 (38.4)	15 (4.4)	17 (5.0)	178 (52.2)
Cough	184 (54.0)	13 (3.8)	11 (3.2)	133 (39.0)
Chest tightness	166 (48.7)	13 (3.8)	14 (4.1)	148 (43.4)
Chest pain	127 (37.2)	17 (5.0)	13 (3.8)	184 (54.0)
Palpitations	118 (34.6)	16 (4.7)	17 (5.0)	190 (55.7)
Fatigue (extreme tiredness)	263 (77.1)	42 (12.3)	8 (2.4)	28 (8.2)
Fever (temprture≥38°C)	256 (75.1)	2 (0.6)	-----	83 (24.3)
Generalized pain	283 (83.0)	15 (4.4)	7 (2.1)	36 (10.6)
Cognitive impairment	113 (33.1)	40 (11.7)	13 (3.8)	175 (51.3)
Headache	278 (81.5)	4 (1.7)	7 (2.1)	52 (15.2)
Sleep disturbance	177 (51.9)	15 (4.4)	19 (5.6)	130 (38.1)
Peripheral neuropathy*	57 (16.7)	6 (1.7)	21(6.2)	257 (75.4)
Dizziness	207 (60.7)	18 (5.3)	18 (5.3)	98 (28.4)
Delirium	51 (14.7)	1 (0.3)	--------	289 (84.7)
Abdominal pain	117 (34.3)	6 (1.7)	7 (2.1)	211 (61.9)
Nausea/ vomiting	110 (32.2)	8 (2.3)	3 (0.9)	220 (64.5)
Diarrhoea	150 (44.0)	7 (2.1)	1 (0.3)	183 (53.7)
Anorexia & reduced appetite	244 (71.5)	12 (3.5)	2 (0.6)	83 (24.3)
Joint pain	158 (46.3)	26 (7.6)	11 (3.2)	146 (42.8)
Muscle pain	176 (51.6)	20 (5.9)	4 (1.2)	141 (41.3)
Symptoms of depression	145 (42.5)	21 (6.2)	23 (6.7)	152 44.6)
Symptoms of anxiety	169 (49.6)	20 (5.9)	21 (6.2)	131 (38.4)
Tinnitus	45 (13.2)	10 (2.9)	10 (2.9)	276 (81.0)
Earache	48 (14.1)	4 (1.2)	7 (2.1)	282 (82.7)
Sore throat	186 (54.5)	8 (2.3)	7 (2.1)	140 (41.1)
Loss of taste and/or smell	214 (62.8)	39 (11.4)	7 (2.1)	81 (23.7)
Skin rashes	22 (6.4)	6 (1.8)	1 (0.3)	312 (91.5)

*symptoms identified with respect to the actions of pins and needles and numbness

Discussion

COVID-19 is a highly infectious disease that developed respiratory, physical, and psychological dysfunction in patients. Post covid-19 seems to be a multifactorial disease that affects different organs such as CNS, GIT, heart, blood, skin, and spleen (Tabary, M. *et al*., 2020) and attributes a wide range of conditions and symptoms that varied from mild symptoms such as a headache, fever, myalgia and anosmia to more critical conditions such as renal failure, stroke, chest pain, pulmonary fibrosis, and dyspnea. Clinical management is required as these symptoms may be recovered or persist with time (Chirwa, G.C., 2020; Davido, B., et al., 2020; Kamal, M. et al., 2021). Similarly, Greenhalgh *et al.,* 2020 reported that about 10% of have post-covid-19 symptoms persisted for months.

Although the minority of the participants in this study was 3.8% diabetes mellitus, 10% hypertension, 4.1% heart problems, and 6.5% renal diseases, there are many speculations about the susceptibility to covid-19 with these comorbidities. Covid-19 makes use of angiotensin-converting enzyme 2 (ACE2) as a receptor for entry into the host pneumocytes and this interaction may lead to an imbalance of the Renin-Angiotensin System (RAS). Once the virus uses this enzyme to gain entry into the host tissue, ACE2 gets downregulated and it is unable to protect against lung injury and increase disease proliferation. The ACE2 inhibitors (ACE2i) and angiotensin-receptor blockers (ARB) are commonly used in patients with hypertension and DM to increase expression of ACE2 as an adaptive response to decrease the angiotensin-II elevated levels. Diabetes mellitus patients are the vulnerability to covid-19 due to decreased viral clearance, higher affinity cellular binding and efficient virus entry, increased susceptibility to cytokine storm syndrome and hyper inflammation, decreased T cell function, and occurrence of cardiovascular system disease. Various mechanisms have been proposed to explain the increased risk of patients underlying hypertension and cardiovascular diseases for severe COVID-19 such as direct myocardial injury, ineffective adaptation to the elevated demand of severe viral illness, diminished systemic oxygenation during pneumonia, immune dysregulation, and electrolyte imbalances. Generally, patients with chronic diseases are more prone to covid-19 mortality risk and may many critical conditions such as worsening of insulin resistance, acute lung injury, cardiac function deterioration, sepsis, uncontrolled hypertension, and renal function impairment (Pal, R., *et al.,* 2020; Tadic, M. *et al.,* 2020; Tadic, M. & Mancia, G. *et al.,* 2020; Hassanein, M. *et al.,* 2020; Babapoor F.S. *et al.,* 2020; Bitencourt, L., *et al.,* 2021).

This study showed only 11.4% were smokers or ex-smokers and this is following the study of Tsigaris *et al*.,2020 indicated a negative association between smoking prevalence and COVID-19 occurrence at the population level in 38 European countries. However, cigarette smoke is related to a wide range of respiratory diseases and lung cancer and some studies revealed that smoking is a risk factor of development COVID-19 infection, as nicotine interacts with the renin-angiotensin system in many organ systems as well the cigarette smoke increases the angiotensin-converting 2 enzyme gene expression by the bronchial epithelium. More experimental researches are needed to underlying the potential links between smoking and COVID-19 (Patanavanich, R. *et al.,* 2020; Shastri, M.D. et al., 2021; Polverino, F., 2020).

This study reported that 69.8% of the ill patients took medications such as anticoagulants, antibiotics to reduce or prevent the severity and co-infection of the disease. Other medications can also be beneficial to use in the management of covid-19 like antiviral agents such as Remdesivir and steroid drugs such as Dexamethasone to modulate the immune response of the host and limit the replication of the virus (Chan, K.W. et al., 2020). However, 5.6% of severe patients required oxygen therapy, and 2.6% required admission to hospital as

the disease frequently progresses to induce complications like septic shock, respiratory failure and to decrease the chance of mortality (Shi, Y., *et al.,* 2020).

Some symptoms such as fatigue, skin rashes, muscle pain, and loss of taste and/ or smell in this study decreased within 12 weeks following the acute phase of the disease. On the other hand, other symptoms such as depression, anxiety, and peripheral neuropathy may persist for more than 12 weeks this may belong to relapse, reinfection, weak or absent antibody response, inflammatory and other immune reactions, direct effects of viral infection, corticosteroid therapy, intensive care unit (ICU) stay social isolation, and stigma deconditioning and mental factors such as post-traumatic stress. Furthermore, Long term musculoskeletal, respiratory, and neuropsychiatric sequelae have pathophysiological parallels with post-acute covid-19 and have been observed for other coronaviruses [Severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome (MERS)]. Also, rare long-term sequelae can result after other viral infections such as measles, infectious mononucleosis, and hepatitis B. Long-term sequelae of COVID-19 are unknown as are many aspects of the acute disease (Candan, S.A. et al., 2020; Garg, P. et al., 2021).

Our study reported that fatigue and cognitive impairment are the main symptoms that persist more than 4 weeks following the covid-19 acute phase. These results are in line with the study of Carfi *et al*., 2020, Goërtz *et al*., 2020 and Huang *et al*., 2021 that these symptoms may persist from 2 to 6 months.

Wearing a mask, washing the hands, management, and follow-up of covid-19 ill patients is required even for the discharged patients taking into account the age, sex, previous history (DM and hypertension), lifestyle, occupation, hobbies, and physical conditions of the patient. Blood tests are necessary to perform for any degree of dysfunction suspected such as WBC count, C reactive protein, natriuretic peptides ferritin, and D-dimer. Also, the rapid development of remote devices that can monitor real-time physical conditions of the patient may encourage better adherence to management training programs (Candan, S.A. *et al.,* 2020; Sun, T. *et al.,* 2020).

Conclusion

The majority of the patients suffered from persistent symptoms of COVID-19 following recovery, some of these symptoms continue for more than 3-4 weeks whereas others persist for longer than 12 weeks such as depression, anxiety, and peripheral neuropathy.

Conflicts of Interest

The authors declare no conflicts of interest.

References

Babapoor F.S., Gill, D., Walker, J., Rasekhi, R.T., Bozorgnia, B., Amanullah, A. (2020). Myocardial injury and COVID-19: Possible mechanisms. *Life Sci*., 253, 117723(1-5). https://doi.org/10.1016/j.lfs.2020.117723

Bitencourt, L., Pedrosa, A.L., de Brito, S.B.C.S., Fróes, A.C.F., de Carvalho, S.T., Fonseca, G.G., Ferreira, G.C., Fradico, P.F., Simões, E., Silva, A.C. (2021). COVID-19 and Renal Diseases: An Update. *Curr Drug Targets,* 22(1), 52-67. https://doi.org/10.2174/1389450121999201013151300

BTS (British Thoracic Society). (2020). BTS guidance on respiratory follow up of patients with radiologically confirmed COVID-19 pneumonia. https://www.brit-thoracic.org.uk/covid-19/covid-19-information-for-the-respiratory-community/#bts-guidance-on-venous-thromboembolic-disease-in-patients-with-covid-19

Candan, S.A., Elibol, N., Abdullahi, A. (2020). Consideration of Prevention and Management of Long-term Consequences of Post-acute Respiratory Distress Syndrome in Patients with COVID-19. *Physiother. Theory Pract.,* 36(6), 663–668. https://doi.org/10.1080/09593985.2020.1766181

Carfì, A., Bernabei, R., Landi, F. (2020). Gemelli against COVID-19 Post-Acute Care Study Group. Persistent Symptoms in Patients after Acute COVID-19. *JAMA*, 324(6), 603-605. https://doi.org/10.1001/jama.2020.12603

Chan, K.W., Wong, V.T., Tang, S.C.W. (2020). COVID-19: An Update on the Epidemiological, Clinical, Preventive and Therapeutic Evidence and Guidelines of Integrative Chinese-Western Medicine for the Management of 2019 Novel Coronavirus Disease. *Am J Chin Med.* 48(3), 737-762. https://doi.org/10.1142/s0192415x20500378

Chirwa, G.C., (2020). Who Knows More, and Why?" Explaining Socio-Economic Related Inequality in Knowledge about HIV in Malawi. *Sci. African*., 7, e00213(1-10). https://doi.org/10.1016/j.sciaf.2019.e00213

Darlenski, R., Tsankov, N. (2020). COVID-19 Pandemic and the Skin: What Should Dermatologists Know? *Clin Dermatol.,* 38(6), 785-787. https://doi.org/10.1016/j.clindermatol.2020.03.012

Davido, B., Seang, S., Tubiana, R., de Truchis, P. (2020). Post-COVID-19 Chronic Symptoms: A Post-Infectious Entity? *Clin. Microbiol. Infect.,* 26(11), 1448-1449. https://doi.org/10.1016/j.cmi.2020.07.028

Garg, P., Arora, U., Kumar, A., Wig N. (2021). The "Post-COVID" Syndrome: How Deep is the Damage? *J. Med. Virol.*, 93(2), 673-674. https://doi.org/10.1002/jmv.26465

Garg, P., Arora, U., Kumar, A., Wig, N. (2021). The "Post-COVID" Syndrome: How Deep is the Damage? *J. Med. Virol.* 93(2), 673-674. https://doi.org/10.1002/jmv.26465

Goërtz, Y.M.J., Van, H.M, Delbressine, J.M., Vaes, A.W., Meys, R., Machado, F.V.C., Houben,W.S., Burtin, C., Posthuma, R., Franssen, F.M.E., Van, L.N., Hajian, B., Spies, Y., Vijlbrief, H., Van't H.A.J., Janssen, D.J.A., Spruit, M.A. (2020). Persistent Symptoms 3 Months after a SARS-CoV-2 Infection: The Post-COVID-19 Syndrome? *ERJ Open Res*., 6(4), 00542-2020(1-10). https://doi.org/10.1183/23120541.00542-2020

Greenhalgh, T., Knight, M., A'Court, C., Buxton, M., Husain, L. (2020). Management of Post-Acute COVID-19 in Primary Care. *BMJ*, 370, m3026(1-8). https://doi.org/10.1136/bmj.m3026

Hassanein, M., Radhakrishnan, Y., Sedor, J., Vachharajani, T., Vachharajani, V.T., Augustine, J., Demirjian, S., Thomas, G. (2020). COVID-19 and the Kidney. *Cleve Clin. J. Med.*, 87(10), 619-631. https://doi.org/10.3949/ccjm.87a.20072

Huang, C., Huang, L., Wang, Y., Li, X., Ren, L., Gu, X., Kang, L., Guo, L., Liu, M., Zhou, X., Luo, J., Huang, Z., Tu, S., Zhao, Y., Chen, L., Xu, D., Li, Y., Li, C., Peng, L., Li, Y., Xie, W., Cui, D., Shang, L., Fan, G., Xu, J., Wang, G., Wang, Y., Zhong, J., Wang, C., Wang, J., Zhang, D., Cao, B. (2021). 6-Month Consequences of COVID-19 in Patients Discharged from Hospital: A Cohort Study. *Lancet*, 397(10270), 220-232. https://doi.org/10.1016/s0140-6736(20)32656-8

Kamal, M., Abo, O.M., Hussein, A., Saeed, H. (2021). Assessment and Characterization of Post-COVID-19 Manifestations. *Int. J. Clin. Pract.*, 75(3), e13746(1-5). https://doi.org/10.1111/ijcp.13746

Madjid, M., Safavi, N.P., Solomon, S.D., Vardeny, O. (2020). Potential Effects of Coronaviruses on the Cardiovascular System: A Review. *JAMA Cardiol*., 5(7), 831-840. https://doi.org/10.1001/jamacardio.2020.1286

Pal, R., Bhadada, S.K. (2020). COVID-19 and Diabetes Mellitus: An Unholy Interaction of Two Pandemics. *Diabetes Metab. Syndr.* 14(4), 513–517. https://doi.org/10.1016/j.dsx.2020.04.049

Patanavanich, R., Glantz, S.A. (2020). Smoking is associated with COVID-19 Progression: A Meta-analysis. *Nicotine Tob. Res.* 22(9), 1653–1656. https://doi.org/10.1093/ntr/ntaa082

Peghin, M., Palese, A., Venturini, M., De Martino, M., Gerussi, V., Graziano, E., Bontempo, G., Marrella, F., Tommasini, A., Fabris, M., Curcio, F., Isola, M., Tascini, C. (2021). Post-COVID-19 Symptoms 6 Months after Acute Infection among Hospitalized and Non-Hospitalized Patients. *Clin. Microbiol. Infect.* 27(10), 1507-1513. https://doi.org/10.1016/j.cmi.2021.05.033

Polverino, F. (2020). Cigarette Smoking and COVID-19: A Complex Interaction. *Am. J. Respir. Crit. Care Med.*, 202, 471-472. https://doi.org/10.1164/rccm.202005-1646le

Shastri, M.D., Shukla, S.D., Chong, W.C., Kc, R., Dua, K., Patel, R.P., Peterson, G.M., O'Toole, R.F. (2021). Smoking and COVID-19: What We Know So Far. *Respir. Med.* 176, 106237 (1-7). https://doi.org/10.1016/j.rmed.2020.106237

Shi, Y., Wang, G., Cai, X.P., Deng, J.W., Zheng, L., Zhu, H.H., Zheng, M., Yang, B., Chen. Z. (2020). An Overview of COVID-19. *J Zhejiang Univ Sci B.* 21(5), 343-360. https://doi.org/10.1631/jzus.b2000083

Sun, T., Guo, L., Tian, F., Dai, T., Xing, X., Zhao, J., Li, Q. (2020). Rehabilitation of Patients with COVID-19. *Expert Rev Respir Med.,* 14(12), 1249-1256. https://doi.org/10.1080/17476348.2020.1811687

Tabary, M., Khanmohammadi, S., Araghi, F., Dadkhahfar, S., Tavangar, S.M. (2020). Pathologic Features of COVID-19: A Concise Review. *Pathol Res Pract.,* 216 (9), 153097(1-5). https://doi.org/10.1016/j.prp.2020.153097

Tadic, M., Cuspidi, C., Mancia, G., Dell'Oro, R., Grassi, G. (2020). COVID-19, Hypertension and Cardiovascular Diseases: Should We Change the Therapy? *Pharmacol Res*., 158, 104906(1-6). https://doi.org/10.1016/j.phrs.2020.104906

Tadic, M., Cuspidi, C., Sala, C. (2020). COVID-19 and Diabetes: Is There Enough Evidence? *J. Clin. Hypertens (Greenwich)*, 22(6), 943-948. https://doi.org/10.1111/jch.13912

Tian, S., Xiong, Y., Liu, H., Niu, L., Guo, J., Liao, M., Xiao, S.Y. (2020). Pathological Study of the 2019 Novel Coronavirus Disease (COVID-19) through Postmortem Core Biopsies. *Mod. Pathol*. 33(6), 1007-1014. https://doi.org/10.1038/s41379-020-0536-x

Tsigaris, P., Teixeira da Silva J.A. (2020). Smoking Prevalence and COVID-19 in Europe. *Nicotine Tob. Res*., 22(9), 1646–1649. https://doi.org/10.1093/ntr/ntaa121

Wang, J., Hang, X., Wei, B., Li, D., Chen, F., Liu, W., Yang, C., Miao, X., Han, L. (2020). Persistent SARS-COV-2 RNA Positivity in a Patient for 92 Days After Disease Onset: A Case Report. *Medicine (Baltimore),* 99(34), e21865 (1-4). https://doi.org/10.1097/md.0000000000021865

WHO (World Health Organization). (2019). Coronavirus disease (COVID-19) pandemic. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Yelin, D., Wirtheim, E., Vetter, P., Kalil, A.C., Bruchfeld, J., Runold, M., Guaraldi, G., Mussini, C., Gudiol, C., Pujol, M., Bandera, A., Scudeller, L., Paul, M., Kaiser, L., Leibovici, L. (2020). Long-term Consequences of COVID-19: Research Needs. *Lancet Infect Dis.* 20(10), 1115-1117. https://doi.org/10.1016/s1473-3099(20)30701-5

Zhou, F., Yu, T., Du, R., Fan, G., Liu, Y., Liu, Z., Xiang, J., Wang, Y., Song, B., Gu, X., Guan, L., Wei, Y., Li, H., Wu, X., Xu, J., Tu, S., Zhang, Y., Chen, H., Cao, B. (2020). Clinical Course and Risk Factors for Mortality of Adult Inpatients with COVID-19 in Wuhan, China: A Retrospective Cohort Study. *Lancet*, 395(10229), 1054-1062. https://doi.org/10.1016/S0140-6736(20)30566-3

Zubair, A.S., McAlpine, L.S., Gardin, T., Farhadian, S., Kuruvilla, D.E., Spudich, S. (2020). Neuropathogenesis and Neurologic Manifestations of the Coronaviruses in the Age of Coronavirus Disease 2019: A Review. *JAMA Neurol.* 77(8), 1018-1027. https://doi.org/10.1001/jamaneurol.2020.2065

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Factors associated with Hospitalization among COVID-19 Home Quarantine Patients in Melaka Tengah District, Melaka, Malaysia

Syafiq, S.S.[1,2,*], J. Mohd Ridzuan[1], Noor Aizam M.S.[1], Kathy Lim Yeen Luan[1,2], Ammar Hamzah[1,2], Muhammad Khairulahnaf Yusof [1,2], Nur Hazifah Z.[1,2] Nur Farhana Hamzah[3]

Abstract

Background: COVID-19 is an emerging new disease, recognized in late 2019, has since caused public health pandemic worldwide. Since the establishment of the COVID-19 Assessment Centre (CAC), cases were staged in terms of the severity. The mild cases were allowed for home quarantine and the severe cases were hospitalized. This study will assist healthcare providers to identify the high-risk patients and anticipate proactively, reducing morbidity and mortality. The study aimed to determine the incidence rate of hospitalization among home quarantined patients and its associated factors.

Methods: A case-control study design was conducted from 16th August until 30th September 2021 involving newly diagnosed COVID-19 patients under the CAC Melaka Tengah monitoring. A case was defined as home quarantined patient whom later required hospitalization, while a control was defined as home quarantined patient throughout the period. Analysis using Chi-square and Multiple Logistic Regression were done to determine the significant associated factors.

Results: There were 13,748 COVID-19 patients; with 8,237 were home quarantined and 82 required hospitalization later (1.0%). A total of 164 patients were included (82 cases and 82 controls). Among the hospitalized, 30.5% were aged 60 and above, 39.0% with comorbidity, 70.7% were symptomatic, and 40.2% were fully vaccinated. From the analysis, the only significant factor associated with hospitalization was age > 60 years old ($p<0.05$).

Conclusion: There were home quarantined patients that required hospitalization later, especially the elderly patients. Thus, the CAC team should give priority for hospital admission to these cases instead of home quarantine order.

Keywords: COVID-19, Hospitalization, Associated factors, Case-control.

*Correspondence Email: syafiqsidqisaidi1985@gmail.com

[1]*Melaka Tengah District Health Office, Jalan Bukit Baru, 75150 Melaka, Malaysia*
[2]*Melaka Tengah COVID-19 Assessment Centre (CAC) Bukit Serindit, Jalan Taman Bandaran, Padang Semabok, 75400 Melaka, Malaysia*
[3]*Poliklinik Fasya, Bukit Beruang, Melaka, Malaysia*

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Introduction

COVID-19 is an emerging new disease, recognized first in Wuhan, China, during the late 2019, and has since caused public health pandemic worldwide. The disease caused by the novel severe acute respiratory syndrome coronavirus-2 (SARS- CoV-2), and as 20th November 2021, there were 255 million cases with over five million deaths worldwide (World Health Organization [WHO], 2021). The virus can spread from an infected person through respiratory droplets and aerosols.

Globally, majority of the cases were mild to moderate cases, as many as 80% of total cases had mild to moderate diseases, 15% having severe diseases, and 5% became critically ill. The case fatality ratio by countries ranges between 1% and 12%. In Malaysia, in year 2020, more than 90% of cases had mild diseases and low fatality rates, and these were contributed by the early compulsory hospitalization policy adopted by Malaysia Ministry of Health, regardless of disease stage upon diagnosis (Lim, B. et al., 2020). Early compulsory hospitalisation of cases allows close monitoring for deterioration and may prevent deaths. With regards to disease severity, similar findings were reported by a study in Melaka (Ahmad, B.Z. et al., 2021).

However, the increasing trend of new cases daily has stretched the ability to admit them to hospitals, and hence, the need of the COVID-19 Assessment Centre (CAC) establishment (Malaysia Ministry of Health [MOH], 2021). The objectives of the CAC are to identify and assess who are suitable for home quarantine, and monitor them with standardized tools. The CACs also will identify cases with disease progression and arrange for either quarantine centers- or hospital- referrals if required. Since then, cases were staged in terms of the severity. The mild cases were allowed for home quarantine, if they met these criteria; less than 60 years old, disease category 1-2, without or with stable comorbidities, suitable obstetric patients, together with suitable caregiver available and suitable home condition (MOH, 2021). The high-risk cases were hospitalized for further management. The CACs are regionally based, or according to each districts in each state. In Melaka state, currently, there are three CACs, one in each district; Melaka Tengah, Alor Gajah and Jasin districts.

COVID-19 is associated with significant morbidity and mortality. A study in Melaka showed that the number of COVID-19 deaths at homes or categorized as "brought-in-death" (BID) COVID-19 had increased up to 14.4%, and majority of them failed to seek early treatment (Intan A.M.D. et al., 2021). However, only a subset of patients becomes critically ill. Even though the home quarantined COVID-19 patients are those with mild severity, they can sometimes require hospitalization as the disease progresses later on. Thus, the study on factors associated with hospitalization among home quarantined patients will assist healthcare providers to identify and anticipate proactively, in order reducing morbidity and mortality. From the data collected for this study, the incidence rate of hospitalization among home quarantined COVID-19 patients could be determined, as well as the study aimed to determine the significant factors associated with hospitalization.

Methods

A case-control study design was conducted from 16th August until 30th September 2021 involving newly diagnosed COVID-19 patients under the CAC Melaka Tengah monitoring. Since the establishment of the CAC Melaka Tengah on the 16th August, all the patients' information; the socio-demographics, clinical data, disease category, vaccination status, triage disposition and latest status, were collected and kept in a computerized system. For this current study, the inclusion criteria were all COVID-19 patients under the CAC Melaka Tengah

supervision with the Home Quarantine order from 16th August – 30th September 2021. Cases with hospitalization upon diagnosis were excluded. Cases with incomplete details were also excluded. A case was defined as home quarantined patient whom later required hospitalization, while a control was defined as home quarantined patient throughout the period. Sample size was 80 for each study group, calculated using the formula for independent case control study using qualitative variable, at 80% power and $\alpha = 0.05$ (Charan, J. & Biswas, T., 2013). During the study period, all Cases were selected and included, and the Controls were selected in a ratio of 1:1 by using Simple Random Sampling technique. Informed consent was obtained prior to the enrollment of patients into the study.

All data gathered were entered into an excel database, and analyzed using IBM Statistical Package for Social Sciences (SPSS) Statistics for Windows version 24. The dependent variable was hospitalization among the home quarantined patients, while the independent variables were the patients' socio-demographics, clinical data, disease category, and vaccination status. For bivariate analysis, analysis-using Chi-square or Fischer exact test, as appropriate, was done to determine the significant associated factors. As for the multivariate analysis, the Multiple Logistic Regression was done to determine the final significant associated factors.

Results

During the study period, there were 13,748 newly diagnosed COVID-19 patients; with 8,237 (59.9%) were mild cases and allowed for home quarantined. A total of 164 patients were included in the study, as 82 patients represented the cases, and 82 patients represented the controls. The median (IQR) age for all studied patients was 33.0 (23.5) years old. Based on the Table 1, majority of the respondents came from the 30-39 years old age group (29.9%). Female patients were slightly dominant (53.7%). Majority of the patients were Malaysians (86.6%) and Malays (71.3%). Majority of the patients were unemployed (71.3%). At the time of the study, only 34.8% of them were fully vaccinated with two doses. Most of the patients had no comorbidities (75.6%) and were adult cases (82.9%). Only 2.4 % were pregnant ladies. In terms of the smoking habit, 94.5% were non-smokers. With regards to the clinical manifestations, 62.2% patients presented with symptoms.

From the data collected with regards to the total of the home quarantined patients, 82 (1.0%) patients were later had been admitted to the hospitals, due to worsening disease condition. Among these hospitalized patients, 30.5% were aged 60 years old and above, 39.0% of them with at least one comorbidity. Majority of the patients (70.7%) were symptomatic, and 40.2% were fully vaccinated with two doses.

From the bivariate analysis (**Table 1**), age, race, occupation, comorbidities, and symptoms were significant associated factors with hospitalization, and hence, these variables were included in the multivariate analysis model. From the analysis, by using Simple Logistic Regression, all mentioned factors were significant, however, by using Multiple Logistic Regression, the only significant factor associated with hospitalization among the home quarantined COVID-19 patients was increasing age (p=0.005) (**Table 2**).

Table 1: Distribution of the variables among the patients

Characteristics	Case N=82 n (%)	Control N=82 n (%)	Total N=164 n (%)	Bivariate	
				X^2 value	p-value
Age (years)					
1-17	12 (38.7)	19 (61.3)	31 (18.9)		
18-29	11 (34.4)	21 (65.6)	32 (19.5)		
30-39	17 (34.7)	32 (65.3)	49 (29.9)	31.60	**< 0.001***
40-49	8 (61.5)	5 (38.5)	13 (7.9)		
50-59	9 (90.0)	1 (10.0)	10 (6.1)		
≥60	25 (86.2)	4 (13.8)	29 (17.7)		
Sex					
Male	38 (50.0)	38 (50.0)	76 (46.3)	0.001	1.000
Female	44 (50.0)	44 (50.0)	88 (53.7)		
Race					
Malay	66 (55.9)	52 (44.1)	118 (72.0)	5.92	**0.015***
Non-Malay	16 (34.8)	30 (65.2)	46 (28.0)		
Occupation					
Unemployed	66 (56.4)	51 (43.6)	117 (71.3)	6.71	**0.01***
Employed	16 (34.0)	31 (66.0)	47 (28.7)		
Vaccination Status					
Not / Partially/	49 945.8)	58 (54.2)	107 (65.2)	2.18	0.14
Fully	33 (57.9)	24 (42.1)	57 (34.8)		
Co-morbidity					
No	50 (40.3)	74 (59.7)	124 (75.6)	19.05	**< 0.001***
Yes	32 (80.0)	8 (20.0)	40 (24.4)		
Smoking Status					
Non-smoker	80 (51.6)	75 (48.4)	155 (94.5)	2.94	0.17
Current smoker	2 (22.2)	7 (77.8)	9 (5.5)		
Patient Category					
Adult	71 (52.2)	65 (47.8)	136 (82.9)	1.55	0.21
Pediatric	11 (39.3)	17 (60.7)	28 (17.1)		
Clinical					
Asymptomatic	24 (38.7)	38 (61.3)	62 (37.8)	5.08	**0.02***
Symptomatic	58 (56.9)	44 (43.1)	102 (62.2)		

Notes: X^2 value – Chi square value, *p-value of < 0.05 was significant

Table 2: Multivariable analysis for significant associated factors with hospitalization among home quarantined patients (N=164)

Parameter	Simple Logistic Regression				Multiple Logistic Regression		
	Coefficient	Crude OR (95% CI)	p-value		Coefficient	Adjusted OR (95% CI)	p-value
Age (years)							
1-17		1				1	
18-29	-0.19	0.83 (0.30, 2.32)	0.721		-0.081	0.92 (0.26, 3.33)	0.902
30-39	-0.17	0.84 (0.33, 2.14)	0.716		0.071	1.074 (0.36, 3.17)	0.898
40-49	0.93	2.53 (0.67, 9.59)	0.171		1.09	2.98 (0.68, 13.13)	0.150
50-59	2.66	14.25 (1.60, 127.17)	**0.017***		2.23	9.28 (0.97, 88.34)	0.053
≥60	2.29	9.90 (2.75, 35.56)	**< 0.001***		2.11	8.28 (1.88, 36.44)	**0.005***
Race							
Malay		1				1	
Non-Malay	-0.87	0.42 (0.21, 0.85)	**0.016***		0.58	1.79 (0.57, 5.64)	0.319
Occupation							
Unemployed		1				1	
Employed	-0.92	0.40 (0.20, 0.81)	**0.011***		-.0.064	0.94 (0.34, 2.61)	0.902
Co-morbidity							
	1.78	1 5.92 (2.52, 13.90)	**< 0.001***		0.67	1 1.94 (0.70, 5.44)	0.205
Clinical							
Asymptomatic		1				1	
Symptomatic	0.74	2.09 (1.10, 3.97)	**0.025***		0.84	2.31 (0.98, 5.43)	0.05

Notes: OR – odds ratio, *p-value of < 0.05 was significant

Discussion

This study finding showed that majority of the COVID-19 cases were mild cases, and this was similar finding worldwide and in Malaysia (Lim, B. et al., 2020). The median age of the studied patients was comparable with other studies across the states in this country (Ahmad, N., et al., 2021, Hasani, W.S. et al., 2021, & Lim, B. et al., 2020). On the contrary, studies in New York, China, Korea and Singapore demonstrated a much older group of patients, between the age of 40 and 63 years old (Lim, B. et al., 2020). In terms of the comorbidities and clinical presentations, the finding was similar with other local studies (Ahmad, N., et al., 2021, Hasani, W.S. et al., 2021, & Lim, B. et al., 2020).

Initially, Malaysia opted for a compulsory hospitalization policy for all COVID-19 cases, upon diagnosis, regardless the disease category and clinical presentations. However, since the

increasing number of cases from mid-to-end August 2021, the capabilities had stretched and only high-risk cases were given priority to be hospitalized. The incidence rate of hospitalization may vary globally, depending on each country own policy. Statistic had been shown that, in Malaysia, the number of cases being admitted to the hospitals had been reduced since the increasing number of fully vaccinated adult population in many states (COVIDNOW, 2021). However, the information on the incidence rate of hospitalization among the home quarantined patients is still lacking. Thus, the study finding gives early information on this, and it showed evidence that, there were still possibilities that the mild, home quarantined patients required hospitalization later during the quarantine period.

From the literature reviews, older age, male, comorbidities such as diabetes, hypertension, obesity, coronary artery disease and chronic kidney disease were significant factors being associated with hospitalization among COVID-19 patients (Gottlieb, M. et al., 2020, Ko, J.Y. et al., 2020, Mendy, A. et al., 2020, Petrilli, C.M. et al., 2020, & Telle, K.E. et al., 2021). Age above 60 years old was significantly associated with hospitalization, with an odds ratio (OR) of 8.28 (95% CI = 1.88 to 36.44). This study finding was consistent with prior literatures (Gottlieb, M. et al., 2020, Ko, J.Y. et al., 2020, Mendy, A. et al., 2020, Petrilli, C.M. et al., 2020, & Telle, K.E. et al., 2021). Another study in Selangor, Malaysia, found that the proportion of COVID-19 patients who required intubation or mechanical ventilation increased with age (Hasani, W.S. et al., 2021). Even though all age groups are at risk of contracting COVID-19, elderly have significant risk of severe disease, possible because of their physiological changes, as the body strength and immune system reduces with ageing. Another explanation is that, elderly patients have more potential underlying health conditions, as this could further increase the risk of severe disease and hospitalization.

Trained and competent healthcare workers did the assessment of each of the COVID-19 patient presented to CACs. They will be assessed according to a guideline or criteria set by the Malaysia Ministry of Health. This study findings further supported and showed that the current management of our COVID-19 patients, especially with regards to elderly, is on the right direction, in ensuring them to be fully recovered, and more importantly, preventing the morbidity and mortality from the disease. However, sometimes, due to the stretched capability, these criteria were treated flexibly, as the decision for hospitalization depends on the judgments of the Family Medicine Specialist onsite. The finding recommends that the CAC team should be more cautious by lowering their decision threshold for hospital admission, for these high-risk group patients.

Understanding the types of patients who are most at risk for hospitalization is vital for a number of reasons. It helps in making triage decisions. It also could help inform policymakers about highest risk populations, who may require particular protection in policy determinations. Lastly, it helps epidemiologists to properly plan about the likely need for hospital beds and staffing needs in a region given its demographic characteristics (Petrilli, C.M. et al., 2020).

Study Limitations

The current study has some limitation. First, the data were derived from a single CAC in a state in Malaysia and may not represent the national population. However, this is the first study done in this location and it is believe it provides unique insights into the disease. Despite the limitation, the study results are consistent with previous studies of COVID-19 cases, both globally and nationally. Secondly, the variables studied were limited, because the source was secondary data that were already available in the CAC settings. One recommendation for future

studies is to include more variables in the study, collected via constructed questionnaires or interviews.

Conclusion

Among the home quarantined COVID-19 patients, some of them might require hospitalization later due to disease progression or worsening conditions, especially the elderly patients. Thus, during the first contact, the CAC team should assess them properly, and given priority for hospital admission to these cases instead of giving the home quarantine order, as they are more vulnerable to severe disease and progression when infected with COVID-19.

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Conflicts of Interest

This research has no conflicts of interests.

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References

Ahmad B.Z., Marleena B.A., Zulraini J., Rusdi A.R., Ismail, A.. (2021). Factors Associated with COVID-19 Infection in Melaka: One Year Experience from March 2020 till March 2021. *BEJ,* 2(S1), November 2021. https://jurcon.ums.edu.my/ojums/index.php/bej/article/view/3591

Ahmad, N., Mohd Ali, N.F., Mohamed Nawi, A., Hassan, M.R., Noor Aizuddin, A., Hod, R., Daud, F., Salleh, S.A., Periyasamy, P., Abdul, G.A.H., Kori, N. (2021). Clinical Characteristics of Patients with Coronavirus Disease 2019 (COVID-19) in a Teaching Hospital in Malaysia. *J. Infect. Dev. Ctries*., 15(8), 1059-1065. https://doi.org/10.3855/jidc.13232

Charan, J., Biswas, T. (2013). How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian J. Psychol. Med.,* 35(2), 121-126. https://doi.org/10.4103/0253-7176.116232

COVIDNOW. (2021). COVIDNOW in Malaysia. https://covidnow.moh.gov.my

Gottlieb, M., Sansom, S., Frankenberger, C., Ward, E., Bala, H. (2020). Clinical Course and Factors Associated With Hospitalization and Critical Illness Among COVID-19 Patients in Chicago, Illinois. *Acad. Emerg. Med.,* 27(10), 963-973. https://doi.org/10.1111/acem.14104

Hasani, W.S.R., Ganapathy, S.S., Lin, C.Z., Mat Rifin, H., Bahari, M.N., Ghazali, M.H., Lodz, N.A., Ramli, M.H.T., Majid, N.L.A., Ling, M.Y.J., Yusoff, M.F.M., Ahmad, N.A., Suleiman, A., Yusoff, A.F., Balan, V., Ngadiman, S. (2021). Comorbidities and Clinical Features Related to Severe Outcomes Among COVID-19 Cases in Selangor, Malaysia. *Western Pac. Surveill. Response J.*, 12(1), 46-52. https://doi.org/10.5365/wpsar.2020.11.3.007

Intan A.M.D., Hazlinda H., Azlina A., Rusdi A.R. (2021). Brought in Death (BID) COVID-19 Cases in Melaka from January to August 2021: A Descriptive Study. *BEJ*, 2(S1), November 2021. https://jurcon.ums.edu.my/ojums/index.php/bej/article/view/3591

Ko, J.Y., Danielson, M.L., Town, M., Derado, G., Greenlund, K.J., Kirley, P.D., Alden, N.B., Yousey, H.K, Anderson, E.J., Ryan, P.A., Kim, S., Lynfield, R., Torres, S.M., Barney, G.R., Bennett, N.M., Sutton, M., Talbot, H.K., Hill, M., Hall, A.J., Fry, A.M., Garg, S., Kim, L. (2020). Risk Factors for COVID-19-Associated Hospitalization: COVID-19-Associated Hospitalization

Surveillance Network and Behavioral Risk Factor Surveillance System. *Clin. Infect. Dis.,* 72(11), e695-e703. https://doi.org/10.1093/cid/ciaa1419

Malaysia Ministry of Health (MOH). (2021). Guidelines on Home Monitoring and Clinical Protocol at Primary Care for Category 1 and Category 2 (mild) Confirmed COVID-19 Cases. Family Health Development Division. 24th March 2021. https://covid-19.moh.gov.my/garis-panduan/garis-panduan-kkm/ANNEX_2m_Guidelines_on_Home_Monitoring_and_Clinical_Protocol_at_Primary_Care_for_Cat_1_and_2_Mild_Confirmed_COVID-19_Cases_02122021.pdf

Mendy, A., Apewokin, S., Wells, A. A., Morrow, A. L. (2020). Factors Associated with Hospitalization and Disease Severity in a Racially and Ethnically Diverse Population of COVID-19 Patients. *medRxiv*., medRxiv2020.06.25.20137323. http://dx.doi.org/10.1101/2020.06.25.20137323

Petrilli, C.M., Jones, S.A., Yang, J., Rajagopalan, H., O'Donnell, L., Chernyak, Y., Tobin, K.A., Cerfolio, R.J., Francois, F., Horwitz, L. (2020). Factors Associated with Hospital Admission and Critical Illness among 5279 People with Coronavirus Disease 2019 in New York City: Prospective Cohort Study., BMJ, 369, m1966 (1-15). https://doi.org/10.1136/bmj.m1966

Telle, K.E., Grosland, M., Helgeland, J., Haberg, S.E. (2021). Factors Associated with Hospitalization, Invasive Mechanical Ventilation Treatment and Death among all Confirmed COVID-19 Cases in Norway: Prospective Cohort Study. S*cand. J. Public Health.,* 49(1), 41-47. https://doi.org/10.1177/1403494820985172

World Health Organization (WHO). (2021). WHO Coronavirus (COVID-19) Dashboard. Accessible at https://covid19.who.int.

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RESEARCH ARTICLE Open Access

COVID-19 Cluster in School: A Study on Epidemiology and Clinical Manifestations among Cases from Rengas Cluster in Perak, Malaysia

Syahrizal Abdul Halim,* Nor Azila Muhd Aris, Muhammad Zikri Fadzil, Husna Maizura Ahmad Mahir

Abstract

Background: A COVID-19 cluster named as Rengas Cluster was declared on 6th November 2020 after nine students from a boarding school in Padang Rengas, Perak diagnosed as positive COVID-19. Risk assessment was conducted and Targeted Enhanced Movement Control Order (TEMCO) was enforced at the school to contain the viral transmission. An investigation was carried out to analyze epidemiological data, clinical manifestations among cases and effect of TEMCO on this cluster.

Methods: A retrospective cross-sectional study was conducted from 2nd August 2021 until 3rd September 2021 using data that obtained from Kuala Kangsar District Health Office Crisis Preparedness and Response Centre (CPRC) Surveillance System through *e-COVID* notification system. The variables used in this current study include socio-demographic and clinical characteristics that include age group, gender, occupation, co-morbidities, symptoms and signs.

Results: There were 132 cases out of 324 exposed populations whereby most cases were students (87.9%) and aged between 11 and 20 years old (84.8%). More than half of cases were female (57.6%) with only one case had existing co-morbidity. Majority of cases were asymptomatic (64.4%). Those symptomatic mainly presented with cough (66%) and the strongest significant positive correlation were observed between anosmia and ageusia (r = 0.807, n = 47, $p < 0.001$). There was no significant association between age group and development of symptoms [χ^2 (6, N = 132) = 6.014, $p > 0.05$]. An abrupt decline in number of cases was observed following TEMCO enforcement.

Conclusion: COVID-19 cases in Rengas Cluster were mostly among young students, asymptomatic and mildly symptomatic. This cluster was timely and effectively controlled by TEMCO enforcement which contributed towards early diagnosis, isolation and treatment for more effective control and preventive measures.

Keywords: COVID-19, Cluster, Clinical Manifestation, School, TEMCO.

*Correspondence Email: syahrizalabdulhalim@yahoo.com

Kuala Kangsar District Health Office, Ministry of Health Malaysia, Jalan Sultan Idris Shah 1, 33000 Kuala Kangsar, Perak, Malaysia

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Introduction

Coronavirus disease (COVID-19) is a novel viral infectious respiratory disease that affects all age group of people worldwide with elderly and those having medical comorbidities are at higher risk of developing severe complication (CDCP,2021). COVID-19 virus is transmitted by human-to-human contact mainly through respiratory droplet (World Health Organization, 2020). This disease was declared as Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) on 11th March 2020 (WHO, 2020). Malaysia had recorded its first COVID-19 case on 24th January 2020 involving a Chinese national tourist who entered Malaysia from Singapore (Shakirah et al., 2020). Subsequently, the disease spread massively into the community and later contributing to the presence of large and small clusters involving both locally transmitted and imported cases.

Malaysia had reported 33,339 and 251 COVID-19 cases and mortalities respectively until 2nd November 2020 (Worldometer, 2021). Meanwhile, Perak state recorded 519 and 7 COVID-19 cases and mortalities respectively until 2nd November 2020 (Malaysia Ministry of Health, 2020). The transmission of COVID-19 in closed institution such as a boarding school is usually faster than others as the students living in the hostel due to living environment that may not feasible to practice precautionary measures at all times. Thus, COVID-19 cluster may easily spark in the institution once the virus introduced there either by students themselves, staff or visitors.

Rengas Cluster (Ministry of Health Malaysia, 2020) that involved nine students from a boarding school in Padang Rengas, Perak who were diagnosed as positive COVID-19 was declared on 6th November 2020. It was named based on the location of the school namely in Padang Rengas. The index cases were two students who stayed in the same school hostel following Influenza-Like-Illness (ILI) screening for being symptomatic since 2nd November 2020. Both of them were merely staying within the school compound during incubation period. Subsequently, they were admitted to a tertiary hospital in Ipoh, Perak on 4th November 2020.

Kuala Kangsar District Health Office had vigilantly taken intensive control and preventive measures by initiating Targeted Enhanced Movement Control Order (TEMCO) that implied total lockdown in a specific locality such as school (Majlis Keselamatan Negara, 2021). This approach is taken in order to prevent the spread of disease into the community outside the institution that may lead the COVID-19 cluster to be prolonged and become uncontrolled. The objectives of this study are to analyze epidemiological data, clinical manifestation among cases related to this cluster and effect of TEMCO enforcement on this cluster.

Materials & Methods

Location and Population of Study

This school is located approximately 12km distance from Kuala Kangsar Royal Town in Perak, Malaysia that comprises of 238 students, 33 teachers, 5 administration staff, 6 dining hall staff, 4 canteen staff, 4 cleaners and 9 security officers. The cases that included in this study were students and staff of the schools as well as those outside the school but had epidemiological link with the cluster which mostly the student's parents and siblings. The nearest government health clinic is Klinik Kesihatan Padang Rengas (about 850 meters apart by main road), whereas the closest government hospital is Hospital Kuala Kangsar (about 10 km distance by main road).

Study design and data collection procedure

This was a retrospective cross-sectional study using universal sampling method involving all 132 COVID-19 positive cases with epidemiological-link to Rengas Cluster from 2nd November 2020 until 24th December 2020. These cases include students and staff of the school as well as those outside the school that had epidemiological link with the cluster. This sampling method was used as all cases were taken as the respondents in view of all of them may provide useful information to test the hypothesis of this study. In fact, all people in the population have different probability of being included in the sample with each one of them has unknown probability of being selected (Richard and Margaret, 1990).

This study was conducted from 2nd August 2021 until 3rd September 2021 using data that obtained from Kuala Kangsar District Health Office Crisis Preparedness and Response Centre (CPRC) Surveillance System through *e-COVID* (online notification system for COVID-19 cases, managed by Ministry of Health Malaysia). The variables used in this current study include socio-demographic and clinical characteristics that include age group, gender, occupation, co-morbidities, symptoms and signs.

Case Definition

Ministry of Health Malaysia (2021) had outlined a case definition of COVID-19 that refers to anyone with positive reverse transcriptase polymerase chain reaction (RTPCR) regardless of presence of any clinical manifestation. Meanwhile, cluster is defined as epidemiologically-linked group of cases such as in educational institution, community and other settings.

All cases in this study had undergone swabs of nasopharyngeal and oropharyngeal whereby all their clinical specimens were sent to either National Public Health Laboratory or Hospital Raja Permaisuri Bainun in Ipoh, Perak to be tested for COVID-19 using RTPCR method with calculated Cycle Threshold (CT) Value. The CT Value is a quantitative measurement that recommended to be used in predicting viral load, disease severity and infectivity as well as provides information on underlying viral dynamics (Rabaan et al., 2021). This is a potential indicator for local outbreaks (Tso et al., 2021) and may assist in estimating epidemic growth rate towards planning the effective and more targeted epidemiological measures to control the epidemic.

Data entry and analysis

Data were coded, manually checked for any inconsistencies, duplication or missing values, statistical assumptions including the normality of data distribution and analysed using the statistical package for social science (SPSS) Version 21.0. Descriptive, Chi-Square for Independence and Pearson product-moment correlation analysis were conducted with data presented in both tabular and figure forms. The quantitative data were presented in mean, minimum, maximum and standard deviation (SD) whereas qualitative data were presented in frequency and percentage. The epidemic curve was constructed based on date of onset for symptomatic cases and date of positive sample taken for asymptomatic cases.

Results

Socio-demographic characteristics

A total of 132 cases out of 324 exposed population were detected with majority of cases aged between 11 and 20 years old (84.8%) [mean (SD) age of 17.91 (10.03)]. Most cases were students (87.9%) particularly from the school where the cluster is identified, followed by teacher (3.8%), unemployed (3.8%), nurse (2.3%), administrator (1.5%) and police officer (0.8%). The male cases were less than females with 42.4% and 57.6% respectively. There was only one case with co-morbidity (0.8%). These findings are summarized in **Table 1** as below.

Table 1: Socio-demographic characteristics of cases (n = 132)

Characteristics	Frequency	Percentage
Age Group (Years)		
0 – 10	4	3.0
11 – 20	112	84.8
21 – 30	4	3.0
31 – 40	5	3.8
41 – 50	3	2.3
51 – 60	2	1.5
More than 60	2	1.5
Mean (SD) Age	17.91 (10.03)	
Minimum	1	
Maximum	66	
Gender		
Male	56	42.4
Female	76	57.6
Occupation		
Student	116	87.9
Nurse	3	2.3
Teacher	5	3.8
Police Officer	1	0.8
Administrator	2	1.5
Unemployed	5	3.8
Co-morbidity		
Yes	1	0.8
No	131	99.2

Epidemiological Investigation

Figure 1 below shows an epidemic curve whereby cases were initially detected among those symptomatic and gradually increased before a sudden spike of cases especially among those asymptomatic. The number of cases was gradually decreased towards the end of the outbreak. Altogether, there were 2820 close contacts to COVID-19 cases identified with ratio for case to close contact of 1:21.

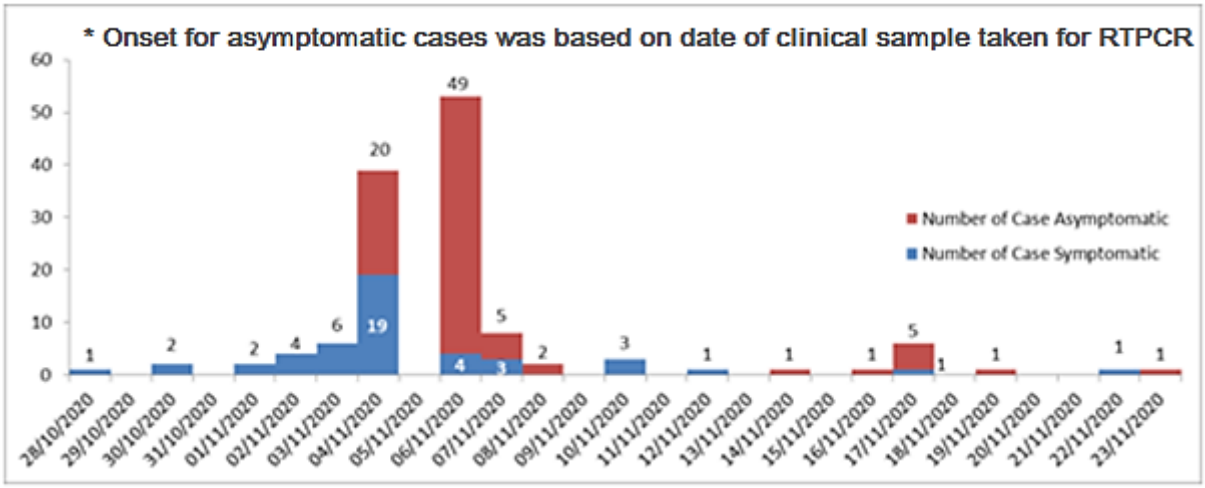

Figure 1: Epidemic Curve of Rengas Cluster (N = 132)

Classification of Symptoms

Asymptomatic cases constituted for more than half of cases (64.4%) as shown in Table 2. Meanwhile, Figure 2 showed that more than half of symptomatic cases presented with cough (66%) compared to other symptoms.

Table 2: Classification of symptoms among cases (n= 132)

Characteristics	Frequency	Percentage
Asymptomatic	85	64.4
Fever only	3	2.3
Fever with any URTI symptoms	6	4.5
URTI symptoms with no fever	5	3.8
Other symptoms with fever only	3	2.3
Other symptoms with URTI only	16	12.1
Other symptoms with fever and URTI	11	8.3
Other symptoms only	3	2.3

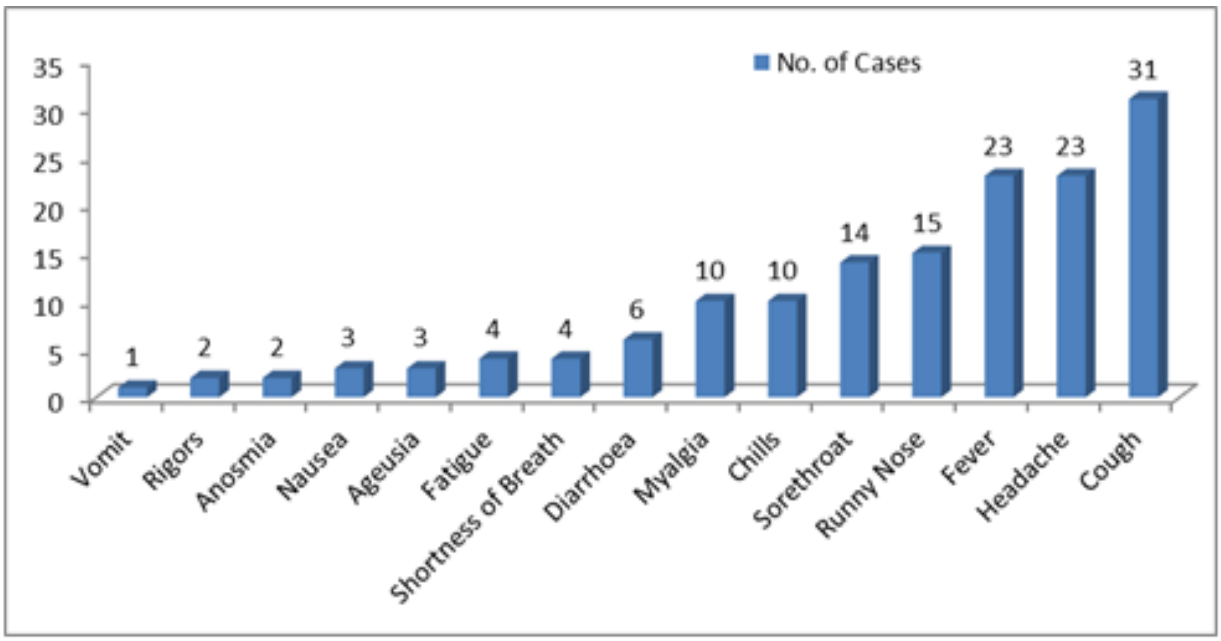

Figure 2: Number of symptomatic cases based on type of symptom (n = 47)

Association between COVID-19 symptoms

A Pearson product-moment correlation was carried out to determine the relationship between each individual symptom that may indicate the significant pair of symptoms experienced by cases. There were statistically significant ($p < 0.05$) positive and strong correlation between anosmia and ageusia ($r = 0.807$, n = 47, $p = 0.000$), chills and diarrhea ($r = 0.580$, n = 47, $p = 0.000$) as well as nausea and vomit ($r = 0.565$, n = 47, $p = 0.000$). Meanwhile, statistically significant ($p < 0.05$) positive and moderate correlation was observed between chills and headache ($r = 0.427$, n = 47, $p = 0.003$), rigors and myalgia ($r = 0.406$, n = 47, $p = 0.005$), chills and rigors ($r = 0.406$, n = 47, $p = 0.005$), chills and myalgia ($r = 0.365$, n = 47, $p = 0.012$), rigors and sore throat ($r = 0.324$, n = 47, $p = 0.026$) as well as headache and myalgia ($r = 0.323$, n = 47, $p = 0.027$). Table 3 summarizes these findings.

Table 3: Significant correlation between each individual symptom

Symptom		Pearson correlation, *r*	Sig.
1	2		
Anosmia	Ageusia	0.807	0.000
Chills	Diarrhoea	0.580	0.000
Nausea	Vomit	0.565	0.000
Chills	Headache	0.427	0.003
Rigors	Myalgia	0.406	0.005
Chills	Rigors	0.406	0.005
Chills	Myalgia	0.365	0.012
Rigors	Sore throat	0.324	0.026
Headache	Myalgia	0.323	0.027

Factors associated with development of COVID-19 symptom(s)

A Chi Square test for independence was conducted to analyse the association between gender and development of symptoms as well as between age group and development of symptoms. More than half of symptomatic cases were female (53.2%) as compared to male (46.8%). However, there was no significant association between gender and development of symptoms whereby χ^2 (1, N = 47) = 0.574, p= 0.449 ($p > 0.05$). Furthermore, more than three-quarter of symptomatic cases were those aged from 11 to 20 years old (83.0%). However, there was no significant association between age group and development of symptoms whereby χ^2 (6, N = 47) = 6.014, p= 0.422 ($p > 0.05$).

Discussion

The most affected age group in this Rengas cluster was those aged between 11 and 20 years old. In fact, most cases were among students staying in the boarding school whom aged between 13 to 18 years old. A boarding school is a closed institution that is potentially high risk for COVID-19 viral transmission. Therefore, appropriate and strict gate keeping is crucial.

Meanwhile, the highest overall incidence of COVID-19 incidence in the United States from 1st March 2020 to 14th November 2020 was among those aged between 18 to 24 years old even though those aged more than 80 years had the highest incidence during the initial phase of pandemic (Duca et al., 2021). Furthermore, those aged below 19 years old recorded the second highest number of cases in Canada as of 26th March 2021 (Government of Canada, 2021). This indicates the recent trend of higher cases among younger adults.

Furthermore, majority of the cases in this cluster were female which is contradictory to finding from a nationwide observational study in Malaysia by Sim et al. (2020) whereby male constituted almost three-quarter of cases (71.7%). Meanwhile, similar proportion between male (48.9%) and female (51.1%) was reported in Canada (Government of Canada, 2021). However, higher cases among female in this cluster may be influenced by higher proportion of female students in this school (52.5%) as well as higher cases among female lives outside school compound that epidemiologically-linked to this cluster (85.7%) as compared to male.

Next, asymptomatic cases constituted for more than half of cases in this cluster. However, a study by Oran (2020) had discovered that a lower proportion of asymptomatic COVID-19 cases in 16 different cohorts at around 40% to 45%. Identification of asymptomatic case in a community is very challenging because no one knows of being infected unless they are screened over the course of infection. Although asymptomatic cases had 42% lower transmission rates than symptomatic cases (Byambasuren et al., 2020), higher proportion of asymptomatic cases in this current cluster indicates the needs to empower practices of hand hygiene, face mask and social distancing as well as enhancing contact tracing by targeting low positivity rate and improvise isolation strategies.

Cough, headache and fever were the most common symptoms experienced among those symptomatic cases in this cluster. A systematic review by Mesquita et al. (2020) had discovered that cough and fever were the most common symptoms presented by positive COVID-19 patients (54.5% and 58.7% respectively) but headache was observed in merely 12.2% of cases only. Similarly, cough and fever were the most commonly observed among Malaysians with 32.2% and 29.5% respectively (Sim et al., 2020). Furthermore, those symptomatic cases were mostly experiencing upper respiratory tract infection (URTI) with other symptoms only (12.1%) but significant correlation was merely observed between sore throat and rigors. The other significant correlation between symptoms was only recognized between symptoms other than fever and any URTI symptoms. Conversely, a study in Shenzhen by Luo et al. (2020) discovered significant correlation between eight pairs of symptoms namely expectoration-cough, expectoration-wheezing, palpitation-fever, palpitation-diarrhoea, dry mouth-bitter taste in mouth, fatigue-poor appetite, dizziness-fatigue and dizziness-headache. Our findings had also shown no significant association of age group and gender with development of symptoms. However, different distribution of comorbidity in different setting may affect this relationship (Clark et al., 2020). Thus, the distribution of cases that largely involved those within a school in Rengas cluster aged between 11 to 20 years old may contribute to this non-significant association.

Moreover, this cluster had initially shown a gradual increase with a sudden surge in number of cases. This had alerted the Kuala Kangsar District Health Office to enforce Targeted Enhanced Movement Control Order (TEMCO) in the affected school for this cluster with the support from the District Disaster Management Committee. The objective was mainly to reduce the risk of widespread transmission of the disease in the school with preventing viral introduction into the school by those especially staff who commute daily.

In fact, this is the first educational institution in Perak being enforced with TEMCO. This was a wise decision as enforcing Enhanced Movement Control Order (EMCO) for the

whole sub-district may be more effective but highly potential to adversely affect the economy. The effectiveness of TEMCO is evidenced by abrupt decline in number of cases following its implementation from 8th November 2020 until 30th November 2020. All cases were admitted to hospital for isolation and treatment whereas all close contacts were either quarantined in the school or other gazetted quarantine centres in Sungkai and Ipoh, Perak. Therefore, TEMCO in Rengas cluster had assisted in early identification of cases regardless of symptomatic status as well as timely isolation of case and quarantine of close contacts to effectively interrupt the spread of disease.

Strength, Limitation and Recommendation

Our study focused on a COVID-19 cluster in a closed institution that is beneficial to be compared with community cluster. However, our data was limited to cases with similar socio-demographic background and culture. Thus, it is recommended for this study to be expanded involving all clusters in Kuala Kangsar district to compare the differences between cluster underwent TEMCO and vice versa as well. Furthermore, strict gate keeping with early isolation and quarantine of cases and close contacts respectively are crucial in managing cluster in any boarding school. Moreover, all students and staff should be vaccinated before school re-open.

Conclusion

Rengas cluster involved mainly those students in affected school with most cases were asymptomatic. However, cough, headache and fever are the most common clinical manifestations whereby age and gender were not significantly associated with symptoms development. In the absence of vaccine availability during this cluster, timely enforcement of TEMCO that had managed to identify, isolate and treat all cases at early stage was subsequently had controlled the spread of the cluster at early stage successfully.

Conflicts of Interest

This research has no conflicts of interests.

Funding Statement

Nil.

Ethical Approval

An ethical approval for this study was obtained from Medical Research and Ethics Committee (MREC) of Ministry of Health Malaysia on 16th July 2021 [Reference number: NMRR-21-1346-59338 (IIR)].

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References

Byambasuren, O., Byambasuren, O., Cardona, M., Bell, K.J.L., Clark, J., Mclaws, M.L., Glasziou, P. (2020). Estimating the Extent of Asymptomatic COVID-19 and its Potential for Community Transmission: Systematic Review and Meta-analysis. *Official J. Assoc. Med. Microbiol. Infect. Dis. Can.*, 5(4), 223-234. https://doi.org/10.3138/jammi-2020-0030

CDC (Centres for Disease Control and Prevention). (2021). COVID-19: Frequently Asked Questions. Retrieved from Centres for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/faq.html

Clark, A., Jit, M., Warren, G.C., Guthrie, B., Wang, H.H.X., Mercer, S.W., Sanderson, C., McKee, M., Troeger, C., Ong, K.L., Checchi, F., Perel, P., Joseph, S., Gibbs, H.P., Banerjee, A., Eggo, R.M. . (2020). Global, Regional, and National Estimates of the Population at Increased Risk of Severe Covid-19 due to Underlying Health Conditiions in 2020: A Modelling Study. *Lancet Glob. Health*, e1003-e1017. https://doi.org/10.1016/s2214-109x(20)30264-3

Duca, L.M., Xu, L., Price, S.F., McLean, C.A. (2021). COVID-19 Stats: COVID-19 Incidence, by Age Group - United States, March 1 - November 14, 2020. *Morbidity and Mortality Weekly Report (MMWR): Centers for Disease Control and Prevention*, 1664. Retrieved from Centers for Disease Control and Prevention (CDCP). https://www.cdc.gov/mmwr/volumes/69/wr/mm695152a8.htm

Government of Canada. (2021). *Coronavirus disease 2019 (COVID-19): Epidemiology Update*. Retrieved from Government of Canada: https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html

Luo, Y., Wu, J., Lu, J., Xu, X., Long, W., Yan, G., Tang, M., Zou, L., Xu, D., Zhuo, P., Si, Q., Zheng, X. (2020). Investigation of COVID-19-related symptoms based on factor analysis. *Annals of Palliative Medicine*, 1851-1858. https://doi.org/10.21037/apm-20-1113

Majlis Keselamatan Negara. (2021). *SOP Perintah Kawalan Pergerakan*. Retrieved from Majlis Keselamatan Negara: http://mkn.gov.my/web/ms/sop-perintah-kawalan-pergerakan/

Mesquita, R.D.R., Junior, L.C.F.S., Santana, F.M.S., Oliveira, T.F.D., Alcantara, R.C., Arnozo, G.M., Filho, E.R.D.S., Santos, A.G.G.D., Cunha, E.J.O.D., Aquino, S.H.S.D., Souza, C.D.F.d. (2020). Clinical Manifestation of COVID-19 in the General Population: Systematic Review. *Wien. Klin. Wochenschr.*, 133 (7-8), 377-382. https://doi.org/10.1007/s00508-020-01760-4

MHM (Ministry of Health Malaysia). (2020). Kemaskini Negeri Sehingga 02 November 2020. Retrieved from Kementerian Kesihatan Malaysia: COVID-19 Malaysia: https://covid-19.moh.gov.my/terkini-negeri/112020/kemaskini-negeri-sehingga-02-november-2020

MHM (Ministry of Health Malaysia). (2020). Tiga (3) Kluster Baharu Dilaporkan Hari Ini (06/11/2020). Retrieved from COVID-19 Malaysia: Kementerian Kesihatan Malaysia. https://covid-19.moh.gov.my/sorotan/112020/tiga-3-kluster-baharu-dilaporkan-hari-ini-06112020

MHM (Ministry of Health Malaysia). (2021). Garis Panduan Kementerian Kesihatan Malaysia. Retrieved from COVID-19 Malaysia: Kementerian Kesihatan Malaysia. https://covid-19.moh.gov.my/garis-panduan/garis-panduan-kkm

Oran, D.P., Topol. E.J. (2020). Prevalence of Asymptomatic SARS-CoV-2 Infection: A Narrative Review. *Ann. Intern. Med.*, 173(5), 362-367. https://doi.org/10.7326/m20-3012

Rabaan, A.A., Tirupathi, R., Sule, A.A., Aldali, J., Mutair, A.A., Alhumaid, S., Muzaheed, Gupta, N., Koritala, T., Adhikari, R., Bilal, M., Dhawan, M., Tiwari, R., Mitra, S., Emran, T.B., Dhama, K. (2021). Viral Dynamics and Real-Time RT-PCR Ct Values Correlation with Disease Severity in COVID-19. *Diagnostics (Basel),* 11(6), 1091(1-18). https://doi.org/10.3390/diagnostics11061091

Richard, M.G., Margaret, W. (1990). *Research in Social Work: A Primer.* Michigan: F.E. Peacock Publishers. https://www.amazon.com/Research-RIchard-Grinnell-Margaret-Williams/dp/087513372X

Shakirah, M.S., Ang, Z.Y., Anis-Syakira, J., Cheah, K.Y., Kong, Y.L., Selvarajah, S., Balqis-Ali, N.Z., Fun, W.H., Sararaks, S. (2020). The COVID-19 Chronicles of Malaysia: In the face of a pandemic. Setia Alam, Selangor: National Institutes of Health. https://maera.nih.gov.my/index.php/component/advportfoliopro/project/41-the-covid-19-chronicles-of-malaysia-edition-3

Sim, B.L.H., Chidambaram, S.K., Wong, X.C., Pathmanathan, M.D., Peariasamy, K.M., Hor, C.P., Chua, H.J., Goh, P.P. (2020). Clinical Characteristics and Risk fFactors for Severe COVID-19 Infections in Malaysia: A Nationwide Observational Study. *Lancet Reg. Health West. Pac.*, 4, 100055(1-8). https://doi.org/10.1016/j.lanwpc.2020.100055

Tso, C.F., Garikipati, A., Green-Saxena, AA., Mao, Q., Das, R. (2021). Correlation of Population SARS-CoV-2 Cycle Threshold Values to Local Disease Dynamics: Exploratory Observational Study. *JMIR Public Health Surveill.,* 2021, 7(6), e28265(1-11). https://doi.org/10.2196/28265

WHO (World Health Organization). (2020). *Coronavirus disease (COVID-19): How is it transmitted?* Retrieved from World Health Organization. https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-covid-19-how-is-it-transmitted

WHO (World Health Organization). (2020). WHO Director-General's Opening Remarks at the Media briefing on COVID-19, 11 March 2020. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Worldometer. (2021). Total Coronavirus Cases in Malaysia. https://www.worldometers.info/coronavirus/country/malaysia/

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SHORT COMMUNICATION Open Access

Mentor-Mentee Program with Medical Students: A Successful Program with Ethical Considerations

Tin Tin Thein,[1,*] Tun Aung,[2] Aye Aye Wynn,[1] Win Win Than,[3] Mie Mie Sein,[4] Nang Khin Mya,[1] Fairrul Bin Masnah@Kadir[5]

Abstract

Background: Mentoring is the relationship of a guide or a teacher with another person/student augmenting his/her carrier growth, knowledge, skills, and experiences implemented by caring, sharing and helping hands. The aim of this paper is to highlight the mentoring, type of mentoring, how important of matching and consideration of ethical issue in mentoring program. Not missing these significant points, mentoring program could be successful in universities including medical faculty.

Methods: The SMART principles of specific, measurable, attainable, relevant, and time-bound are essential to structure the matching between mentor and mentee. The rule of etiquette and ethical issues are crucial and beneficial for mentor mentee relationship. Clinical mentoring programs help to develop students' clinical skills and can increase interest in under-subscribed specialties. Positive mentoring plays a part in reversing the decline of academic medicine, by sparking interest through early research experiences.

Results: There is the short term goal which is to introduce an immediate support network for incoming students and the long term goal is to cultivate a mentoring culture to engage all strata of medical students and every faculty member. Medical students expressed that mentoring program is to provide counselling, develop professionalism, increase students' interest in research, and support them in their personal growth.

Conclusion: The goal of mentorship is to provide additional support to student or mentee by steering of the academic needs or social prerequisites to accelerate the personal and professional development of mentee with advice, guide and feed backs from the mentor.

Keywords: Mentoring, Mentor-mentee, Matching, Ethical issues, Medical students.

*Correspondence Email: dr.jasminetin@ums.edu.my

[1]*Department of Pathology and Microbiology, Faculty of Medicine and Health Sciences,Universiti Malaysia Sabah*
[2]*Retired General Surgeon*
[3]*Department of Obstetics and Gynaecology, Faculty of Medicine and Health Sciences,Universiti Malaysia Sabah*
[4]*Department of Medical Education, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah*
[5]*Department of Emergency Medicine, Faculty of Medicine and Health Sciences,Universiti Malaysia Sabah*

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Introduction

The plan of Ministry of Higher Education Malaysia is to enhance complete national and international quality of human capital (Abdullah, M.C., 2008). The student's orientated teaching and learning system in this era often affect them to face cumulative stress of university atmosphere and programs where adaptation is gloomy merely for them (Barber, J.E., 2010). There comes a mentor who is a guide as well as a role-model. The mentor will build trust, respect and interchange with mentee with regular meeting exchanging the ideas, improvement discussion to fulfill the goal. The mentor will detect the development problem and social recessions mainly long duration separation from parents or families amalgamated by learning stress. The benefits of mentees are developing strength and overcome the weakness, obtaining new ideas and thinking as well as exposure to new skills and knowledge (Jusiah, I., 2017). The aim of this paper is to highlight the mentoring, type of mentoring, how important of matching and especially consideration of ethical issue in mentoring program. Not missing these significant points, mentoring program could be successful in universities including medical faculty.

Methods

Mentoring

The mentoring is cost effective and efficient in resuming strength of attitude and to retain high potential student (University of People, 2021). The common objectives are: helping to develop leadership abilities, trying to get satisfactory outcomes accordingly, sharpening (honing) their capabilities resulting career development, having productive relationship among students and building of reputation of faculty outputs being the students (Arsad, N. *et al.,* 2013).

In university, mentoring programs support resolute any social issues (economy and long term separation from family and loved ones). Next the program is offering to facilitate the acclimatization of student to faculty environment. This program is ready to help novices when they come after pre-university foundations to the eminent campus. Mentorship programs also provide students to improve with good career in next working places after graduation (University of People, 2021).

For career a mentor has two primary functions for the mentee. The career-related function establishes the coaching to develop professional status. The psychosocial function is a role model and support for the mentee. A mentee is a "learner" in mentoring relationships, regardless of the age or position of the mentor and mentee. Both functions raise the development of a profession and suitability in independent service in future (Bellevue, W.A., 2021).

Clinical mentoring programs help to develop students' clinical skills and can increase interest in under-subscribed specialties. Positive mentoring plays a part in reversing the decline of academic medicine, by sparking interest through early research experiences (Danielle, N. *et al.,* 2019).

Medical Education Unit, UCMS and GTB Hospital, University of Delhi expressed a guide to mentoring medical students, in which program there are two short-term and long-term goals. The short term goal is to introduce an immediate support network for incoming students. The long term goal is to cultivate a mentoring culture at UCMS and GTBH that will engage all strata of students and every faculty member (Upreet, D. *et al.,* 2021).

There are three types of mentors: Mentors who have professional roles. They are the university staffs (often teaching staffs) and sometimes they may be administrative authorities who can assess career progress and support of any kind and shared the experience. Peer mentors: they do not influence the student, but support and they let the students learn actively. They do not overwhelm the mentees, but they support and share lessons learned for the progress of student's career and development. Subordinate mentors: they are not equivalent with above two mentors but they are working at a level to provide convenient assess for the novice students for evaluation or help once admitted in new atmosphere (Bellevue, W.A., 2021).

In addition to that, informal mentoring and formal mentoring are two more entities. The characteristics of formal mentoring which can reflect the program's effectiveness are:
(a) Program objectives, (b) Participants selection (c) Matching between mentor and mentee
(d) Training programs for both guide and students (e) Guide for meeting, and (f) Setting up a goal for the program. Structuring the good goals will follow SMART principles: specific, measurable, attainable, relevant, and time-bound (University of People., 2021).

Matching

Productive mentoring requires training of both mentor and mentee in view of understanding goals, role of participants and the process of the program. It means a good match for relationship. Sometimes the matching can face competency affairs, student background, style of studying and their needs. The consideration of matching may be by mentor himself or with administrative body depending upon the student (Bellevue, W.A. 2021).

A good match is important for a productive mentoring relationship. It is one of the critical parts of the program. A self-matching (mentor himself) is administratively light process, it allows mentees to select a particular mentor or they can submit their choice of three mentors. Matching with administrative body is applied for more structured programs such as a large group of new students at universities or new employees.

There are three steps for successful matching: 1).Develop a profile of data such as gender, college, interest and function, 2). Method of matching either self-matching or administrative matching, and 3). Intelligently match based on profiles (Bellevue, W.A. 2021).

Best practices of matching start with a solid profile for all participants (mentors and mentees). Development goals, specific interests, location, experiences, and preferences of matching are included in profile elements. For self-matching, participants might get the connection from the same previous employer, or the same college. Some prefer self-matching because if they know the about each other, a happy and productive mentoring outcome will be established. However, for more structured programs, such as new students at universities or groups of new corporate employees, administrative matching is usually applied. In medical university in Malaysia, administrative matching is being conducted and one mentor covers up to 10 mentees. There is monthly meeting with mentees where mentor supervise not only their academic progress but also take care of their physical and mental wellbeing. In intelligently match based on profile, improving match quality is appeared by using software and it can also save time (Bellevue, W.A. 2021).

Results

Etiquette and Ethics in Mentoring Program

The quality of relationship may derive from added personal information to get professional growth and success of the program. The rule of etiquette is crucial and beneficial for mentor mentee relationship. In problematic episodes a mentor can support through the relationship to encourage for adjustment t and ability to get up. The respect, reliability and calmness can create the environment for mentor to seek the needs of the student who will have good perspectives, good deeds and self-confident conduct of work.

The mentor and mentee should be aware of ethical issues. In an effort to facilitate the development of functional and successful mentor relationships, articulating the rules of etiquette for these encounters may prove beneficial for both mentors and mentees. Ethical principles are Beneficence and Non-maleficence, Fidelity and Responsibility, Integrity, Justice and Respect for People's Rights and Dignity. There is a question that is these ethical guidelines needed for mentor-mentee relationship? Actually, it needs to follow these guidelines.

Discussion

It is better to prepare for both mentor and mentee. The actual process of addressing beneficence and non-maleficence will be related to the purpose the mentoring. Both mentor and mentee must also be aware that mentoring is a mutual relationship and mutual respect. Each can benefit from the other over the course of the relationship. There are issues of workload and publication credit in a research context and confidentiality and navigation of internal political systems in organizational context, in which the benefit should go to both mentor and mentee.

A clarification process should be established regarding fidelity, responsibility and integrity to be able to develop a healthy and mature mentor relationship. If a point of conflict or confusion arises, each person should be willing to resolve that issue. A mentor is a guide or supervisor but mentor is not intended to dictate how to do something. Mentees follow the instructions of mentor however mentees him or herself takes responsibility of their duties and should not always depend on mentor.

A mentor should have a justice if a particular mentee will be chosen as opposed to other possible candidates. Respect for people's right and dignity highlight the personal differences between mentor and mentee which do not bias their interaction (American Psychological Association., 2012).

One review article of mentoring program for medical students expressed that mentoring program is to provide counselling, develop professionalism, increase students' interest in research, and support them in their personal growth. There are both one-to-one and group mentorships, established in the first two years of medical school and continuing through graduation. Other benefits are an increase in research productivity and improved medical school performance in general. Mentored students also rate their overall well-being as higher (Frei, E., et al., 2010).

Conclusion

Including medical university, mentor programs offer a great place for mentors and mentees to learn and grow together. Successful mentorship leads to friendships with learning and support each other. The effective and productive mentor-mentee relationship has open communications and helping expectations, support and contact maintenance with honesty and friendship to get trust and respect. The mentor must participate creative activity and be innovative with guidance of etiquette and ethics. Thus mentorship programs are especially useful for new college students who want to get accustomed to the environment, culture and loving kindness of being in university.

Conflicts of Interest

The authors declare no conflicts of interest.

References

Abdullah, M.C. (2008). Contribution of Emotional Intelligence, Coping, and Social Support to Adjustment and Academic Achievement amongst Fresh Students in the University. Universiti Putra Malaysia. http://psasir.upm.edu.my/4903

American Psychological Association. (2012). Introduction to Mentoring: A Guide for Mentors and Mentees, Washington, DC 2002-4232. http://www.apa.org/education-career/grad/mentoring

Barber, J.E. (2010). An Examination of Happiness and Its Relationship to Community College Students' Coping Strategies and Academic Performance. Morgan State University. http://hdl.handle.net/11603/10658

Frei, E., Stamm, M., Buddeberg, F.B. (2010). Mentoring Programs for Medical Students: A Review of the PubMed Literature 2000-2008. *BMC Med Educ.,* 10, 32(1-14). https://doi.org/10.1186/1472-6920-10-32

Jusiah, I., Melissa, E.S., Mohd. S.I. ((2017). Preliminary Review of Implementation Mentoring Program among Students in Public University in Kota Kinabalu. *J. Adv. Rese. Soc. Behav. Sci.* 8(1), 67-76. https://www.akademiabaru.com/doc/ARSBSV8_N1_P67_76.pdf

University of People. (2021). What Makes a College Mentoring Program Successful? California. https://www.uopeople.edu/blog/what-makes-a-college-mentoring-program-successful

Arsad, N., Kamal, N., Elias, S.N., Moubark, A.M., Ibrahim, A.A., Yusof, Y., Rahman, Ab., Mohammad, S., Husain, H., Ismail, M. (2015). Implementing the Use of E-Mentor Mentee and Mind Twister Program in Monitoring & Improving the Student's Academic Performance. *J. Eng. Sci. Technol.*, Special Issue 2 on UKM Teaching and Learning Congress 2013, 1-9. https://jestec.taylors.edu.my/Special%20Issue%20UKM%20TLC%202013_2/UKMTLC%202013_6_2015_2_001_009.pdf

Bellevue, W.A. (2021). How to Start a High Impact Mentoring Program? CHRONUS. https://chronus.com/how-to-start-a-mentoring-program

Danielle, N., Shaista G., Joe, R. (2019). Medical Student Mentoring Programs: Current Insights. Advances in Medical Education and Practice, *Adv. Med. Educ. Pract*. 2019(10), 113-123. https://doi.org/10.2147/amep.s154974

Upreet, D., Kalra, O.P., Bhatia, A., Singh, N. (2021). A Guide to Mentoring Medical Students Medical Education Unit, UCMS and GTB Hospital, University of Delhi http://medicaleducationunit.yolasite.com/resources/A%20Guide%20to%20Mentoring%20Medical%20Students.pdf.

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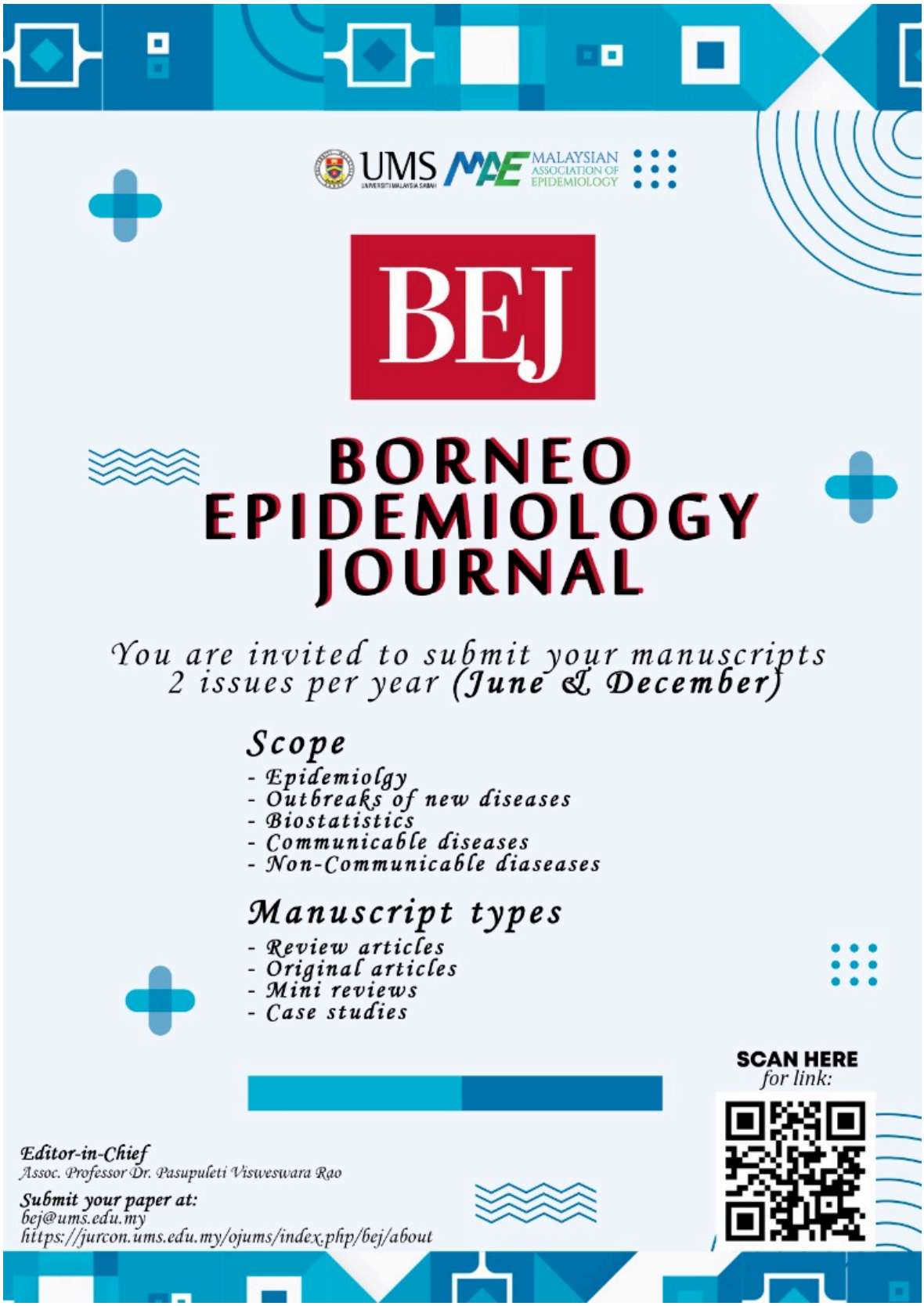
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