



A Post-Pandemic Insight on The Covid-19 and Pregnancy In Malaysia

Hana W. Jun Chen ^{1,*}, Jegathambigai Rameshwar Naidu ^{1,*}, Mohamed Najimudeen ¹, Sakina Ruhi ¹, Roy Rillera Marzo ², Abdulah Y. Al-Mahdi ¹, Haryati Anuar ¹, Mohammed Faez Baobaid ¹, Fatmawati Syamsu ³, Mohammed A. Abdalqader ⁴

Abstract

A December 2023 COVID-19 outbreak in Southeast Asia prompted an update on Malaysia's existing understanding of COVID-19 and pregnancy. Research suggests that COVID-19 increases the risk of adverse maternal and perinatal outcomes. Pregnant women are more susceptible to COVID-19 due to physiological changes in the coagulation, immune, respiratory, and cardiovascular systems during pregnancy. Evidence indicates that pregnant COVID-19 patients are at an increased risk for severe illness and intensive care unit (ICU) admission. Stillbirth, neonatal death, and preterm labour are some of the most often reported adverse foetal outcomes. Data shows vertical transmission of COVID-19 is possible but rare. Currently, vaccination remains the most effective and safest strategy for protecting risk groups from severe illness, complications, and death. Although Malaysia has no plans to reinstate its movement control order, following a sharp rise in COVID-19 cases across the country, the Ministry of Health Malaysia (MOH) has prepared a five-point strategy as well as updated the COVID-19 Management Guidelines, including the therapeutic management of pregnant patients with COVID-19. The

MOH encourages safe public practices and general measures including vaccinations, wearing masks, and maintaining hand hygiene. This review provides important insights into the COVID-19 pregnancy in Malaysia, susceptibility to COVID-19 in pregnancy, maternal and perinatal outcomes in pregnant women with COVID-19, transmission of COVID-19 to a newborn, COVID-19 treatment in pregnancy, COVID-19 vaccination in pregnancy and breastfeeding, and management of unvaccinated pregnant and lactating mothers in Malaysia.

Keywords: COVID-19; Pregnancy; Maternal outcome; Fetal outcome; Treatment; Vaccination

Introduction

A COVID-19 surge in Southeast Asia during December 2023 has prompted an update on the current insight regarding COVID-19 and pregnancy in Malaysia (Ministry of Health Malaysia, 2023a). On 19th December 2023, the Ministry of Health Malaysia (MOH) announced the status of COVID-19 cases in Malaysia for Epidemiological Weeks (ME 50/2023) from December 10-16, 2023. The report indicated that new cases have shot up by 62.2%, to 20,696, in which 151 cases required treatment in the Intensive Care Unit (ICU) and 28 death cases (Ministry of Health Malaysia, 2023a). The World Health Organization (2023) suggested that Omicron sub-variants are driving the spike.

Spread of Omicron variants globally

There have been periodic spikes ever since various variants and sub-

Significance | In the midst of the Omicron surge, Malaysia is adjusting its approach, highlighting the importance of vaccination, updated guidelines, and community engagement as crucial means to mitigate the impact of COVID-19.

*Correspondence. Hana W. Jun Chen, Department of Community Medicine, International Medical School, Management and Science University, Selangor, Malaysia. E-mail: hana_chen@msu.edu.my, +60132312021
And Jegathambigai Rameshwar Naidu, Department of Biochemistry, International Medical School, Management and Science University, Selangor, Malaysia. E-mail: jegathambigai@msu.edu.my

Author Affiliation.

¹ International Medical School, Management and Science University, Selangor, Malaysia
² Faculty of Humanities and Health Sciences, Curtin University, Sarawak, Malaysia
³ Department of Nursing, Poltekkes Kemenkes Palu, Central Sulawesi, Indonesia
⁴ Faculty of Medicine, University of Cyberjaya, Selangor, Malaysia

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variants started to circulate, particularly after the resumption of international travel (World Health Organization, 2023). Since it was first identified in November 2021, Omicron has been the most infectious COVID-19 variant in most of the countries worldwide including Malaysia (Ministry of Health Malaysia, 2022a). Compared to previous variants, the highly contagious mutations typically cause less severe illnesses. Omicron seems to have a higher rate of replication than Delta variant, making it more infectious and contributing to a higher risk of reinfection in people who have contracted the disease previously with a different strain (Ministry of Health Malaysia, 2022a).

Although Omicron strain was also the most infectious variant among pregnant and lactating mother, data suggested that the risk of severe disease with Omicron infection is lower than with other variants (Ministry of Health Malaysia, 2022a). In fact, the Delta strain was associated with significant maternal and fetal implications where one in seven symptomatic mothers infected with the delta strain required ICU admissions (Ministry of Health Malaysia, 2022a).

In 2021, severe COVID-19 infections were directly responsible for 41% of all maternal deaths in Malaysia, with a total of 191 maternal deaths (Ministry of Health Malaysia, 2022a). The frequency of stillbirth among infected moms was nearly doubled, and the risk of iatrogenic preterm deliveries was increased by two to three times (Ministry of Health Malaysia, 2022a). However, there were no foetal defects, and the risk of vertical transmission was minimal (Ministry of Health Malaysia, 2022a). This review will provide more information regarding the susceptibility to COVID-19 in pregnancy, maternal and perinatal outcomes in pregnant women with COVID-19, and transmission of COVID-19 to a newborn in the subsequent section.

Currently, Malaysia has no plan to impose pandemic-era restrictions and reactivate its movement control order (MCO) despite a significant increase in COVID-19 cases nationwide as the country is more aware of the pathogenesis of the disease and more prepared for it (Ministry of Health Malaysia, 2023a). Following the spike, the MOH encourages residents and travelers to wear masks in crowded places and airports even if they are not sick, especially indoors or around vulnerable people. Lessons learned from the COVID-19 pandemic also highlighted the importance of public practices to stay safe (Abdalqader et al., 2020a; Abdalqader et al., 2020b). General measures such as vaccinations, wearing masks in crowded places, and maintaining hand hygiene are highly recommended at the moment. Table 1 summarises the previous, current, and future approach for preventing COVID-19 in Malaysia.

Risk and Susceptibility to COVID-19 in Pregnancy

Various physiological changes during pregnancy may increase

susceptibility to COVID-19. These modifications include alterations in the immune system, respiratory system, cardiovascular function, and coagulation (Wastnedge et al., 2020). COVID-19 is an immune condition which is marked by reduced lymphocytes and elevated selected proinflammatory cytokines (Phoswa et al., 2020), along with a weakened immune system in pregnant women, these further increase the risk of COVID-19 in pregnancy.

Additionally, pregnant and recently pregnant women (up to at least 42 days after pregnancy) are at increased risk of severe illness with COVID-19 compared to non-pregnant individuals in terms of death, hospital admission, ICU admission, receipt of invasive mechanical ventilation, and extracorporeal membrane oxygenation (Jamieson & Rasmussen, 2022; Zambrano et al., 2020, Allotey et al., 2020). Pregnant mothers are considered most vulnerable and susceptible to severe COVID-19 infections, especially in the second and third trimesters (Ministry of Health Malaysia, 2022a).

All women with identifiable risk factors are advised to complete their vaccination before getting pregnant. Table 2 outlines the risk factors for COVID-19 infection in pregnancy, degree of risk and preventive actions.

Maternal and Perinatal Outcomes in Pregnant Women with COVID-19

Although the COVID-19 vaccine has reduced the severity of the disease, all pregnant mothers are at potential risk of getting adverse obstetric and perinatal outcomes. Research indicates that the coronavirus enters host cells through the ACE2 receptors on the villous cytotrophoblast and syncytiotrophoblast, which are found on the placenta (Taglauer et al., 2020). The interruption of ACE2 physiological function could be a main factor contributing to higher risks of complications and disease in mother and foetus exposed to COVID-19 during pregnancy.

There has also been evidence of lower levels of ACE2 protein in placentas from COVID-19 positive pregnancies, suggesting that SARS-CoV-2 infection may alter ACE2 expression and biological functions in the placenta as well as in the circulations of the mother and foetus directly or indirectly (Taglauer et al., 2020). This provided more evidence to support the research findings that SARS-CoV-2 infection during pregnancy increases the severity of COVID-19 and risk of adverse outcomes. Table 3 outlines the maternal and perinatal outcomes among women with COVID-19 during pregnancy.

Transmission of COVID-19 to a Newborn

The term “vertical transmission” encompasses different types of transmission that may happen: (I) “**In-utero**” transmission during pregnancy through the placenta, infecting the amniotic fluid and subsequently entering the airways or the gastro-intestinal tract or

Table 1. The previous, current and future approach for preventing COVID-19 in Malaysia.

Public Health Strategies	Previous Approach	Current Approach	Recommended Future Approach
General preventive measures	<ul style="list-style-type: none"> - Strict lockdowns like the MCO. - Strict adherence to preventive measures such as practicing social distancing, hand hygiene, and wearing mask. (Abdalqader et al., 2020a; Abdalqader et al., 2020b) 	<ul style="list-style-type: none"> - Encourage adherence to preventive measures such as practicing social distancing, hand hygiene, and wearing mask. (Ministry of Health Malaysia, 2023a) 	<ul style="list-style-type: none"> - Gradual easing of restrictions.
Surveillance and monitoring	<ul style="list-style-type: none"> - Adopt the outbreak preparedness and response from previous experiences to the severe acute respiratory syndrome (SARS) in 2003. - Implementation of the Malaysia Strategy for Emerging Diseases and Public Health Emergencies (MySED II) and established the Crisis Preparedness and Response Centre (CPRC). (World Health Organization, 2020) 	<p>Five-point strategy by the MOH:</p> <ul style="list-style-type: none"> i. Early case detection via the Heightened Alert System (HAS), ii. Community tracing via TRIIS (test, report, isolate, inform, and seek) system, iii. Monitoring of health facilities, (Ministry of Health Malaysia, 2023a) 	<ul style="list-style-type: none"> - Strengthen digital health platforms and the use of artificial intelligence in healthcare industry.
Community empowerment	<ul style="list-style-type: none"> - Communicate health information via mass media and social media platform. - Start to digitise health system via the establishment of the MySejahtera application. (Marzo et al., 2022) 	<p>(Continued) Five-point strategy by the MOH:</p> <ul style="list-style-type: none"> iv. Effective risk communication, and v. Digitisation of the health system via the MySejahtera application. (Ministry of Health Malaysia, 2023a) 	<ul style="list-style-type: none"> - Enhance community empowerment approach and community resilience for future pandemic.
Vaccination	<ul style="list-style-type: none"> - The phase 1 COVID-19 National Immunisation Program (NIP) only prioritised healthcare workers and frontliners. - Phase 2 prioritised high-risk group. - Phase 3 is opened to adult population aged 18 years and above. - Lastly, the NIP also covers children aged 5-11. (Ministry of Health Malaysia, 2021a) 	<ul style="list-style-type: none"> - Increased general populations' access to vaccination and continue to emphasise on vaccination. (Ministry of Health Malaysia, 2023a) 	<ul style="list-style-type: none"> - Continued research for advances in vaccine technology and development.
COVID-19 management	<ul style="list-style-type: none"> - Malaysia joined the WHO coordinated Solidarity Trial, involving the testing of remdesivir, a combination of two drugs, lopinavir and ritonavir; the two drugs plus interferon beta; and chloroquine, as a potential treatment for COVID-19. (World Health Organization, 2020) - Establishment of the COVID-19 Management Guidelines in Malaysia in 2020. (Ministry of Health Malaysia, 2020) 	<ul style="list-style-type: none"> - The MOH has updated the COVID-19 Management Guidelines in Malaysia for Annex 2: COVID-19 Admission & Discharge Criteria and Annex 2e: Clinical Management of Confirmed COVID-19 Case in Adult and Paediatric (Ministry of Health Malaysia, 2023b). 	<ul style="list-style-type: none"> - Continued research to discover new drugs and interventions for COVID-19 management.

Table 2. Risk factors of COVID-19 in pregnancy, degree of risk and preventive actions.

Risk factor	Degree of risk	Preventive actions	Reference
Presence of any risk factor during pregnancy	Moderate to high risk	General preventive measures that are applicable to all related risk factors: - Consultation with healthcare provider for guidance. - Pregnant women should be counselled about the increased risk for severe disease from SARS-CoV-2 and the preventive measures to protect themselves and their families from COVID-19. - Encourage adherence to nonpharmacologic measures include practicing social distancing, hand hygiene, and wearing mask as per guidance from the Centers for Disease Control and Prevention (CDC). - Close monitoring of maternal health. - Enhanced surveillance and regular monitoring of COVID-19 symptoms and prompt testing if symptoms develop.	(Centers for Disease Control and Prevention, 2024; Ministry of Health Malaysia, 2022a)
1) Advanced maternal age, especially with age ≥ 40	Moderate risk	- Follow general preventive measures.	(Ministry of Health Malaysia, 2022a)
2) Obesity, especially with BMI ≥ 40kg/m ²	High risk	- Follow general preventive measures. - Emphasize maintaining a healthy lifestyle, including regular physical activity and a balanced diet. - Ensure proper management of overnutrition according to the Malaysian clinical practice guidelines.	(Ministry of Health Malaysia, 2023c)
3) Pre-existing health conditions or comorbidities:	High risk	- Follow general and additional preventive measures for the respective risk factor.	(Ministry of Health Malaysia, 2022a)
(i) Hypertension	High risk	Additional preventive measures: - Close monitoring of blood pressure. - Ensure proper management of hypertension according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2018a)
(ii) Diabetes mellitus	High risk	Additional preventive measures: - Close monitoring of blood sugar levels. - Ensure proper management of diabetes according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2017a)
(iii) Cardiac disease	High risk	Additional preventive measures: - Close monitoring of maternal cardiac health. - Ensure proper management of cardiac disease according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2016)
(iv) Significant lung condition like Tuberculosis, severe asthma	High risk	Additional preventive measures: - Regular monitoring of lung function and respiratory symptoms. - Ensure proper management of lung disease according to the Malaysian clinical practice guidelines and hospital protocols. - Minimize exposure to potential triggers, including respiratory irritants and allergens.	(Ministry of Health Malaysia, 2021b; Ministry of Health Malaysia, 2017b)
(v) Moderate and severe renal diseases	High risk	Additional preventive measures: - Close monitoring of renal function. - Ensure proper management of renal disease according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2018b)
(vi) Patients with liver diseases, including Hepatitis B patients on antiviral	High risk	Additional preventive measures: - Close monitoring of liver function. - Ensure proper management of liver disease according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2022b)

Table 2. continued.

(vii) HIV patients	High risk	Additional preventive measures: - Close monitoring of HIV viral load and CD4 count. - Ensure proper management of HIV according to the Malaysian clinical practice guidelines. - Ensure adherence to antiretroviral therapy for HIV management.	(Ministry of Health Malaysia, 2008)
(viii) Other underlying medical diseases or conditions such as connective tissue diseases, severe anaemia, patients on immunosuppressive therapy, organ transplantation, undergoing cancer treatment, history of splenectomy or asplenia, pulmonary embolism	High risk	Additional preventive measures: - Close monitoring of related organ’s function and symptoms. - Ensure proper management of underlying conditions according to the Malaysian clinical practice guidelines and hospital protocols.	(Ministry of Health Malaysia, 2022a)

Note: The list above is supported by meta-analysis/ systematic review, and other evidence. Please refer to CDC and MOH references cited above.

Table 3. Adverse maternal and perinatal outcomes in pregnant women with COVID-19.

Adverse maternal and perinatal outcomes (Supported by meta-analysis/ systematic review)	Reference
<ul style="list-style-type: none"> • Maternal death, all-cause mortality • Caesarean delivery • Admission to ICU • Invasive ventilation • Extracorporeal membrane oxygenation • Severe COVID-19 • Cardiac, liver, or renal failure • Hypertensive disorders of pregnancy • Gestational diabetes • Preterm birth • Stillbirth • Neonatal death • Low birth weight • Neonatal complications such as pneumonia, respiratory distress syndrome and etc. • Admission to Neonatal ICU 	(Wei et al., 2021; Allotey et al., 2020; Capobianco et al., 2020)
Adverse maternal and perinatal outcomes (Supported by other evidence)	Reference
<ul style="list-style-type: none"> • Miscarriage • Postpartum complications, including postpartum haemorrhage (Limited studies reported outcomes by trimester for symptom onset, making it challenging to assess the rates of miscarriage and postpartum complications.)	Cohort study (Balachandren et al., 2022; Metz et al., 2022; Molina et al., 2022)

Note: The list above is supported by meta-analysis/ systematic review, and other evidence. Please refer to the references cited above.

Table 4. Clinical Stage of COVID-19.

Clinical stage	Disease severity
1	Asymptomatic
2	Symptomatic
3	Symptomatic, Pneumonia
4	Symptomatic, Pneumonia, Requiring supplemental oxygen*
5	Critically ill with or without other organ failures

Note: *In patients who present with hypoxia, it is important to determine if the cause is due to COVID-19 pneumonia or other causes (such as bronchial asthma, fluid overload and heart failure). Hypoxia does not necessarily categorise the patients as category 4.

the ear canal, **(II) “Intrapartum”** transmission at the moment of delivery, through the contact with the maternal genital mucosa and its secretions or with another maternal biological fluid (i.e., blood, fecal matter, urine etc.) and, **(III) “Ascending”** infection - during the pregnancy or the delivery as vaginal ascending infection with the virus passing from the vagina into the uterine cavity via the cervical mucosa (Luca et al., 2023).

While vertical transmission of SARS-CoV-2 is theoretically possible, current data suggest that it is rare (Dumitriu et al., 2021). Transmission of the COVID-19 virus to the foetus can be intrauterine, at the time of labour or after delivery. The extreme preterm babies and babies born to the mother diagnosed with COVID-19 within 14 days of delivery are more liable to get infection. However, most babies born to mothers with COVID-19 were negative for it. A study conducted by Yan et al. (2019) found no cases of vertical transmission to neonates during the third trimester of pregnancy. Another study conducted in Northern Italy reported that a COVID-19-positive pregnant woman who vaginally delivered a baby tested positive for COVID-19 despite the mother wearing a surgical mask and the healthcare provider wearing appropriate personal protective equipment during labour and delivery (Ferrazzi et al., 2020).

The COVID-19 also do not pass through breast milk (Yan et al., 2019). Therefore, the breastfeeding is not contraindicated. Nevertheless, it is recommended that mothers who may be having COVID-19 symptoms to take standard precautions like wearing a mask when breast feeding and washing their hands before touching their baby or breast pump.

COVID-19 Treatment in Pregnancy

In Malaysia, the therapeutic management of pregnant patients with COVID-19 is based on the treatment guideline set by the MOH (Ministry of Health Malaysia, 2023b), namely the COVID-19 Management Guidelines in Malaysia for Annex 2e: Clinical Management of Confirmed COVID-19 Case in Adult and Paediatric.

Likewise, pregnant patients with COVID-19 should receive the same therapeutic management as non-pregnant individuals. It is not appropriate to deny treatment for COVID-19 to pregnant and breastfeeding mothers due to theoretical safety concerns (National Institutes of Health, 2023). Doctors should communicate with patients concerning the use of medications that have been approved for COVID-19 treatments, the medication's safety for the pregnant or breastfeeding mothers and the foetus, and the severity of the mother's illness throughout the decision-making process.

Provided there is a contraindication, every pregnant woman should have her risk of venous thromboembolism assessed and be given the prescription for thromboprophylaxis using low molecular weight heparin (LMWH). In unwell mothers, imaging should be done as

per the recommendations when indicated and without delay due to concerns of potential radiation exposure to the mother or foetus (Ministry of Health Malaysia, 2023b). For COVID-19 positive pregnant or postpartum women (up to six weeks) who require supplemental oxygen, corticosteroid therapy should be administered for ten days or until discharge, whichever comes first (Saad et al., 2020).

The clinical management of the confirmed COVID-19 patients is based on the 5 clinical stages or categories (Ministry of Health Malaysia, 2023b), as stated in Table 4.

Additionally, it is also important to understand the phases of disease for COVID-19 management. Antiviral therapy is beneficial during the early stage of infection, whereas immune modulators and anticoagulation therapy are important throughout the hyperinflammation phase (Ministry of Health Malaysia, 2023b). The diagram below provides an illustration of these phases and their respective treatments.

Currently, the MOH uses two important treatment algorithms for COVID-19: Algorithm 1 for mild to moderate COVID-19 infection (Category 2-3) and algorithm 2 for severe COVID-19 infection (Category 4-5) (Ministry of Health Malaysia, 2023b). These algorithms are presented in Figure 1, 2 and 3.

COVID-19 Vaccination in Pregnancy and Breastfeeding

Based on the previous the MOH COVID-19 vaccination in pregnancy guidelines in November 2021, it was recommended for all pregnant mothers to take the booster dose as an essential initiative to flatten the Omicron curve. Currently, vaccination remains the most effective and safest strategy at protecting people from severe illness, hospitalizations, long-term health outcomes, complications, and death (Ministry of Health Malaysia, 2022a). In Malaysia, the National COVID-19 Immunisation Programme is offering vaccination for all pregnant women between 14-33 weeks of pregnancy. As of 25th June 2021, Malaysia has 3 vaccines available for pregnant women – Pfizer, AstraZeneca, and Sinovac (Figure 4).

As for the safety of COVID-19 vaccines, the Pfizer's messenger RNA (mRNA) COVID-19 vaccine is not infective to the pregnant woman and her foetus because it triggers an immune response by building spike proteins that resemble the surface protein of the SARS-CoV-2 and it is free of live virus. The Pfizer's mRNA-based vaccine has been studied in the developmental and reproductive toxicology (DART) studies by administering high doses of the vaccine (several times higher than the human equivalent) in rodents or rabbits. The study's findings indicate that mRNA vaccines are safe to use during pregnancy without any significant safety signals (Allotey et al., 2020). In fact, accidental pregnancies occurred in the initial clinical trials that have excluded pregnant women and study participants were asked to avoid pregnant, incidences of accidental

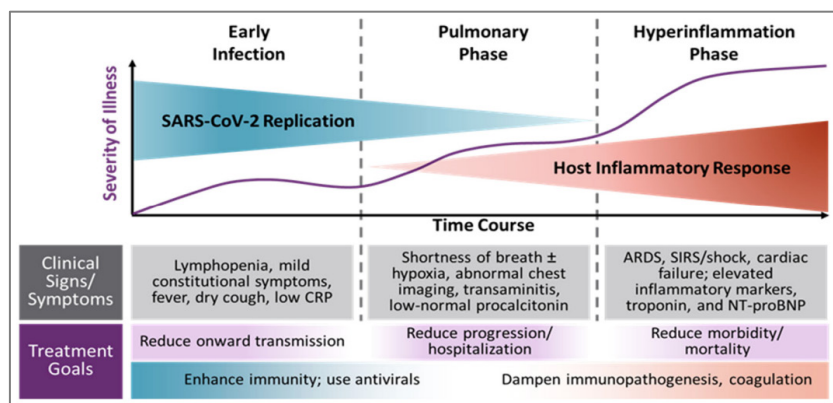


Figure 1. Phases of pulmonary COVID-19 infection and treatments. (Photo courtesy of Ministry of Health Malaysia)

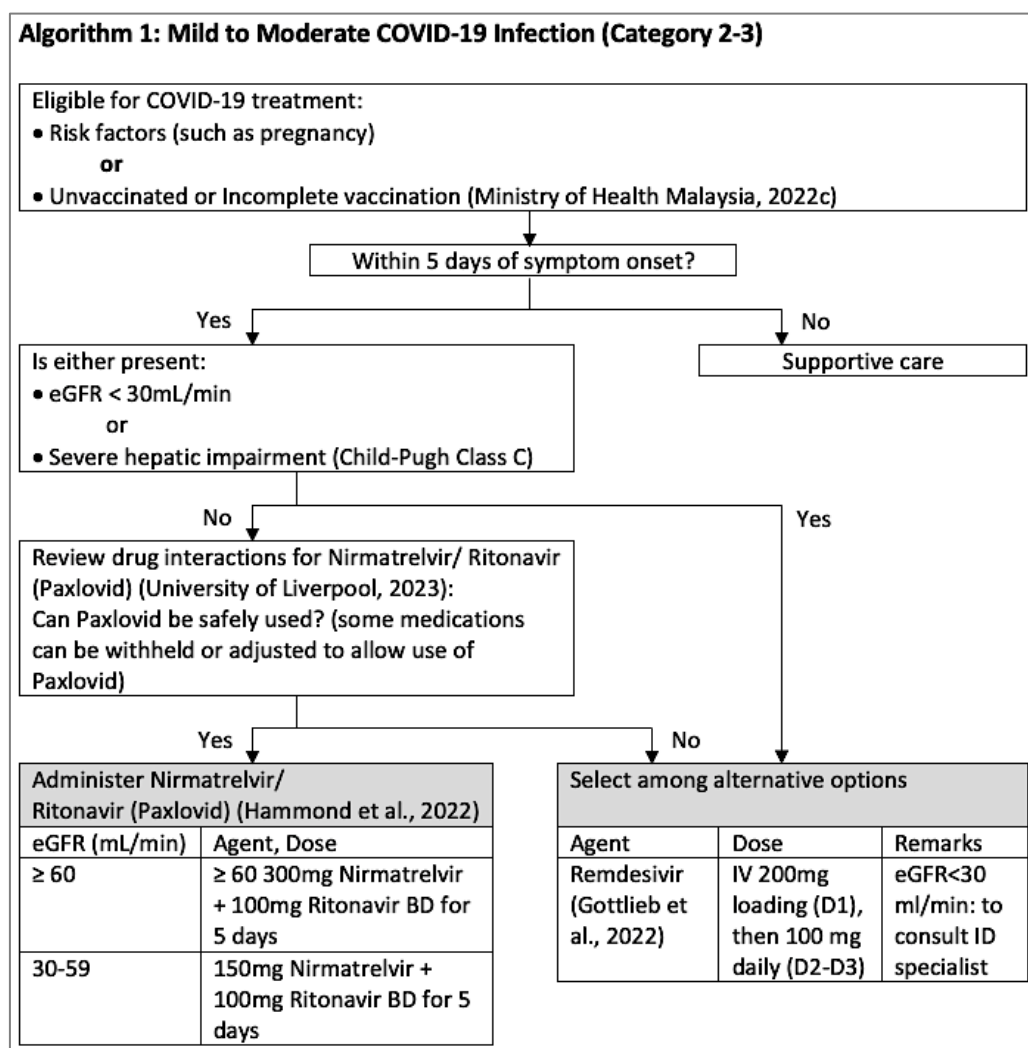


Figure 2. Algorithm 1 – Mild to Moderate COVID-19 Infection (Category 2-3). This algorithm is adapted from the COVID-19 Management Guidelines in Malaysia for Annex 2e: Clinical Management of Confirmed COVID-19 Case in Adult and Paediatric. The authors only included details for COVID-19 treatment in pregnancy. (Photo courtesy of Ministry of Health Malaysia)

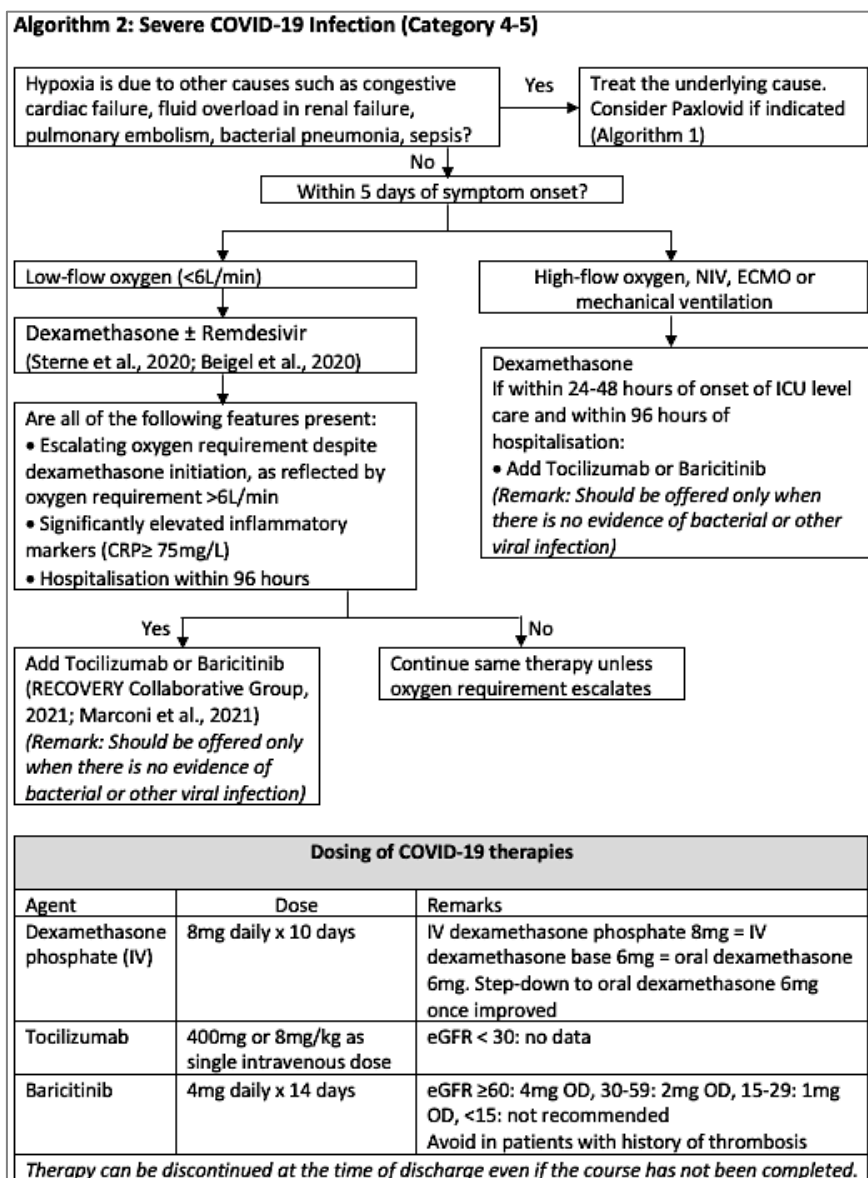


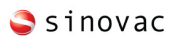


Figure 3: Algorithm 2 – Severe COVID-19 Infection (Category 4-5). This algorithm is adapted from the COVID-19 Management Guidelines in Malaysia for Annex 2e: Clinical Management of Confirmed COVID-19 Case in Adult and Paediatric. The authors only included details for COVID-19 treatment in pregnancy. (Photo courtesy of Ministry of Health Malaysia)

	Pregnant mothers	Lactating mothers
	Suitable for pregnant mothers between 14-33 weeks of pregnancy	Suitable to be vaccinated
	Suitable for pregnant mothers between 14-33 weeks of pregnancy	Suitable to be vaccinated
	Suitable for pregnant mothers between 14-33 weeks of pregnancy	Suitable to be vaccinated

• For gestational beyond 33 weeks, vaccination may be possible after consultation with a doctor
 • Please consult a doctor if you have any concerns
 • Updates on vaccines' suitability will be informed from time to time

vaksincovid.gov.my




Figure 4: COVID-19 vaccines for pregnant and lactating mothers. (Photo courtesy of Special Committee on Ensuring Access to COVID-19 Vaccine Supply (JKJAV), Ministry of Health Malaysia)

pregnancies occurred in both vaccinated and unvaccinated groups have also showed that the vaccine did not prevent pregnancy (Allotey et al., 2020). Thus, these findings support the MOH guidelines that recommend pregnant and breastfeeding mothers in Malaysia to receive the Pfizer vaccination.

AstraZeneca, Johnson & Johnson and CanSinoBio are vector-based vaccines. Based on available pregnancy data, there are no reported concerns for pregnant and breastfeeding mothers to receive vector-based vaccines (Allotey et al., 2020; The American College of Obstetricians and Gynecologists, 2023). According to the available data, pregnant women have safely received vector-based vaccines such as Zika and Ebola vaccines. Although not contraindicated as it is not a live vaccine, pregnant women who are keen to receive the AstraZeneca vaccine should discuss with their doctors to fully understand the risks and benefits before making a decision. As for breastfeeding, the WHO Strategic Advisory Group of Experts on Immunisation (SAGE) interim guidelines on AstraZeneca do not recommend stopping breastfeeding after immunisation, nor is it contraindicated for breastfeeding mothers (World Health Organization, 2022).

Sinovac uses inactivated vaccines, such as Hepatitis B and Tetanus with well-established safety profiles. Given the mechanism of these inactivated vaccines which do not contain live virus, it is unlikely for it to cause an infection. Regarding the safety of vaccine administration during pregnancy, currently, there is no known risk associated with administering inactivated virus or bacterial vaccines or toxoids during pregnancy or whilst breast-feeding (Allotey et al., 2020; Centers for Disease Control and Prevention, 2022). Moreover it has been years since vaccinations such as tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) and influenza vaccine have been administered to pregnant women without evidence of harm to the foetus (Centers for Disease Control and Prevention, 2022). Considering the advantages of Sinovac outweigh any possible risks, it is still recommended for pregnant and breastfeeding mothers, regardless of the lack of safety data related to the use of Sinovac in pregnancy.

Since there is limited safety data regarding inactivated vaccine (Sinovac) and less experience with regards to the use of vector-based vaccine (AstraZeneca) as compared to the mRNA vaccine (Pfizer), the Pfizer's mRNA vaccine remains the preferred option for pregnant women in Malaysia due to large evidence studies and availability of safety data by the MOH (Ministry of Health Malaysia, 2021c).

Management of Unvaccinated Pregnant and Lactating Mothers

To date, vaccination remains the most effective strategy for preventing severe illness from COVID-19, but misinformation has left many hesitant about its efficacy and safety. Some popular COVID-19 vaccine myths include the COVID-19 vaccine affects

fertility, it has a secret tracker microchip, the AstraZeneca COVID-19 vaccine causes blood clots and the COVID-19 vaccine changes people's DNA (Cascini et al., 2022). As a consequence, vaccine hesitancy not only continues to limit the country's effort in combatting the resurgence of COVID-19 cases but also poses significant barriers to achieving vaccination coverage and protecting pregnant women and children (Ruhi et al., 2024). As such, pregnant and breastfeeding mothers who refuse and remain unvaccinated are treated as higher risk. Therefore, it is crucial to manage unvaccinated pregnant and lactating mothers appropriately.

Concerning the management of pregnant women with vaccine hesitancy, healthcare providers serve as reliable information sources and play a vital role in addressing misinformation and helping to build trust in COVID-19 vaccination. In Malaysia, healthcare workers follow the MOH's latest COVID-19 Management Guidelines, Annex 23a: Guidelines on the Management of COVID-19 in Obstetrics (Ministry of Health Malaysia, 2022a) in managing unvaccinated pregnant and lactating mothers.

When a patient refuses the COVID-19 vaccine, the initial step is to conduct a risk assessment (Ministry of Health Malaysia, 2022a). It is crucial to assess and understand the reasons behind vaccination refusal in terms of one's perspective, and cultural or religious beliefs. Healthcare personnel should pay attention to the patient's reasons for declining the vaccination and explore their concerns in a non-judgmental manner. Throughout the process, it is important to respect the patient's decision and reasons to refuse vaccination.

Next is education and communication (Ministry of Health Malaysia, 2022a). Pregnant women who refuse vaccination despite being at risk should be given the opportunity for further discussion with an obstetrician or gynaecologist and should be documented in their clinical notes (Ministry of Health Malaysia, 2021c). Doctors or specialists in related fields should provide extra counselling to pregnant women who refuse the vaccination, even if they haven't previously contracted COVID-19. Doctors should offer updated and reliable information regarding the safety, efficacy, and advantages of vaccinations and booster shots during pregnancy to patients and their partners. It is also important to discuss the risk of COVID-19 infections during pregnancy including severe illness, and maternal and foetal adverse outcomes.

In addition, reassurance is another important aspect. Doctors can reassure patients by explaining the stringent safety monitoring processes for vaccines, including scientific evidence on vaccine safety in pregnancy. Healthcare providers should also try to address any concerns or misconceptions the patient may have and emphasize the importance of vaccination in protecting maternal and foetal health. An approach that may reassure them if they are

worried about the adverse effects is to offer the vaccination under close surveillance (Ministry of Health Malaysia, 2022a).

Patient-centred care with the provision of ongoing support and guidance throughout the vaccination process is essential to offer continuous motivation and encourage vaccine uptake. As the doctor-patient relationship is a key driver of clinical outcomes, building trust between healthcare providers and pregnant women is crucial for promoting vaccine acceptance.

Other managements for unvaccinated pregnant and breastfeeding mothers include increasing vaccination opportunities and availability at every antenatal visit, advising patients to seek medical attention for early diagnosis, admission, and management if a fever occurs due to higher susceptibility, patients are not recommended to practice home quarantine as their risk of developing severe infection is high, and monoclonal antibodies can be considered if unwell (Ministry of Health Malaysia, 2023b). It is recommended to practice general measures for the prevention of infection such as avoiding crowded places and unnecessary travel, wearing a three-ply mask in public areas, practising hand hygiene and adhering to standard operating procedures issued by the Ministry of Health.

The Role of Digital Health Platforms and Community Engagement Initiatives

Ever since the onset of the COVID-19 pandemic, healthcare organizations worldwide have been increasingly exploring and implementing advances in digital health technologies to enhance patient care, improve healthcare delivery, and strengthen resilience in the face of public health crises. The digitisation of the health system during the COVID-19 pandemic has played a vital role in the prevention and control of COVID-19 by improving surveillance, enabling remote consultations and telemedicine, providing health information, and navigating vaccine information to improve vaccine confidence and uptake (Marzo et al., 2023). With the risk of infection abounding under the COVID-19 paradigm, the public prioritises online platforms for healthcare services and access to health information. Research shows that the use of digital platforms such as social media and networking sites for cognitive needs fulfilment in acquiring health information is linked to better physical and mental health quality (Marzo et al., 2024; Chen et al., 2023). This indicates reliable health information technology can be a powerful tool for improving patient care and health outcomes.

Nevertheless, the continued appearance of emerging and re-emerging infectious diseases as potential threats and outbreaks (Najimudeen et al., 2022; Jun Chen et al., 2021), shed light on the importance of digital platforms use in enhancing pandemic preparedness in the future. However, inclusive public health policies and practices are extremely crucial in enabling more access to health information via digital health platforms among vulnerable

and marginalised groups, and promoting self-care and health information-seeking behaviour. With that, community engagement initiatives are paramount to ensure that the promotion of preventive measures can be effectively communicated and delivered to diverse populations, including marginalised communities and support equity-informed responses (Gilmore et al., 2020).

For instance, community engagement initiatives can make certain that health information is reachable to rural communities when digital health platform is not accessible. Community health intervention programs also able to bridge the language and cultural gap to tailor health promotion and education to local communities (Gilmore et al., 2020). Such activities can foster social support and trust within the community, which is important to promote COVID-19 vaccination by addressing vaccine hesitancy and misconceptions. Therefore, both digital health platforms and community engagement initiatives are equally important as these cater different populations with varies needs.

Conclusion

The recent COVID-19 surge in Malaysia during December 2023 was due to the Omicron sub-variants. Although the latest variant is less severe compared to previous variants, pregnant women are still considered at high risk for severe disease from SARS-CoV-2. Pregnancy with COVID-19 increases the risk of adverse maternal and foetal outcomes such as maternal death, admission to ICU, invasive ventilation, stillbirth, preterm birth, neonatal death, low birth weight, neonatal complications and admission to NICU. To date, there is limited data that indicates vertical transmission of COVID-19 to newborns. In terms of management, the MOH has updated the COVID-19 management guidelines. Nirmatrelvir/Ritonavir (Paxlovid) and Remdesivir can be considered in pregnant or breastfeeding mothers after a risk-benefit assessment. All pregnant women should be vaccinated against COVID-19. Pfizer, AstraZeneca, and Sinovac are COVID-19 vaccines included in the National COVID-19 Immunisation Programme for the vaccination of all pregnant women between 14-33 weeks of pregnancy in Malaysia. For public health measures, without the need to reactivate lockdowns or MCOs, the MOH developed a five-point strategy in response to the recent surge in COVID-19 cases in the nation. These include monitoring health facilities, effective risk communication, digitisation of the health system via the MySejahtera application, early case detection via the Heightened Alert System (HAS), and community tracing via the TRIIS (test, report, isolate, inform and seek) system. Currently, general precautions including immunisations, mask use in crowded areas, and hand hygiene are strongly recommended.

Future research is required to gather more reliable data to further elucidate these findings, assess and evaluate the Malaysian MOH

five-point strategy and COVID-19 management, and improve preventive measures for pregnant COVID-19 patients.

Author contribution

H.W.J.C., M.N. conceptualized; H.W.J.C., J.R.N., S.R. reviewed the literature; H.W.J.C., M.N., R.R.M., H.A. wrote, prepared the draft; A.Y.Y., M.F.B. wrote, reviewed, edited; F.S., M.A.A. supervised the article. All authors have read and agreed to the published version of the manuscript.

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Competing financial interests

The authors have no conflict of interest.

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