

A literature review on the impact of COVID-19 pandemic towards patients living with chronic diseases

Wei Thing Sze, Siew Yung Huong, Shi Ying Oon, Idham Bin Zaharudie, Vijay A/L Sundaresen

Faculty of Pharmacy, SEGi University, Selangor, Malaysia

Article Info

Article history:

Received Jul 19, 2021

Revised Apr 15, 2022

Accepted Jun 21, 2022

Keywords:

COVID-19

Chronic disease

ABSTRACT

The coronavirus disease 2019 (COVID-19) has changed the daily living of people, especially those with chronic diseases. This study aimed to review the recent evidences on the impact of COVID-19 pandemic towards patients living with chronic diseases. The database and search engines used for this literature review are PubMed and Google Scholar. Abstracts were reviewed for relevance to the topic and a total of 17 articles were deemed pertinent to be summarised. Cancellation or postponement of medical consultations or procedures for chronic diseases was reported. Patients with chronic diseases also suffer worsening mental health. COVID-19 has also impacted the lifestyle of patients with chronic diseases due to reduced opportunity to go outdoors, inaccessible to fresh food, and disrupted sleep. Some pharmaceutical manufacturers shifted their focus to producing medical equipment and pharmaceutical preparations to fight against COVID-19. Difficulties in medication distributions owing to lockdown measures had been reported, as well as shortage of healthcare resources in delivering care for chronic diseases. A relationship between COVID-19 pandemic and worsening of chronic diseases was also reported. Evidence-based strategies are needed to better direct the management of chronic diseases during this unprecedented time and beyond, such as the use of telehealth and education on self-management of chronic diseases.

This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Wei Thing Sze

Faculty of Pharmacy, SEGi University

Jalan Teknologi, 47810 Selangor, Malaysia

Email: weithing@gmail.com

1. INTRODUCTION

The coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organization (WHO) due to its global spread within months. Most people who were infected with this disease experience mild to moderate respiratory symptoms and recover without needing any extraordinary therapy, however for elderly and people with underlying comorbidities like diabetes mellitus, heart diseases and cancer, they usually develop more serious illnesses [1]. Chronic diseases have been consistently associated with higher healthcare utilisation and worsening health outcomes when care is disrupted [2]. Before the COVID-19 pandemic, previous studies had shown that patients with chronic conditions are often not receiving optimal care [3]. These shortfalls in the chronic disease management was aggravated even more during the COVID-19 pandemic. The pandemic has immensely affected the daily lifestyle of the people. Social distancing, travelling restriction, closing borders, and changes in healthcare systems were implemented to accommodate the current pandemic. Online education, working from home, limitation of group exercises and gym activities, stockpiling of food to reduce grocery shopping has become a norm [4]. However, these measures also brought consequences such as diminished access to healthy food, widening of

inequities between communities, suboptimal physical activity levels, exacerbation of anxiety and stress, impairment of the quality of optimum sleep, as well as substance abuse to allay anxiety and fear of the disease [5]. Healthcare resources have shifted away from chronic disease management and prevention during the COVID-19 outbreak, and there has been lockdown on certain health services, a decrease in referrals and reduced hospitalisations of patients who were not infected by COVID-19 [6]. There has been scattered reports suggesting that patients with chronic diseases have postponed visits to health institutions [6], some of them because of the fear of getting infected with the coronavirus [7].

Due to high infection risk and tight resources, health care providers have been struggling in managing chronic care provision amidst the peak of the outbreak [8]. Patients' worsened health outcomes during the pandemic could be attributed by the unintended consequences of preventive measures and lockdowns to combat the pandemic [9]. Although these strategies have helped in delaying the spread of COVID-19, they have brought forth impacts on people's daily living, especially those who have chronic diseases and need long term medication supply. In addition, the interruption of the work routine caused by the quarantine could result in boredom, which in turn is associated with a greater energy intake [4].

These concerns indicate the need for a more in depth analysis of the impact of COVID-19 pandemic among the population battling with chronic medical conditions. Important research questions that we would like to address in this review in relation to COVID-19 crisis are: How does COVID-19 pandemic impact the patients living with chronic diseases? Since lifestyle is key to management of chronic diseases, does COVID-19 pandemic alters the lifestyle of patients living with COVID-19? What are the other impacts to the overall health system that indirectly affect the care for patients living with chronic diseases?

This paper will address the gaps in the literature by providing a broad overview on the impacts brought by COVID-19, which can be a reference for health care professionals to take note on as the world continues to battle with the COVID-19 pandemic. This review of literature aims to explore the impact of COVID-19 pandemic towards patients. This may be essential for the health care professionals to understand the issues faced by the patients and develop strategies to rectify the problems in the future, such as the potential of telehealth in chronic disease and medication management [10]. Better understanding can enable us to identify ways to increase the resilience of the health system and be better prepared for flare-ups of the COVID-19 pandemic and other emergency situations. By reviewing studies that were carried out globally, it permits knowledge and experience sharing among health care professionals for the better management for patients living with chronic diseases.

2. RESEARCH METHOD

The databases and search engines used for this literature review are PubMed and Google Scholar. A total of 4,241 registers were obtained with the keywords of "COVID-19 pandemics" AND "chronic disease". Further specification of the search by using MeSH terms like "COVID-19 pandemics", "chronic disease", and "pharmaceutical preparations" filters the searches till 72 registers are left. All the relevant articles included were published as of May 16th, 2021; any articles published thereafter were not included.

The study was conducted according to the Prisma Methodology for Preferred Reporting Items for Systematic Reviews and Meta-analyses, protocols 2020 [11]. The criteria that were established for the selection of the articles were papers relating to the chronic disease management or lifestyle of patients suffering from chronic diseases during the COVID-19 pandemic. Case reports, non-human studies, studies which were not chronic disease-related, studies with no major outcome of interest, reversed relationship, as well as articles with no abstract were excluded accordingly. A first preliminary reading of the title and summary of each article were independently screened by the authors which made it possible to rule out papers that did not meet the above-mentioned criteria. The complete article was reviewed in cases of a difference of opinions on the inclusion based on title or abstract, and disagreement on the inclusion of a full-text article was discussed with all the authors. Studies that did not meet the inclusion criteria were excluded from full text review and disagreement between researchers was resolved through discussion. A more exhaustive reading of the selected articles was then carried out, leaving a final sample of 18 scientific papers that were sought for retrieval. After excluding one article due to foreign language (non-English), the total number of articles used for the final review is 17. Finally, all the articles are read in full text and data extraction was performed. The preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram illustrates the search process as shown in Figure 1.

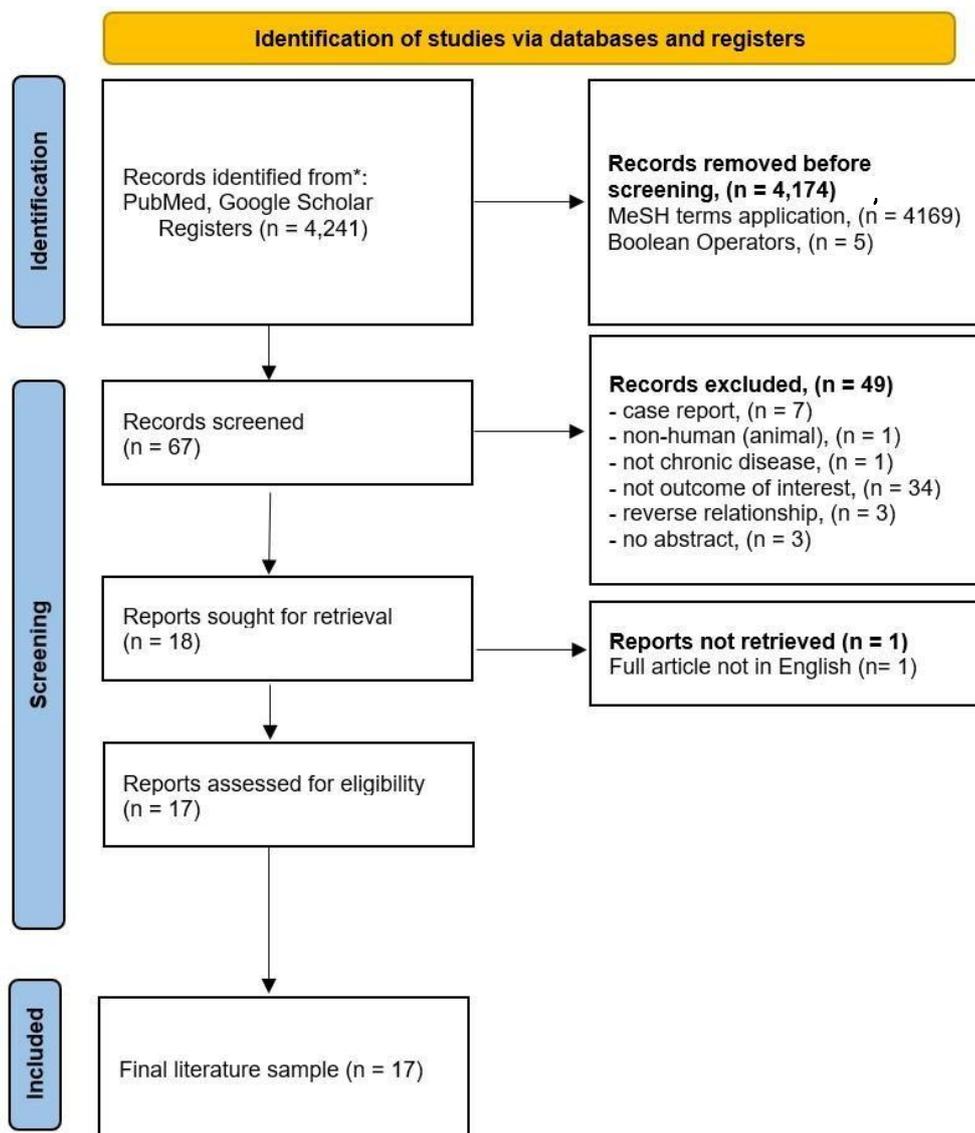


Figure 1. PRISMA diagram on literature search process

3. RESULTS AND DISCUSSION

Our findings revealed several impacts of COVID-19 pandemic towards management of chronic diseases, which include cancellation or postponement of routine check-ups and elective procedures for chronic diseases, deterioration of mental health and changes in lifestyle practice among people living with chronic diseases, interruptions of medication supply, shortages of healthcare resources in chronic disease care, and worsening of chronic diseases.

3.1. Cancellation or postponement of routine check-ups and elective procedures

In an attempt to contain the transmission of virus during the COVID-19 pandemic, many countries decided to implement measures such as lockdown. Patients with chronic medical conditions who require regular medical consultations, health screenings and prescriptions refills may face barriers in accessing the health facilities. Eleven publications addressed a common issue, which was the cancellation or postponement of regular consultations or procedures for chronic diseases. The findings are summarised in Table 1.

Table 1. A summary of literature on cancellation and postponement of medical care or procedures for patients with chronic diseases during COVID-19 pandemic

Author(s)	Main focus(es)	Findings
[11]	Routine care for chronic diseases Care for patients with end-stage renal disease (ESRD)	<ul style="list-style-type: none"> • Cancellation of outpatient appointments • Postponement of treatment leads to moderate or severe effects • Deferred vascular access procedures due to the risk of infection during the pandemic • 82% of cancellation rate for elective and non-oncologic surgeries in three months • Rejected access to health facilities or physicians
[12]	Chronic disease management and medication adherence in low-and-middle income countries (LMICs) Patients with Chronic Rheumatoid Arthritis	<ul style="list-style-type: none"> • Reduced access to care causes rises in exacerbations of rheumatoid arthritis, increased pain experiences and functional alteration
[13]		<ul style="list-style-type: none"> • Cases surge with limited number of rheumatologists causes delay in diagnosis, inaccessibility to urgent care and further burdening the primary care system
[14]	Patients with non-communicable diseases (NCD) Patients with NCDs	<ul style="list-style-type: none"> • Mental disorder patients unable to follow-up regularly with doctors for evaluation and prescription review <p>Scaling down of outpatient visits caused reduced medication adherence.</p> <ul style="list-style-type: none"> • Disallowance of primary cancer screenings (i.e. colonoscopy) for patients who do not have significant risk and cause delay in diagnosis.
[15]		<ul style="list-style-type: none"> • Delay of cancer treatments (e.g. radiation therapy, chemotherapy) due to reduced capacity of operating rooms and provider reassignment • Lengthened interval for regular surveillance visits of cancer survivors and secondary screening
[16]	Care for patients with cardiovascular disease (CVD)	<ul style="list-style-type: none"> • Delays in blood pressure control due to suspended routine screening and follow-up increased the rate of CVD events.
[17]	Patients with chronic heart failure	<ul style="list-style-type: none"> • Interruption of follow-up appointments
[18]	Patients on home dialysis	<ul style="list-style-type: none"> • Short-term deferral of the non-essential routine tests • Continuous ambulatory peritoneal dialysis becomes the default option for patients on home dialysis due to less time-consuming and simplicity.
[19]	Patients with diabetes mellitus Cirrhosis care	<ul style="list-style-type: none"> • Delayed essential interventions • Deferral of routine care (e.g., screening) for varices and hepatocellular carcinoma (HCC) and cancellation of elective therapeutic procedures increases complications like variceal hemorrhage, diagnosis of HCC at later stage.
[20]		

The table shows that there has been deferral of routine care across different chronic medical conditions such as liver disorder, diabetes, cardiovascular diseases, mental health, and rheumatoid arthritis. Deferral of care may be associated with the intensity of the surrounding epidemic in the region [21]. There were decrease in hospital admissions and emergency department visits during the COVID-19 pandemic compared to baseline [22]. Rates of heart failure-related hospitalizations decreased 40–50% during the COVID-19 period compared to before [23].

It was reported that avoidance of routine medical care during COVID-19 pandemic was highly prevalent among unpaid caregivers for adults, persons with two or more underlying medical conditions, and persons with disabilities [24]. There is a need to address the fears about exposure to coronavirus among patients living with chronic diseases. Patients should be given the reassurance that the healthcare institutions are following safety precautions to prevent transmission in the clinics and hospitals.

It is also important to promote the importance of seeking the routine medical care among people living with chronic diseases [25]. The deferrals in health care seeking among patients could also be due to the economic impacts caused by COVID-19 pandemic [26], therefore policymakers will need to address other long-standing concerns like poverty, financial instability, and affordability of health insurance to ensure equitable access to medical care [27].

3.2. Psychological impact and deteriorated mental health

A global survey done by Chudasama *et al.* [11] revealed that 80% of the healthcare professionals reported worsened mental health of patients during the pandemic. Likewise, Leo Sher reported that individuals with chronic psychiatric disorders are especially vulnerable, therefore were critically affected by this crisis [28]. Existing literature points to a significant association between mental health conditions and chronic diseases, such as diabetes mellitus, cardiovascular diseases and pneumonia [29], [30]. Chronic stress, economic difficulties, social isolation, fear of contagion and uncertainties were said to cause further development or worsening of existing mood disorders. Giving up treatment among patients having chronic diseases was noted [28].

Fear of contagions has been a common impact for patients having chronic diseases, rendering them avoiding visiting hospitals for regular consultations even when urgent medical care is warranted [12], [13],

[20], [31]. It has been demonstrated that those who have been exposed to the risk of infection may develop extensive fears about their health, worries to infect others and fear of infecting family members [32], [33]. Kretchy *et al.* underlined the negativity due to pandemic that left many chronic disease patients feeling hopeless about their health status, hence reducing compliance and even eroding health revenues gained before the crisis [13].

Moreover, Oreskovic *et al.* reported that fear of using corticosteroid among patients due to the suggested statement of having delayed effect on viral clearance and increasing death in COVID-19 patients had largely limited the use of this medication in asthma control, thereby leading to an increment in acute asthma attacks and its severity [34]. A similar scenario was discussed by Palmer *et al.* who emphasized the influence of the media during this pandemic. For instance, the spreading of premature findings that claim Angiotensin-converting-enzyme inhibitors or Angiotensin II receptor blockers have the potential to increase the contracting risk and seriousness of COVID-19 has made patients stop their medications which indeed jeopardised their health [15]. Poor or inadequate information from public health authorities may be a stressor for people living with chronic diseases, such as confusion about the measures implemented to prevent the pandemic spread as well as contradictory health messages [32].

To mitigate the impact of COVID-19 pandemic on the mental health of patients with chronic diseases, telemedicine, telephone helplines, online social support groups, dedicated blogs and forums should be readily available [35]. The scientific community should disseminate evidence-based information to attenuate the impact of fear and anxiety among the public. Public health policymakers should not neglect incorporating mental health outreach strategies to patients with existing chronic disease.

3.3. Lifestyle changes

As discussed earlier, the implementation of lockdown during the pandemic has a profound impact on patients with chronic diseases. Reasons for this include the reduced opportunity to go outdoors, inaccessible to fresh food supply, economic hardship and poverty. Palmer *et al.* highlighted physical activity as of particular importance for patients with chronic medical conditions, since lifestyle modifications are necessary to mitigate these diseases in the long term [15]. Reduced exposure to sunlight that eventually gives rise to Vitamin D deficiency were known to compromise the management of obesity, hypertension and diabetes. This impact is noteworthy as evidence has shown a linkage between vitamin D deficiency and compromised immunity [36]. Reduced physical activity during the pandemic has caused deterioration of their diabetic condition, due to unnecessary weight gain [20], [37]. Despite counteracting measures taken to increase overall activity at home by offering online “at home physical activity classes” through various social media platforms, present results indicate that it has not been possible for individuals to adequately maintain their normal activity patterns with suggested home activities [38]. On the other hand, Oreskovic *et al.* highlighted the negative impact of confinement in a limited indoor space [34]. Despite the benefits of reducing exposure to viruses and reducing complications that may worsen asthma by limiting outdoor activities, the authors pointed out that exposure to harmful indoor matter including second hand smoke and allergens like mold could further worsen or exacerbate asthma.

Since dietary habits also play an important role in most chronic disease management, inaccessibility to fresh food posed a major challenge during this pandemic [15]. Tapper *et al.* stated malnutrition following long term consumption of cheap processed foods, which indirectly hindered salt restriction and worsened the volume overload in patients with cirrhosis [39]. This statement was supported by Caballero *et al.* who discovered increased snacks and carbohydrates intake by patients during the pandemic [20]. It is well known that the experience of negative emotions can lead to overeating, the so-called “emotional eating” [40]. Similarly, an international online survey identified unhealthier food consumption and meal patterns, as well as decreased physical activity and increased sedentary time, during quarantine [41]. A study in Italy also revealed that people with chronic medical conditions were associated with a higher prevalence of sleep disturbances during COVID-19 lockdown [42]. Sleep disorders has been associated with various non-communicable chronic diseases such as hypertension and diabetes [43], [44]. A change of routine to accommodate with the pandemic can alter the architecture of sleep and further exacerbate the sleep quality of people living with chronic diseases [45]. There is a need to promote health awareness on the importance of physical activities, balanced nutritional intake, and healthy lifestyle in order to cope with COVID-19. The increasing penetration of smartphones and wearable devices provide attractive means of continuous monitoring people’s health and lifestyle remotely [46].

3.4. Interruptions of medication supply for chronic diseases

In light of this pandemic, many manufacturers shifted their focus to producing medical equipment and medicines to fight against COVID-19 and there has been a reduction in medications imports and exports [13]. For low-and-middle-income countries (LMICs), this impact is particularly severe as they rely heavily

on pharmaceutical imports to get medications. Bell *et al.* also highlighted the disruption of supply and shifts in demands as culprits of medication shortage [47]. Most of the pharmaceutical companies perform drug manufacturing just-in-time to avoid unnecessary costs and maintain efficacy. Consequently, with limited supply of chronic disease medicines to fulfill the escalating demand, the prices of medications have increased, making them unaffordable for patients in LMICs [13]. Besides, the uncertainty of pandemic has resulted in stockpiling and panic buying of medications. This leads to inequity of medication, especially for drugs like Salbutamol, Budesonide and Hydroxychloroquine which are in high demand during COVID-19. Eventually, the supply of essential medications has been kept down with supplementary restrictions to retain the equity of supply to all patients [47].

As chronic disease management requires strict continuous compliance for sufficient therapeutic outcomes, the intermittent medication supply may not be effective for managing chronic disease in the long term [48]. Cooperation between different governmental agencies is crucial to overcome the challenges in obtaining medication supplies for chronic diseases. Inter-ministerial discussion and collaboration can be done to obtain the approval for the pharmaceutical manufacturers and related companies to operate like normal at full force during the COVID-19 pandemic. Cooperation between different nations is equally important to manage the exportations of pharmaceutical products as well as active pharmaceutical ingredients [49].

It is imperative for the pharmacy departments to monitor the stock status of medications used for chronic diseases [49]. Taiwan Food and Drug Administration (FDA) had set up a drug supply and shortage information network in which an online platform is provided for the public to report cases of medication shortages [50]. On the community level, community pharmacies can support the drug supply of chronic disease patients through real-time information sharing on drug purchase and drug delivery services. Pharmacies can also share the information of drug availabilities and its store locations online or through mobile applications to guide patients when they need to buy medications [51].

3.5. Shortages of healthcare resources and healthcare system breakdown

Szymanski *et al.* illustrated that lack of preparedness of the healthcare system against the pandemic had led to a significant shift in healthcare resources [52]. Redeployment of staff to fight COVID-19 indirectly burdened the load of healthcare providers [20]. In addition, the rise in urgent cases due to delayed or inaccessibility to healthcare services during this unprecedented period further burdened the primary care system [14].

COVID-19 pandemic also led to a shortage of manpower due to the high number of infected healthcare providers and the need to quarantine those who had been in close contact with suspected or confirmed infected patients [7], [12]. Lack of staff in providing integrated care in the management of chronic disease contribute to poor effects for the treatment outcome for patients with multimorbidity [7]. The COVID-19 pandemic has also brought financial consequences on healthcare systems throughout Europe due to redistribution of healthcare resources [7]. The socio-economic gap together with poor quality access to health care has become even more evident in these times, and the inequitable health access within LMICs is further widened by the COVID-19 pandemic [13].

Truong *et al.* reported that the shortages of dialysis machines, staffs, personal protective equipment and continuous renal replacement therapy solutions had been the challenges for the nephrology community in the USA at this time. Consequently, these circumstances increased the frequency of intermittent hemodialysis, shortened treatment times as well as the rationing of dialysis. Lack of staff had also significantly limited the ability of medical facilities to dialyse both inpatients or outpatients [12]. Also, Yerram and Misra had brought up the concern that disruption of medical supply chains would influence the delivery of home dialysis supplies to patients [19]. There is a need for contingency and crisis strategies to cope with the disruption of the healthcare system brought by the pandemic, such as considering alternate care sites for the provision of chronic disease care for patients with COVID-19, and implementing return to work criteria for providers contracting the virus to ensure minimal disruption to the care for patients with chronic diseases [53].

3.6. Worsening of chronic diseases

A relationship between COVID-19 pandemic and worsening of chronic diseases had been reported. 67% of the healthcare professionals rated moderate to severe effects for the status of patients with chronic diseases, indicating that the diseases were not well-managed [11]. COVID-19 wave had resulted in uncontrolled blood glucose level in diabetes patients which potentially contributed to the increased rate of various complications such as diabetic foot ulcers, ketoacidosis and hyperosmolar syndrome which may eventually lead to coma or death [20]. The financial burden incurred by lockdown and loss of employments also rendered patients unable to afford medications or self-monitoring equipment. Consequently, patients tend to skip their medications to cover more days of treatments, which eventually contribute to disease complications [20], [39].

Bhatia *et al.* illustrated the rise in exacerbations of rheumatoid arthritis, along with increment of pain experiences and functional alteration amidst lockdowns due to the reduced access to care and additional risk of flares of disease [14]. Patients with chronic medical conditions are predisposed to a greater risk of worsening health outcome from the pandemic since combatting the virus requires a strong immune system. Furthermore, chronic diseases like renal diseases, diabetes mellitus and HIV are immune-compromising, thereby posing patients even more easily to be infected and difficult to manage [13]. Likewise, Puntillo *et al.* reported a quicker progression of chronic pain during the pandemic. Untreated chronic pain can weaken the immune system, thereby eliciting immunosuppression [31]. Moreover, the usage of steroids in pain management which alters immune response might eventually worsen patients' disease status [54].

One study pointed out that worsening of chronic conditions was associated with the decreased admittance rate for non-COVID-19 cases [48]. The claim was sustained by a study conducted by Hall *et al.* which showed an approximate decrease of 50% in the number of hospitalisations for heart failure [55]. From the worrying data, the authors discussed the issue of increased mortality and worsened patients' prognosis during the pandemic, especially in the long run. Likewise, a study done by Tano *et al.* showed that 25% of the 110 chronic heart failure patients presented with worsened general conditions during the crisis [18].

Our findings reveal the importance of supporting telehealth, chronic disease self-management, and care coordination among providers. In the time of lockdowns and restricted movements, health care providers can apply technology to remind patients of their medications and lifestyle regimen in order to enhance adherence [56]. Health care providers in the community, such as community pharmacists can be entrusted with the responsibility using their judgement to review prescriptions for patients with chronic diseases and provide appropriate medication review [13]. Health care providers need to adapt new ways of virtual healthcare and digital technologies to continue the routine appointment and treatment monitoring. Self management of chronic conditions should be highly encouraged among patients, such as continuous glucose monitoring through mobile health apps to enable continuous support with for patients with diabetes [11].

3.7. Other impacts

Four studies, all originating from the US, reported other impacts of COVID-19 pandemic. In response to the pandemic, the majority of healthcare systems adapted several models to deal with uncertainties. Those changes might give rise to health inequality as has been discussed by Truong [12]. Prioritisation of procedures with higher revenues rather than the urgency of the procedures was observed during the pandemic. This is mainly attributed to the shortfalls of revenue as a result of cancellation that has been discussed earlier.

Moreover, a systematic review done by Chang *et al.* had reported decreased donations of blood, bone marrow and solid organs owing to fear of contagion in healthcare facilities [16]. There is also reduction of donor liver transplantation due to uncertain availability of hospital beds and blood products, which increased the mortality of waitlisted patients [39]. On the other hand, since the beginning of the pandemic, improved air quality due to the reduced number of vehicles on the roads has provided a positive impact on asthma. In addition, potential increase of vigilance and medication adherence in children with asthma could be seen under concerns of parents or caregivers during the current respiratory illness pandemic [34].

Plevinsky *et al.* illustrated the possible changes within the family system during the pandemic. The youths were forced to be independent to perform their self-care routines when their caregivers were occupied with work. On the contrary, better adherence and self-management could be observed with the increased parental supervision and support at home. Additionally, paediatric patients were likely to envisage reduced access to medical care and support which are provided by their school system in response to school closings [57]. Impact of the pandemic towards low-socioeconomics communities has also been addressed by the authors. Termination of insurance coverage for youth could happen due to job loss and material hardship caused by the pandemic [58]–[60].

3.8. Call for a long-term solution

Our review presents similar findings to another review that focus on impact of COVID-19 pandemic on chronic diseases care follow-up in low resource settings, which suggest that COVID-19 pandemic impacts the chronic disease care in both the low resource settings and high income countries [61]. At the time of writing, some nation's continuously face the threat of new COVID-19 waves and outbreak even with vaccinations, therefore a long term solution is warranted to prepare for future emergencies [62]. The potential of mobile and digital self-management support channels for patients can be further promoted especially among the pre-identified vulnerable patients, as it can address at least five impacts of COVID-19 that was being brought up in this study: which are postponements of medical appointments, worsening of chronic diseases, unhealthy lifestyle during the pandemic, shortage of health care professionals, as well as issues of

mental health deterioration. Awareness messages on the importance on continuous chronic disease monitoring should be broadcasted.

There is a need for developed countries to not only provide aid in supplying vaccines and medications, but to also build up the technology capacity and the digital literacy of the people around the globe. Telehealth interventions that focus on lifestyle changes and leverage the power of social networks, such as allow for effective chronic disease management in the COVID-19 era. For example, Bluetooth-enabled blood pressure cuffs can be distributed to hypertensive patients that synchronize with the electronic health record [63], [64]. Program that allows remote monitoring of patients with chronic diseases by health care professionals in the community can potentially relieve the work burden of health care providers in the hospitals.

3.9. Limitations

As this literature review aims to broadly describe the impact of COVID-19 pandemic towards patients living with chronic diseases, the risk of biases of each study were not assessed. We only included articles published up to May 2021, therefore this review only captures the articles related to the early and middle stages of the pandemic, when the healthcare institutions are adapting to the landscape of this pandemic. Further research is needed to review the continuously-evolving practice of chronic disease management as the COVID-19 pandemic progresses into the late stage as well as the post-pandemic phase.

4. CONCLUSION

The COVID-19 pandemic has brought upon many impacts on chronic disease management at the global level, namely cancellation or postponement of routine check-ups and elective procedures, deteriorated mental health among patients living with chronic diseases, changes in lifestyle which encompasses physical activities, dietary habits, sleep and outdoor activities, interruptions of medication supply for chronic diseases, shortage of healthcare resources and health system breakdown that affect the care delivery of chronic diseases, and worsening of chronic diseases. These impacts also indirectly reveal the flaws in the conventional chronic care delivery model and we ought to learn from these lessons. As research has suggested that continuing COVID-19 surges are possible, it is imperative to implement better design of chronic disease care delivery system as a long-term solution during this unprecedented time and beyond. The use of telehealth and education on self management of chronic diseases should be given attention as a mean in rectifying some of the impacts discussed in this review.

REFERENCES

- [1] D. Cucinotta and M. Vanelli, "WHO declares COVID-19 a pandemic," *Acta Biomedica*, vol. 91, no. 1, pp. 157–160, 2020, doi: 10.23750/abm.v91i1.9397.
- [2] C. Hajat and E. Stein, "The global burden of multiple chronic conditions: A narrative review," *Preventive Medicine Reports*, vol. 12, pp. 284–293, Dec. 2018, doi: 10.1016/j.pmedr.2018.10.008.
- [3] WHO, "COVID-19 significantly impacts health services for noncommunicable diseases," *WHO*, 2021. [Online]. Available: <https://www.who.int/news/item/01-06-2020-covid-19-significantly-impacts-health-services-for-noncommunicable-diseases> (accessed Nov. 23, 2021).
- [4] A. B. Moynihan, W. A. P. van Tilburg, E. R. Igo, A. Wisman, A. E. Donnelly, and J. B. Mulcaire, "Eaten up by boredom: consuming food to escape awareness of the bored self," *Frontiers in Psychology*, vol. 6, Apr. 2015, doi: 10.3389/fpsyg.2015.00369.
- [5] K.-H. Park, A.-R. Kim, M.-A. Yang, S.-J. Lim, and J.-H. Park, "Impact of the COVID-19 pandemic on the lifestyle, mental health, and quality of life of adults in South Korea," *PLoS ONE*, vol. 16, no. 2, p. e0247970, Feb. 2021, doi: 10.1371/journal.pone.0247970.
- [6] M. A. Zakeri and M. Dehghan, "The impact of the COVID-19 disease on the referral and admission of the non-COVID-19 patients," *The International Journal of Health Planning and Management*, vol. 36, no. 1, pp. 209–211, Aug. 2020, doi: 10.1002/hpm.3060.
- [7] V. Verhoeven, G. Tsakitzidis, H. Philips, and P. Van Royen, "Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in Flemish GPs," *BMJ Open*, vol. 10, no. 6, p. e039674, Jun. 2020, doi: 10.1136/bmjopen-2020-039674.
- [8] L. A. Morgantini *et al.*, "Factors contributing to healthcare professional burnout during the COVID-19 pandemic: A rapid turnaround global survey," *PLoS ONE*, vol. 15, no. 9, p. e0238217, Sep. 2020, doi: 10.1371/journal.pone.0238217.
- [9] U. N. Yadav, B. Rayamajhee, S. K. Mistry, S. S. Parsekar, and S. K. Mishra, "A syndemic perspective on the management of non-communicable diseases amid the COVID-19 pandemic in low- and middle-income countries," *Frontiers in Public Health*, vol. 8, Sep. 2020, doi: 10.3389/fpubh.2020.00508.
- [10] E. Monaghesh and A. Hajizadeh, "The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence," vol. 20, no. 1, Aug. 2020, doi: 10.1186/s12889-020-09301-4.
- [11] Y. V Chudasama *et al.*, "Impact of COVID-19 on routine care for chronic diseases: A global survey of views from healthcare professionals," *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, vol. 14, no. 5, pp. 965–967, Sep. 2020, doi: 10.1016/j.dsx.2020.06.042.
- [12] T. Truong, M. Dittmar, A. Ghaffari, and E. Lin, "Policy and pandemic: the changing practice of nephrology during the coronavirus disease-2019 outbreak," *Advances in Chronic Kidney Disease*, vol. 27, no. 5, pp. 390–396, Sep. 2020, doi:

- 10.1053/j.ackd.2020.06.003.
- [13] I. A. Kretchy, M. Asiedu-Danso, and J.-P. Kretchy, "Medication management and adherence during the COVID-19 pandemic: Perspectives and experiences from low-and middle-income countries," *Research in Social and Administrative Pharmacy*, vol. 17, no. 1, pp. 2023–2026, Jan. 2021, doi: 10.1016/j.sapharm.2020.04.007.
- [14] A. Bhatia, M. KC, and L. Gupta, "Increased risk of mental health disorders in patients with RA during the COVID-19 pandemic: a possible surge and solutions," *Rheumatology International*, vol. 41, no. 5, pp. 843–850, Mar. 2021, doi: 10.1007/s00296-021-04829-z.
- [15] K. Palmer *et al.*, "The potential long-term impact of the COVID-19 outbreak on patients with non-communicable diseases in Europe: consequences for healthy ageing," *Aging Clinical and Experimental Research*, vol. 32, no. 7, pp. 1189–1194, May 2020, doi: 10.1007/s40520-020-01601-4.
- [16] A. Y. Chang, M. R. Cullen, R. A. Harrington, and M. Barry, "The impact of novel coronavirus COVID-19 on noncommunicable disease patients and health systems: a review," *Journal of Internal Medicine*, vol. 289, no. 4, pp. 450–462, Oct. 2020, doi: 10.1111/joim.13184.
- [17] C. N. Floyd and A. S. Wierzbicki, "Reorganizing the treatment of cardiovascular disease in response to coronavirus disease 2019; time for the polypill?," *Current Opinion in Cardiology*, vol. 35, no. 4, pp. 428–433, May 2020, doi: 10.1097/hco.0000000000000759.
- [18] G. Di Tano, S. Verde, M. Loffi, R. De Maria, and G. B. Danzi, "Impact of the COVID-19 pandemic on the management of heart failure outpatient clinics. Lessons during the lockdown restrictions," *Giornale Italiano di Cardiologia*, vol. 21, no. 10, pp. 750–756, 2020, doi: 10.1714/3431.34197.
- [19] P. Yerram and M. Misra, "Home dialysis in the coronavirus disease 2019 Era," *Advances in Chronic Kidney Disease*, vol. 27, no. 5, pp. 442–446, Sep. 2020, doi: 10.1053/j.ackd.2020.07.001.
- [20] A. E. Caballero *et al.*, "COVID-19 in people living with diabetes: An international consensus," *Journal of Diabetes and its Complications*, vol. 34, no. 9, p. 107671, Sep. 2020, doi: 10.1016/j.jdiacomp.2020.107671.
- [21] H. P. Bhambhani, A. J. Rodrigues, J. S. Yu, J. B. Carr, and M. H. Gephart, "Hospital volumes of 5 medical emergencies in the COVID-19 pandemic in 2 US medical centers," *JAMA Internal Medicine*, vol. 181, no. 2, p. 272, Feb. 2021, doi: 10.1001/jamainternmed.2020.3982.
- [22] M. I. Papafakis *et al.*, "Missing' acute coronary syndrome hospitalizations during the COVID-19 era in Greece: Medical care avoidance combined with a true reduction in incidence?," *Clinical Cardiology*, vol. 43, no. 10, pp. 1142–1149, Jul. 2020, doi: 10.1002/clc.23424.
- [23] A. Almuehleh *et al.*, "Short-term outcomes in ambulatory heart failure during the COVID-19 pandemic: insights from pulmonary artery pressure monitoring," *Journal of Cardiac Failure*, vol. 26, no. 7, pp. 633–634, Jul. 2020, doi: 10.1016/j.cardfail.2020.05.021.
- [24] M. É. Czeisler *et al.*, "Delay or avoidance of medical care because of COVID-19-related concerns—United States, June 2020," *MMWR. Morbidity and Mortality Weekly Report*, vol. 69, no. 35, Sep. 2020, doi: 10.15585/mmwr.mm6935e3.
- [25] J. M. Liao, P. J. Pronovost, and A. S. Navathe, "To Re-Open Health Care, Leaders Should Address Patient Fear," *NEJM Catalyst Innovations in Care Delivery*, 2020. <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0276>.
- [26] P. Hashmi, S. Fahad, H. N. Khan, M. Zahid, A. Sadruddin, and S. Noordin, "Covid-19 pandemic: Economic burden on patients with musculoskeletal injuries in a tertiary care hospital of LMIC; retrospective cross sectional study," *Annals of Medicine and Surgery*, vol. 60, pp. 5–8, Dec. 2020, doi: 10.1016/j.amsu.2020.09.049.
- [27] S. A. Berkowitz, C. W. Cené, and A. Chatterjee, "COVID-19 and health equity—time to think big," *New England Journal of Medicine*, vol. 383, no. 12, p. e76, Sep. 2020, doi: 10.1056/nejmp2021209.
- [28] L. Sher, "The impact of the COVID-19 pandemic on suicide rates," *QJM: An International Journal of Medicine*, vol. 113, no. 10, pp. 707–712, Jun. 2020, doi: 10.1093/qjmed/hcaa202.
- [29] S. S. Rozario and S. W. Masho, "The associations between mental health status, hypertension, and hospital inpatient visits in women in the United States," *American Journal of Hypertension*, vol. 31, no. 7, pp. 804–810, Apr. 2018, doi: 10.1093/ajh/hpy065.
- [30] M. MUKESHIMANA and A. G. CHIRONDA, "Depression and associated factors among the patients with type 2 diabetes in Rwanda," *Ethiopian Journal of Health Sciences*, vol. 29, no. 6, Jan. 1970, doi: 10.4314/ejhs.v29i6.7.
- [31] F. Puntillo *et al.*, "Impact of COVID-19 pandemic on chronic pain management: Looking for the best way to deliver care," *Best Practice & Research Clinical Anaesthesiology*, vol. 34, no. 3, pp. 529–537, Sep. 2020, doi: 10.1016/j.bpa.2020.07.001.
- [32] M. A. Cava, K. E. Fay, H. J. Beanlands, E. A. McCay, and R. Wignall, "The Experience of Quarantine for Individuals Affected by SARS in Toronto," *Public Health Nursing*, vol. 22, no. 5, pp. 398–406, Sep. 2005, doi: 10.1111/j.0737-1209.2005.220504.x.
- [33] H. Jeong *et al.*, "Mental health status of people isolated due to Middle East Respiratory Syndrome," *Epidemiology and Health*, vol. 38, p. e2016048, Nov. 2016, doi: 10.4178/epih.e2016048.
- [34] N. M. Oreskovic, T. B. Kinane, E. Aryee, K. A. Kuhlthau, and J. M. Perrin, "The unexpected risks of COVID-19 on Asthma Control in Children," *The Journal of Allergy and Clinical Immunology: In Practice*, vol. 8, no. 8, pp. 2489–2491, Sep. 2020, doi: 10.1016/j.jaip.2020.05.027.
- [35] G. Serafini, B. Parmigiani, A. Amerio, A. Aguglia, L. Sher, and M. Amore, "The psychological impact of COVID-19 on the mental health in the general population," *QJM: An International Journal of Medicine*, vol. 113, no. 8, pp. 531–537, Jun. 2020, doi: 10.1093/qjmed/hcaa201.
- [36] A.-S. Vanherwegen, C. Gysemans, and C. Mathieu, "Regulation of Immune Function by Vitamin D and Its Use in Diseases of Immunity," *Endocrinology and Metabolism Clinics of North America*, vol. 46, no. 4, pp. 1061–1094, Dec. 2017, doi: 10.1016/j.ecl.2017.07.010.
- [37] A. Ghosh, B. Arora, R. Gupta, S. Anoop, and A. Misra, "Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India," *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, vol. 14, no. 5, pp. 917–920, Sep. 2020, doi: 10.1016/j.dsx.2020.05.044.
- [38] L. D. O. Neto, H. M. Elsangedy, V. D. D. O. Tavares, C. V. L. S. Teixeira, D. G. Behm, and M. E. Da Silva-Grigoletto, "#TrainingInHome- Home-based training during COVID-19 (SARS-COV2) pandemic: physical exercise and behavior-based approach," *Revista Brasileira de Fisiologia do Exercício*, vol. 19, no. 2, p. 9, Apr. 2020, doi: 10.33233/rbfe.v19i2.4006.
- [39] E. B. Tapper and S. K. Asrani, "The COVID-19 pandemic will have a long-lasting impact on the quality of cirrhosis care," *Journal of Hepatology*, vol. 73, no. 2, pp. 441–445, Aug. 2020, doi: 10.1016/j.jhep.2020.04.005.
- [40] C. Evers, A. Dingemans, A. F. Junghans, and A. Boevé, "Feeling bad or feeling good, does emotion affect your consumption of food? A meta-analysis of the experimental evidence," *Neuroscience & Biobehavioral Reviews*, vol. 92, pp. 195–208, Sep. 2018, doi: 10.1016/j.neubiorev.2018.05.028.

- [41] A. Ammar *et al.*, “Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey,” *Nutrients*, vol. 12, no. 6, p. E1583, 2020, doi: 10.3390/nu12061583.
- [42] M. R. Gualano, G. Lo Moro, G. Voglino, F. Bert, and R. Siliquini, “Effects of COVID-19 lockdown on mental health and sleep disturbances in Italy,” *International Journal of Environmental Research and Public Health*, vol. 17, no. 13, p. 4779, Jul. 2020, doi: 10.3390/ijerph17134779.
- [43] P. E. Peppard, T. Young, M. Palta, and J. Skatrud, “Prospective study of the association between sleep-disordered breathing and hypertension,” *New England Journal of Medicine*, vol. 342, no. 19, pp. 1378–1384, May 2000, doi: 10.1056/nejm200005113421901.
- [44] P. M. Nilsson, M. Rööst, G. Engström, B. Hedblad, and G. Berglund, “Incidence of diabetes in middle-aged men is related to sleep disturbances,” *Diabetes Care*, vol. 27, no. 10, pp. 2464–2469, Oct. 2004, doi: 10.2337/diacare.27.10.2464.
- [45] M. M. Ohayon, M. A. Carskadon, C. Guilleminault, and M. V Vitiello, “Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan,” *Sleep*, vol. 27, no. 7, pp. 1255–1273, Oct. 2004, doi: 10.1093/sleep/27.7.1255.
- [46] A. Vegesna, M. Tran, M. Angelaccio, and S. Arcona, “Remote patient monitoring via non-invasive digital technologies: a systematic review,” *Telematic and e-Health*, vol. 23, no. 1, pp. 3–17, Jan. 2017, doi: 10.1089/tmj.2016.0051.
- [47] J. S. Bell, L. Reynolds, C. Freeman, and J. K. Jackson, “Strategies to promote access to medications during the COVID-19 pandemic,” *Australian Journal of General Practice*, vol. 49, no. 8, pp. 530–532, Aug. 2020, doi: 10.31128/ajgp-04-20-5390.
- [48] M. Viswanathan *et al.*, “Interventions to improve adherence to self-administered medications for chronic diseases in the United States,” *Annals of Internal Medicine*, vol. 157, no. 11, p. 785, Dec. 2012, doi: 10.7326/0003-4819-157-11-201212040-00538.
- [49] Ministry of Health Malaysia, *COVID-19 pandemic in Malaysia: a journey*. Pharmaceutical Services Programme, Ministry of Health Malaysia, 2021.
- [50] T. F. and D. A. FDA, “The food and drug administration clarified that there is no doubt about lack of medicines, and has advanced plans to respond as [news release],” *FDA*, 2016. [Online]. Available: <http://www.fda.gov/tc/newsContent.aspx?cid=4&id=1569421> (accessed Nov. 23, 2021).
- [51] S. Zheng, L. Yang, P. Zhou, H. Li, F. Liu, and R. Zhao, “Recommendations and guidance for providing pharmaceutical care services during COVID-19 pandemic: A China perspective,” *Research in Social and Administrative Pharmacy*, vol. 17, no. 1, pp. 1819–1824, Jan. 2021, doi: 10.1016/j.sapharm.2020.03.012.
- [52] F. M. Szymanski, C. Smuniewski, and A. E. Platek, “Will the COVID-19 pandemic change national security and healthcare in the spectrum of cardiovascular disease?,” *Current Problems in Cardiology*, vol. 45, no. 9, p. 100645, Sep. 2020, doi: 10.1016/j.cpcardi.2020.100645.
- [53] CDC, “Healthcare Workers,” *Centers for Disease Control and Prevention*, 2020. [Online]. Available: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/mitigating-staff-shortages.html> (accessed Nov. 23, 2021).
- [54] M. M. Liu, A. B. Reidy, S. Saatee, and C. D. Collard, “Perioperative steroid management,” *Anesthesiology*, vol. 127, no. 1, pp. 166–172, Jul. 2017, doi: 10.1097/aln.0000000000001659.
- [55] M. E. Hall *et al.*, “Reductions in heart failure hospitalizations during the COVID-19 pandemic,” *Journal of Cardiac Failure*, vol. 26, no. 6, pp. 462–463, Jun. 2020, doi: 10.1016/j.cardfail.2020.05.005.
- [56] B. B. Granger and H. B. Bosworth, “Medication adherence: emerging use of technology,” *Current Opinion in Cardiology*, vol. 26, no. 4, pp. 279–287, Jul. 2011, doi: 10.1097/hco.0b013e328347c150.
- [57] J. M. Plevinsky *et al.*, “The impact of COVID-19 on pediatric adherence and self-management,” *Journal of Pediatric Psychology*, vol. 45, no. 9, pp. 977–982, Sep. 2020, doi: 10.1093/jpepsy/jsaa079.
- [58] G. A. Millett *et al.*, “Assessing differential impacts of COVID-19 on black communities,” *Annals of Epidemiology*, vol. 47, pp. 37–44, Jul. 2020, doi: 10.1016/j.annepidem.2020.05.003.
- [59] D. Witteveen and E. Velthorst, “Economic hardship and mental health complaints during COVID-19,” *Proceedings of the National Academy of Sciences*, vol. 117, no. 44, pp. 27277–27284, Oct. 2020, doi: 10.1073/pnas.2009609117.
- [60] A. van Dorn, R. E. Cooney, and M. L. Sabin, “COVID-19 exacerbating inequalities in the US,” *The Lancet*, vol. 395, no. 10232, pp. 1243–1244, Apr. 2020, doi: 10.1016/s0140-6736(20)30893-x.
- [61] G. Fekadu *et al.*, “Impact of COVID-19 pandemic on chronic diseases care follow-up and current perspectives in low resource settings: a narrative review,” *International Journal of Physiology Pathophysiology Pharmacology*, vol. 13, no. 3, pp. 86–93, 2021.
- [62] K. Morawski *et al.*, “Association of a smartphone application with medication adherence and blood pressure control: The MedISAFE-BP Randomized Clinical Trial,” *JAMA Internal Medicine*, vol. 178, no. 6, pp. 802–809, 2018, doi: 10.1001/jamainternmed.2018.0447.
- [63] T. Fisayo and S. Tsukagoshi, “Three waves of the COVID-19 pandemic,” *Postgraduate Medical Journal*, vol. 97, no. 1147, p. 332, Aug. 2020, doi: 10.1136/postgradmedj-2020-138564.
- [64] N. D. L. Fisher *et al.*, “Development of an entirely remote, non-physician led hypertension management program,” *Clinical Cardiology*, vol. 42, no. 2, pp. 285–291, Jan. 2019, doi: 10.1002/clc.23141.

BIOGRAPHIES OF AUTHORS



Wei Thing Sze     is a registered pharmacist, and lecturer in Faculty of Pharmacy, SEGi University. Previously, Ms Sze was a hospital pharmacist with Ministry of Health, Malaysia. Ms Sze received a Bachelor's degree in Pharmacy from International Medical University in Malaysia, and a Master of Science degree in Clinical Pharmacy, International Practice and Policy from United Kingdom. Her research focuses on role of pharmacists in the primary care, medication management as well as and digital health for self-management of chronic diseases. She can be contacted at email: weithing@gmail.com.



Siew Yung Huong    is a final year Bachelor of Pharmacy (Hons) student at SEGi University. She can be contacted at email: siewyung6008@gmail.com.



Shi Ying Oon    is a final year Bachelor of Pharmacy (Hons) student at SEGi University. She can be contacted at email: oonshying@gmail.com.



Idham bin Zaharudie    is a final year Bachelor of Pharmacy (Hons) student at SEGi University. He can be contacted at email: idhamzaharudie95@gmail.com.



Vijay A/L Sundaresen    is a final year Bachelor of Pharmacy (Hons) student at SEGi University. He can be contacted at email: vijaysundaresengow@gmail.com.