JAN
Leading Global Nursing Research   WILEY

A nursing informatics response to COVID-19: Perspectives from five regions of the world

1 | INTRODUCTION

The 21st century has seen several infectious disease outbreaks that have turned into epidemics and pandemics including Severe Acute Respiratory Syndrome (SARS) which began in Asia in 2003 (Poon, Guan, Nicholls, Yuen, & Peiris, 2004), followed by H1N1 that emerged in Mexico and the United States (US) in 2009 (Belongia et al., 2010). Next came the lesser known Middle East Respiratory Syndrome (MERS) originating in Saudi Arabia in 2012 (Assiri et al., 2013), after which the Ebola outbreak in West Africa took place from 2014–2016, with a more recent occurrence in the Democratic Republic of Congo from 2018–2019 (Malvy, McElroy, de Clerck, Günther, & van Griensven, 2019). To date, the coronavirus (COVID-19) outbreak that started in Wuhan, in the Hubei province of China, in late December 2019 seems to be eclipsing all of these previous infectious diseases in terms of its global reach and impact (Wang, Horby, Hayden, & Gao, 2020). After being declared by the World Health Organization (WHO) as a public health emergency on 30 January 2020 (World Health Organization, 2020c), it was elevated to a pandemic status on 11 March 2020 (World Health Organization, 2020d). As of 28 April 2020, there are more than 2.9 million cases and 202,597 deaths reported worldwide (World Health Organization, 2020b).

Healthcare workers around the world, for example nurses, medical doctors and community healthcare workers are on the front lines caring for those infected (Zhang, Sun, Latour, Hu, & Qian, 2020), whereas epidemiologists, public health officials, and others work behind the scenes to control the spread of COVID-19 and protect population health. Scientists across many disciplines are also researching how to address the myriad problems that this disease has created and exacerbated, such as the shortage of personal protective equipment (Chughtai, Seale, Islam, Owais, & Macintyre, 2020), the need for more critical care facilities and expertise (Grasselli, Pesenti, & Cecconi, 2020), the development of therapeutics (Dhama et al., 2020) and new vaccines that could prevent the virus in the future (Anderson, Heesterbeek, Klinkenberg, & Hollingsworth, 2020). Nursing informaticians who use information technology to enhance nursing education, clinical practice and policy are collaborating with colleagues and contributing to and leading research and digital health initiatives in the face of COVID-19. Here, we discuss some perspectives from nursing informaticians based in nine countries across five regions of the world (Ronquillo, Topaz, Pruinelli, Peltonen, &

Nibber, 2017). We explain how the nursing informatics community is responding to this global crisis and offer some early lessons learned that could be useful in future outbreaks of infectious disease.

1.1 | East and South East Asia

Despite the swift implementation of a lockdown of the Hubei province, COVID-19 spread beyond Chinese borders. Approximately 400,000 people cross the shared border between Hong Kong and China per day (Hong Kong Immigration Department, 2020), posing a risk of repeating the SARS outbreak more than a decade earlier that killed 299 people in Hong Kong (World Health Organization, 2003). Within days of the first reported case of coronavirus, the Hong Kong government raised the response level to 'emergency' (Cheung, Lok-kei, Lau, & Ho-him, 2020). This saw the halting of transportation to and from Wuhan, the cancellation of large events in spite of the Lunar New Year celebrations, an extension of school holidays and work from home arrangements (Lum & Lok-kei, 2020). However, the outbreak triggered painful memories of the 2003 SARS epidemic for many residents who were already mired in a time of civil unrest and government dissatisfaction throughout 2019 and 2020 (Lau & Cheung, 2020; Stevenson, Ramzy, & May, 2020). Despite the government justifying the maintenance of its borders with China, pressure from the public and healthcare workers, as well as a burgeoning rise in local COVID-19 cases led to border closures and the suspension of schools and examinations (Ho-him, 2020). In response, nursing informaticians in Hong Kong are helping to move nursing education fully online to support students, while teaching about this new infectious disease through social media and developing virtual learning activities around public health interventions.

Among Southeast Asian nations, the Philippines ranks high on the list of countries with the total number of cases and deaths from COVID-19 (Center for Strategic & International Studies, 2020). The government placed the largest of the islands, Luzon which includes the capital city of Manila (home to about 60 million people), in enhanced community quarantine (i.e. lockdown) on 16 March 2020 to reduce the impact of the disease on the country's healthcare system (Gregorio, 2020). Despite being a top global exporter of healthcare workers (Castro-Palaganas et al., 2017), the Philippines is now experiencing a lack of nurses and other clinicians to serve during the pandemic. As a result, the government called for healthcare worker volunteers in March (Cruz-Bacani, 2020) and

temporarily banned overseas deployment of healthcare workers in April 2020 (ABS-CBN News, 2020b). The main nursing associations including the Philippine Nurses Association, Filipino Nurses United and Ang Nars are urging the government to give nurses higher wages, on top of the ₱500 pesos (USD $10) per day allowance announced, to mitigate nurse migration and ensure they are adequately compensated for the high risk, critical role they provide caring for people infected with COVID-19 (ABS-CBN News, 2020a; deLeon, 2020). In response to the pandemic, nursing informaticians in the Philippines are helping to deploy distance learning and e-learning technologies to ensure nursing students and professionals are adequately trained. Social media are also being used to disseminate appropriate health information to local communities across the numerous islands and provide emotional support to nurses working on the frontlines caring for those infected.

1.2 | Middle East

Like other regions, COVID-19 quickly spread to almost all parts of the Middle East. The Kingdom of Saudi Arabia is one of the countries in the Arab world that has been significantly affected with more than 20,000 cases (Abueish, 2020). The holy month of Ramadan which requires fasting, prayer and reflection started on the evening of the 23 April 2020 and lasts for 30days which could make self-isolation and social distancing challenging (Atique & Itumalla, 2020). In addition, millions of Muslims would normally undertake the Umrah, an Islamic pilgrimage to Mecca, which the government cancelled in a bid to repress the spread of the disease (Ebrahim & Memish, 2020; Gautret, Al-Tawfiq, & Hoang, 2020). The Middle Eastern region, especially the Kingdom of Saudi Arabia, is already facing the MERS and therefore further vigilance is required to combat COVID-19 (Jazieh et al., 2020). The Ministry of Health has directed healthcare workers to strictly follow the previous guidelines for MERS as this is an emerging and complex situation (Ministry of Health, 2020). The country largely relies on a foreign workforce which comes from around the globe to staff its health sector, bringing knowledge and skills from a diverse range of nationalities and ethnicities. Furthermore, some hospitals have started telemedicine and related digital services to provide health care to people at home (Saudi German Hospitals, 2020). In response to the pandemic, nursing informaticians in the Kingdom of Saudi Arabia are helping to provide digital health and care services such as telemedicine. They are also using online tools to reach and educate patients and local communities about the disease to help reduce transmission and rates of infection.

1.3 | Europe

Europe was the epicentre of the pandemic for several weeks, with Belgium, Italy, Spain, and the United Kingdom (UK) among the countries with the highest number of reported cases and deaths from COVID-19 (Henley & Pilkington, 2020). In the UK, the Prime Minister Boris Johnston, who was hospitalized in critical care with the coronavirus (Stewart & Campbell, 2020) and the Tory political party that holds the government majority, initially took an alternative approach to tackling the disease by advocating for 'herd immunity' on 12 March 2020 (Yong, 2020). The Tory party leadership suggested that most of the population, approximately 65 million across four countries (England, Northern Ireland, Scotland and Wales), should become infected to enable healthy individuals to build up an adequate immune response to this contagious disease (Horton, 2020). This was followed by mixed messages around social distancing and self-isolation mid-March 2020, despite the rapidly rising death tolls in Italy and Spain where British citizens were holidaying at the time (Hunter, 2020). It has garnered a varied response from professionals and the public alike, both at home and abroad, given this does not follow the traditional public health response to an infectious disease outbreak that includes testing, contact tracing and isolating potentially infected individuals (Alwan et al., 2020; Hellewell et al., 2020). Despite a change in UK government policy away from this approach, some of the conversations surrounding this debacle and others such as the shortage of personal protective equipment and critical care beds have reverberated on social media. These data are now being analysed by nursing informaticians, as Twitter and other online platforms can be used to discern trends in the public's perception of important health-related issues which can be used to inform and promote health protection (Meng, Kath, Li, & Nguyen, 2017). Other nurse informaticians are working to develop digital dashboards to monitor and improve the quality of care in acute hospital settings (Randell et al., 2020) or testing virtual reality applications as a way to improve mental health (O'Connor, 2019).

Switzerland, a country with 8.6 million inhabitants living across 26 cantons and four language regions (French, German, Italian and Rhaeto-Romance), is responding to the COVID-19 pandemic by closing non-vital services and implementing WHO recommendations such as rapid testing, case isolation or self-isolation and social distancing (Federal Office of Public Health, 2020; Salathé et al., 2020). Like many countries, the health service and frontline clinicians face numerous challenges such as the shortage of personal protective equipment, disinfectant and ventilators and a lack of knowledge on how to prevent, diagnose and treat the disease. These rapid changes have expedited a digital transformation in Switzerland with family doctors and hospital laboratories exchanging data in more structured, electronic ways and patients remotely monitored by nurses and physicians using telemedicine or telecare systems (Wanner, 2020). In addition, numerous scientific research initiatives have begun to address some of these challenges. One example is the Corona Science community, an interdisciplinary group of researchers including nursing informaticians, who are working with sponsors and partners to provide an application to collect anonymized, aggregated self-reported data related to COVID-19. This includes measures for physical health, psychological well-being and social impact, for example employment, education and home schooling, caring

responsibilities and community activism, to enable a better understanding of this infectious disease (Corona Science, 2020).

In Finland, the government declared a state of emergency in March 2020 and implemented a range of measures including closing most educational institutions and shifting to online education, closing businesses and cultural venues, limiting travel and banning large gatherings to curb the spread of the virus. The southern region of Uusimaa, where the capital Helsinki lies and where many of the 5.5 million citizens live, faced tougher restrictions to limit the transmission of COVID-19 to the rest of the country. These restrictions are planned to remain in force until the 13 May 2020. On 1 April 2020, an Operations Centre for managing the pandemic was established by the Prime Minister's Office to improve situational awareness, monitor the impact of government policies on the coronavirus outbreak and develop an exit plan (Finnish Government, 2020b). In addition, an arm of the government called Media Pool, which supports media organizations in Finland and a marketing company, PINK Helsinki, jointly launched a national social media campaign to counteract misinformation about the infectious disease (Finnish Government, 2020a). Nationally, the Finish Institute for Health and Welfare continuously update their online resources with information and materials on COVID-19 for professionals and the public (Finnish Institute for Health & Welfare, 2020). Existing digital health services have also been expanded. For example an online symptom assessment tool called 'Omaolo' is available to help the public gauge the likelihood of a coronavirus infection and provide referral and treatment advice (SoteDigi Oy, 2020). A 'Coronabot' web service that gives guidance regarding exposure to and symptoms of COVID-19 has also been established and a national online database for professionals was updated with COVID-19 specific information and guidance via a collaboration across university hospital districts of Helsinki, Tampere, Oulu, Kupio and Turku (Health Village, 2020). Nursing informaticians in Finland have assisted these efforts and beyond e.g. by developing COVID-19 related data interfaces for electronic health records, providing digital education on caring for those infected with the virus and improving mobile documentation to speed up access to real-time patient information.

1.4 | North America

In Canada, the structure of healthcare provisioning is determined by provincial governments which has resulted in variations in the public health and political response to the COVID-19 pandemic. Nevertheless, there are concerted efforts across the country to focus public education and policy on physical distancing as a key strategy to 'flattening the curve' and preserving a level of acute care capacity for those that need it (Woods, 2020). This has led to a restructuring of healthcare service delivery via the increased use of health information technologies. In Western Canada, there has been a push for virtual health teams to increase capacity for telehealth appointments (e.g. telephone, video conferencing, email and text) to deliver patient care (Provincial Health Services Authority, 2020).

This rapid development and implementation of digital services has required nursing informaticians to lead much of this work. Furthermore, virtual teaching tools have been created to help prepare nurses, nursing students and retired nurses entering frontline health services to support COVID-19 efforts.These include online educational resources related to the clinical presentation, detection and care (e.g. e-learning module on the use of personal protective equipment) of people diagnosed or suspected to have the infectious disease (Canadian Institute of Health Information, 2020; Canadian Nurses Association, 2020). A systematic and centralized approach to collecting, coding (using the WHO International Classification of Disease), synthesizing and sharing up-to-date information about coronavirus cases is also underway among the health informatics community, who are adopting new digital and visualization tools to enable better epidemiological modelling (Canadian Institute of Health Information, 2020).

In the US, the federalist system of public health governance divides power among the federal, state and local governments. Each of these entities has an authority, to some extent, to initiate responses to the COVID-19 pandemic. Early in March 2020, federal government in the US started its response by introducing a travel ban on flights from China. Further federal policies included declaring a national 'State of Emergency' and providing financial stimuli to the US economy (Wallach & Myers, 2020). Although responses varied from state to state, virtually all states issued stay-at-home orders for non-essential workers as of early April 2020 (National Conference of State Legislatures, 2020). In late April 2020, the situation remains dire, with the US becoming an epicentre of COVID-19 cases and deaths worldwide. Nursing informaticians in the US have responded to the COVID-19 pandemic in several important ways. In educational settings, nursing informaticians have supported the switch to online modes of education to reduce in-person contact between nursing students. In clinical settings, nurse informaticians are using a diverse range of health data to help alleviate the impact of COVID-19. For example, nurse informaticians across hospitals in New York have built efficient and streamlined ways of tracking the availability of and forecasting the need for critical health equipment such as ventilators. In other initiatives, nurse informaticians are collaborating on providing access to timely data, for example guidelines on nursing responses to the COVID-19 pandemic (Omaha System Community of Practice, 2020). In addition, nurse informaticians have contributed to creating ways of assessing COVID-19 related symptoms; for example by assisting in the creation of an online survey, CovidWatcher, that tracks disease symptoms (University of Columbia, 2020).

1.5 | Latin America and the Caribbean

Finally, Latin America and the Caribbean have been the last major region of the world to experience the coronavirus. The government and public response to COVID-19 has varied due to the differing health systems, economies and politics of each country. However, high levels of inequality and poverty (Santos & Villatoro, 2018),

along with limited health systems capacity and a lack of healthcare workers are common characteristics amongst many Latin American countries (Laurell & Giovanella, 2018). The first confirmed coronavirus case was in Brazil on 26 February 2020 and Argentina was the first country to confirm a death on 7 March 2020 related to COVID-19 (World Health Organization, 2020a). The demographic profile in Latin America is younger with a smaller percentage of individuals over 65 (Pan American Health Organization, 2017). Despite having a younger profile, the socioeconomic disparities in health, access to health care and the prevalence of chronic diseases raises the possibility of needing intensive care (Biener & Zuvekas, 2019). In Mexico, the government restricted international travel, banned large gathering events and encouraged social distancing to limit people's exposure by staying at home. The government has been widely critiqued for delaying action to limit the spread of the virus, reasoning the costs of closing down industries would have a negative impact on the economy. However, it is complicated to limit exposure as approximately 60% of the population have informal jobs (Organisation for Economic Co-operation & Development, 2019). As over 125 million people reside in Mexico, there is a need to use virtual health. Hence, the government has developed a website and an app where signs and symptoms of the disease and how to prevent transmission of the virus are explained to help educate the public (Secretaria de Salud de México, 2020). Telehealth is also beginning to be used to remotely monitor the health of at risk populations and to reduce the numbers of people presenting at local hospitals, with many nursing informaticians involved in these initiatives (Sood, Pollard, Le Suer, Vlahovich, & Walker, 2020).

To conclude, nursing informaticians worldwide are working with colleagues in clinical settings to advance and implement electronic systems and digital infrastructure that supports healthcare professionals caring for patients with COVID-19, while those in educational settings prepare and deliver virtual learning to train nursing students and nurse practitioners about the infectious disease. Many nursing informaticians are also researching how different technologies can be employed to understand the spread of the virus and its impact on people's health and well-being. Some early lessons learned during this pandemic are to leverage interdisciplinary networks to scope out robust platforms for symptom and disease monitoring, collaborate with the technology industry to scale up digital solutions for health professionals, patients and their families, and capitalize on existing social media and health applications to reach key stakeholders quickly such as at risk vulnerable groups. More work still needs to be done, in particular by employing artificial intelligence and visualization tools on real-time COVID-19 datasets to enhance decision making by clinicians, policy makers and the public. The international nursing informatics community plan to convene in Australia for their bi-annual conference in August 2021, after postponing the original July 2020 event (https://ni2020.org/). Here, COVID-19 and how it is being tackled across the regions of the world is likely to take centre stage so that the technical, organizational, social, cultural and political challenges we face can be discussed and new ideas about how technology and informatics can help nurses address them are generated.

Suleman Atique MSHI, Pharm-D, PhD, Assistant Professor[1]

John R. Bautista RN, MPH, PhD, Bullard Research Fellow[2]

Lorraine J. Block RN, MSN, PhD Nursing Student[3]

Jung Jae Lee BSc, MSc, PhD, RN, Research Assistant Professor[4]

Erika Lozada-Perezmitre RN, MPH, Associate Professor[5]

Raji Nibber RN, MSN, Lead - Chronic Disease Management[3]

Siobhan O'Connor BSc, CIMA CBA, BSc, RN, FHEA, PhD, Lecturer[6]

Laura-Maria Peltonen RN, PhD, Clinical Lecturer[7]

Charlene Ronquillo MSN, RN, Assistant Professor[8]

Jude Tayaben RN, PhD, Assistant Professor[9]

Friederike J. S. Thilo PhD, RN, Postdoctoral Research Fellow[10]

Maxim Topaz PhD, RN, MA, Elizabeth Standish Gill Associate Professor[11]

[1]Department of Health Informatics, College of Public Health and Health Informatics, University of Ha'il, Ha'il, Saudi Arabia

[2]School of Information, The University of Texas at Austin, Austin, USA

[3]School of Nursing, University of British Columbia, Vancouver, Canada

[4]School of Nursing, The University of Hong Kong, Pokfulam, Hong Kong

[5]Nursing Faculty, Benemérita Universidad Autónoma de Puebla, Puebla, Mexico

[6]School of Health in Social Science, The University of Edinburgh, Edinburgh, United Kingdom

[7]Department of Nursing Science, University of Turku, Turku, Finland

[8]Daphne Cockwell School of Nursing, Ryerson University, Toronto, Canada

[9]College of Nursing, Benguet State University, Benguet, Philippines

[10]Applied Research and Development in Nursing, Department of Health Professions, Bern University of Applied Sciences, Bern,

Switzerland

[11]*School of Nursing and Data Science Institute, Columbia University, New York, USA*

Correspondence

Siobhan O'Connor, School of Health in Social Science, The Edinburgh of University, Doorway 6 Old Medical Quad, Teviot Place, Edinburgh EH8 9AG, United Kingdom.
Email: siobhan.oconnor@ed.ac.uk

ORCID

Suleman Atique https://orcid.org/0000-0002-5149-0703
John R. Bautista https://orcid.org/0000-0002-4892-9543
Lorraine J. Block https://orcid.org/0000-0002-9496-3208
Jung Jae Lee https://orcid.org/0000-0001-9704-2116
Erika Lozada-Perezmitre https://orcid.org/0000-0002-0515-8662
Raji Nibber https://orcid.org/0000-0003-1305-3606
Siobhan O'Connor https://orcid.org/0000-0001-8579-1718
Laura-Maria Peltonen https://orcid.org/0000-0001-5740-6480
Charlene Ronquillo https://orcid.org/0000-0002-6520-1765
Jude Tayaben https://orcid.org/0000-0003-4539-5694
Friederike J. S. Thilo https://orcid.org/0000-0002-5085-3664
Maxim Topaz https://orcid.org/0000-0002-2358-9837

TWITTER

Siobhan O'Connor @shivoconnor

REFERENCES

ABS-CBN News. (2020a). DOH apologizes for P500 daily allowance for COVID-19 hospital volunteers. *ABS-CBN News*. Retrieved from https://news.abs-cbn.com/news/03/28/20/doh-apologizes-for-p500-daily-allowance-for-covid-19-hospital-volunteers

ABS-CBN News (2020b). Philippines suspends deployment of health workers abroad to fight COVID-19. *ABS-CBN News*. Retrieved from https://news.abs-cbn.com/news/04/10/20/philippines-suspends-deployment-of-health-workers-abroad-to-fight-covid-19

Abueish, T. (2020). Coronavirus: Expats 77 pct of all cases in Saudi Arabia as infections pass 20,000. Retrieved from https://english.alarabiya.net/en/coronavirus/2020/04/28/Coronavirus-Cases-in-Saudi-Arabia-surpass-20-000-after-1-266-new-cases-reported-.html

Alwan, N. A., Bhopal, R., Burgess, R. A., Colburn, T., Cuevas, L. E., Smith, G. D., ... Wilson, A. (2020). Evidence informing the UK's COVID-19 public health response must be transparent. *The Lancet*, *395*(10229), 1036–1037. https://doi.org/10.1016/S0140-6736(20)30667-X

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet*, *395*(10228), 931–934. https://doi.org/10.1016/S0140-6736(20)30567-5

Assiri, A., McGeer, A., Perl, T. M., Price, C. S., Al Rabeeah, A. A., Cummings, D. A. T., ... Memish, Z. A. (2013). Hospital Outbreak of Middle East Respiratory Syndrome Coronavirus. *The New England Journal of Medicine*, *369*(5), 407–416. https://doi.org/10.1056/NEJMoa1306742

Atique, S., & Itumalla, R. (2020). Hajj in the Time of COVID-19. *Infection, Disease & Health.*, https://doi.org/10.1016/j.idh.2020.04.001

Belongia, E. A., Irving, S. A., Waring, S. C., Coleman, L. A., Meece, J. K., Vandermause, M., ... Shay, D. K. (2010). Clinical Characteristics and 30-Day Outcomes for Influenza A 2009 (H1N1), 2008–2009 (H1N1) and 2007–2008 (H3N2) Infections. *JAMA*, *304*(10), 1091–1098. https://doi.org/10.1001/jama.2010.1277

Biener, A. I., & Zuvekas, S. H. (2019). Do racial and ethnic disparities in health care use vary with health? *Health Services Research*, *54*(1), 64–74. https://doi.org/10.1111/1475-6773.13087

Canadian Institute of Health Information (2020). COVID-19 resources. Retrieved from https://www.cihi.ca/en/covid-19-resources

Canadian Nurses Association (2020). Resources and FAQs. Retrieved from https://www.cna-aiic.ca/en/coronavirus-disease/faqs-and-resources

Castro-Palaganas, E., Spitzer, D. L., Kabamalan, M. M. M., Sanchez, M. C., Caricativo, R., Runnels, V., ... Bourgeault, I. L. (2017). An examination of the causes, consequences and policy responses to the migration of highly trained health personnel from the Philippines: The high cost of living/leaving—a mixed method study. *Human Resources for Health*, *15*(1), 1–14. https://doi.org/10.1186/s12960-017-0198-z

Center for Strategic and International Studies (2020). Southeast Asia Covid-19 Tracker. Retrieved from https://www.csis.org/programs/southeast-asia-program/southeast-asia-covid-19-tracker

Cheung, T., Lok-kei, S., Lau, C., & Ho-him, C. (2020). Coronavirus: Hong Kong faces escalated medical strike despite government move to expand border closures. *South Morning China Post*: Retrieved from https://www.scmp.com/news/hong-kong/health-environment/article/3048738/coronavirus-hong-kong-leader-carrie-lam-declares

Chughtai, A. A., Seale, H., Islam, M. S., Owais, M., & Macintyre, C. R. (2020). Policies on the use of respiratory protection for hospital health workers to protect from coronavirus disease (COVID-19). *International Journal of Nursing Studies*, *105*, 103567. https://doi.org/10.1016/j.ijnurstu.2020.103567

Corona Science (2020). Corona Science: Together against the Coronavirus. Retrieved from https://coronascience.ch/en/

Cruz-Bacani, X. (2020). The Workers on the Front Lines of the Philippines' Fight Against Coronavirus. *The Nation*. Retrieved from https://www.thenation.com/article/world/coronavirus-philippines-covid/

deLeon, R. S. (2020). Position Statement to DOH Call for Mobilization of Professional Nurses in Response to CoVID-19 Health Emergency. Retrieved from https://pna-ph.org/archives/position-papers/934-pna-s-position-statement-to-doh-call-for-mobilization-of-professional-nurses-and-health-workers

Dhama, K., Sharun, K., Tiwari, R., Dadar, M., Malik, Y. S., Singh, K. P., & Chaicumpa, W. (2020). COVID-19, an emerging coronavirus infection: Advances and prospects in designing and developing vaccines, immunotherapeutics and therapeutics. *Human Vaccines & Immunotherapeutics*, 1–7, https://doi.org/10.1080/21645515.2020.1735227

Ebrahim, S. H., & Memish, Z. A. (2020). Saudi Arabias measures to curb the COVID-19 outbreak: Temporary suspension of the Umrah pilgrimage. *Journal of Travel Medicine*, https://doi.org/10.1093/jtm/taaa029

Federal Office of Public Health (2020). New coronavirus. Retrieved from https://www.bag.admin.ch/bag/en/home/krankheiten/ausbrueche-epidemien-pandemien/aktuelle-ausbrueche-epidemien/novel-cov.html

Finnish Government (2020). Combating coronavirus together by sharing reliable information. Retrieved from https://valtioneuvosto.fi/en/article/-/asset_publisher/10616/torjutaan-koronaa-yhdessa-jaa-luotettavaa-tietoa-eteenpain

Finnish Government (2020b). Prime Minister's Office appoints Operations Centre to support management of COVID-19 situation. *Government Communications Department*: Retrieved from https://valtioneuvosto.fi/en/article/-/asset_publisher/10616/valtioneuvoston-kanslia-perusti-operaatiokeskuksen-tukemaan-koronavirustilanteen-johtamista-

Finnish Institute for Health and Welfare (2020). Coronavirus COVID-19 – Latest Updates. Retrieved from https://thl.fi/en/web/infectious-diseases/what-s-new/coronavirus-covid-19-latest-updates

Gautret, P., Al-Tawfiq, J. A., & Hoang, V. T. (2020). COVID 19: Will the 2020 Hajj pilgrimage and Tokyo Olympic Games be cancelled? *Travel Medicine and Infectious Disease*, *34*, 101622, https://doi.org/10.1016/j.tmaid.2020.101622

Grasselli, G., Pesenti, A., & Cecconi, M. (2020). Critical Care Utilization for the COVID-19 Outbreak in Lombardy, Italy: Early Experience and Forecast During an Emergency Response. *JAMA*, *323*(16), 1545. https://doi.org/10.1001/jama.2020.4031

Gregorio, X. (2020). Movement of people in Luzon restricted as island placed under 'enhanced' community quarantine. In: CNN Philippines. Retrieved from https://cnnphilippines.com/news/2020/3/16/luzon-enhanced-community-quarantine-covid-19.html

Health Village. (2020). Epidemic bot: Corona COVID-19. Retrieved from https://www.terveyskyla.fi/koronabotti/en#

Hellewell, J., Abbott, S., Gimma, A., Bosse, N. I., Jarvis, C. I., Russell, T. W., … van Zandvoort, K. (2020). Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *The Lancet Global Health*, *8*(4), e488–e496. https://doi.org/10.1016/S2214-109X(20)30074-7

Henley, J., & Pilkington, E. (2020). Covid-19: Europe toll passes 50,000 as Japan declares emergency. *The Guardian*. Retrieved from https://www.theguardian.com/world/2020/apr/07/covid-19-trump-adviser-memos-emerge-as-japan-takes-emergency-measures

Ho-him, C. (2020). Coronavirus: Thousands of Hong Kong hospital workers back strike to demand closure of border with mainland China. *South Morning China Post*. Retrieved from https://www.scmp.com/news/hong-kong/health-environment/article/3048548/caronavirus-thousands-hong-kong-hospital-workers

Hong Kong Immigration Department (2020). Cross-boundary passenger traffic estimation and arrangements for Lunar New Year festive period. Retrieved from https://www.immd.gov.hk/eng/press/press-releases/20200120.html

Horton, R. (2020). Offline: COVID-19—a reckoning. *The Lancet*, *395*(10228), https://doi.org/10.1016/S0140-6736(20)30669-3

Hunter, D. J. (2020). Covid-19 and the Stiff Upper Lip—The Pandemic Response in the United Kingdom. *New England Journal of Medicine*, *382*(16), e31. https://doi.org/10.1056/NEJMp2005755

Jazieh, A.-R., Al Hadab, A., Al Olayan, A., AlHejazi, A., Al Safi, F., Al Qarni, A., … Alenazi, T. H. (2020). Managing Oncology Services During a Major Coronavirus Outbreak: Lessons From the Saudi Arabia Experience. *JCO Global Oncology*, *6*, 518–524. https://doi.org/10.1200/GO.20.00063

Lau, C., & Cheung, E. (2020). Coronavirus: Hong Kong reliving Sars nightmare as outbreak spreads. Retrieved from https://www.scmp.com/news/hong-kong/health-environment/article/3050029/coronavirus-hong-kong-sars-victims-and-frontline

Laurell, C. A., & Giovanella, L. (2018). Health policies and systems in Latin America. *Oxford Research Encyclopedia of Global Public Health*, https://doi.org/10.1093/acrefore/9780190632366.013.60

Lum, A., & Lok-kei, S. (2020). China coronavirus: Hong Kong leader hits back at delay criticism as she suspends school classes, cancels marathon and declares city at highest level of emergency. *South Morning China Post*. Retrieved from https://www.scmp.com/news/hong-kong/health-environment/article/3047645/china-coronavirus-hong-kong-students-get-two-more

Malvy, D., McElroy, A. K., de Clerck, H., Günther, S., & van Griensven, J. (2019). Ebola virus disease. *The Lancet*, *393*(10174), 936–948. https://doi.org/10.1016/S0140-6736(18)33132-5

Meng, H., Kath, S., Li, D., & Nguyen, Q. C. (2017). National substance use patterns on Twitter. *PLoS One*, *12*(11), e0187691. https://doi.org/10.1371/journal.pone.0187691

Ministry of Health. (2020). Coronavirus Disease 19 (COVID-19) Guidelines February 2020 V1.1. Retrieved from https://www.moh.gov.sa/CCC/healthp/regulations/Documents/Coronavirus%20Disease%202019%20Guidelines%20v1.1.pdf

National Conference of State Legislatures (2020). State Action on Coronavirus (COVID-19). Retrieved from https://www.ncsl.org/research/health/state-action-on-coronavirus-covid-19.aspx

O'Connor, S. (2019). Virtual reality and avatars in healthcare. *Clinical Nursing Research*, *28*(5), 523–528. https://doi.org/10.1177/1054773819845824

Omaha System Community of Practice (2020). COVID-19 Response. Retrieved from https://sites.google.com/view/omahasystemguidelines/covid-19-response

Organisation for Economic Co-operation and Development (2019). Presentation of the 2019 Economic Survey of Mexico. Retrieved from https://www.oecd.org/mexico/2019-economic-survey-of-mexico-may-2019.htm

Pan American Health Organization (2017). Health Status of the Population; Population Characteristics and Trends. Retrieved from https://www.paho.org/salud-en-las-americas-2017/?p=1864

Poon, L. L. M., Guan, Y., Nicholls, J., Yuen, K., & Peiris, J. (2004). The aetiology, origins and diagnosis of severe acute respiratory syndrome. *The Lancet Infectious Diseases*, *4*(11), 663–671. https://doi.org/10.1016/S1473-3099(04)01172-7

Provincial Health Services Authority (2020). Office of Virtual Health. Retrieved from http://www.phsa.ca/health-professionals/professional-resources/office-of-virtual-health#Partner–with–us

Randell, R., Alvarado, N., McVey, L., Greenhalgh, J., West, R. M., Farrin, A., … Dowding, D. (2020). How, in what contexts and why do quality dashboards lead to improvements in care quality in acute hospitals? Protocol for a realist feasibility evaluation. *British Medical Journal Open*, *10*(2), https://doi.org/10.1136/bmjopen-2019-033208

Ronquillo, C., Topaz, M., Pruinelli, L., Peltonen, L. M., Nibber, R., & (2017). Competency recommendations for advancing nursing informatics in the next decade: International survey results. *Volume 232: Forecasting Informatics Competencies for Nurses in the Future of Connected Health*. Paper presented at the *Studies in Health Technology and Informatics*, Studies in Health Technology and Informatics (Vol. *232*, pp. 119–129). IOS Press. Retrieved from http://ebooks.iospress.nl/publication/46073

Salathé, M., Althaus, C. L., Neher, R., Stringhini, S., Hodcroft, E., Fellay, J., … Eckerle, I. (2020). COVID-19 epidemic in Switzerland: on the importance of testing, contact tracing and isolation. *Swiss Medical Weekly*, *150*(1112), https://doi.org/10.4414/smw.2020.20225

Santos, M. E., & Villatoro, P. (2018). A multidimensional poverty index for Latin America. *Review of Income and Wealth*, *64*(1), 52–82. https://doi.org/10.1111/roiw.12275

Saudi German Hospitals (2020). "Saudi German hospitals group" provides a new service "at home" to treat patients at their homes. Retrieved from https://www.sghgroup.com.sa/en/branches/riyadh/news/saudi-german-hospitals-group-provides-new-service-home-treat-patients-their

Secretaria de Salud de México (2020). Información sobre Servicios Digitales. Retrieved from https://coronavirus.gob.mx/multimedia/

Sood, A., Pollard, C., Le Suer, K., Vlahovich, K., & Walker, J. (2020). Caring for Miners During the Coronavirus Disease-2019 (COVID-19) Pandemic. *The Journal of Rural Health*, https://doi.org/10.1111/jrh.12444

SoteDigi, O. (2020). Omaolo. Retrieved from https://www.omaolo.fi/en

Stevenson, A., Ramzy, A., & May, T. (2020). *In Hong Kong, the Coronavirus Strikes a Wounded City*. The New York Times. Retrieved from https://www.nytimes.com/2020/02/07/business/hong-kong-coronavirus.html

Stewart, H., & Campbell, D. (2020). NHS workers angered at Hancock's warning not to overuse PPE. *The Guardian*. Retrieved from https://www.theguardian.com/society/2020/apr/10/matt-hancock-urges-public-not-to-overuse-ppe

University of Columbia (2020). CovidWatcher. Retrieved from https://covidwatcher.dbmi.columbia.edu/

Wallach, P. A., & Myers, J. (2020). The federal government's coronavirus response—Public health timeline. Retrieved from, https://www.brookings.edu/research/the-federal-governments-coronavirus-actions-and-failures-timeline-and-themes/

Wang, C., Horby, P. W., Hayden, F. G., & Gao, G. F. (2020). A novel coronavirus outbreak of global health concern. *The Lancet*, *395*(10223), 470–473. https://doi.org/10.1016/S0140-6736(20)30185-9

Wanner, C. (2020). Das Schweizer Gesundheitswesen rüstet auf. Retrieved from https://www.srf.ch/news/schweiz/schub-fuer-digitalisierung-das-schweizer-gesundheitswesen-ruestet-auf

Woods, M. (2020). Flatten The Curve: What It Means For Coronavirus In Canada. *The Huffington Post*. Retrieved from https://www.huffingtonpost.ca/entry/flatten-the-curve-coronavirus-canada_ca_5e6ab55fc5b6dda30fc5cfb1?guccounter=1&guce_referrer=aHR0cHM6Ly9kdWNrZHVja2dvLmNvbS88&guce_referrer_sig=AQAAAJu_kBqcHwUDSHo-WYMUf6KeEYG-ZiF49fQYpaM2jQm7kqrsNrKbf9_fcsovqQWdwuXHIJxxg3XMAhOflOWzjhYSaeL-3E-v2PL1zWP7dWnf0lChMd2zCgt7nXVsw49xZ8B8dSGP-97ppq_RnCnQIRaGnCgCi53HBhlhm1Ec3kGO

World Health Organization (2003). Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. Retrieved from https://www.who.int/csr/sars/country/table2004_04_21/en/

World Health Organization (2020a). Coronavirus Disease (COVID-19). Retrieved from https://covid19.who.int

World Health Organization (2020b). Novel Coronavirus (2019-nCoV) Situation Reports. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports

World Health Organization (2020c). Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). Retrieved from https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)

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

Yong, E. (2020). The U.K'.s Coronavirus 'Herd Immunity' Debacle. The Atlantic. Retrieved from https://www.theatlantic.com/health/archive/2020/03/coronavirus-pandemic-herd-immunity-uk-boris-johnson/608065/

Zhang, Y., Sun, Z., Latour, J. M., Hu, B., & Qian, J. (2020). Hospital response to the COVID-19 outbreak: The experience in Shanghai, China. *Journal of Advanced Nursing.*, https://doi.org/10.1111/jan.14364