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RESEARCH ARTICLE

A RETROSPECTIVE EVIDENCED-BASED APPROACH FOR PREVENTING THE SPREAD OF COVID-19 IN THE STATE OF TEXAS, USA

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ABSTRACT

This research project provides evidence-based scientific methods for preventing SARSCoV2. SARSCoV2 is a viral pathogen responsible for causing COVID-19 infections in human populations. Educating Texans about the importance of using technology, wearing masks, social distancing, hand washing, screening, vaccination, and developing more interagency cooperation between the Texas Department of State Health Services (DSHS) and other local health departments is essential for preventing more epidemics and or pandemics. Establishing more state agencies between the Texas Department of State of Health Services (DSHS) and local health departments could bridge the existing gap between the DSHS and local health departments. Mitigating this gap is one fundamental solution for preventing epidemics or pandemics in the future.

INTRODUCTION

Severe Acute Respiratory Syndrome (SARSCoV2) causes Coronavirus disease (COVID-19). The first outbreak occurred in Wuhan (China) in December 2019. Thousands of mortalities due to respiratory complications from COVID-19 was noted (1). On March 11th, 2020, the World Health Organization (WHO) officially declared the SARSCoV2 as the fifth global pandemic in the last 100 years. SARSCoV2 is transmissible via respiratory droplet infection and faecal-oral means by ingesting the virus via mucosal openings in the mouth, eyes, and nasal passages. The virus may cause a rapid cascade of a complex immune response that typically affects the lungs, which may result in respiratory or systemic multi-organ failure (2). Coronaviruses have existed for many years. Many respectable scientists have described this phenomenon (3). Is it possible that different types of mutations in the viral genome of coronaviruses may be responsible for developing more virulent strains that have led to the current global COVID-19 pandemic? The DNA footprint of the SARSCoV2 may appear to have similarities with the Systemic Inflammatory Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). A thorough comprehension of the DNA sequence and footprint of the SARSCoV2 may be the initial step for preventing further pandemics (3). The chronological events leading to the resurgence of the SARSCoV2 virus since the Spanish Flu pandemic in 1918 is essential for preventing the spread of SARSCoV2 from one person to another (3).

The SARSCoV2 that is responsible for the COVID-19 infection may be a zoonotic infection. Global warming could be responsible for destroying some of the natural habitats of animals that harbour the SARSCoV2 virus. Human encroachment, physical destruction of natural habitats such as deforestation, horticulture, migration, and environmental pollution are possibilities that may be a cause for the increase of the SARSCoV2 pandemic. Some animals living in some of these natural habitats end up migrating closer to environments inhabited by human beings. This increases the likelihood of zoonotic transmission of the SARSCoV2 to human beings. Ingesting raw beef products of these infected animals by human beings is an example of zoonotic transmission. Keeping domesticated pets such as bats, pigs, pangolins, and camels may increase the risk of zoonotic transmission of SARSCoV2 and MERS (4). The development of newer environmental policies that support global warming eradication is required globally. The United States of America (USA) has suffered lots of losses from COVID-19 in 2020. The mortality rate due to COVID-19 across most states is still rising despite aggressive vaccination campaigns. Texas has implemented an aggressive COVID-19 Contact Tracing Program (CTP) that is slowly paying off dividends. A reduction of COVID-19 related mortalities between March 2020 and February 2021 (5). What can be learned from other countries such as Taiwan, South Korea, and Singapore that have implemented effective CTPs in the past? The governments of Taiwan, South Korea, and Singapore have established epidemiology related command

centers over the last few years after learning hard lessons from the SARS and MERS epidemics a few years back. In Taiwan, the government has established a National Health Command Center (NHCC) system. The NHCC is further subdivided into a Central Epidemic Command Center (CECC), the Biological Pathogen Disaster Command Center (BPDCC), the Central Medical Emergency Operations Center (CMEO), and the Counter-Bioterrorism Command Center (6). These agencies work collaboratively and expeditiously to counter and mitigate any biological threat. The NHCC and other rapid response systems protect border control in air and sea during any epidemic or pandemic. These control systems, massive data and technology-based identification of cases, systemic quarantine of highly infectious persons or exposed contacts, and proactive case finding are some of the successful public health measures in Taiwan (6).

The NHCC, CECC, BPDCC, and CMEO systems are possible solutions for preventing pandemics in Texas. Meaningful collaborations between federal, state, and local agencies are essential in ensuring that developing interventions such as vaccines, contact tracing, and surveillance programs is reached within a realistic time frame. Mitigating the spread of COVID-19 in Texas may require advanced innovation and technology. For example, geospatial mapping of infrared cameras fitted with smart thermometers that accurately capture increased human body temperatures above 100 degrees Fahrenheit at strategic points. These cameras and thermometer could be installed at passenger termini at airports, subway stations, malls, stadia, offices, schools, and universities. Usage of these thermometers and infrared cameras should only be used for beneficial and not malevolent reasons. The public should also be made aware of this technology and its usage before installation in public or private facilities.

RESEARCH METHODS

A retrospective meta-analysis of 100 evidence-based articles provided different types of public health interventions for preventing SARSCoV2. The inclusion criteria were articles from 2015 to 2020 years. The exclusion criteria were articles published before 2014. 20 articles were selected for providing more insight into preventing SARSCoV2 in Texas. A scoring algorithm of 1-10 was be used for determining the strengths and weaknesses of the top 20 articles for preventing SARSCoV2 virus prevention in Texas, USA. A score of 1-3 referred to the least effective interventions whereas scores of 4-6 medium interventions and 7-10 the most effective interventions.

RESULTS

20 articles of the best articles provided evidence-based solutions for preventing the spread of COVID-19 in Texas.

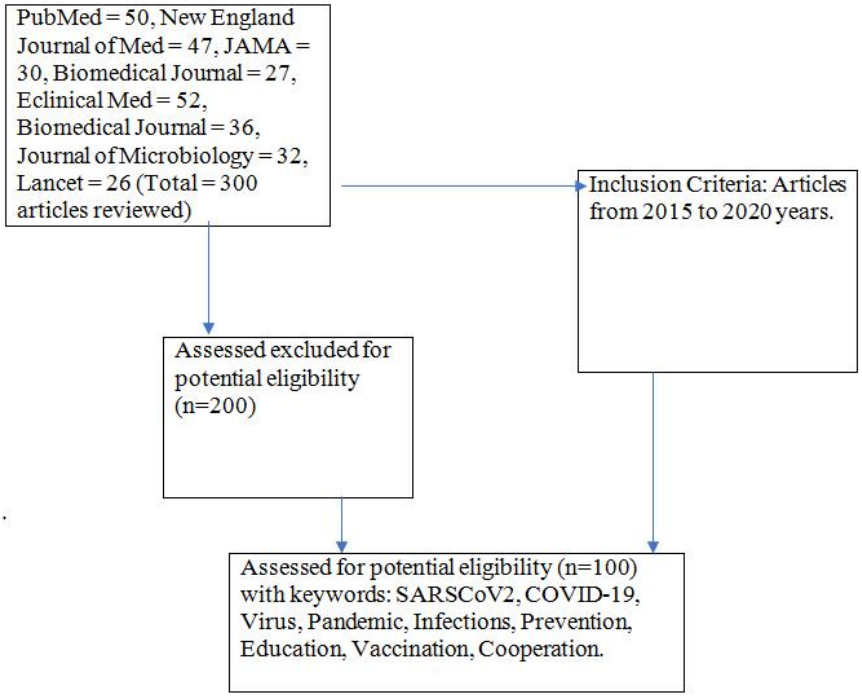

Table (I).

These solutions addressed the essential benefits of social distancing, use of Alcohol Bases Hand Sanitizer (ABHS), vaccination, and increased interagency cooperation.

DISCUSSION

Public health is a science that mainly focuses on disease prevention in populations. John Snow demonstrated that primary prevention practices such as sanitation mitigated the spread of the cholera epidemic that killed approximately 22,000 people between 1831-1832 in Soho, England (8). The sanitary movement was the forerunner of public health and an essential primary prevention component of disease prevention (9). Viral diseases continue evolving and are a source of major public health threats described by the World Health Organization (WHO). Several viral epidemics occurred in the last 20 years. For example, SARS occurred between 2002 and 2003 and H1N1 in 2009 (10). COVID-19 was initially identified in December 2019 in the wet markets in Wuhan and Hubei located in China (10). On February 11th, 2020, The World Health Organization (WHO) General Director Dr

Table II. Showing the Top 20 Articles Identified out or 100 Articles for Providing Effective Preventative Methods and Interventions for SARS-COV-2 virus Prevention in Texas, USA

Article Title	Author(s)	Strong Intervention	Medium Intervention	Least Intervention
Rapid establishment of COVID-19 biobank in NHRI by National Biobank Consortium of Taiwan	Huang, S., Huang, Y., Chang, Lin, Chiu, C. & et al. (2020).	Rapid establishments of a COVID-19 biobank. Presents a consortium for multiple samples for research by scientists. A great template for the Texas Department of Date Health Services to emulate. Score (9)		
The application of DNA nucleotide footprint plotting in coronavirus	Krem, S (2020)	Provides scientific evidence-based understanding of the SARSCov2 virus by distinguishing DNA structure from other viruses that is necessary for comprehending futuristic virulence of COVID-19 and prevention. (Score 9)		
Expeditious responses to COVID-19 crisis: From governmental management laboratory approach	Sytwu, H. (2020)	Explains the rapid response system of government agencies with rapid development of multiple establishments of different non-governmental agencies to identify, study, prevent, and mitigate the spread of COVID-19. A great template for the Texas Department of Date Health Services to emulate. Score (10)		
Examination of air pollution's relationship with COVID-19. physical and mental health	Islam, H., Shakoori, S., Aslam, F., Ashraf., & Akram, H. (2020).	Compares the environmental relationship with COVID-19 and the effects on physical and mental health. Also, discusses proposed primary and secondary interventions for preventing COVID-19 (Score 8)		
Features, evaluation and treatment coronavirus (COVID-19).	Cascella, M., Rajnik, M., Cuomo, A., Dulebohn, S. C., & Di Napoli, R. (2020).	Discusses a comprehensive approach for COVID-19 etiology, epidemiology, differential diagnosis, proposed treatment, and prevention (Score 7)		
Effect of coronavirus disease 2019 (COVID-19) on maternal, perinatal and neonatal outcome: systematic review	Juan, J., Gil, M. M., Rong, Z., Zhang, Y., Yang, H., & Poon, L. C. (2020).			Does not propose definitive prevention mechanisms against COVID-19. Strengths: Measuring SARSCov2 samples in vaginal and breast milk samples. (Score 3)
Hand sanitizers: A review of ingredients, mechanisms of action, modes of delivery, and efficacy against coronaviruses	Golin, A. P., Choi, D., & Ghahary, A. (2020).		Discusses the efficacy of ABHS in preventing COVID-19. (Score 6)	
Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia	Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., et al.	Discusses the early transmission of COVID-19 and defines the pneumonia-like illness. Very important for understanding the early epidemiological spread of the disease and detection mechanisms (Score 8)		
Detection of SARS-CoV-2 in different types of clinical specimens	Wang, W., Xu, Y., Gao, R., Lu, R., Han, K., Wu, G., & Tan, W. (2020).		Very important for understanding the early epidemiological spread of the disease and detection mechanisms (Score 6)	
The resilience of Taiwan's health system to address the COVID-19 pandemic	Han, E., Chiou, S. T., McKee, M., & Legido-Quigley, H. (2020).	Discusses Taiwan's government actions in early detection, prevention, treatment, mitigation protocols against SARS viruses including SARScov2. A great template for the Texas Department of State Health Services to emulate (Score 10)		

Continue …

Inactivation of SARS-COv-2 by commercially available alcohol-based sanitizers.	Leslie, R. A., Zhou, S.S., & Macinga, D.R. (2020).	Discusses the efficacy of ABHS and the right alcohol concertation for eliminating SARS-Cov2 virus in hands in tandem with CDC guidelines for use of hand sanitizers and hand washing practices (Score 8)		
How to protect yourself and others - The best way to prevent COVID-19 is to avoid being exposed to the virus	CDC (2020).	Discusses the importance of educating the public as an essential step against COVID-19 prevention (Score 9)		
Reports of Anaphylaxis After Receipt of mRNA COVID-19 Vaccines in the US-December 14, 2020-January 18, 2021	Shimaburuko T.T, Cole M, Su J.R. (2021)	Discusses the meaning of anaphylaxis complications between Moderna and Pfizer vaccines. Also, assures the public that the benefits of vaccination outweigh the risks researched (Score 10)		
Evaluating the effectiveness of social distancing interventions to delay or flatten the epidemic curve of coronavirus disease.	Matrajt, L., & Leung, T. (2020).	Discusses the benefit of social distancing for preventing COVID-19 and flattening the curve for cumulative infections over time (Score 10)		
Model-informed COVID-19 vaccine prioritization strategies by age and serostatus. Science.	Bubar, K. M., Reinholt, K., Kissler, S. M., Lipsitch, M., Cobey, S., Grad, Y. H., & Larremore, D. B. (2021).	Discusses the early efficacy of vaccination depending on the serostatus of patients with or without COVID-19 (Score 10)		
Lessons learned from Taiwan and South Korea's tech enabled COVID-19 communications.	Tworek, H. (2020)	This article provides evidence-based pragmatic solutions for mitigating the gap that is lacking between the TX DSHS and local health departments in Texas by incorporating use of technology and development of better prevention protocols (Score 10)		
Seoul and Taipei show the world how to contain pandemics	Onchi, Y. & Ihara, K. (2020).	This article provides evidence-based pragmatic solutions for mitigating the gap that is lacking between the TX DSHS and local health departments in Texas by establishment of a strong central authorities for preventing SARS and MERS epidemics (Score 9)		
Response to COVID-19 in Taiwan Big Data Analytics, New Technology, and Proactive Testing	Wang, J., Ng Y.C., & Brook, R.H. (2020)	This article provides a tier evidence-based approach for preventing COVID-18 in Taiwan using modern technology, development of rapid response systems, and proactive testing despite Taiwan's close proximity to China that was the epicenter of the first case of COVID-19 (Score 10)		
Coronavirus: Germany improves ventilation to chase away COVID	Hill, J. (2020)	Discusses the robust financial approach of investing in $488M for upgrading all existing air by installing new air purifiers-condition units in Germany's public offices, museums, theatrics, universities, and schools to prevent COVID-19 (Score 9)		
Evaluation of the effectiveness of surveillance and containment measures for the first 100 patients with COVID-19 in Singapore Jan 2-Feb 29, 2020	Ng, Y., et al (2020)	Discusses how string surveillance and containment strategies adopted by the Singapore Health Authorities for preventing COVID-19 are essential in the beginning stages of the pandemic (Score 8)		

Tedros Adhanom Ghebreyesus announced that COVID-19 is a disease caused by this new (SARSCoV2). The SARSCoV2 triggered a large-scale epidemic starting in China involving two dozen countries with around 8,000 cases and 800 deaths (fatality rate of 9.6 per cent) (11). A global public health crisis of more than 3 million individuals affected worldwide occurred on May 2nd, 2020 (12)(13)(14). When it comes to dealing with such a catastrophic highly infectious public health emergency, prevention is one of the most effective measures. Non-pharmaceutical interventions (NPI) such as wearing a mask, social distancing and hand washing may reduce the transmission rate of the virus before the vaccine is readily available (15)(16). Wearing a mask effectively reduces the efficiency of aerosol or droplet infection and secondary transmission of the virus (16) (17). However, the mask does not replace social distancing and other personal hygiene practices, such as hand washing (17). Quarantine and isolation are two primary prevention measures that can prevent COVID-19 in Texas. Quarantine is the separation of persons (or communities) exposed to an infectious disease. Isolation, in contrast, applies to the separation of persons who are known to be infected (18). An alternative way to hand washing is the increased use of a hand sanitiser for preventing COVID-19. It is more effective to use a hand sanitiser after hand washing for at least 20 seconds or when there is no access to soap and water. (19) Hand sanitisers are hygienic products used to avoid microorganisms such as viruses, bacteria and fungi (20). An alcohol-based hand sanitiser (ABHS), ethanol formulations between 60 and 95 per cent are generally known to be significantly effective in preventing the spread of microbial infections and are generally considered safe (20)(21). In a variety of forms, hand sanitisers are available, mostly in gel or liquid preparations. An active ingredient, perhaps ethanol or isopropanol, is functional in every container of hand sanitiser. The ABHS antimicrobial property depends on its active ingredient. Polyacrylic acid, glycerin, propylene glycol, or plant extract are part of the inactive ingredients in hand sanitiser constituents (19). ABHS could potentially prevent a community from spreading highly contagious diseases such as COVID-19.

Hand washing under running tap water for at least 20 seconds and use of ABHS in the absence of soap and water are two primary prevention methods suggested by the WHO for COVID-19 prevention. However, because of its ease of use and capacity for stalling microbial spread, the use of ABHS is recommended over soap use (22). Effective screening and immediate medical response for infected patients is a significant need to combat the spread of COVID-19. In COVID-19 patients, reverse transcription-polymerase chain reaction (RT-PCR) is the most used clinical screening method that uses respiratory specimens for testing (23). More effective screening kits (RT-PCR) is key for the early detection of COVID-19 in Texas. In the upper and lower respiratory tracts, patients with COVID-19 showed higher viral loads within five to six days of symptom onset (24)(25)(26)(27).

A nasopharyngeal swab (NP), oropharyngeal swab (OP), blood draw, are often recommended for early SARSCov2 diagnosis (28)(29). A single RT-PCR NP swab has become the preferred swab as the patient tolerates it better. The inherent quality control of NP swabs is that they generally reach the correct area to be tested in the nasal cavity. Sputum sampling or bronchoalveolar lavage also should ideally be used to collect specimens of the lower respiratory tract as they have yielded the highest viral loads for COVID-19 diagnosis (30). There rapid lateral flow testing of IgM and IgG antibodies plays a critical role in COVID-19 prevention. IgM and IgG antibody testing arepredictors of achieving herd immunity (31). More IgM and IgG antibody testing for every 1-2 persons per single RT-PCR is highly recommended for analyzing the state of herd immunity in Texas. Consistent enlightenment of different types of primary prevention types among varied populations is imperative for preventing the spreading of SARSCoV2 in the state of Texas. These primary prevention types may include public health education and sanitation measures in Texas.

Integration of all local and state public health agencies in Texas is imperative. Developing a syndromic surveillance tool among multiple agencies is crucial for preventing the spread of highly infectious diseases through a shared community health practice. Shared community practices agencies are the Department of State Health Services (DSHS), the Department of Homeland Security, the Department of Transportation, and the Department of Education is a crucial step towards preventing future epidemics in Texas. South Korea, Taiwan, Sweden, and Germany have effective inter-agency collaborations between local and state departments have been successful in detecting, mitigating, and preventing the spread of infectious disease outbreaks (32). Texas also may have effective means of preventing infectious disease outbreaks. However, due to the unprecedented spread of SARSCoV2 in February 2020 and a larger population density in Texas compared to South Korea, Taiwan, Sweden, and Germany, it is imperative to strengthen the aforementioned primary prevention measures for effectively preventing the spread of COVID-19 in Texas (33)(34)(35). An effective public health system that prides itself on a strong primary prevention foundation. This makes secondary prevention measures such as vaccination and treatment of infectious diseases more effective and affordable (36).

Continuous education of Texans about the recommended ABHS with the correct alcohol concentrations of 60%-90%, regular hand washing, and vaccination practices are imperative for eradicating the spread of SARSCoV2. Standardized legislation by the leadership in Texas is required for ensuring that manufacturers produce ABHS that meet the recommended percentage for eradicating pathogens such as SARSCov2. This would imply that various manufacturers of ABHS produce more standardized concentrations and percentages of hand sanitisers with the required alcohol content. Various types of alcohol hand sanitisers are currently sold in the market range from 60% - 91% isopropyl alcohol concentration (37)(38). Variations of the alcohol concentration in different types of ABHS could result in more COVID-19 cases in Texas due to a lack of inadequate public health education and health promotion among Texans. This is why interagency cooperation is important for developing policies that ensuring that proper ABHS with the correct alcohol content is manufactured, distributed, and sold to the public in healthcare settings, airports, schools, nursing homes and long-term care facilities. The recent rollout of the Pfizer-BioNtech and Moderna mRNA-based COVID-19 vaccines by the US Food and Drug Administration (FDA) is an essential type of secondary intervention for preventing COVID-19. Continuous education of Texans by healthcare providers and public health experts about the risks and benefits of the two vaccines is very crucial during this process. Anaphylaxis is one risk, which is a life-threatening allergic reaction following the administration of either of the two vaccines is imperative (39). These types of anaphylactic reactions have been identified among patients thanks to a collaborative partnership among the CDC, Vaccine Adverse Event Reporting System (VERS), National Passive Surveillance (NPS), and the Brighton Collaboration Case definition for anaphylaxis classification (40). This is a great example of the importance of inter-agency cooperation among state and local public health departments in Texas for understanding the prevention of COVID-19.

Conclusion

Social distancing has been used in public health for a very long time and is a proven tool for preventing the spread of infectious diseases. Social distancing includes instructions to keep a distance from others, use limits on gatherings, deter businesses from working, and stay home (41). Immunization for COVID-19 is an outstanding priority for ending the pandemic. Great vaccines are being developed, which is fortunate to be facilitated by science and medicine. Providing evidence of protection would be essential. Vaccines will offer both direct and indirect protection because they reduce susceptibility to disease and infection. There will initially be limited availability of a COVID-19 vaccine. Workers who provide health care are in the first-tier category and help preserve the health care system by protecting those who control it (42). The next priority will be direct protection of those at highest risk, especially elderly people 65 years and older including people with certain comorbidities. death, or hospitalization, when infected. This approach may be optimal if the vaccine is a little less effective in these groups, but it can reduce mortality. However, if a vaccine in high-risk groups offers little or no protection yet can reduce infection or infectiousness in younger adults, an indirect strategy could be preferred as the supply of vaccines becomes sufficiently large (43)(44).

It is also important to establish additional agencies between the Texas Department of State Health Services (DSHS) and local health departments in Texas. These additional agencies will improve interagency cooperation for detecting, surveilling, and preventing future pandemics like COVID-19. The same principle has been established and proven successful in Taiwan, South Korea, Germany, and Singapore for preventing other SARS and MERS-related infections. In April 2020, South Korea reported 10,600 confirmed COVID-19 cases whereas Taiwan reported just over 400 cases and only four reported deaths (45)(46)(47). These prevention protocols should incorporate the use of technology by the TX DSHS for better informing Texans about the importance of better communication strategies, openness and transparency, equitable information access, more education for accessing online resources for preventing highly infectious diseases, developing a clear division of labor between public health officials and politicians. The same evidence-based approach used in South Korea, Taiwan, Singapore, and Germany could result in effective Contact Tracing Programs (CTP) and development prevention protocols against COVID-19 in Texas (48)(49).

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