REVIEW ARTICLE

# Role of Non-pharmaceutical Interventions (NPIs) During COVID-19 Pandemic: A Systematic Literature Review

Su Peng Chua, Faiz Daud, Normaslina Mustaza

Department of Community Health, Faculty of Medicine, University Kebangsaan Malaysia, 56000, Cheras, Kuala Lumpur, Malaysia

**ABSTRACT**

Non-pharmaceutical interventions (NPIs) as a means of prevention during the COVID-19 pandemic have gained increasing attention. NPIs are important to reduce infectious diseases and flatten the curve of infection. However, data or literature on the effectiveness of NPIs is scarce. In this review, we aim to investigate the effectiveness of NPIs in the community based on previous literature. A literature search was conducted on seven databases (OVID, EBSCOHOST, WOS, SCOPUS, TRIP, JSTOR, and PUBMED) using the PICO method which yielded 208 articles from 12th March to 1st April 2020. A PRISMA flow diagram and extraction tables were used to analyze the final 14 eligible articles spanning nine countries. There were nine articles on human surveillance, two on patient and contact management, two on community restrictions, and one article discussing the combination of NPIs (quarantine, closure of facilities, and transit site surveillance). With the use of NPIs, there was a significant reduction of infection episodes among the target population. There has been an increasing demand for scientific evidence on NPIs during the COVID-19 pandemic, and present policy recommendations rely heavily on expert judgement. Randomized trials are required to obtain better evidence for these interventions. However, this review will help experts create feasible and widely acceptable policies and protocols for mitigation plans in the absence of definitive evidence.

**Keywords:** COVID-19 pandemic, Cough etiquette, Hand hygiene, Quarantine, face mask

**Corresponding Author:**
Faiz Daud, MPH
Email: faizdaud@ppukm.ukm.edu.my
Tel: +6019-2712008

## INTRODUCTION

As of June 4, 2020, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), or otherwise known as COVID-19, has affected more than 6.56 million individuals worldwide and caused more than 387,987 deaths (1). The World Health Organization (WHO) has declared the pandemic as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 (2). Governments across the globe quickly implemented emergency lockdowns in their respective countries to help flatten the curve of infection. With the unavailability of effective vaccines, non-pharmaceutical interventions (NPIs) have been given serious attention to prevent and curb COVID-19 transmission. Numerous unknown factors, such as the distance of infective spread and the mode of transmission, have thrown a curveball to scientists. Some argue that the infection is spread via aerosolized droplets, whereas some state that it is airborne. Nevertheless, until an effective vaccine or treatment intervention becomes available, COVID-19 prevention will continuously rely on NPIs, including pandemic mitigation in the community (3). To prevent the disease from spreading and to reduce morbidity and mortality among the public, policymakers have introduced conflicting advice on physical and social distancing. Besides, the use of N95 respirators and face masks have been controversial, especially when personal protective equipment (PPE) shortages arose. Among the other implemented NPIs include self-quarantine, isolation of ill individuals, cough etiquette, hand hygiene, and the use of PPE (4). NPIs are important to reduce infectious disease and flatten the curve of infection. However, data or literature on the effectiveness of NPIs is scarce. In this review, we aim to determine the effectiveness of NPIs in the community based on previous literature.

## METHODOLOGY

### The review protocol – PRISMA

The study was guided by the PRISMA review protocol. PRISMA or otherwise known as Preferred Reporting Items for Systematic Reviews and Meta-Analyses is designed specifically for systematic reviews and meta-analyses (5). PRISMA aims to prompt researchers so that they will source the right information with an accurate level of detail. Based on this review protocol, the researchers started their systematic literature review by formulating

appropriate research questions. The researchers started the systematic search that consists of three main sub-processes: identification, screening (inclusion and exclusion criteria), and eligibility. Next, the researchers proceeded to appraise the quality of the selected articles using the Mixed Methods Appraisal Tool (MMAT) Version 2018 (6) to ensure the quality of the articles for reviewing. Finally, the researchers explore in detail the data that were extracted for analysis and validation.

**Formulation of research questions**

The formulation of the research question for this study was based on PICO from 12th March to 1st April 2020. PICO is a tool that assists authors to develop a suitable research question for the review. It is based on three main concepts namely Population or Problem, Interest, and Context (7). Based on these concepts, the researchers have included the three main aspects in the review namely community (Population), non-pharmaceutical interventions (Interest), and flattening the curve, reducing morbidity and mortality of COVID-19 pandemic (Context) which guided the researchers to formulate its main research question "What are the non-pharmaceutical interventions (NPIs) effective in combating COVID-19 pandemic in the community?".

**Systematic searching strategies**

There are three main processes in the systematic searching strategies process namely identification, screening, and eligibility (Fig. 1).

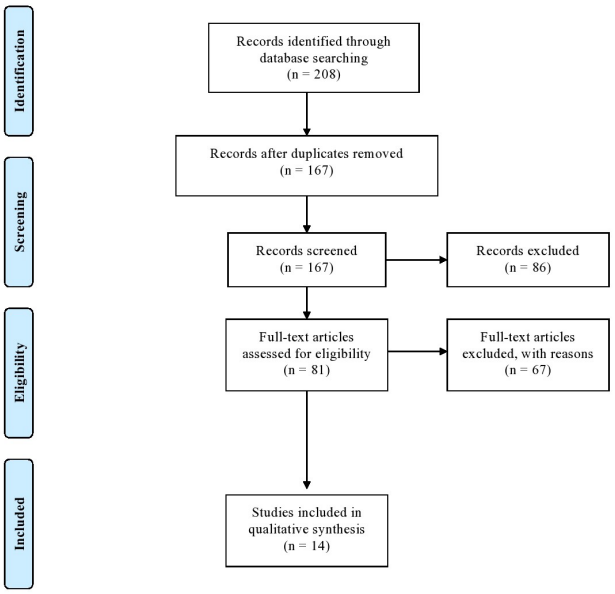


**Figure 1: Prisma diagram showing the results of the literature search**

### *Identification*

Identification is the first stage involved for systematic searching strategies in this current review, whereby the identification of the synonym, related MeSH terms, and variation for the main keywords for the study are made. This process will allow more options for the selected databases to search for more relevant articles. Other search terms included people with WHO-defined confirmed or probable COVID-19, MERSCOV, SARS, or influenza-like illnesses (ILI). Close contacts to the index cases were also accounted for. NPIs such as one-meter social distancing, quarantine, use of a face mask or N95 respirators, proper hand hygiene and cough etiquette, and closure of facilities were also included. Various combinations of the Medical Subject Headings (MeSH) were searched for in the databases from the year 2000 using the PICO method (7). Seven primary databases were used for literature search namely TRIP, OVID, EBSCOHOST, WoS, Scopus, PubMed, and JSTOR. The search was also enriched by using Boolean operators and phrase searching technique; resulted in a total of 208 articles from all the included databases. The found articles were then exported from the databases and arranged for the screening process in the excel sheet.

### *Screening*

Screening is a stage in which articles will be screened and chosen by the researchers based on specific criteria. Firstly, the titles for all articles were screened to look for duplicates. Duplicates may occur as the search was done from multiple databases. Out of 208 articles, 41 duplicate articles were removed and the balance of 167 articles was then filtered using title screening. Title screening was done based on the inclusion and exclusion criteria that have been discussed and agreed upon by all the researchers of this review. The inclusion criteria were: (1) articles that were published from 2000 to 2020, (2) full original articles, (3) articles written in the English language, and (4) observational and interventional studies related to the current study. Meanwhile, exclusion criteria were: (1) animal studies, (2) in vivo/in vitro studies, and (3) systematic reviews. Articles that were not original articles such as conference abstracts, book chapters, reports, systematic reviews, and meta-analysis were also omitted. Based on these inclusion and exclusion criteria, title screening was done and if the title seemed uncertain, the researcher would read the abstract to decide if it should be included or excluded. From this screening stage, a total of 86 articles were removed. The remaining 81 articles then proceeded with full-text articles assessments and eligibility.

### *Eligibility*

The third stage is the eligibility process which was manually monitored by the researchers for eligibility. Full articles were retrieved and were divided among the researchers. Articles that focus on NPIs during epidemics were all included for data synthesis. This stage excluded 67 articles due to various reasons such as not focusing on NPIs during epidemics and the main outcome was not on reducing mortality or morbidity or flattening the curve of infections. Therefore, 11 eligible articles then proceeded with the quality appraisal.

### Quality appraisal

The final list of studies was ranked for quality according to the MMAT which is a valid tool proven to be effective and practical for the quality assessment of a mixed-methods review (6). Narrative analysis and appraisal of selected articles were done using standardized predesigned data extraction form to ensure all related information was extracted accurately (6). Two reviewers are needed to appraise these articles. Both reviewers must accept the articles to be included in the systematic review. Any disagreement will be discussed among them and a final decision will be made. In the end, 14 articles were selected for the review.

### Data extraction and analysis

Thematic analysis was used in this systematic review (8). The thematic analysis is a descriptive analysis that allows data to be merged with other data analysis techniques (9). The researchers went through all selected articles comprehensively where findings were extracted and presented in a table. The thematic analysis then began where the researchers identified patterns of extracted data of reviewed articles and gathered them in a group before successfully categorized them into three different themes. The themes developed were then discussed with a group of panel experts in public health-related research. The panel expert group subsequently approved the themes generated as being appropriate to the results of the review. To avoid the risk of bias, two authors independently assessed the articles. Disagreements were resolved by discussion and consensus. Data were extracted by study identifier, study design, setting, population, intervention and comparator characteristics, main outcomes, and findings. The NPIs ascertained through our database search included (i) human surveillance, (ii) patient and contact management, and (iii) community restrictions (Table I).

**Table I: Non-pharmaceutical interventions (NPIs) during influenza outbreaks.**

| |
|---|
| **Human Surveillance** |
| • Case reporting |
| • Early rapid viral diagnosis |
| • Disinfection |
| • Hand hygiene |
| • Respiratory etiquette |
| • Surgical & N95 masks |
| • Other personal protective equipment* |
| **Patient Management** |
| • Isolation of sick individuals |
| • Provision of social support services to the isolated |
| **Contact Management** |
| • Quarantine** |
| • Voluntary sheltering*** |
| • Contact tracing |
| **Community Restrictions** |
| • School closures |
| • Workplace closures |
| • Cancellation of group events |
| • International and domestic travel restrictions**** |

*Gowns, gloves and protective eye covers **Separating exposed individuals from others
***Voluntary sequestration of healthy persons to avoid exposure
****Exit and entry screening, travel advisories

## RESULTS

### Human Surveillance

A total of nine articles were identified, which involved hand hygiene, respiratory etiquette, and use of face mask in community settings (4, 10-18). The studies are presented in Table II based on their results, applicability, and limitations as there were vast differences in the study design, participants, and interventions.

Of the nine studies, four were conducted in school settings, in which the outcome of the intervention was measured by the number of total absent days and numbers of secondary infections. A 3-year quasi-experimental study conducted by Apisarnthanarak et al. in Thailand found a significant reduction in laboratory-confirmed influenza infection which was associated with the practice of hand hygiene and cough etiquette among preschoolers, 60.8% in period 2 ($p = 0.008$) and 19% in period 3 ($p = 0.002$)(10). A similar intervention performed by Stebbins et al. which measured a randomized controlled trial among elementary school students in the USA showed that there was no significant effect of the intervention on the primary study outcome of all laboratory-confirmed influenza cases (incidence rate ratio [IRR] 0.81; 95% CI: 0.54–1.23). However, the study revealed a statistically significant difference in protocol-specified ancillary outcomes in which a significant reduction in laboratory-confirmed influenza A infections was observed among children in intervention school compared with those in control schools, with an adjusted IRR of 0.48 (95% CI: 0.26–0.87). Moreover, the study demonstrated a significant reduction in total absent days among the intervention group compared with the control group, with an adjusted IRR of 0.74 (95% CI: 0.56–0.97)(16). A few randomized controlled studies were conducted among households to assess the involvement of hand hygiene with the usage of face masks. The studies conducted by Cowling in Hong Kong found no significant difference between the intervention group and the control group. Nevertheless, a reduced transmission among influenza confirmed cases to contacts in the intervention group was observed (adjusted OR, 0.33 [95% CI: 0.13–0.87]) (11).

Two other studies conducted by Aiello et al. and Seuss et al. also found a significant reduction in secondary infection in the intervention group compared with the control group (4, 15). However, the study by Simmerman found no significant difference in terms of secondary infection in the hand hygiene group (OR = 1.20; 95% CI: 0.76–1.88; $p = 0.442$) or the hand hygiene and face mask group (OR = 1.16; 95% CI: 0.74–1.82; $p = 0.525$) (14).

Three studies were conducted to evaluate the effectiveness of hand hygiene. A randomized controlled trial conducted by Talaat et al. in Egypt included 20,882

**Table II: Summary of the nine articles under human surveillance**

| Study | Setting | Participants and follow-up | Study design | Interventions evaluated | Main outcomes | Findings |
|---|---|---|---|---|---|---|
| Aiello et al., 2012 (4) | 5 university residence hall, Michigan University, USA | 1178 individuals | Randomized intervention trial | Hand hygiene, face mask, and control group | Incidence of ILI cases | Significant reduction in the rate of ILI in the intervention group as compared with the control group |
| Apisarnthanarak et al., 2009 (10) | Private Thailand Kindergarten | 240 children | Quasi-experimental study | Hand hygiene and cough etiquette | Incidence of ILI cases | Significant reduction of cases in period 2 and period 3 |
| Cowling, 2009 (11) | 45 outpatient clinics in the private and public sectors in Hong Kong | 794 households | Cluster-randomized controlled trial | Hand hygiene, hand hygiene plus surgical face mask, and control group | rT-PCR-confirmed influenza infection | Significant fewer infection cases in the intervention arm compared with the control arm |
| Lau et al., 2012 (13) | 2 Chicago Public Elementary Schools | 981 students | Prospective cohort study | Hand hygiene and control group | The percentage of the total absent days and percentage of illness-related absent days | The low percentage of absenteeism could be associated with the use of hand hygiene |
| Salvolainen-Kopra et al., 2012 (18) | 21 clusters in 6 companies in Helsinki, Finland | 683 employees | Cluster-randomized intervention trial | Hand hygiene with soap and water, alcohol rub, and control group | Infection episodes | Significant reduction of infection episodes in hand hygiene with soap arm compared with alcohol rub and control group arm |
| Simmerman et al., 2011 (14) | The outpatient department of the Queen Sirikit National Institute of Child Health (QSNICH) in Bangkok | 1589 households | Randomized controlled trial | Hand hygiene, hand hygiene plus surgical face mask, and control group | Secondary influenza infection cases | No significant difference between intervention groups |
| Stebbins et al., 2011 (16) | 10 elementary schools in Pittsburgh, USA | 3360 students | Randomized controlled trial | Hand hygiene, cough etiquette, and control group | Total absenteeism episodes and laboratory-confirmed cases of influenza | No significant differences in laboratory-confirmed cases, but there was a reduction in total absenteeism episodes |
| Suess et al., 2012 (15) | Recruited by the general practitioner and pediatrician in Berlin, Germany | 84 households | Cluster-randomized controlled trial | Hand hygiene, face mask, and control group | Secondary infection cases | Significant reductions of infections in the intervention group compared with the control group |
| Talaat et al., 2011 (17) | 60 elementary schools in Cairo, Egypt | 20882 students | Randomized controlled trial | Hand hygiene and control group | Laboratory-confirmed influenza and the number of absenteeism caused by ILI | Significant decrease in the intervention group compared with the control group |

school children who were divided into the intervention arm and control arm. In this trial, a significant decrease in the amount of absenteeism (reduced by 40%, $p < 0.0001$) and laboratory-confirmed influenza (reduced by 50%, $p < 0.0001$) (17) was found. Another study conducted by Lau et al. revealed that the percentages of total absent days and illness-related absent days were significantly lower in the intervention group during the flu season ($p = 0.002$, $p < 0.001$, respectively). The difference was significant during the influenza season but declined in the following months (13). Finally, Savolainen-Kopra concluded that hand hygiene, with the use of water and soap, was associated with reduced influenza infection (reduced by 6.7%, $p = 0.04$) (18).

**Patient and Contact Management**

Two observational studies that evaluated the effectiveness of quarantine during the SARS outbreak in Taiwan in 2003 (Table III) were identified. A study by Hsieh et al. found that quarantining contacts that were potentially exposed to suspected SARS patients (Level A quarantine) prevents approximately 461 additional cases of SARS and 62 additional deaths, as compared with quarantining travellers from SARS-infected areas (Level B quarantine) (19). A study conducted by Wang supported Hsieh's findings. They both found that people who are potentially exposed to suspected SARS patients have a three times higher risk of developing SARS compared with travellers from SARS-infected areas. Wang also stated that only people with known exposure to persons infected with SARS could reduce the number of people that needed to be quarantined by 64% (20).

**Community Restriction**

Two observational studies on school closure during the influenza outbreak in Israel and Australia (Table IV) were conducted. A study by Heymann found a statistically significant difference in the weekly ratio of influenza-like diagnoses to non-respiratory diagnoses ($p = 0.0074$) during school closure compared with other years (21). A survey on 233 parents in Perth, Australia, revealed that 47% thought the school closure was appropriate, 33% thought it was inappropriate, and 20% did not respond. During the school closure, only six cases reported that fulfilment of the case definition for ILI indicates the effectiveness of school closure during influenza outbreak (22).

**Combination**

Finally, Bartlett (23) investigated the effects of quarantine,

**Table III: Summary of the two articles under patient and contact management**

| Study | Setting | Participants and follow-up | Study design | Interventions evaluated | Main outcomes | Findings |
|---|---|---|---|---|---|---|
| Hsieh et al., 2007 (19) | SARS outbreak in Taiwan | Community | Observational study | Quarantine Level A: people with potential contacts with suspected SARS patients Quarantine Level B: people traveling from SARS area | Number of SARS cases and mortality | Level A quarantine could be associated with the prevention of approximately 461 additional SARS cases and 62 additional deaths as compared with Level B quarantine |
| Wang et al., 2007 (20) | SARS outbreak in Taiwan | Community | Observational study | Quarantine Levels A & B (as above) | Identifying people who fit the criteria for quarantine | Quarantining people with known exposure to persons infected with SARS could have reduced the number of persons quarantined by approximately 64% |

**Table IV: Summary of the two articles under community restriction**

| Study | Setting | Participants and follow-up | Study design | Interventions evaluated | Main outcomes | Findings |
|---|---|---|---|---|---|---|
| Effler et al., 2010 (22) | Elementary schools in Perth, Australia | 233 parents | Observational study | School closure | Survey on family preparedness and impact during the closure of the school | 47% thought the school closure was appropriate, 33% thought it was inappropriate, and 20% remain unknown |
| Heymann et al., 2009 (21) | Israel nationwide elementary schools | Children (6–12 years)<br>Household members aged >12 years presumed to be living with these children and all other Maccabi members | Observational study | School closure | The weekly ratio of ILI diagnoses to non-respiratory diagnoses | The weekly ratio of ILI diagnoses to non-respiratory diagnoses was statistically significant for school children |

closure of facilities, and transit site surveillance during the SARS outbreak in Beijing in 2003 (Table V). An estimated number of around 2,610 public schools; public entertainment, such as theatres, bars, and libraries; and indoor sports facilities were closed from April 24, 2003, until early July 2003. From his observation, around 2,195 close contacts were quarantined. The attack rates were 6.3% (95% CI: 5.3%–7.3%), with a range of 15.4% (95% CI: 11.5%–19.2%) among spouses to 0.36% (95% CI: 0%–0.77%) among work and school contacts. He found that the attack rate increased as the age of the group increased. The attack rates were 5.0% (95% CI: 0%–10.5%) in children younger than 10 years and 27.6% (95% CI: 18.2%–37.0%) in adults aged 60 to 69 years. Through transit site screening, only 12 out of 14 million individuals who were screened for fever were found to have probable SARS. The time lag between illness onset and hospitalization decreased from a median of 5–6 days on or before April 20, 2003 (the day the outbreak was announced to the public), to 2 days after April 20 ($p < 0.001$) (23).

## DISCUSSION

In our review, there was limited evidence to support the effectiveness of NPIs in reducing the transmission of the influenza virus during outbreaks. It is important to determine which public health interventions would be effective as preventive measures to mitigate the influenza pandemic. NPIs such as hand hygiene, respiratory etiquette, face mask, and PPE could be most effective in short-distance transmission, either through direct or indirect contact. More comprehensive precautions are required to prevent the spread of disease in larger groups of people, such as isolation of sick people, quarantine of close contacts, closure of facilities, massive screening, restrictions of domestic and international travels, and cancellation of group events.

In a recent review by Bankston, it was concluded that influenza transmission among human beings occurs generally in short rather than long distances (24). This emphasizes the importance of personal prevention in

**Table V: Summary of articles under the combined non-pharmaceutical intervention**

| Study | Setting | Participants and follow-up | Study design | Interventions evaluated | Main outcomes | Findings |
|---|---|---|---|---|---|---|
| Bartlett, 2004 (23) | SARS outbreak in Beijing, China | 2521 probable cases | Observational study | Quarantine, closure of facilities and transit site screening | Attack rate and number of probable cases | The multiple control measures implemented in Beijing likely led to the rapid resolution of the SARS outbreak |

reducing the spread of infectious diseases within the community. Most of the infections that occurred caused an increase in absenteeism in schools and workplaces. Further evidence revealed that the substantial benefit of hand hygiene to prevent influenza transmission (13, 17, 18) is suggestive for direct or indirect contact as one of the most important modes of transmission. Furthermore, the effectiveness of combining personal prevention (hand hygiene, cough etiquette, and face mask) indicated (4, 10, 11, 15) that the interventions were able to reduce infections. However, there have been growing concerns about the implementation of the closure of facilities as it will negatively impact the socioeconomic status of the community (22). Nevertheless, NPIs have resulted in major improvements in containing the spread of infectious diseases based on the available data and their outcomes.

The effectiveness of the NPIs was probably impacted by the compliance issues in the community (14, 22). Various studies revealed low or non-compliance to NPIs (14, 22) or low acceptance among the communities. Thus, further research is required to investigate the influence of cultural and socio-behavioural factors on the levels of compliance to NPIs during a pandemic. For example, the use of face masks is more common during the SARS epidemic in Hong Kong than in Singapore (25). This may be due to the differences in culture, which will also affect the implementation of NPI policies. Due to a lack of evidence of other forms of NPIs, such as cancellation of group events and restrictions of international and domestic travels, further research is needed to determine the effectiveness of NPIs as part of the mitigation strategy of public health. The use of disinfectants as personal prevention is also important, but due to lack of research or literature, it is less encouraged as part of the prevention method during a pandemic. Pandemic guidelines provided by the WHO and the US Centers for Disease Control and Prevention (CDC) have clearly outlined various methods for implementing NPIs to enhance its effectiveness in containing infectious diseases, especially during influenza outbreaks, such as COVID-19 (26, 27). The strengths of our review include a comprehensive literature search before the selection of articles and critical discussion of the findings which comprise wide coverage of NPIs that have been commonly used during the outbreak and related to the current situation. However, the primary limitation of our study is that during our review, articles related to the application of NPIs during the COVID-19 outbreak were lacking, which lead us to focused more on NPIs use during the influenza pandemic.

## CONCLUSION

While waiting for new pharmacological treatment for COVID-19 and effective vaccines, this systematic review further reaffirms the need for NPIs to curb influenza transmission and to prevent further spread. Human surveillance, patient, and contact management, as well as community restriction, play significant roles in combating this pandemic. The demand for scientific evidence of NPIs during the influenza pandemic is imminent. Expert judgments on NPIs that are likely to be beneficial, feasible, and socially acceptable during outbreaks will guide policymakers in creating future guidelines and protocols. These findings should be considered while creating national, state, local, or facility epidemic mitigation plans. Further studies to evaluate the impact of NPIs to reduce the cases of ILI or Severe Acute Respiratory Infection (SARI) in the community will contribute to the promotion of public health and preparedness planning for emerging infectious diseases.

## REFERENCES


1. Worldometer. COVID-19 Coronavirus Pandemic: Worldometer; 2020 [Available from: https://www.worldometers.info/coronavirus/.
2. WHO. COVID-19 Public Health Emergency of International Concern (PHEIC) Global research and innovation forum 2020 [cited 2020. Available from: https://www.who.int/who-documents-detail/covid-19-public-health-emergency-of-international-concern-(pheic)-global-research-and-innovation-forum.
3. Qualls N, Levitt A, Kanade N, Wright-Jegede N, Dopson S, Biggerstaff M. Community mitigation guidelines to prevent pandemic influenza—United States, 2017. MMWR Recomm Reports. 2017;66(1).
4. Aiello AE, Perez V, Coulborn RM, Davis BM, Uddin M, Monto AS. Facemasks, hand hygiene, and influenza among young adults: A randomized intervention trial. PLoS One. 2012;7(1).
5. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS med. 2009;6(7):e1000097.
6. Hong QN, Pluye P, Fabregues S, Bartlett G, Boardman F, Cargo M, et al. Mixed methods appraisal tool (MMAT), version 2018. Registration of copyright. 2018;1148552.
7. Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. JBI Evidence Implementation. 2015;13(3).
8. Flemming K, Booth A, Garside R, Tunзalp Ll, Noyes J. Qualitative evidence synthesis for complex interventions and guideline development: clarification of the purpose, designs and relevant methods. BMJ Global Health. 2019;4(Suppl 1):e000882.
9. Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing & health sciences. 2013;15(3):398-405.
10. Apisarnthanarak A, Apisarnthanarak P,

Cheevakumjorn B, Mundy LM. Intervention with an Infection Control Bundle to Reduce Transmission of Influenza-Like Illnesses in a Thai Preschool. Infect Control Hosp Epidemiol. 2009;30(9):817–22-–22.
11. Cowling BJ, Chan KH, Fang VJ, Cheng CKY. Annals of Internal Medicine Article Facemasks and Hand Hygiene to Prevent Influenza Transmission in Households. Ann Intern Med. 2009;151):437–46.
12. Potter LA, Scholze DA, Biag HMB, Schneider A, Chen Y, Nguyen D V. A Randomized Controlled Trial of Sertraline in Young Children With Autism Spectrum Disorder. Front psychiatry [Internet. 2019;10.
13. Lau CH, Springston EE, Sohn MW, Mason I, Gadola E, Damitz M. Hand hygiene instruction decreases illness-related absenteeism in elementary schools: a prospective cohort study: BMC Pediatr; 2012.
14. Simmerman JM, Suntarattiwong P, Levy J, Jarman RG, Kaewchana S, Gibbons R V. Findings from a household randomized controlled trial of hand washing and face masks to reduce influenza transmission in Bangkok, Thailand. Influenza Other Respi Viruses. 2011;5(4):256–67-–67.
15. Suess T, Remschmidt C, Schink SB, Schweiger B, Nitsche A, Schroeder K. The role of facemasks and hand hygiene in the prevention of influenza transmission in households: Results from a cluster randomised trial. 2009.
16. Stebbins S, Downs JS, Vukotich CJ. Using nonpharmaceutical interventions to prevent influenza transmission in elementary school children: Parent and teacher perspectives. J Public Heal Manag Pract. 2009;15(2):112–17-–17.
17. Talaat M, Afifi S, Dueger E, El-Ashry N, Marfin A, Kandeel A. Effects of hand hygiene campaigns on incidence of laboratory-confirmed influenza and absenteeism in schoolchildren, Cairo, Egypt. Emerg Infect Dis. 2011;17(4).
18. Savolainen-Kopra C, Haapakoski J, Peltola PA, Ziegler T, Korpela T, Anttila P. Hand washing with soap and water together with behavioural recommendations prevents infections in common work environment: An open cluster-randomized trial. Trials. 2012.
19. Hsieh YH, King CC, Chen CWS, Ho MS, Hsu SB, Wu YC. Impact of quarantine on the 2003 SARS outbreak: A retrospective modeling study. J Theor Biol. 2007;244(4):729–36-–36.
20. Larson EL, Ferng YH, Wong-McLoughlin J, Wang S, Haber M, Morse SS. Impact of non-pharmaceutical interventions on URIs and influenza in crowded, urban households. Public Health Rep. 2010;125(2):178–91-–91.
21. Heymann AD, Hoch I, Valinsky L, Kokia E, Steinberg DM. School closure may be effective in reducing transmission of respiratory viruses in the community. Epidemiol Infect. 2009.
22. Effler P V, Carcione D, Giele C, Dowse GK, Goggin L, Mak DB. Household responses to pandemic (H1N1) 2009-related school closures, Perth, Western Australia. Emerg Infect Dis. 2010;16(2):205–11-–11.
23. Bartlett JG. Effect of antibacterial home cleaning and handwashing products on infectious disease symptoms: A randomized, double-blind trial. Infect Dis Clin Pract. 2004;12(4).
24. Brankston G, Gitterman L, Hirji Z, Lemieux C, Gardam M. Transmission of influenza A in human beings. 2007.
25. Leung GM, Ho LM, Chan SKK, Ho SY, Bacon-Shone J, Choy RYL. Longitudinal assessment of community psychobehavioral responses during and after the 2003 outbreak of severe acute respiratory syndrome in Hong Kong. Clin Infect Dis. 2005;40(12):1713–20-–20.
26. Alert E. RESPONSE WHO checklist for influenza pandemic preparedness planning. 2005.
27. Your G, Ready C, Flu P. Get Your Community Ready for Pandemic Influenza Using Nonpharmaceutical Interventions. 2017.