A meta analysis of prevention and control measures

aimed at COVID-19 spread control

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made by Code in Space team

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**Summary**.

The outbreak of a coronavirus disease firstly happened at Wuhan, China, December 2019 caused a great impact on various fields of a global society. Even though humankind has faced massive and devastating diseases spread~~s~~ throughout history, nature and the global scope of current pandemic shedded light on the vulnerability of many countries` health systems, as has been covered by respective analyses[[1]](#footnote-1) and public announcements[[2]](#footnote-2).

The World Health Organization's Emergency Committee ~~have~~ has declared coronavirus a Public Health Emergency of International Concern[[3]](#footnote-3) and recommended measures to be taken by governments[[4]](#footnote-4) and the general public[[5]](#footnote-5) to follow, and at the date of this study many countries are expecting to enter into recovery stage[[6]](#footnote-6).

The current impact of measures is tremendous - overall direct initial hit to the level of GDP is, as approximated, typically between 20-25% in many major advanced economies[[7]](#footnote-7). Depending on different figures used to calculate GDP growth projections, an increase in extreme poverty for the year 2020 is estimated at a range of 50 million 420 million people[[8]](#footnote-8).

It is worth mentioning that a vaccine or common standardized approaches to drug treatment, for coronaviruses in general[[9]](#footnote-9) and COVID-19 precisely[[10]](#footnote-10), are not yet developed and the current approach to this disease is still to control the source of infection[[11]](#footnote-11).

The measures taken are showing a direct impact on the disease`spread, even though it is still hard to predict how the coronavirus could spread in the future. In such a situation of high unpredictability, the analysis of measures approached by different countries and their effectiveness shall be studied thoroughly to make a model for policymakers to make the most optimal decisions on further measures.

Steps done during the research:

1. Analysis of some measures performed by selected countries.
2. Analysis of factors impacting measures` efficiency, such as general economical condition of countries and population density.

Result of the research:

1. Design a rationale for a solution that could be used by policymakers to auto-generate a set of the most optimal measures for combating the spread of covid-19.
2. **Measures showing negative and / or absence of results.**

We decided to narrow the scope of measures to analyse by considering less effective measures first.

1. Personal Protection Equipment.

It is being shown in recommendations that there is no current evidence that wearing a mask (whether medical or other types) by healthy persons in the wider community setting, including universal community masking, can prevent them from infection with respiratory viruses, including COVID-19. It is suggested to take into consideration that use of mask by healthy people could lead to potentially risky action, like touching face while putting a mask on, that could facilitate transfer of disease[[12]](#footnote-12).

Based on these recommendations, we could presume actions for the spread of personal protective equipment among the population as not having a proven efficiency.

It shall be mentioned at the same time, that use of personal protective equipment by people involved in medical care should be considered alongside with additional protective measure according to high risk of medical personnel of getting sick due to everyday direct exposure to vast viruses sources[[13]](#footnote-13).

1. Outdoor air disinfection.

No solid evidence was found during this study to support the effectiveness of this method, although there is no clear evidence against it. As it is not proven to be effective, we should focus more on potential disadvantages of the method. There is an Indirect evidence showing exposure of disinfectors to higher risk of chronic obstructive pulmonary disease[[14]](#footnote-14). Until there is a proof of the method effectiveness, its implementation should be avoided and other methods should be considered.

1. **Measures showing positive results.**

The novel coronavirus is a respiratory virus which spreads primarily through droplets generated when an infected person coughs or sneezes, or through droplets of saliva or discharge from the nose[[15]](#footnote-15). That is why we decided to concentrate our study on measures that prevent people interacting within communities and between them. The following measures, in our opinion, have repeatedly shown positive results.

1. Quarantine measure.

Quarantine measures are widely reported to be of high effectiveness. Implementing the combined intervention of quarantining infected individuals and their family members after the outbreak showed high results, especially if complemented by workplace distancing [[16]](#footnote-16). It has been discovered that quarantine measures decreased the growth rate COVID-19 transmission network over time[[17]](#footnote-17).

Very low‐certainty evidence suggests that the earlier quarantine measures are implemented, greater the cost savings[[18]](#footnote-18).

Relevant studies show great potential of the given method - its application tends to show the most effective results on a second stage of the disease spread - after spread of the disease outside the initial place of an outbreak, especially if combined with workplaces` closure. We suggest considering: ?

1. Travel ban.

Traffic control measures were shown to be a moderately effective measure. The travel quarantine of Wuhan delayed the overall epidemic progression by a few days in China, though had an impressive impact on delaying spread to other countries[[19]](#footnote-19).

That was also indicated that most of the effects were reached in regions with higher GDP per capita and population size[[20]](#footnote-20).

We suggest considering travel bans to be more a complementary measure, and, depending on the exact circumstances, to prioritize other measures over it.

1. Taiwan unique experience

One of the countries to implement innovative solutions is Taiwan - having previous experience with SARS outbreak in 2004, the local authorities established a single disaster management center that focused on large outbreak response that acted as the operational command point for direct communications among the central, regional and local authorities[[21]](#footnote-21). The single command point allowed establishing board control and testing of every passenger coming to the country, with further deployment of a framework to track individuals who had traveled to Wuhan in preseeding days and had infection symptoms at the point of entry; suspected cases were screened for 26 viruses including SARS and Middle East respiratory syndrome (MERS)[[22]](#footnote-22). Anyone at a higher risk of infection was urged to go into self-isolation - their cell phones were used to insure a continuation of isolation; additionally, false reporting of health information became a fineable offence[[23]](#footnote-23).

During the first quarter of 2020, Taiwan recorded the lowest number of cases per million people compared to the rest of the world[[24]](#footnote-24). Combined with spreading information about the disease under a single lead and fighting with misinformation, Taiwan authorities achieved the lowest total infection cases and deaths comparing to the rest of the world[[25]](#footnote-25)

Through using active monitoring of citizens and aggregating large amounts of personal data into a single hands, when combined with timely actions, showed the most efficient results of all the measures studied during this research. Policy makers should consider taking additional measures on preventing abuse of personal data. Monitoring of citizens should not prevent the exercising of human rights, like the right for privacy.

**III. Temperature factors**

During previous outbreak of SARS at 2004, there was a significant correlation between the SARS cases and the environmental temperature[[26]](#footnote-26). The other study showed a pattern of correlation with the temperature with respiratory mortality of individuals > 60 years[[27]](#footnote-27).

More modern studies argue that the number of diagnosed cases increase below a maximum temperature of 10 °C and linearly decrease afterward[[28]](#footnote-28)Though the evidence of the opposite was shown in the other study showing the suitable temperature range for 2019-nCoV coronavirus survival is (13-24 degree Celsius), among which 19 degree Celsius lasting about 60 days is conducive to the spread between the vector and humans[[29]](#footnote-29)

Result:

A single solution could be created on the basis of analysis of measures` effectiveness. This solution could be provided both to local governments and international organizations, like the WHO, to allow the respective bodies to create the most optimized policies for each of the country and region based on local current situation.

References

1. How much do we know about countries preparedness to respond to pandemics? Insights from two country-level indices <https://www.unsdsn.org/how-much-do-we-know-about-countries-preparedness-to-respond-to-pandemics-insights-from-two-country-level-indices>
2. An Inclusive, Green Recovery is Possible: The Time to Act is Now

<https://ccacoalition.org/en/blog/inclusive-green-recovery-possible-time-act-now>

1. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV), 30 January 2020

<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)>

1. Coronavirus disease (COVID-19) technical guidance: Infection prevention and control / WASH

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control>

1. Coronavirus disease (COVID-19) advice for the public

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>

1. Report on the comprehensive economic policy response to the COVID-19 pandemic

<https://www.consilium.europa.eu/en/press/press-releases/2020/04/09/report-on-the-comprehensive-economic-policy-response-to-the-covid-19-pandemic/>

1. OECD Policy Responses to Coronavirus (COVID-19) / Evaluating the initial impact of COVID-19 containment measures on economic activity

<http://www.oecd.org/coronavirus/policy-responses/evaluating-the-initial-impact-of-covid-19-containment-measures-on-economic-activity-b1f6b68b/>

1. Coronavirus: the economic impact

<https://www.unido.org/stories/coronavirus-economic-impact>

1. SARS and MERS: recent insights into emerging coronaviruses

<https://www.nature.com/articles/nrmicro.2016.81>

1. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version)

<https://mmrjournal.biomedcentral.com/articles/10.1186/s40779-020-0233-6>

1. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China

<https://jamanetwork.com/journals/jama/article-abstract/2761044>

1. Advice on the use of masks in the context of COVID-19<https://www.who.int/publications-detail/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak>
2. Aerosol Generating Procedures and Risk of Transmission of Acute Respiratory Infections to Healthcare Workers: A Systematic Review

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3338532/>

1. Association of Occupational Exposure to Disinfectants With Incidence of Chronic Obstructive Pulmonary Disease Among US Female Nurses

<https://pubmed.ncbi.nlm.nih.gov/31626315/>

1. Coronavirus disease (COVID-19) advice for the public: Myth busters

<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters>

1. Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study

<https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30162-6/fulltext>

1. Quantitative Analysis of the Effectiveness of Public Health Measures on COVID-19 Transmission

<https://www.researchgate.net/publication/341475376_Quantitative_Analysis_of_the_Effectiveness_of_Public_Health_Measures_on_COVID-19_Transmission>

1. Quarantine alone or in combination with other public health measures to control COVID‐19: a rapid review

<https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD013574/full>

1. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak

<https://www.researchgate.net/publication/339757623_The_effect_of_travel_restrictions_on_the_spread_of_the_2019_novel_coronavirus_COVID-19_outbreak>

1. Which Measures are Effective in Containing COVID-19? Empirical Research Based on Prevention and Control Cases in China

<https://www.medrxiv.org/content/10.1101/2020.03.28.20046110v1>

1. Taiwan Centers for disease controls

<https://www.cdc.gov.tw/En/Category/MPage/gL7-bARtHyNdrDq882pJ9Q>

1. Response to COVID-19 in Taiwan. Big Data Analytics, New Technology, and Proactive Testing

<https://jamanetwork.com/journals/jama/fullarticle/2762689#jvp200035r5>

1. Is Taiwan's impressive response to COVID-19 possible in Canada?

<https://www.cbc.ca/news/health/taiwan-covid-19-canada-1.5502194>

1. COVID-19: No new case in Taiwan as strategy bears fruit

<https://www.aa.com.tr/en/asia-pacific/covid-19-no-new-case-in-taiwan-as-strategy-bears-fruit/1804256>

1. Lessons from Taiwan’s experience with COVID-19

<https://www.atlanticcouncil.org/blogs/new-atlanticist/lessons-from-taiwans-experience-with-covid-19/>

1. An initial investigation of the association between the SARS outbreak and weather: with the view of the environmental temperature and its variation

<https://jech.bmj.com/content/59/3/186>

1. Isolated and synergistic effects of PM10 and average temperature on cardiovascular and respiratory mortality

<https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102014000600881&lng=en&tlng=en>

1. How much do we know about countries preparedness to respond to pandemics? Insights from two country-level indices <https://www.unsdsn.org/how-much-do-we-know-about-countries-preparedness-to-respond-to-pandemics-insights-from-two-country-level-indices> [↑](#footnote-ref-1)
2. An Inclusive, Green Recovery is Possible: The Time to Act is Now

   <https://ccacoalition.org/en/blog/inclusive-green-recovery-possible-time-act-now> [↑](#footnote-ref-2)
3. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV), 30 January 2020

   <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)> [↑](#footnote-ref-3)
4. Coronavirus disease (COVID-19) technical guidance: Infection prevention and control / WASH

   <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control> [↑](#footnote-ref-4)
5. Coronavirus disease (COVID-19) advice for the public

   <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public> [↑](#footnote-ref-5)
6. Report on the comprehensive economic policy response to the COVID-19 pandemic

   <https://www.consilium.europa.eu/en/press/press-releases/2020/04/09/report-on-the-comprehensive-economic-policy-response-to-the-covid-19-pandemic/> [↑](#footnote-ref-6)
7. OECD Policy Responses to Coronavirus (COVID-19) / Evaluating the initial impact of COVID-19 containment measures on economic activity

   <http://www.oecd.org/coronavirus/policy-responses/evaluating-the-initial-impact-of-covid-19-containment-measures-on-economic-activity-b1f6b68b/> [↑](#footnote-ref-7)
8. Coronavirus: the economic impact

   <https://www.unido.org/stories/coronavirus-economic-impact> [↑](#footnote-ref-8)
9. SARS and MERS: recent insights into emerging coronaviruses

   <https://www.nature.com/articles/nrmicro.2016.81> [↑](#footnote-ref-9)
10. A rapid advice guideline for the diagnosis and treatment of 2019 novel coronavirus (2019-nCoV) infected pneumonia (standard version)

    <https://mmrjournal.biomedcentral.com/articles/10.1186/s40779-020-0233-6> [↑](#footnote-ref-10)
11. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China

    <https://jamanetwork.com/journals/jama/article-abstract/2761044> [↑](#footnote-ref-11)
12. Advice on the use of masks in the context of COVID-19<https://www.who.int/publications-detail/advice-on-the-use-of-masks-in-the-community-during-home-care-and-in-healthcare-settings-in-the-context-of-the-novel-coronavirus-(2019-ncov)-outbreak> [↑](#footnote-ref-12)
13. Aerosol Generating Procedures and Risk of Transmission of Acute Respiratory Infections to Healthcare Workers: A Systematic Review

    <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3338532/> [↑](#footnote-ref-13)
14. Association of Occupational Exposure to Disinfectants With Incidence of Chronic Obstructive Pulmonary Disease Among US Female Nurses

    <https://pubmed.ncbi.nlm.nih.gov/31626315/> [↑](#footnote-ref-14)
15. Coronavirus disease (COVID-19) advice for the public: Myth busters

    <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters> [↑](#footnote-ref-15)
16. Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study

    <https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(20)30162-6/fulltext> [↑](#footnote-ref-16)
17. Quantitative Analysis of the Effectiveness of Public Health Measures on COVID-19 Transmission

    <https://www.researchgate.net/publication/341475376_Quantitative_Analysis_of_the_Effectiveness_of_Public_Health_Measures_on_COVID-19_Transmission> [↑](#footnote-ref-17)
18. Quarantine alone or in combination with other public health measures to control COVID‐19: a rapid review

    <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD013574/full> [↑](#footnote-ref-18)
19. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak

    <https://www.researchgate.net/publication/339757623_The_effect_of_travel_restrictions_on_the_spread_of_the_2019_novel_coronavirus_COVID-19_outbreak> [↑](#footnote-ref-19)
20. Which Measures are Effective in Containing COVID-19? Empirical Research Based on Prevention and Control Cases in China

    <https://www.medrxiv.org/content/10.1101/2020.03.28.20046110v1> [↑](#footnote-ref-20)
21. Taiwan Centers for disease controls

    <https://www.cdc.gov.tw/En/Category/MPage/gL7-bARtHyNdrDq882pJ9Q> [↑](#footnote-ref-21)
22. Response to COVID-19 in Taiwan. Big Data Analytics, New Technology, and Proactive Testing

    <https://jamanetwork.com/journals/jama/fullarticle/2762689#jvp200035r5> [↑](#footnote-ref-22)
23. Is Taiwan's impressive response to COVID-19 possible in Canada?

    <https://www.cbc.ca/news/health/taiwan-covid-19-canada-1.5502194> [↑](#footnote-ref-23)
24. COVID-19: No new case in Taiwan as strategy bears fruit

    <https://www.aa.com.tr/en/asia-pacific/covid-19-no-new-case-in-taiwan-as-strategy-bears-fruit/1804256> [↑](#footnote-ref-24)
25. Lessons from Taiwan’s experience with COVID-19

    <https://www.atlanticcouncil.org/blogs/new-atlanticist/lessons-from-taiwans-experience-with-covid-19/> [↑](#footnote-ref-25)
26. An initial investigation of the association between the SARS outbreak and weather: with the view of the environmental temperature and its variation

    <https://jech.bmj.com/content/59/3/186> [↑](#footnote-ref-26)
27. Isolated and synergistic effects of PM10 and average temperature on cardiovascular and respiratory mortality

    <https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102014000600881&lng=en&tlng=en> [↑](#footnote-ref-27)
28. Is temperature reducing the transmission of COVID-19 ?

    <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7165096/> [↑](#footnote-ref-28)
29. Analysis of meteorological conditions and prediction of epidemic trend of 2019-nCoV infection in 2020

    <https://www.medrxiv.org/content/10.1101/2020.02.13.20022715v1> [↑](#footnote-ref-29)