A Website with an Activity based Traffic Indicator System as a Warning Tool for the COVID-19 Pandemic

Justin Junsay, Aaron Joaquin Lebumfacil, Ivan George Tarun and William Emmanuel Yu
School of Science and Engineering, Ateneo de Manila University, Katipunan Avenue, Loyola Heights, Quezon City, Philippines

Keywords: Big Data and the Web, Web Programming, Pandemic Management.

Abstract: This study describes an activity based traffic indicator system to provide information for the management of the COVID-19 pandemic. The purpose of the indicator is to be able to discern what activities (e.g., grocery shopping and sports) are dangerous, uncertain, or safe to do in the Philippines on a per-region basis through a traffic light's color of red, yellow, and green. The activity based traffic indicator system does this by utilizing a social probability model based on the birthday paradox to determine the exposure risk which is the probability of meeting someone infected (PoMSI). Additionally, a website called SANITTISE was created to host the indicator system and also to display other pandemic related graphs. Furthermore, a user interface/user experience (UI/UX) test was conducted through a survey to measure the effectiveness of the website created. Regarding the results of the test, it was positive since all of the sections were well received in the survey. This meant that the work done on the website appears substantial as the respondents were able to understand the contents and purpose of the website and also effectively traverse the website and create deductions from the information available on the website.

1 INTRODUCTION

In 2020, Shereen et al. stated that the world experienced a pandemic due to a highly transmissible and pathogenic viral infection, called COVID-19 (Shereen et al., 2020). Additionally, Çelik et al. said that the zoonotic virus that caused the disease is called SARS-CoV-2 (Çelik et al., 2020). As of April 2021, according to the Philippines Department of Health (DOH), the Philippines has a total case of more than 812,000 infected while more than 646,000 recovered and more than 13,000 Filipinos died (DOH, 2021b). Regarding information technology, there are already data visualizations developed in the Philippines to keep track of the local spread of COVID-19. An example of which is the DOH COVID-19 tracker and the Feasibility Analysis of Syndromic Surveillance using Spatio-Temporal Epidemiological Modeler (FASSSTER) website (DOH, 2021b; FASSSTER, 2020). These websites already present the relevant information like the total cases and they are vital for devising a response for the COVID-19 pandemic. However, the problem here is that not everyone is able to make sense of the current situation given the information found in these websites. To be specific, not everyone knows how to act appropriately nor interpret the data once it is shown to them. Therefore, this study aims to create an activity based traffic indicator system for COVID-19. The purpose of the indicator is to be able to discern what activities (e.g., grocery shopping and sports) are dangerous, uncertain, or safe to do in the Philippines on a per-region basis through a traffic light's corresponding red, yellow, and green colors. In the study titled Activity based Traffic Indicator System for Monitoring the COVID-19 Pandemic, the team already established the calculations needed to be done to indicate the risk of certain activities (Junsay et al., 2021a). In the previous study, the probability model used for the calculations was based on the birthday paradox theory and the risk it estimates is the exposure risk or the probability of meeting potential COVID hosts in public places. Moreover, part of this study is also to create a website to host the indicator system. After that, a user interface/user experience (UI/UX) test must be conducted to measure the effectiveness of the indicator and other statistics/graphs to be implemented on the website. Since the scope of the study is only within the Philippines, any pandemic related case information used for the calculations of the indicator is limited to the daily data drop of the DOH (DOH, 2021a). In

Junsay, J., Lebumfacil, A., Tarun, I. and Yu, W.
A Website with an Activity based Traffic Indicator System as a Warning Tool for the COVID-19 Pandemic.
DOI: 10.5220/0010648700003058
In *Proceedings of the 17th International Conference on Web Information Systems and Technologies (WEBIST 2021)*, pages 250-256
ISBN: 978-989-758-536-4; ISSN: 2184-3252

visualizing the risk of activities through a traffic light's color, the activity based traffic indicator system would make it much easier for people to understand the situation during the COVID-19 pandemic. Hopefully, the indicator should also help in lowering potential infections.

2 METHODS

2.1 Components of the Traffic Indicator

As mentioned in the team's previous study, there are a total of 10 activities for the indicator: exercise with equipment, exercising without equipment, shopping in a store, mall strolling, going to a concert, restaurant dining, grocery shopping, riding a bus, riding a train, and going to the office (Junsay et al., 2021a). In addition, the exposure risk used for the activity based traffic indicator was based on the modified birthday paradox model established in the study titled COSRE: Community Exposure Risk Estimator for the COVID-19 Pandemic (Sun, 2020). Furthermore, the team relabeled the exposure risk that the COSRE model calculates into PoMSI or the probability of meeting someone infected (Junsay et al., 2021a).

$$Pr_{(p,n,a)} = 1 - \frac{(p-a)!^n}{p!^n}, \text{ if p}\neq 0 \text{ and n}\neq 0 \text{ and a}\neq 0 \quad (1)$$

$$Pr_{(p,n,a)} = 0, \text{ if } p = 0 \text{ or } n = 0 \text{ or } a = 0 \quad (2)$$

As seen on Equation 1 and Equation 2, the model utilizes three parameters: [*p*, *a*, and *n*]. To summarize the model, the first thing to do is to calculate the odds of not meeting any infected person and subtract that odds from 1 to get the probability of meeting at least one infected person (Junsay et al., 2021a). In the team's previous study, it was already established that *p* is equivalent to the total population of each of the 17 regions in the Philippines and *a* is equivalent to the active cases per region which is the infected population. The value of *n* is the occupant load, and it is the number of people in a building or establishment. Its formula is the square footage of an area over the occupant load factor. If the venue has fixed seating, then the occupant load is equivalent to the seating capacity. Moreover, the team relied on sample square footage areas and seating capacities obtained on the Internet to be used as a component of the occupant load for each activity.

Table 1: Activities' Capacity Percentage and its Occupant Load per Quarantine Type.

Activity	ECQ	MECQ	GCQ	MGCQ	No Quarantine
Exercise w/ Equipment	B	B	30% 6	50% 10	100% 19
Exercise w/o Equipment	B	B	30% 8	50% 12	100% 24
Sales (Retail Stores)	B	50% 45	100% 90	100% 90	100% 90
Malls	B	50% 1167	100% 2334	100% 2334	100% 2334
Restaurant Dining	B	B	30% 42	50% 70	100% 139
Concert	B	B	B	50% 10000	100% 20000
Supermarket	50% 347	100% 694	100% 694	100% 694	100% 694
Bus	B	B	50% 23	50% 23	100% 45
Train	B	B	50% 591	50% 591	100% 1182
Office	B	50% 61	100% 122	100% 122	100% 112
Legend:	**B = Banned**				

However, it is worth noting that the team in their previous study did not consider the different quarantine types established in the Philippines (Junsay et al., 2021a). Essentially, the Philippines' Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF) stated that there are four community quarantine types: enhanced community quarantine (ECQ), modified enhanced community quarantine (MECQ), general community quarantine (GCQ), and modified general community quarantine (MGCQ) (IATF, 2020). In addition, ECQ would be the most restrictive while MGCQ would be the most lenient. Basically, not all activities can operate in certain quarantine types since some activities are riskier than the others. If an activity can function, capacity must also be reduced depending on the quarantine type. Therefore, the capacity percentage of an activity per quarantine type authorized by the Philippines' Department of Trade and Industry (DTI) and Department of Transportation (DOTr) was applied to the initial calculations of *n* or the occupant load (100% occupancy) (DTI, 2020; DOTr, 2020a, 2020b). However, 100% occupancy would still be included as an option for the indicator so that the people would still have an idea what the

Figure 1: Activity Based Traffic Indicator (MECQ, NCR).

value of PoMSI would be if no quarantine were imposed. It is worth noting that local government units (LGUs) in the Philippines implement different protocols and requirements for domestic travelers to follow (Aguilar, 2021). For consistency, the authorized statements of the departments mentioned above were used as the basis for the activity restrictions per quarantine type. Table 1 contains the capacity percentage of an activity and its corresponding occupant load per quarantine type. In the table, the activity is marked as "banned" if it is not allowed to operate. When applying the different capacity percentage to the occupant loads, if the output was a decimal number, it was rounded up to the next largest whole number. This was done since it is illogical to represent people with decimal numbers when computing for n. It is also important that the risk that the indicator system calculates must be classified based on the riskiness of the activity. In the team's previous study, a risk level classification was already devised (Junsay et al., 2021a). Basically, there are 3 risk levels: green (below 25%), yellow (25% to 75%), and red (above 75%). For yellow, it has two sub levels which is why the range of values is greater compared to the other two colors. As the risk level increases, more precautionary measures are needed to be done when the exposure risk of an activity is greater.

2.2 SANITTISE Showcase

The created website has adopted the name SANITTISE (Systematic Analysis of nCoV Information Through Traffic Indicator Structured Evaluations) out of preference for having a convenient name that is easy to remember for the public (Junsay et al., 2021b). The website includes a Landing Screen that visitors would first see upon viewing the website. The Landing Screen contains the logo of the website, a quick description, and the top header incorporating the primary navigation menu. The section below this contains the Region Selection portion of the website. This is where users can select what region the activity based traffic indicator will display further down the website. The website also shows the legend for the traffic indicator and it is displayed right after the Region Selection Screen. The legend reflects the finalized risk level classification which shows the necessary precautions that are needed to be taken depending on the output of the indicator. Next is the actual implementation of the activity based traffic indicator. This comes after the legend and it shows the ten activities along with their respective PoMSI values and corresponding color based on the legend. Each activity in the indicator is accompanied by a short description which can be toggled through a dropdown menu. The top portion of the indicator contains buttons where users can select

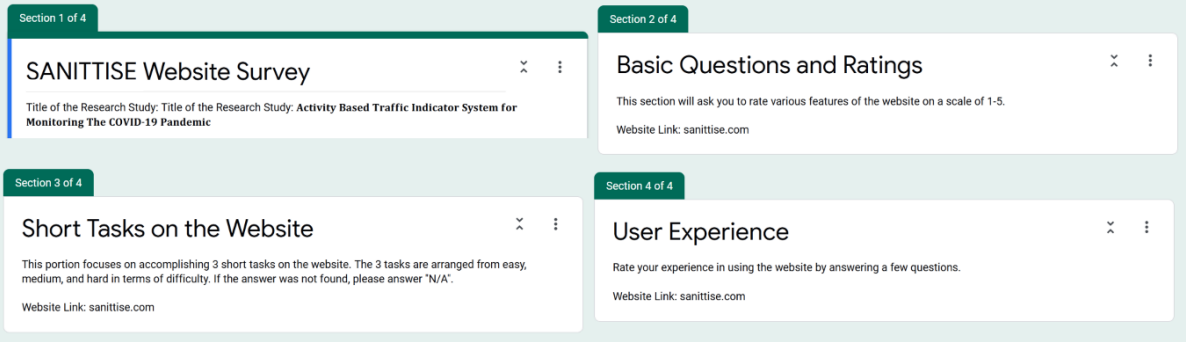

Figure 2: Sections of the Survey.

what quarantine type should be displayed, choosing one will subsequently change the PoMSI values along with which activities are allowed or banned. The values shown in Figure 1 are the PoMSI values for NCR when the quarantine type is set to MECQ. The black bordered activities signify that an activity is prohibited when that particular quarantine type is being enforced. Below the indicator would be the accompanying regional statistics graphs. These graphs show the cases, deaths, and recoveries over time for the selected region. They are fully interactive with the ability to do panning, box zoom, mouse wheel zoom, x-axis zoom, crosshairs, and hover tooltips. There are two types of ranges that can be displayed. One would be the entire duration of the pandemic so far while the other range only depicts the last seven days. Their corresponding headings exhibit the total number of cases, deaths, or recoveries that have occurred thus far. In general, these are the main features of the SANITTISE website. As for the mobile version, the website is responsive and can handle varying screen sizes. The layout of the elements change depending on the screen dimensions, but the content remains the same overall. Lastly, the website checks for new updates every three hours since the DOH Data Drop is not updated at a regular time each day (DOH, 2021a).

3 UI/UX TESTING

To gauge the usability and effectiveness of the indicator, testing was done on the website. Hence, the website must be tested by multiple people to find out the improvements needed to be done and also to identify what features should be retained. Unmoderated testing was carried out since it entails the participants to complete the test requirements at their own convenience. Candidate participants were contacted through online messaging sites (e.g., Facebook Messenger) to answer the survey. Since the indicator is for the use of the public, healthy adults (including university students) are the perfect candidate participants since this categorization is still broad enough to represent the public and they are the only ones allowed to leave their houses during the pandemic. Even though it is unmoderated, answering the survey would take at least 15 minutes for it to be completed. Additionally, the target number of respondents for the survey is 20. After the participant has finished answering the survey, the findings can be recorded, and the personal data of the participant will be stored for six months before deletion. Moreover, the survey used to test the website was created through Google Forms and it was split into four sections (Junsay et al., 2021c). For the first section, its purpose is to introduce the goal of the study and to obtain the consent of the participants. The second section of the survey contains questions that gauge the first impression of the respondents regarding the website. Basically, it was made to check whether they find the interface of the website understandable and appealing. In addition, this section and the fourth section of the survey were inspired by some questions found on the article titled 15 Website Survey Questions to Customers in 2021 (Dossetto, 2021). For the third section of the survey, it was created to test the ease of using the website when the respondents are given a certain scenario or a certain thing to look at to measure the accessibility of the features of the website. The fourth section of the survey was created to ask the respondents regarding their thoughts about the website after going through and using it. It also asks them how likely they will be using the website in the future and how likely they will be recommending it to others. Lastly, the last part of the survey asks the participants if they have comments and suggestions that can help improve the website. Responses for most of the questions in the survey are limited to a 5-point scale except for the questions that require typewritten responses from the respondents

(e.g., third section of the survey). The survey was opened on February 10, 2021 and the final survey was answered on March 5, 2021. The respondents consisted of people with ages ranging from 18 to 50 years old. The study included 6 non-university students.

4 RESULTS

Table 2: Survey Results for Section 2 (Basic Ratings and Questions).

Question	1	2	3	4	5
How well do you understand what SANITTISE does from its description?	0	0	3	11	8
How readable is the font used on the website?	0	0	0	3	17
What would you rate the color scheme of the website?	0	0	5	9	6
How clear is the distinction between the colors of the traffic indicator system (red, yellow, and green)?	0	0	1	6	13
How well are you able to understand the information given on the website?	0	0	3	9	8
Without being told what to do, how well are you able to use the website in determining the risk of each activity in each region?	0	0	3	7	10
Judging by appearances only, how inclined are you to use the website again in the future?	0	0	1	9	10

These are the results for the UI/UX testing done for the study which is carried out through asynchronous/unmoderated testing. For the first impressions, which is the second section of the survey, they looked promising with four out of seven of the questions having a majority of a rating of 5 which was excellent. These questions had to do with the font, distinction between the colors, and their inclination to use the website again. Three out of the seven questions had a rating of four out of five which meant that the respondents felt more than unmoved (3) but less than excellent (5). These questions had to do with the understanding of the SANITTISE website, the color scheme, the information shared on the website, and the inclination to reuse the website in the future. For the remaining questions, which tackled the understanding of SANITTISE from its description, the color scheme of the website, and the ability to understand the information given on the website, 4 and 5 were the majority chosen instead of 3 which leads the researchers to believe that the website was taken in good favor.

Table 3: Survey Results for Section 2 (Short Tasks on the Website).

Short Task	Correct	Wrong
(Easy) How many total recoveries from COVID-19 are there in Region VII?	16	4
(Medium) What is the risk of meeting someone with COVID-19 in the office in NCR under no quarantine?	19	1
(Hard) What activity is banned in ARMM if the quarantine type is set to “GCQ”?	20	0

For the results of the short tasks, which is the third section of the survey, it showed different results on the easy, medium, and hard tasks. In order to get these results, the researchers had to check the date the survey was answered and compared the answers of the respondents to an SQL file where all the data of the COVID cases were recorded. The task wherein people blundered the most was the easy task (How many Total Recoveries from COVID-19 are there in Region VII?) only having 80% of the participants getting the right answer. This most likely had to do with the fact that the total recoveries on the website was labeled as “200,000 Recoveries” for example and does not include the word “Total” which the respondents were probably trying to find specifically. Therefore, the researchers changed the label of confirmed cases/deaths/recoveries to daily cases/total deaths/total recoveries and added a total count amount right below the “daily” titles for clarity. For the medium difficulty task (What is the risk of meeting someone with COVID-19 in the office in NCR under no quarantine?), 95% of the respondents got the answer correct. Lastly, for the hard difficulty task (What activity is banned in ARMM if the quarantine type is set to "GCQ") 100% of the respondents got it correct.

For the user experience results, which is the fourth section of the survey, they were collected after the short tasks were carried out. This meant that at the time of taking these responses, the respondents have had ample time to go through the website and experience it firsthand. For seven out of the eight questions on the user experience part of the survey, it showed that the majority of the participants thought that overall, using the website was a pleasant experience. These questions had to do with the confidence in using the website, the difficulty of finding recovered cases, the difficulty of finding the risk level of each activity, the difficulty of finding the banned activities, the confidence in repeating the 3 tasks from the previous section, the likeliness to visit the website again, and lastly, the likeliness of

Table 4: Survey Results for Section 2 (User Experience).

Question	1	2	3	4	5
After completing the 3 tasks asked in the previous section, how confident are you now with using the website to determine each risk of an activity in each region?	0	0	1	6	13
What was the difficulty of finding the number of recovered cases for each region?	1	0	2	6	11
What was the difficulty of finding the risk level of each activity for each region?	1	0	3	5	11
What was the difficulty of finding banned activities, given a quarantine type, for each region?	0	1	1	6	12
How confident are you in completing the 3 previous tasks again if asked?	0	0	1	1	18
How likely are you to visit the website again?	0	0	3	8	9
How likely are you to consult this website in planning what activities to do?	0	0	2	9	9
How likely are you to recommend this website to other people?	0	0	0	5	15

recommending the website to other people. Although it is believed that the website has been taken very well, in a few of the questions there is one outlier who believed that it was difficult to do some tasks on the website. Upon further analysis, when compared to their other answers on the questionnaire, it appears as though the outlier misunderstood the question. This is because when it came to answering the questions on whether they would go back to using the website again and when they were asked about their confidence on completing the tasks again, the outlier gave those questions high marks. Also, when it came to the short task results, the outlier got every answer correct (from easy to hard) which meant that it was not impossible for them to use the website. This can be seen as one of the disadvantages of unmoderated and asynchronous testing as the participants are not able to clear up misunderstandings with the surveyors. For the last question, which tackled the likeliness of the participants to consult the website on what planning for activities, rather than having a majority of responses on the highest rated option (5), this question had a split tie between the two highest rated options (4 and 5). This would mean that although the respondents would not guarantee using the website, most of the respondents believe that they would return to the website to use it for planning their activities.

5 CONCLUSIONS

The aim of this study was to create an activity based traffic indicator system for managing the COVID-19 pandemic. The indicator created uses the COSRE social probability model which calculates the exposure risk or the probability of meeting someone infected (PoMSI) (Sun, 2020). Basically, when the value of PoMSI is high, the chances of meeting someone infected with COVID-19 is also high. Furthermore, part of this study was also to create a website to host the indicator system and also test its usability by conducting a UI/UX test through a survey. With this, the created website was called SANITTISE and it contains the activity based traffic indicator which calculates PoMSI for all of the 17 regions in the Philippines. To accompany the indicator, the website also contains regional statistics and graphs which can normally be found in tracker websites. The results of the UI/UX testing showed positive results as all of the sections were well received in the survey. This meant that the work done on the website appears substantial as the respondents were able to understand the purpose of the website and also effectively traverse the website and create deductions from the information available on the website. Although it appears as though the website is already in its final form, the survey showed the researchers that there were some improvements that could be done on the website. This was manifested through changing some of the labels on the website as well as adding support for the visually impaired on the website. Overall, the aim of the study was achieved with the creation of the activity based traffic indicator being successful along with it being deemed usable by the public.

6 LIMITATIONS AND IMPROVEMENTS

Regarding the focus of the indicator, it is restricted to an activity based traffic indicator system for COVID-19. Since the indicator caters to one disease, the indicator may only apply to the COVID-19 pandemic. If used for other infectious disease pandemics, the usability and effectiveness of the core functions of the indicator depends on the similarities of potential diseases to COVID-19. Next, the indicator is not diagnostic nor medical, it is more of a visualization tool. This means that the indicator is meant to aid in public awareness to support pandemic management. As the data is in aggregates, it is not meant to be the

only tool for pandemic-related decision making. Hence, it cannot reflect individual cases. Third, it's also worth mentioning that this indicator is not meant to replace existing visualizations of pandemic data such as the DOH COVID-19 tracker (DOH, 2021b). Tracker websites already present relevant data about a specific infectious disease and the indicator of this study gives insights or interpret these established data instead so that it can be more readable or easily understood supplemented by research on the safety of particular activities. Lastly, the geographic scope of the indicator encapsulates every region of the Philippines. There is an indicator per region that shows the selected region's risks associated with carrying out certain tasks while in the midst of a pandemic.

As for potential improvements, existing COVID-19 data used in the study was only limited to the Philippines. With this, a possible improvement is to create an activity based indicator system which can be applied for more than one country. Facebook also published a per municipality public dataset about how people are responding to physical distancing measures (Facebook, n.d.). The dataset has two different metrics: the Change in Movement metric (how much people are moving around) and the Stay Put metric (the fraction of the population that appears to stay within a small area surrounding their home for an entire day). This may further be incorporated into the calculations of the indicator system since it is related to general movement of a population.

ACKNOWLEDGEMENTS

We would like to show our gratitude to Dr. William Yu, our research advisor, for directing the flow of the study. To the FASSSTER team and the Ateneo Center for Computing Competency and Research (ACCRe), thank you for creating and giving access to the FASSSTER website. We would also like to give thanks to the DOH's Epidemiology Bureau for creating and maintaining the COVID-19 data drop used in the study.

REFERENCES

Aguilar, K. (2021, February 10). *Gov't to discuss standardized travel requirements between LGUs*. Inquirer. https://newsinfo.inquirer.net/

Department of Health. (2021). COVID-19 data [Data file]. Retrieved from https://drive.google.com/drive/folders/1ZPPcVU4M7T-dtRyUceb0pMAd8ickYf8o

Department of Health. (2021, April). *COVID-19 tracker Philippines*. ncovtracker. https://ncovtracker.doh.gov.ph/

Department of Trade and Industry. (2020, October 2). *Memorandum circular no. 20-52*. Official Gazette. https://www.officialgazette.gov.ph/downloads/2020/09sep/20201002-MEMORANDUM-CIRCULAR-NO-20-52-S-2020.pdf

Department of Transportation. (2020, April 30). *DOTr issues guidelines for road transport sector in areas under GCQ*. DOTr. https://dotr.gov.ph/

Department of Transportation. (2020, October 17). *MRT, LRT, PNR to gradually increase passenger capacity to accommodate more commuters starting Monday*. DOTr. https://dotr.gov.ph/

Dossetto, F. (2021). *The 15 best website survey questions to ask customers in 2021*. Hotjar. https://www.hotjar.com/

Facebook. (n.d.). Movement Range Maps. Facebook Data for Good. https://dataforgood.fb.com/tools/movement-range-maps/

FASSSTER team. (2020). *DOH FASSSTER COVID-19. FASSSTER*. https://fassster.ehealth.ph/covid19.

Inter-Agency Task Force for the Management of *Emerging Infectious Diseases. (2020, October 22). Omnibus guidelines on the implementation of community quarantine in the Philippines with amendments as of October 22, 2020*. Official Gazette. https://www.officialgazette.gov.ph/downloads/2020/10oct/OMNIBUS-Guidelines-with-Amendments-as-of-October-22-2020.pdf

Junsay, J., Lebumfacil, A., Tarun, I., & Yu, W. (2021). Activity based traffic indicator system for monitoring the COVID-19 pandemic. *In Proceedings of the 23rd International Conference on Enterprise Information Systems (ICEIS 2021), 1,* 183-191. https://doi.org/10.5220/0010399201830191

Junsay, J., Lebumfacil, A., Tarun, I., & Yu, W. (2021). *SANITTISE COVID-19 Activity Indicator.* SANITTISE website. https://sanittise.com

Junsay, J., Lebumfacil, A., Tarun, I., & Yu, W. (2021, April 8). *SANITTISE Website Survey*. Google Drive. https://drive.google.com/file/d/1mRw2LBQWZTUCM9ogVmWabYg5l5cSEKjS/view?usp=sharing

Shereen, M. A., Khan, S., Kazmi, A., Bashi, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *Journal of Advanced Research, 24*, 91–98. https://doi.org/10.1016/j.jare.2020.03.005

Sun, Z. (2020, May 22). COSRE: Community exposure risk estimator for the COVID-19 pandemic. arXiv. https://arxiv.org/

Çelik, I., Saatçi, E., & Eyüboğ, A. F. (2020). Emerging and reemerging respiratory viral infections up to Covid-19. Turk J. Med Sci, 557–562. https://doi.org/10.3906/sag-2004-126