Anonymously Tracking Covid-9 Patient Using Lbeling Graph Approach and GPS Tracking Technology

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Anonymously tracking covid-19 patient using labeling graph approach and GPS tracking technology

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Abstract. The increasing number of patient infected by Covid-19 viruses in Indonesia, causing each personal to be more vigilant in doing activities outside. Many patients who are positively exposed to the corona viruses are self isolating in their own house because the hospital is full. Patiens who have recovered and tested negative from the corona viruses can work outside the house. The purpose of this study is to provide information regarding patients infected with Covid-19 in certain area through a tracing application. This apllication can help public to find out how many individuals are infected with Covid-19 in the surrounding environment by priorizing patient privacy and in real time anonymously. The method used is a combination of labelling graph theory and the GPS tracing system applied to the gadget. The programming language use in this gadget cases is flutter. The stages that will be carried out are starting from tracing patients infected with Covid-19 based on the position of tracing area, then predicted through a graph model approach based on distance and percentage of transmission. The result of this research is the percentage of prediction about personal vulnerability. The initiation of prediction divide into saveral categories, including vulnerable, moderate, or safe.

1. Introduction

The number of patients who are self-solating due to exposure to the Covid-19 virus in Indonesia cause many people to be even more vigilant. The urgency of this research is to increase the efficiency of using mobile tracking applications in patients infected with Covid-19 by predicting personal susceptibility to contracting the Corona virus disease. The stages of the method that will be carried out start from tracking patients infected with Covid-19 based on the position of residence, then predicting it through a mathematical model. In modelling the prediction of susceptibility to contracting Covid-19, there are many variables that determine wether or not a person is vulnerable to Covid-19 transmission, this depends on personal distance from the patient, GPS accuracy, approach model, and other variables that influence such as body immunity [1]. This study was made considering the importance of contact tracing in confirmed Covid-19 patients. The advantage of using GPS tracking is that personal can find out how many individuals are infected with Covid-19 through their respective gadgets without having to be in direct proximity. In Addition, the advantage is that the privacy data of patients infected with Covid-19 is not published so that it is safe accordance with the provisions of medical regulations [2].

Prediction of this vulnerability is expected to help the community in controlling health through predictions that have been generated in the applicaton record. Prediction is related to time, in this case time series data makes an important role. One example of time series data that can be used to make predictions is data that is presented sequentially [3]. The result of the analysis obtains form previous studies explain that the trend of Covid-19 pandemic provides an overview of the stage of an endemic in a region based on the trend of the prevalence of Covid-19 in Italy, Spain, and France. The advantage of this research to be carried out is that there is no application that confirms on gadgets that

provide information that arround us there are personal infected with Covid-19. This application also prioritizes patient privacy in accordance with medical regulations, so that the data of patient is not published and also safe. In this way, individuals or the community can take further action through a swab/PCR test if they are in the location that has high susceptibility to Covid-19 exposure within a certain time span. During Covid 19 outbreaks, the patient often go into quarantined until they can isolated the source to stop the spread. For outbreaks of respiratory diseases, even with a vaccined population a bigger concern is to stop the spread between people than to find the source [4]. On research that has been done before show that outbreaks in contained environments full of older individuals, such as in a cruise ships, nursing home, school environment, and dormitory, create a problem of heightened transmission rates and severe cases, and modelling them can show us the best way to mitigates an outbreaks in a close environment [5].

There are some key lessons that the research before believed that the viruses can be reasonably carried over to informs real-world decisions [6]:

- Testing accuracy is a critical issue which needs immediate attention
- Holding large classes greatly increase the risk of a significant outbreak on campus or dormitory
- It is extremely important that students refrain from all contact outside of academic and residential settings
- All instruction need to prepare for axtended student absences due to quarantine.

There is certainty from big data,it can provide long term or short term possibilities for users [6]. This research will be successfull, accurate, and be right on target if it is done by combining how quarantines possible be successful if we can accurately determine the infected individual who are not showing outward symptoms or immune individuals through appropriate test and contact tracing. This paper aims to provide a simple models with very few adjustable parameters, so it can be completely when the data about Covid 19 viruses are complex. In calculating using GPS tracking in the gadget, a distance concept related to graphs is needed, namely the concept of graph labeeling. The following in the Figure 1, is an example about labelling graph concept.

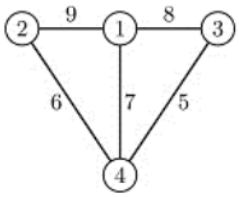

Figure 1. Labeling of graph fan F_3, for $3 \leq n \leq 6$.

A labeling graph is called edge-magic total (vertex-magic total) if the edge weights (vertex weights) are all the same. If the edge weights (vertex weights) are pairwise distinct then the total labeling called edge-atimagic total (vertex-antimagic total). A graph that admits edge-magic total (edge-antimagic total) labeling or vertex-magic total (vertex-antimagic total) labeling is called a edge-magic (antimagic total) graph, respectivelty [7]. Then, Graph fan F_4, F_5, and F_6 is a simultaneously super edge-magic total and super vertex-anti magic for $4 \leq n \leq 6$. The following in the Figure 2, Figure 3, and Figure 4 is an example about labeling graph concept.

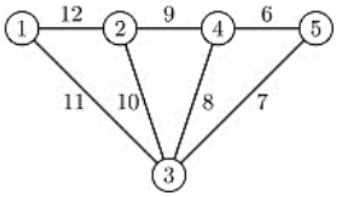

Figure 2. Labeling of graph Fan F_4, for $4 \leq n \leq 6$.

A simultaneously super edge-magic total and super vertex-anti magic total labeling of the fan F_5 [7].

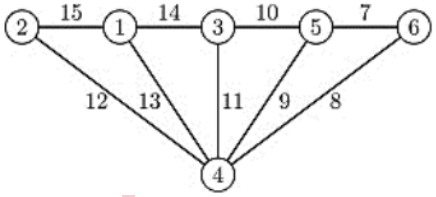

Figure 3. Labeling of graph fan F_5.

A simultaneously super edge-magic total and super vertex-anti magic total labeling of the fan F_6 [7].

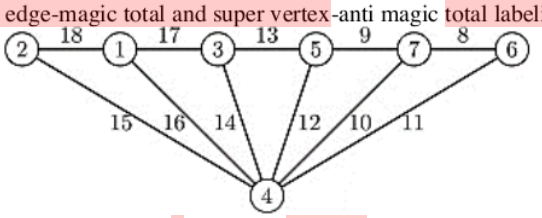

Figure 4. Labeling of graph fan F_6.

2. Graph Labeling Relevant to GPS Network

In this study, the depiction of the epidemic on individuals infected with Covid-19 carried out using a weighted graph also a graph labeling [8]. Graph labeling can also use for issues in Mobile Adhoc Networks (MANETS). In Adhoc Networks, issues such as connectivity, scalability, routing, modeling the network and simulation are to be considered. Since the network can be modeled as a graph, the model can be used to analyze these issues. Graph can be agebraically represented as matrices. Also, network can be automated by means of algorithms [9]. This issues such as node density, mobility among the nodes, link formation between the nodes and packet routing have to be simulated. Various algorithms are also available to analyze the congestion in tracking Covid-19 where the network are modeled based on graph theoretical ideas [9].

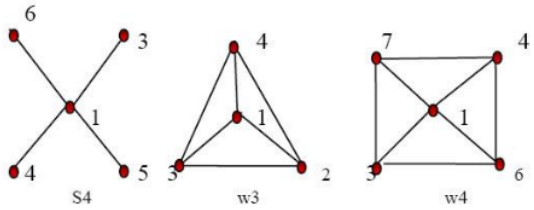

Figure 5. Radio labeling on different kind of graph [9].

A weighted graph is a graph with edges that are weighted by numbers or numbers, where the numbers are the weights, or the distance from one vertex or vertex to another [9]. If graph $G = (V, E)$ consist of $v_1, v_2, \cdots, v_p$ and edge $e_1, e_2, \cdots, e_q$, so $V(G) = \{v_1, v_2, \cdots, v_p\}$, and $E(G) = \{e_1, e_2, \cdots, e_q,\}$ [11]. The methid used is a combination of weighted graph , shortest path, time series data with exponential function [10]. In a report release by Scientist.com [11], journalist David Adam mentions that scientist are stuggling to predict the behavior of the spread of Covid-19 shown in Figure 5. This trend is the basis for conducting related research.

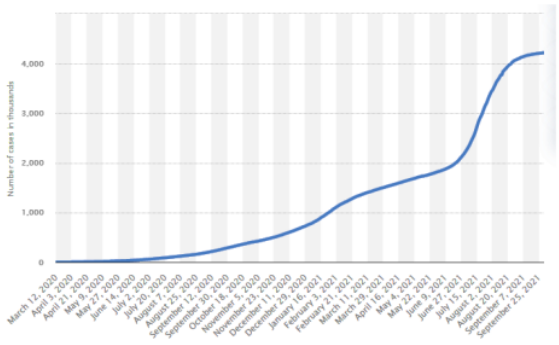

Figure 6. Graph of infected patient in some country [12].

The model is designed with initial initiation, where the minimum distance between a person and individuals who has confirmed the Covid-19 virus is 1 meter [10]. Programming is done by applying the Djikstra algorithm on the shortest path [13]. Time series data relates to the time at which r, α, β, γ and K shows the initiation of average growth (person/day) asymptotic effect, and carrying capacity. If $\alpha = 1$, equations become a differential equations whose solution is given inbthe following equation [14].

$$y(t) = \frac{K}{\left(1+\alpha \exp\left(-r(t-t_m)\right)\right)^{1/\alpha}} \quad (1)$$

By using differential equations [15]:

$$\frac{dI}{dt} = \beta I \frac{S}{N} - \gamma I \quad (2)$$

$$\frac{dS}{dt} = -\beta I \frac{S}{N} \quad (3)$$

$$\frac{dR}{dt} = \gamma I \quad (4)$$

The tracking application is based on GPS on each device, so the accuracy of GPS detection will vary according to the brand and type of device owned. In addition, the vulnerability prediction model was obtained from other variables related to immunity, distance, and the number of confirmed personnel around [10].

3. Flutter for Android Development

Android can either create animations using XML, or animate method on a view. In this research, the animate widgets using animation library by wrapping widget in Flutter. Flutter was chosen to support advanced development, because flutter is a cross-platform framework. Flutter also has a feature to still be able to write code natively using Kothlin languange, so that acces to sensors can be wider. Flutter is Google's proprietary technology for building apps with a sleek UI that can be natively compiled into mobile, web, and desktop apps from just one codebase.

4. Results and Discussion

In this research, it was decided to use the flutter framework. Flutter was chosen to support advanced development because flutter is a crooss-platform framework. Flutter also has a feature to be able to write code natively using Kotlin language, so that acces to sensors can be wider. Flutter is also used in application development for android and IOS systems.

This flutter system consists of an Android application a a client and cloud fire stone as a database (server). Some of the applications that must be provided include :

- Java Development Kit (JDK)
- Android Studio

- Android SDK
- Flutter SDK
- Text Editor (Or use Android Studio)

The following figure 6 shows about the initiation using graph apllied in GPS application technology :

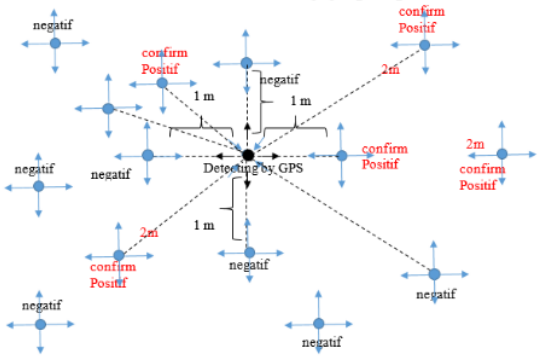

Figure 7. Initiation graph in detecting the suspect positif corona virus [10].

If the distance of 1 meter there are several individuals who have confirmed Covid-19 then at a distance of 2 meters there are more individuals who have confirm Covid-19, so only close distance are included in the prediction model, while for distances that are not close together, distance is still taken the shortest path.

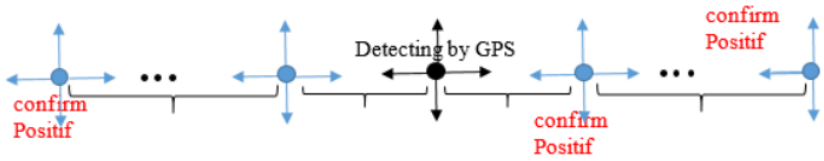

Figure 8. Graph models if $n = 1$.

The design of this system aims to form a mathematical model with the help of a graph model on a GPS sensor detection tool with several assumptions that have the same purpose, including :

- Signal GPS categorized as a graph with nodes on the sensor of smartphone and trhe signal is an egde that spreads in all directions detecting signals on other sensors.
- Many to one routing

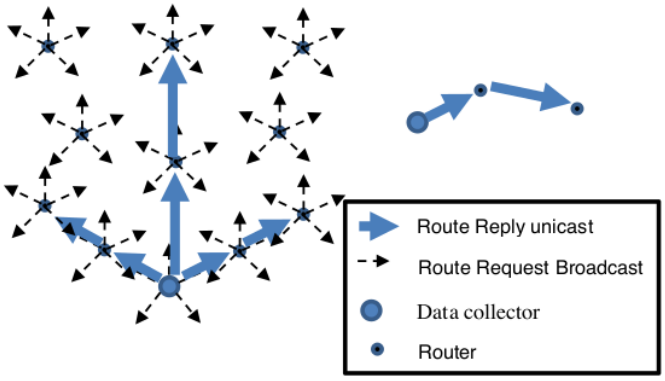

Figure 9. Graph models if many to one route.

- It is assumed that the GPS sensor can also transmit and receive signals from and to the confirm positif corona virus signals in all directions.

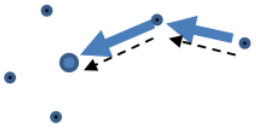

Figure 10. Route transmission.

The following is the vulnerability percentage (Pk) in (100%) which can be calculated by the relationship between the variable, distance, and the number of confirmed patients, as follows [10]:

$$(Pk) = \frac{100n_{(k,n)}\delta\left(\sum_{k=1,n=1}^{n}\frac{1}{x_n(k)}\right)\left(\sum_{n=1,k=1}^{n}x_n(k)\right)}{n} \quad (5)$$

with

$x_n(k) = x_1[t] + x_2[t] + x_3[t] + \cdots + x_n[t]$

For $n = 1$, where r is the number of individuals confirmed Covid-19 and by combining the models, we get a prediction model for $n = 1$, as follows [17]:

$$\delta = \alpha\beta\gamma K\left(\frac{(x_1[t] + x_2[t] + x_3[t] + \cdots + x_n[t])}{\left(1 + \alpha\exp\left(-r(t - t_m)\right)^{1/\alpha}\right)n}\right) \quad (6)$$

In this research, there are three possible parts in analyzing the Covid-19 models such as susceptible (S), Infected (I), and Recovered (R) [16]. Individuals but have not been infected are devided into two, there are diagnosed with positive confirmed Covid-19 (E_i), and individuals who have not been diagnosed with confirmed positive Covid-19. Indonesia terms are OTG (Asymptomatic People E_n), isolated individuals (W), infected individuals who can transmit and have not been dignosed with Covid-19 (I), recovered individuals (R), and individuals who die from disease Covid-19 (D) and N is the total population [18].

The value compartement diagram for the parameteres is presented as follows :

Table 1. The parameters in the models.

Parameter	Definition	Value
$\boldsymbol{\beta}$	Transmission Rate GPS	0.25
$\boldsymbol{1/k}$	Average laten individuals (E_n dan E_i) supceptible to infection or can be isolated	6.37
$\boldsymbol{\gamma_1}$	Recovery rate of infected individuals	0.0352
$\boldsymbol{\gamma_2}$	Recovery rate from isolated individuals	0.0425
$\boldsymbol{\alpha}$	Rate of infected individuals	0.206
$\boldsymbol{\delta}$	Death rate	0.0279
$\boldsymbol{\sigma}$	Proportion of vulnerable individuals	[0,1]
$\boldsymbol{P_k}$	Percentage of individual vulnerabilities	[0,1]* 100%

In this research, the widget used is an application in mobile tracking so that the system uses android material and flutter for the framework materials. The following is shown in Figure 11. It is a UI display design that is used in the android system in detecting vulnerability predictions in patients infected with Covid-19, as folllows :

- Testing $n = 1$

Program testing with $n = 1$ means that there are 1 infected patients around us. The distance is determined by the accuracy of the GPS which can be seen on the map.
The menu contained in the program UI display include :

a. Changing user or smartphone ID so that is cannot be identified
b. Percentage of susceptibility probability of contracting Covid-19
c. Map for checking the Location

The map is likened to a graph, where the position of the tracking individuals is the center and the individual who confirm Covid-19 is the other node.

Figure 11. Map for checking the location.

d. Dummy Data collection menu, which contains the experimental data used in program testing
e. Add dummy data menu which can be used to add dummy data manually

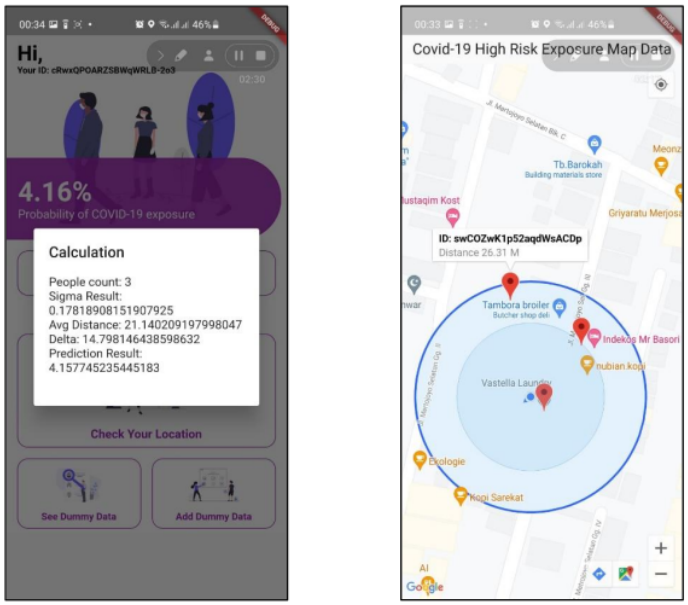

Figure 12. Testing program.

From the testing with the program, the result group in the table bellow acocording to the experiment in the dummy data such as :

Table 2. The relationship between the number of patient confirm covid-19, if $n = 1$.

DISTANCE	**RESULT**					
DISTANCE (x_1)	1	2	3	4	5	6
DELTA (δ)	0,5	0,5	0,5	0,5	0,5	0,5

Table 3. The relationship between the number of patient confirm covid-19, if $n = 2$.

DISTANCE	**RESULT**					
DISTANCE (x_1)	10	10	20	20	30	30
DISTANCE (x_2)	10	20	20	30	30	40
DELTA (δ)	0,6	0,9	1,2	1,5	1,8	2,1

Table 4. The Relationship between the number of patient confirm covid-19, if $n = 3$.

DISTANCE	**RESULT**					
DISTANCE (x_1)	1	1	1	2	2	3
DISTANCE (x_2)	1	1	2	2	3	3
DISTANCE(x_3)	1	2	2	2	3	3
DELTA (δ)	0,7	0,933333	1,166667	1,4	1,866667	2,1

Table 5. The relationship between the number of patient confirm covid-19, if $n = 4$.

DISTANCE	**RESULT**					
DISTANCE (x_1)	1	1	2	2	3	3
DISTANCE (x_2)	1	1	2	2	3	3
DISTANCE(x_3)	1	2	2	3	3	4
DISTANCE (x_4)	1	2	2	3	3	4
DELTA (δ)	0,8	1,2	1,6	2	2,4	2,8

Table 6. The correlation Between Number of Confirm Patients, if $n > 2$.

PERCENTAGE OF PERSON VULNERABILITY (%)							
PERSONAL AMOUNT (n)	**Results**						**Characteristic**
$n(1)$	50	25	16,67	12,5	10	8,33	Safe
$n(2)$	60	45	30	25	20	17,5	Safe
$n(3)$	**70**	58,3333	46,66667	35	27,2222	23,3333	Safe
$n(4)$	80	60	40	33.3333	26,66667	23,33333	Moderate
$n(5)$	90	61,71429	36	32.5	24	22,23529	Quite Vulnerable

5. Conclusion

Based on the results of the research obtained, vulnerability prediction is influenced by various factors including GPS mobile, and several other factors as follows :

- Prediction of vulnerability using GPS mobile tracking, produce a model in the form of an exponential function. This model is based on GPS distance data with reduced accuracy if the detected distance is less than 10 km, so a delta variable is needed.
- Delta itself is recursive from the distance to the number of patients who confirmed Covid-19 based on the time series. The result of the δ is directly proportional to the distance, the greater the distance, the greater the value of the δ.
- Based on the calculation result, it is initiated that the prediction of personal vulnerability occurs in the initiation of predictions in the form of vulnerability occurs in the initiation of prediction in the form of vulnerable, moderately vulnerable, and safe. Personal is said to be vulnerable if the percentage generated is round 90%-100%, quite vulnerable if the percentage result is between 75%-89%, and less than 75% personal is considered safe.

- The result of this vulnerability prediction are influenced by many variables, including personal distance $x_n(k,t)$ with patients infected with Covid-19, GPS accuracy ($\propto$), movement (β), and personal immunity
- (γ). This research is limited to the use of GPS with respect to distance, and minimizes the error of other related variables.

Open Problem. In this study does not close the possibility of adding variables or models, this is due to the many factors that influence the detection of vulnerable individuals or not to the transmission of Covid-19. In addition, the involvement of medical personal/data and also many other factors that play an important role are not included in the variables in this models. Research on Covid-19 is still being developed in relation to the many related variables in order to obtain more accurate results in accordance with real conditions in the field.The hope is that with this research, individuals can find out how vulnerable the situation in an area to Covid-19, so that they can take preventive measures.

Acknowledgment
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References

[1] D. Nataliana 2013 Design and Realization of GPS Data Transmission System Using SMS Technology *Jurnal Teknik Elektro,* pp. 48-59

[2] K Kominfo 2020 Care and Protect Kominfo Ministry Indonesia

[3] A G C P a R A K R Hrasko 2019 Time series prediction using restricted boltzmann machines and backpropagation *Procedia Comput. Sci*. vol. **55** pp. 990-999

[4] G B S H e a T Aquino 2014 Influenza outbreaks in a vaccined population-USS Ardent *MMWR Morb Mortal Wkly* vol. **42** pp. 947-949

[5] D D K G K N R Berlinda Batista 2020 Minimizing disease spread on a quarantined cruise ship: A model of *Mathematical Biosciences* vol. **329** pp. 1-11

[6] G N E A Efthimios Kaxiras 2020 the First 100 Day: Modelling the Evolution of the Covid-19 pandemic *ELSEVIER*

[7] Muhammad Irfan 2016 On total labelings of graphs with prescribed weights *AKCE International Journal of Graphs and Combinatorics* vol. **13** no. 2 pp. 191-199

[8] d. Gross 2006 *Graph Theory and Its Application (Second Edition)* New York

[9] N L Prasanna 2014 Applications of Graph Labeling in Communication Networks *An International Research Journal Computer Science and Technology* vol. **7**(1) no. Computer Science and Technology

[10] Munir 2016 Algoritm and Programming using C, dan C++ Vol. **6**, Bandung

[11] R Munir 2017 Pascal Algorithm Using C, dan C++ revised edition Bandung

[12] N L Azizah 2021 Predicting Personal Vulnerability to Civid-19 Using Graph Approch *Soulmath*

[13] Adam 2020 Modellers Struggle to Predict the Future of The Covid 19 Pandemic *The Scientist March 12* https://www.the-scientist.com/news-opinion/modelers-struggle-to-predict-the-future-of-the-covid-19-pandemic-67261

[14] M R M D W a K P M Maleki 2020 Time series modelling to forecast the confirmed and recovered cases of COVID-19 *Travel Med. Infect. Dis.,,* no. doi: 10.1016/j.tmaid.2020.101742.

[15] D Nuraini 2019 Analisys of The Differences of Customer Satisfaction *Journal of Economics-Management and Accounting* pp. 231-239

[16] G N A Efthimios Kaxiras 2020 The first 100 days: Modeling the evolution of the COVID-19 pandemic *Chaos, Solitons and Fractals* no. www.elsivier.com pp. 1-9

[17] J R P Philip T Gressman A Simulating COVID-19 in a university environment *Mathematical Biosciences www. elsevier.com,* vol. **328**

[18] M R a O-O Roser 2020 Covid 19 Research and Statistic

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