

Mitigating the Tsunami of COVID-19 through Sustainable Traceability

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Abstract Many countries differed in its way of response and management to the fierce infectious COVID-19 outbreak. Almost all the world countries agreed on the adequate verification and traceability of the suspected infected contacts, besides followed strict measures for containment and isolation. However, life has to go on towards regular routines at a certain point, to fulfil many of the demanding socio-economic needs. The literature does not have enough methods on how to do go back smoothly to life routines. In contrast, the infected individuals or those who have a probability of spreading infections will not go without being identified. This work focus on selective traceability that would be like a default system that would ensure the availability of sustainable community preparedness model. Therefore, this paper focuses on developing a simple. Yet, robust implementable scale and framework that help any public health authority, or organizations to take appropriate decision when to quarantine, direct for self-isolate, or consider the case to be safe; afterlife starts to go back to normal. The framework helps to sustain the testing without disrupting the people life, based on evidence-based selective sampling. The paper concludes with recommending the sustainable traceability framework be added to post-surveillance strategy as active case-finding technique. The main implication of this paper is that it raises the competence of the community in mitigating the risks of virus tsunami, similar to the COVID-19, and closes its future vulnerability to any new outbreak. The paper concludes with limitations and future research recommendations.

Keywords COVID-19 Coronavirus, Pandemic, Contact Tracing, Virus Transmissions, Sustainability, Traceability, Selective Sampling, Resilient Solutions

1. Introduction

Since the frightening spike of the COVID-19 outbreak on the second week of March 2020, many countries imposed strict restrictions on the movements and activities of its people and started a public health intervention at a scale that unprecedented in public health history. This intervention depends on many variables; however, the most determinant variable is tracing and traceability.

Traceability is an essential process for mitigation against COVID-19 threat and risks. The differentiation between any country or health system depends a lot on the effectiveness of their traceability process or protocols.

Any weakness or absence in this process might cause many later deaths due to daunting amount of critical cases that would be discovered too late, besides it would overwhelm the critical care units in the local hospitals. Slow traceability also found to be a source of debate. Some

governments believed that the faster the traceability, the better the capacity of the governments, or the public health authorities to manage COVID-19, especially in the first three months since the inception of this zoonotic virus.

Traceability of the public during lockdown is another development taken during the COVID-19 epidemic. Certainly, the experience of the China lockdown to Wuhan, did help to mitigate the COVID-19 threat and eliminate its causes. The overview of traced people helps to bring a proper evaluation of the national status, more accurately.

This paper emphasizes the type of sustainable traceability that needs to be taken in relevance to COVID-19 and its threats. The literature reviews what it takes to create an effective program for traceability, taking into consideration a long-term war with the virus.

The review starts with defining the contacts traceability and its role in case the COVID-19 continues to spread. The category of traceability and its situation during containment and mitigation, especially in epidemics, is explored. The characteristics of traceability systems and how it was operated in various countries are reviewed. The review also includes best practices as the utilization of Apps in tracing. Soo-Youn (2020).

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2. Literature Review

2.1. Definition of Contacts Traceability

Traceability is a process that targets to raise the ability of any system to either capture, retrieve or isolate a specific application, or location, or individual, or item.

Contact tracing is part of a traceability system where the public health officials would attempt to find all the contacts of a confirmed case, in order to test or monitor them for possible infection. Subsequent collection of further information about these contacts is part of traceability and contact tracing. The goal of both traceability and contact tracing is to stop the spread of disease by finding and isolating cases, as early as possible, and before they become super spreaders.

Traceability of infected contacts is essential for global health and security and in many countries, it is beyond individual freedom. WHO usually follows the public health authorities in every country to see what preventive health programs deployed aims to reduce any possibilities for infectious diseases from contacts carrying HIV, Ebola, Measles, Tuberculosis, or any novel and zoonotic viruses as SARS, MERS and recently COVID-19.

During emergencies and threats like the zoonotic COVID-19 breakout, the public health authorities and governments, besides the medical staff would usually have two primary missions: preparedness and response. Hence, prevention and control programs need to be always developed, assessed and effectively deployed and enforced in the field. For both and prevention and control one of the common dominators which are highly essential, especially in the highly contagious disease that became epidemic infectious, as COVID-19, is traceability and tracking. Boodman (2020).

WHO focused on sending essential messages on traceability and tracking through different slogans that the director-general, Tedros Adhanom Ghebreyesus mentioned in his weekly and daily news briefs. In the first two months of the virus, the traceability slogan was '*Find-Test-Isolate-Treat*', to outline the WHO Guidelines at that moment. The second message the high message important and emphasis on traceability became when Tedros announced, on 19th of March 2020, that COVID-19 became pandemic and he used the slogan '*Isolate- Test- Treat- Trace*'. Boseley (2020).

The collective outcome of this traceability is that it would build the accumulated knowledge, which is evidenced-based. This knowledge since it is traceable it would help to put more scientific facts-driven guidelines that would enhance the healthcare and the public health officials to take the precise decisions at the right time and place.

2.2. Traceability Role in Case the COVID-19

2.2.1. Goals of Contact Tracing

To interrupt ongoing transmission and reduce the spread

of infection by alerting the contacts that have the possibility of infection and offering preventive for the non-infected, or treatment for the already infected individuals.

Contact tracing helps to prevent reinfection of the initially infected patients. The proper tracing with the high availability would help the epidemiologists to estimate the spread of the disease in the population and how to design a specific plan or program to mitigate further spreading.

Similar to contact tracing, traceability can be used in investigations and assessment of the quality of testing, the hygiene, the morality, the morbidity, the contamination, the incidents and the accidents. The traceability would help to categorise the repeated incidents in relevant to virus transmittance. NZ Public Health (2020).

2.2.2. Role of Traceability if the COVID-19 Continues to Spread

Traceability would help lots of governments and public health authorities to practice 'pull thinking' in the case when the COVID-19 continues to spread. This means with traceability; we can selectively focus on the specific type of cluster of individuals, say based on their demographics and history, and define for them protocol for followup or isolation. With traceability, we could have more information on how the virus is being transmitted between the community. Thus, an effective 'sustainable traceability program' could help in designing more suitable tracks that would eliminate the virus threats without taking the people for long term lockdown. Boseley (2020).

Now, and more than the previous coronavirus outbreaks of such as SARS and MERS, effective, sustainable traceability certainly would make a difference, as COVID-19 is expected to stay for a long time and similar future outbreaks are expected to come in more lethal forms. With COVID-19, the virus has the capacity for more easy transmission, and mostly, about 80% of the infected are asymptomatic. Hence, without effective, sustainable tracing, the asymptomatic and the mild symptoms patients would play a substantial role in transmitting the virus. Buheji and Buhiji (2020).

Through effective traceability we do not need to spend much to convince the risk-prone people who look healthy to distance themselves, you will need only to show the evidence of their risk on the community and then isolate them. Due to the traits of the virus, such as being contagious, which has the capacity to invade the human cells and replicate the viral genome, sustainable traceability program should be active in all the countries. Boodman (2020).

An effective surveillance strategy could lead to enhance case detection and reduce transmission of highly infectious diseases such as COVID-19. Besides, the availability of such program should help to ease the psychological burden and worries of having too many infected patients or virus carriers/contacts that are spreading the virus without being traced or pulled in the right time before having the new wave of virus spread exponentially again without being noticed.

2.3. Category of Traceability

2.3.1. Traceability During Containment and Mitigation

The types of contacts that are relevant for public health epidemic management vary, as per the nature of the communicable disease because of their different modes of transmission. For sexually transmitted infections, for example, the focus would be on the sexual contacts. For blood-borne infections, blood transfusion recipients, contacts who shared a needle, and anyone else who could have been exposed to the blood would be the targeted contact. For pulmonary tuberculosis, people living in the same household or spending a significant amount of time in the same room would be the contact of focus. Baird (2020), Soo-Youn (2020).

In the case of novel infectious diseases outbreaks, all the people who have been in contact with the case within a distance of less than one meter, within a confined space and for more than 15 minutes would be a suspectable contact that needs to be traced. This was applied in cases of SARS, MERS, H1N1, Ebola and recently COVID-19 where the contact tracing was used to determine if the secondary transmission is taking place and in which community. Therefore, it is expected that more contact tracing would be adopted in airports in the future, especially after the COVID-19 became pandemic.

In certain countries, like Korea, the traceability was used as a response strategy. The increasing reports of local transmissions of coronavirus among the Korean signalled that the fight against the novel coronavirus should focus more on “mitigation,” rather than focusing on “containment,” which work on isolating infected patients. With traceability, the response made the Koreans divide the patients depending on their level of symptoms.

In USA, experts called for mitigation measures, since shifting to containment will stretch resources too early. CIDRP (2020), Soo-Youn (2020).

WHO recommends both mitigation and containment programs. Within the one county, WHO recommends that the health authorities might use containment as quarantine and contact tracing. Also, epidemiologists tend to use both containment and mitigation to limit both the extent and the rate of infection. Containment is used at the start of an outbreak. It involves tracking the dissemination of a disease within a community, and then using isolation and individual quarantines to keep people who have been infected by or exposed to the disease from spreading it. With containment infected people found and traced early would be prevented from staying in their contacts circulation and minimise their fatality. Baird (2020).

Studies now show that the early start with containment as the infection breakout, supported by school closings and social-distancing strategies, appears to have limited the spread of covid-19 in Hong Kong and Singapore. On the other hand, mitigation starts when the public health authorities see they can't drive transmission to zero with

containment measured. Hence, mitigation would start by closing any large gatherings, and calling for schools and employees to do the work online. Soo-Youn (2020).

2.3.2. Chain Traceability

This type of traceability focuses on building a link and keeping the traced contact within the chain. This technique allows the concerned authorities to flow the data about individual and even empower the public authority to follow all the movement of the infected contact. This chain traceability can be identified by codes, such as QR or Apps, or zones. This coding helps later the planning for staged returning towards normal life zone by zone. Hence, it contributes towards gradual production or even in the case where the distribution of food or medicine needs to be delivered or prioritised. Le Guillou (2020).

2.3.3. Traceability Once a Case is Confirmed

Rapid identification and isolation of cases, quarantine of close contacts, and active monitoring of other contacts have been effective in suppressing expansion of the outbreak. Once a case is confirmed as a positive test for SARS-CoV-2, the virus that causes COVID-19, in certain countries the patient would be asked to either self-isolate if he/she do not have severe or emergency symptoms. In other countries, such patients would be called for the hospital. The patients would receive a chest x-ray, and RT-PCR testing on at least two nasopharyngeal swabs collected 24 hours apart. All the reports suspected and confirmed that COVID-19 patients would go through a centralized disease notification system for ease of traceability.

2.3.4. Spillovers Expected Regarding Traceability in the Future

Traceability can be considered in four distinct contexts: people, products, process and data. We need to create a link between the human to human, human to animal, human to materials. Through traceability, we could investigate the original destinations of anything, or anyone be it humans, animal and products. Also, tracing for the history of travelling and transits would be demanded more than ever after the COVID-19. Le Guillou (2020)

2.4. Traceability in Epidemics

2.4.1. Role of Traceability in Containing the Pandemic

The problem with this COVID-19 (SARS-Cov2) epidemic is that it can so quickly enter our bodies without realising, and bind with the Histamine H2 receptors of the lung cells and then it starts to regenerate itself and its RNA through the cell. Hence, over time, i.e. after a few months of this epidemic, and unless vaccination is found for eliminating this virus, many people would have the probability of either being infected or potentially would be infected. Thus, a more efficient and effective traceability program needs to be in place for the effective selection and isolation of people, even

if they go back to their normal life again, i.e. no more lockdown. Since it would be more possible to create early catchment and diagnosis followed by prioritising treatment for those who need it, through traceability, we can also prepare more the hospital and the secondary and the tertiary care staff about what's coming up. Soo-Youn (2020).

With the announcement of the COVID-19 as a pandemic disease virus, the importance of traceability became more important. However, to enhance the means of traceability people who developed respiratory symptoms were urged to stay home and manage their symptoms with over-the-counter medications, unless serious difficulty breathing develops. Traceability in countries where there are vulnerable populations, and people with underlying health conditions or weakened immune systems, might be debatable. Therefore, many of those with such conditions were asked to stay at home and apply social distancing to prevent the disease.

This epidemic of SARS-Cov2 depends on certain vectors for transmission, i.e. the droplets is a vector, the hand is a vector, the distance is a vector and the individual (the contact or the identified patient) is a vector. Since lots of work have been in relevance to hygiene and self-protection issues, this paper would focus on the individual being a vector for transmission.

Hence, through profound knowledge-based, driven traceability system or program, we could enhance our ability to stop the patient or the potential contact from shedding the virus, with optimisation of risk management. Thus, such traceability system would help us to flatten the curve of those infected over time, which means also improve the health care system to cope with the emergency and severe cases in time. Besides, the availability of this traceability program would make people and decision-makers trust there is a system or scheme that is helping them to work with confidence and slowly go back to their normal life. New York Times (2020)

2.4.2. How Dangerous is Non-Traceable Contacts?

Once the COVID-19 infected people are classified, and contacts are traced, useful measurement is expected for the 7-day interval where the identified person would move from symptom onset to isolation in hospital or quarantine. Hence, any non-traceable contacts can be a super-spreader, i.e. its hit is fast and sharp. The more the disease is contagious, like in the case of this zoonotic virus, COVID-19, the more non-traceable contacts would be a source of infecting hundreds than tens of people. Of course also this depends on the way of life the infected person if he is very social, active and likes to go for high gatherings the virus would find the right environment in spreading. Boodman (2020).

Hence, a non-traceable contact can spread wildly in a heavily crowded, closed environments, like restaurants, classroom, buses, airports, offices, etc. The more these non-traceable also live in confined spaces and share common facilities, the more the damage they could do. Hence, the danger would be the increase in the higher number of contacts which could make this epidemic or

pandemic spread with capacity for tracing or control. This is exactly what happened in Italy and different European countries where many cases began popping up with limited power to control them. Cohen and Kupferschmidt (2020).

The non-traceable contact is thus thought to be a threat to the efforts of detecting the chain of transmissions. Once the number of the traceable contacts rises, the contact tracing would be daunting, and with time it would be too late to contain the epidemic unless you start the mitigation strategy. CIDRP (2020)

2.4.3. When to Stop Contact Tracing?

Studies confirm that contact tracing would be valuable even if there is a widespread epidemic transmission as it slows the spread of the disease and smoothens the flow of the critically ill infected cases reaching the Intensive Care Units (ICUs) or admissions in general. CIDRP (2020), Cohen and Kupferschmidt (2020).

Although epidemiologists have tried to develop mathematical models to understand when the costs of contact tracing outweigh its benefits, there is no agreed formula for determining when an outbreak has become too widespread for contact tracing to be of use, or when to switch from contact tracing to community mitigation measures. Baird (2020).

2.5. Characteristics of Traceability Systems During COVID-19

The basic characteristics of traceability are identification with information that links between the person or the product and retrieve information. In practice, traceability brings a series of record-keeping and the path of the particular person and/or product, besides how it influenced through all the intermediate steps. The importance of the traceability of people and products is based on the ability to identify them uniquely at any point in the transmittance chain.

The specific requirements for the extent of traceability (i.e. how much information is carried within the traced contact) will vary and depend on the nature of the infection, on the situation of the emergency in the country.

Many countries healthcare systems carried contact tracing around confirmed cases only. Contacts with a fever of more than 38 °C, or respiratory symptoms were transferred directly to hospitals. Close contacts of less than 2 meters and prolonged for less than 30 minutes were recalled. Contacts at lower risk were persons who had some interactions with the COVID-19 patient for shorter periods. Khalik (2020).

2.6. Overseas COVID-19 Contact Tracing

Almost all countries complained that the cases of COVID-19 came from overseas. In order to verify this claim, countries need to establish in the future traceability system which tracks down people who may have been exposed to the virus during travel, or when they were overseas through 'contact tracing'. As of now, i.e. in the time of writing this paper, most governments and health authorities and since the

epidemic at its peak or just starting to, except in China, there are two solutions regarding overseas passengers, or citizens arriving from overseas: either the borders and ports are closed, or each passenger would go into quarantine and testing. With testing also, the contact tracing is applying. Boseley (2020).

Now, this is totally not practical as a long-term resolution, should the virus stay or come again. Overseas arriving citizens or visitors would have a traceability test, sampled every says 20 passengers, where the passenger would go through contact tracing to find people who may have been exposed to an infectious disease. There are two types of contacts: close contacts and casual contacts. Therefore, deeper analysis models are needed.

A close contact is anyone who has been close to someone with COVID-19. This can mean living in the same house or spending more than 15 minutes close to someone with COVID-19 such as on a flight, bus or train or in your workplace. While a casual contact is someone who has had contact with a case but doesn't meet the criteria for a close contact. This could mean someone travelling on the same aeroplane who was seated away from the case. For example, they were only close to the person with COVID-19 for less than 15 minutes or were at the same place but not near them.

2.7. Quality of Sustainable Traceability System

2.7.1. Case Theory as a Means for Sustainable Traceability Method

A case theory is a detailed and accurate story of what occurred involving both causes of action and the explanation of how a particular course of events could have happened. Case theory is very important for a sustainable COVID-19, or any similar epidemic disease traceable system. The public health officials or healthcare staff are supposed to give a logical description of events of why specific contact was traced.

2.7.2. Chain Traceability

For traceability between the links in the chain in relevant to contagious disease as COVID-19, the people and the products would be traced from one link in the chain to the other. The purpose here is to extend traceability through all the stages of the journey. Thus, through the chain, we can trace and follow a person, or an item, or a process or substance through all stages.

The chain helps to trace the person or the group from the current stage back through all its stages they encountered through accurate and timely record-keeping. This needs a good simple computer records that could help to search and find a specific name or time, or place, as part of the evidence.

2.7.3. Quality Cost of Contact Tracing

Contact tracing is needed lots of resources if it is used in broader community management and control measures. Hence, the return of such tracing controls would be more

costly if it is followed by a strict community or country lock-down, widespread screening and travel restrictions.

Sustaining traceability is cost-effective if it would help to learn more about the disease characteristics, including its infectiousness. In areas where the disease highly spread, screening or focused testing would need to be evaluated according to the country plan and how it wishes to contain the virus or balance the socio-economic life.

2.8. Early Traceability Programs

2.8.1. Purpose of Early Tracing

The main purpose of any effective tracing, especially in a pandemic similar to COVID-19 is to minimise the size of the suspected infected individuals or groups and withdraw their potential cross-infection to others. Tracing also helps to diagnose problems of the infected and thus build reliable treatment approaches with high availability.

With tracing, we can minimise the spread of any contagious disease of persons to all their potential chain of contacts. Without such sustainable tracking, the public would lose confidence in the capacity of the system and its availability and hence its reliability, based on the following formula:

$$Reliability = P (Availability),$$

where P= Percentage of Probability.

Early traceability practices can be used by public health to take a proactive approach to prevent diseases and cross-infections. Through traceability, we can emphasis control of any disease that comes from the people, or any other things they are in contact with. In diseases similar to COVID-19 pandemic, early traceability can be used for controlling the rapid spread of the disease sources and its possibility to endanger its contacts. Khalik (2020).

While the primary role of early traceability is to protect public health by facilitating the rapid withdrawal of the infected people so that to mitigate the quantity of those that might become so ill. Thus, the intention of a strong early traceability program during a pandemic like COVID-19 is to avoid overwhelming the healthcare system at any specific time and ensure the proper turnover of the emergency beds.

2.8.2. QR Based Traceability – the Taiwanese Experience

Scher (2020) mentioned that despite that Taiwan is only 81 miles from mainland China, it has managed to control COVID-19 spread with only 77 confirmed cases and a single death. The country kept its population safe and healthy compared with nearby countries because of its early traceability screening for travellers from Wuhan, since December 20.

Suspected cases were screened for 26 viruses, including SARS and MERS. Passengers displaying symptoms were quarantined at home and assessed whether medical attention at a hospital was necessary. By late January, Taipei had established a Central Epidemic Command Center, centralizing policy measures to protect public health. On

January 26, Taiwan became the first country to ban flights from Wuhan.

Based on the Taiwanese Government experience with SARS outbreak during 2003, intensive health monitoring using big data and repeated testing made Taiwan ahead of the game. Travellers were classified with a QR code, based on their travel and health history, including classifying travellers' infectious risks based on on-flight origin and travel history in the last 14 days. People who had not travelled to high-risk areas were sent a health declaration border pass via SMS for faster immigration clearance. Those who had travelled to high-risk areas were quarantined at home and tracked through their mobile phones to ensure that they stayed home during the incubation period. Knight (2020), Le GuillouI (2020).

2.9. Traceability through Apps

2.9.1. Leadership in Using Apps as Part of Traceability System

The idea of using phones to control contagious diseases is not new. In 2011, two scientists at Cambridge University in the UK proposed a model to control the spread of the flu, through an app called FluPhone. The app used Bluetooth and other wireless signals as a proxy for interactions between people, and asked users to report flu-like symptoms. Besides slowing the spread of the flu, the app targeted to help health authorities to monitor the spread of influenza. However, with COVID some western countries seen that such apps might be unnecessary as it would cause alarm or confusion.

Therefore, one could say that the South Asian countries: Singapore. South Korea and Hong Kong followed by China, as considered to the leaders in the utilisation of epidemic apps. The South Asian countries optimised their utilisation of the strong ICT infrastructure and started directly mobile Apps to track coronavirus infected cases by the third week of the outbreak. Each country used its app in a different way for either containment or mitigation. Knight (2020).

2.9.2. Singapore Tracing App

The Singapore government, for example, used the app to allow the authorities to identify those who have been exposed to people infected with coronavirus as part of efforts to slow the spread of the disease. The app recorded the encounters and the level of social distancing exercised. Through the default distances in the Bluetooth which are stored locally on each phone with the app, the government monitored the practising of safety distances. Users then send their logs when requested by the health ministry.

Singapore implemented a multipronged surveillance and containment strategy that contributed to enhanced case ascertainment and slowing of the outbreak. Based on the review of the first 100 cases, the mean interval from symptom onset to isolation was 5.6 days and declined after approximately one month.

The effectiveness of Singapore's surveillance and containment traceability efforts helped to calculate the intervals from symptom onset to isolation in hospital or quarantine. This measure indicates the time spent within the community when a person with COVID-19 is potentially infectious.

2.9.3. China and South Korea App

China and South Korea used smartphone apps to monitor people with the disease, breaking some privacy during data collection. Knight (2020).

China achieved what many public health experts thought was impossible: containing the spread of a widely circulating respiratory virus. The most dramatic measures were supported by apps that showed codes of green, yellow and red, which helped the help officials monitor the movement of the people in Wuhan. Also, the government used an app to show the houses of the infected people so that people avoid going near them. Such applications effectively contained the exportation of the virus to the rest of China. In other regions of mainland China, people voluntarily quarantined and were monitored electronically by appointed leaders in neighbourhoods. VOA Student Union (2020)

2.9.4. Traceability of Mild Infected Patients

In Europe and also China, the public health authorities offered electronic preventive advice or self-treatment from the infection. These apps helped the contacts to isolate themselves at home, and many COVID-19 fit patients have been asked to do. And if one of these contacts turns out to have the disease of interest, they become the focus of the health officials.

Asymptomatic close contacts were placed under compulsory quarantine for 14 days. The contacts at lower risk were placed under active monitoring and were assessed by phone for fever or respiratory symptoms. Close contacts were called thrice daily and once daily for contacts at a lower risk. Contacts who became symptomatic were transferred to a hospital. All hospitalized patients with pneumonia, ICU patients with possible infectious causes, patients with influenza-like; and deaths from possible infectious causes were shared by the health workers by a phone app.

Besides, the phone played a role in straining the transmission of the COVID-19 by helping to determine the position of the people, besides the contact tracing. However, these apps also were misused. There are cases in South Korea, for example, where the authorities have sent out texts detailing the movements of specific people infected with Covid-19, stirring up public shaming and rumour. Illmer (2020), Kuhm, A (2020)

However, one could say that we expect to more of apps utilisation where the government would monitor through them how people are abiding the 'stay home' when they are ordered to quarantine themselves. The app of AliPay in China is expected to be used more to codify people by colours, to determine whether they should quarantine

themselves, or may move around freely. VOA Student Union (2020).

2.10. Sustainable Traceability as a Resilient Solution

The COVID-19 epidemic showed how the current sophisticated economic and security systems are fragile in front of this contagious threat. The question now how we come back to business, including the freedom of transportation and distribution without crippling the economy and create negative socio-economic impacts in the name of preventive measures.

Taking the lesson learned and knowing that we need to stay globally and locally interconnected, we need to re-think how to build a resilient community that choose effective, sustainable creative actions towards the new realities. One of the most important resilience practices is to have a clear feedback system that helps to would enable us to detect changes and evaluate the consequences of any threats and risk changes. Thus, in order to respond to the changing conditions that the COVID-19 have established, a sustainable trusted system need to be established. Such a system would help to enhance the world trust in its capacity to effectively and efficiently detect any potential infection from contacts at the right time and place. Buheji (2020)

To bring resilience and trust to the life of many people, a deployed feedback system should help to support the productivity of the community, while having a mechanism that pull the sources of risks without any disruption to the chain. Having a sustainable traceability system or program would enable the reconstruction needed by the world socio-economy, since it would stimulate self-sufficient practices and ensure a safety program that supports better well-being outcomes. Buheji (2018).

3. Synthesis of the Literature

COVID-19 infectious power shows that so far, that every infected person could infect at least three people per day unless identified and isolated or quarantined or treated. Although the world is waiting for a lifesaving medicine or vaccine, the threat of such contagious diseases is coming more and more in the future. Hence, the world needs more sustainable traceability which contact tracing is one of its pillars.

With the increase of infectious diseases, people might start use apps, voluntarily or compulsorily, or even we might see the days where implanted devices would be in our bodies which would help them and the authorities to detect and then trace and isolate them, or even define their immunization status.

Since COVID-19 is a very infectious disease, there should be model scenarios of the probability of the individual 'contacts', be it close contacts or casual contacts. These models should help us to score the extent of the probability of the individual being infected and the consequences of these risks on the specific type of vulnerable people. Hence,

the model needs to go into certain protocols, or help to calculate the risk of being a virus carrier with mild symptoms and would have a certain score to decide along with the consequences he/she would go through, or the consequences they would create to potentially vulnerable contacts. This in-depth analysis can be applied to either high sampled population as done during the COVID-19 epidemic in many countries, or used in random sampling, i.e. like the case of testing the passengers as a long-term solution, after the epidemic is over.

The world and specific governments could have saved themselves lots of lives, efforts and countless resources; if they collaboratively worked on identifying through sustainable traceability the contacts before they travel from the country where they could have been detected first, i.e. before they fly on the aeroplane. If all the world communities collaborated with WHO public health efforts, the value of contact tracing really could have made a difference despite the geographically widespread of this globalized world. Hence, the literature clearly points for a significant gap that needs to be addressed regarding sustainable traceability.

4. Setting Sustainable COVID-19 Traceability Program

4.1. Risk Matrix for Classifying Cases for Continuity of Traceability

In order to avoid the sudden breakout impact in the future, and based on the literature gap, a sustainable traceability program is proposed, using the basis of risk mitigation formula and tools. This program targets to address the gap found as per the synthesised literature for sustainable, pull thinking (selective) contacts evaluation and tracing. The program targets to help governments and health authorities to reduce the (COVID-19) transmissions in the long and short term and avoid similar virus to go and spread globally without being unnoticed.

A risk matrix is established for effective, sustainable traceability. The matrix is based on the formula of:

$$\text{Traceability Risk Factor} = \text{Probability of being Infected} \times \text{Level of Consequences,}$$

where the level of the consequences would be influenced by the demographics the patient, or the risks of the contact to be a super-spreader and a hidden threat to the community.

The scale of potential risk, as shown in Figure (1), is defined into three levels of risks: (high, Medium, Low). The 5x5 risk matrix scale helps to define the highest score in the matrix to be 25, and the lowest is 1. While the level of the probability of being infected might be influenced by the model of contacts and in some instances, the destination they came from.

As shown Figure (1) the other part of the formula is the level of consequences, which for the scope of this paper we put that it is influenced mainly by the demographics of the

patients and the risks of being a super-spreader of a hidden threat.

Both the scale and the framework help the public health authority representative, or even any organization to take a decision to decide when to quarantine, direct for self-isolate, or consider the case to be safe. Hence, the framework helps to sustain the testing without disrupting the people life, based on evidence-based selective sampling.

The matrix suggests that only six out of twenty-five conditions need to be quarantined or self-isolated, which are represented by the high-risk cases shown in dark colour in Figure (1). The rest, i.e. the medium or low-risk cases can be either followed by the health visitors, or through telemedicine and can function normally.

To accurately define and codify the levels of probability of being infected, the following models are suggested. The reader or the user can visualize the other models in between the three main models suggested in Figure (2a), (2b) and (2c). The models proposed goes beyond ‘close’ or ‘casual’ contacts, so that to open up more niche for possible future

research.

For the first Figure (2a) model, since the traced contact has a history or high probability of mixing with infected people or come from places of the high possibility of being infected, for example, an international passenger besides being husband or wife of someone working in the hospital, then this contact needs to be tested and quarantined for 14 days before they can join the work again.

For the second Figure (2b) model, since the traced contact has a relation with a major group that has been found to be infected, but most of his friends or family are not infected, then this contact needs to be tested and then a decision to be taken based on the result whether to be quarantined or self-isolate before they can join the work again.

For the third Figure (2c) model, since the traced contact has an indirect relation mild cases contacts and youth and most of his/her friends or family are not infected, then this contact needs to be tested and then to be self-isolated before they can join the work again.

Level of Probability of Being Infected

Level of Consequences
(as per the Demographics of the Patient or risks of the contact to be a super spreader and a hidden threat)

	5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Scale of Potential Risk

High	Medium	Low
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Figure (1). Risk Matrix for Classifying Cases for Continuity of Traceability

Table (1). Codifying the Level of Consequences (as per the Health and Socio-economic Demographics of the Patients)

Level of Health Consequences (Examples)	Level of Socio-Economic Consequences (Examples)	Score
<ul style="list-style-type: none"> • High Morbidity & Mortality Case • Patient with Complications • Patient with Non-Communicable Disease(s) • Patient Found to Carry Different Genome Proteins 	<ul style="list-style-type: none"> • Infected and Serving Food in Restaurants • Infected and working as Medical-Healthcare Staff • A worker in the Nursing Home • Teacher in High School 	5
<ul style="list-style-type: none"> • Possibility of Not Responding to Treatment • Possibility of being Asymptomatic • Showing High Pains and illness 	<ul style="list-style-type: none"> • Works as Bus Driver 	4
<ul style="list-style-type: none"> • Multiple Similar Cases have been Reported • Many Similar Complaints 	<ul style="list-style-type: none"> • An active member of Sports Team 	3
<ul style="list-style-type: none"> • Needs Medication and distant followups 	<ul style="list-style-type: none"> • Run a small family business (not food) 	2
<ul style="list-style-type: none"> • Nothing very mild symptoms 	<ul style="list-style-type: none"> • Retired and Working from Home 	1

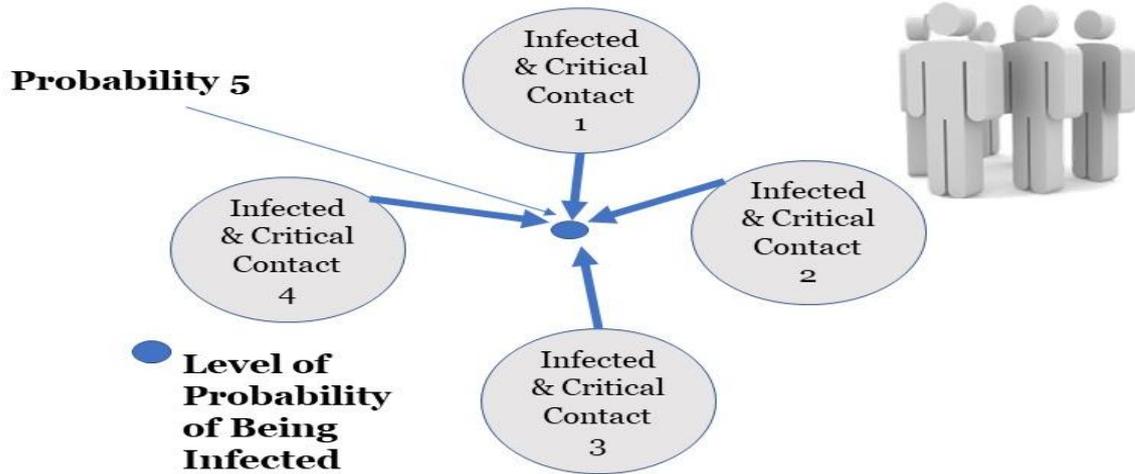


Figure (2a). Defining Level of Probability of Being Infected – Model of Very High Probability Patient/Individual

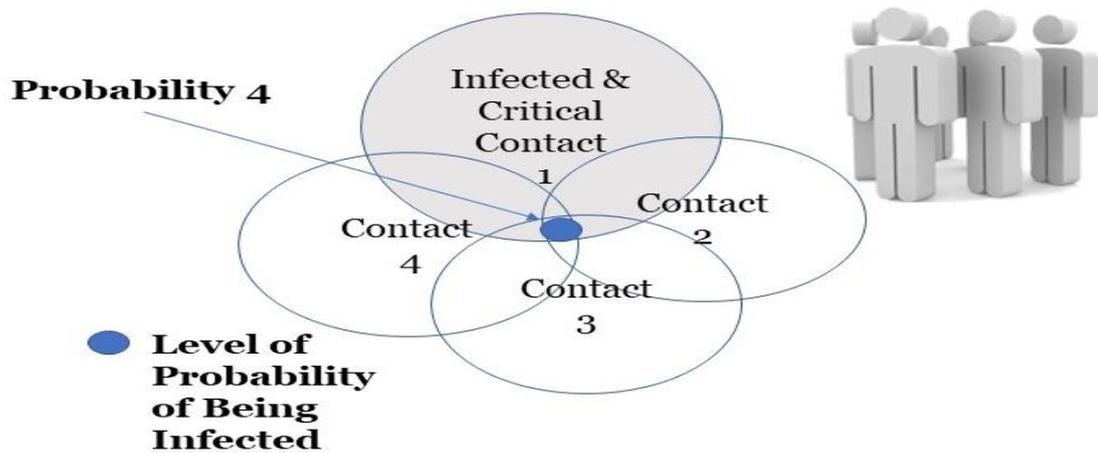


Figure (2b). Defining Level of Probability of Being Infected – Model of High Probability Patient/Individual

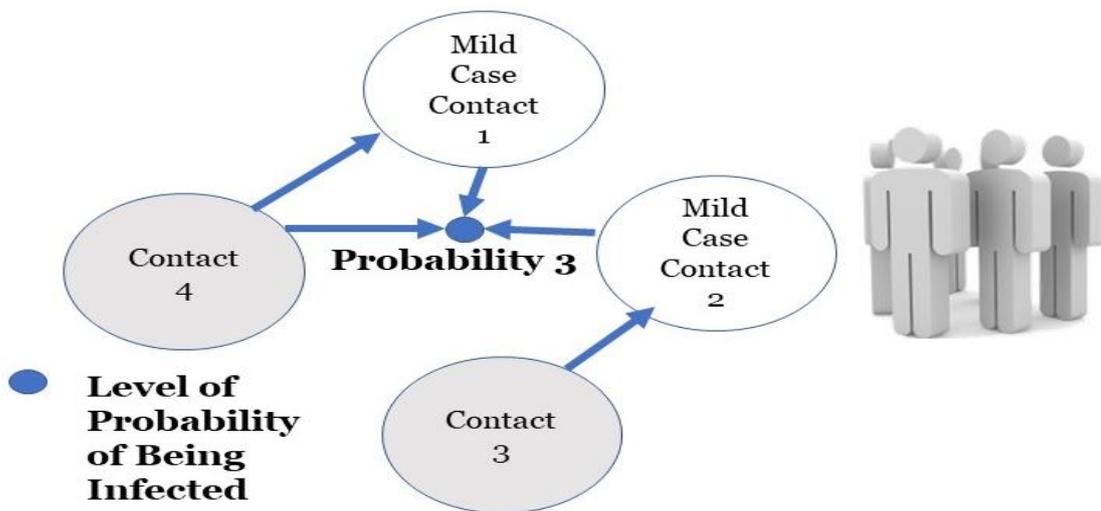


Figure (2c). Defining Level of Probability of Being Infected – Model of Medium Probability Patient/Individual

In order to complement the efforts for classifying the cases as part of a proposed continual/sustainable traceability we need to link the probability of being infected with the consequences that would happen in the traced contact, or the sampled individual got a certain probability. In order to help to encourage customizing the matrix, to be used effectively, the author gives here examples of the level of consequences, as shown in Table (1). The table shows the only sample of what could be established by the public health authorities or the hospitals, or the organisations that are going to use the matrix and later the comprehensive sustainable traceability framework. Besides, the health consequences, the author suggests the socio-economic conditions or outcomes be considered as part of the consequences that should be taken during the judgement of pulling the sample.

5. Discussion & Conclusion

5.1. Selective Traceability & Tracking of COVID-19 Risk Spreaders Framework

Based on the proposed sustainable traceability program, the following framework is proposed to ensure that any infected patient, or the contact that carries a potential risk to spread COVID-19, or similar contagious disease, can be identified in the right time and with confidence. The framework focuses on the accumulated experiences and the profound knowledge that would come from both observing and then triaging the traced cases of potential infection, or risk being a contact super-spreader. Therefore, the availability of such a program should help people to go back gradually to their normal life without undermining health and safety monitoring.

As illustrated in Figure (3), based on the established observation and triage practices, the level of probability of being infected should be defined in the right time. Then, the level of consequences would be codified, as per the health or the socio-economic data, or the demographics of the

individual sampled. These first three steps are essential for the effectiveness of the framework. The tools provided in the sustainable traceability program, can be further modified and improved once the purpose is understood.

Thus, this resilient framework would act on emphasising ‘selective traceability and tracking’ of the potential COVID-19 risk spreaders, after the cases are effectively codified. These cases would be further classified, using the proposed models, in Figure (2a), (2b) and (2c) or similar models that would help in effective classification of the sample. Then, the risk of the traced case/contact could be selected to be either quarantined, or self-isolated. This framework along with its matrix and tables should be re-evaluated periodically to emphasis its fitness for the purpose it is made for, that is to ease the sustenance of monitoring a very infectious virus as COVID-19, without disrupting the livelihood of the community.

5.2. The Advances on the Virus Genome and Sustainable Traceability

With the advances in genome sequencing, the novel coronavirus COVID-19, or (SARS-CoV-2) could be monitored, and its pandemic could be traced faster than any previous outbreaks. However, to complement this knowledge, we need now to build knowledge on how to trace those that carry the risk of infecting people not only now, but in the long run, so that we prevent the devastating effect of the second wave expected of this virus. This again would raise our preparedness and response capacity compared to the demand of the people, i.e. the demand to go back confidently to their normal life and businesses.

In order to meet the sequencing demands of the new genome, the models of the possible COVID-19 spreads are estimated, besides its throughput. The resilience-based framework should help to raise the capacity to determine the number of people that are infected, or most probably would be of risk to spreading the virus, i.e. not infected but might carry the virus in their hands, clothes, items, etc.

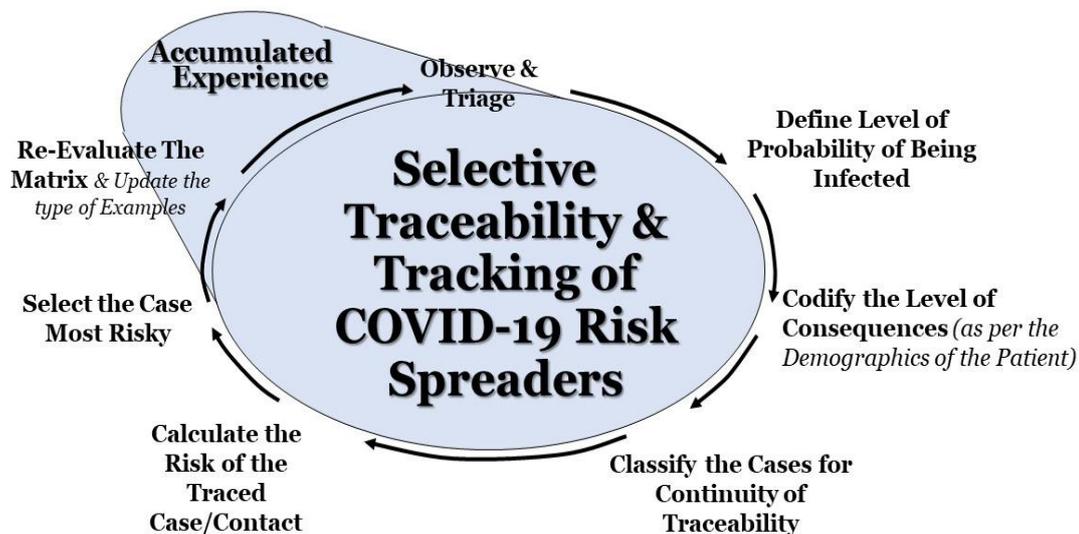


Figure (3). Selective Traceability & Tracking of COVID-19 Risk Spreaders

Through this sustainable traceability, we can blind the knowledge of the estimated sequences, i.e. how the virus spreads, the speed at which it is spreading, with the actual traceability records of the infected, or potential contacts at risk. This can enhance both local and international public collaboration and make them speak a common language regarding levels of risk, with numbers crunch. Boodman (2020).

5.3. Role of Sustained Traceability Framework in Flattening the Curve and Building People Confidence to go Their Normal Life

People cannot live a repeated panic, fear and isolation like they have gone and are going through since the first day of the first quarter of 2020. By sustainable traceability and tracking, we would avoid totally disrupting the socio-economic life again as happened in the first months of 2020, in most of the countries. This proposed framework supposed always to help to effectively pull the most potential sources of risk, depending on their history and other probability factors with minimal cost and without creating so much noticed chaos as we experienced with the first months of the COVID-19 epidemic. Having a simple yet effective sustainable traceability program around is a key to this health and safety default system.

One the most important implications of the proposed framework, is its potential influence on creating sustainable semi-protective measures in the country, or the community, or even in the organisation, i.e. helping to continuously ‘flattening the curve’ without disrupting its socio-economic life.

Figure (4) integrates the popular CDC ‘flatten the curve’ model with the proposed framework. The figure illustrates how the framework is supposed to ensure that the healthcare

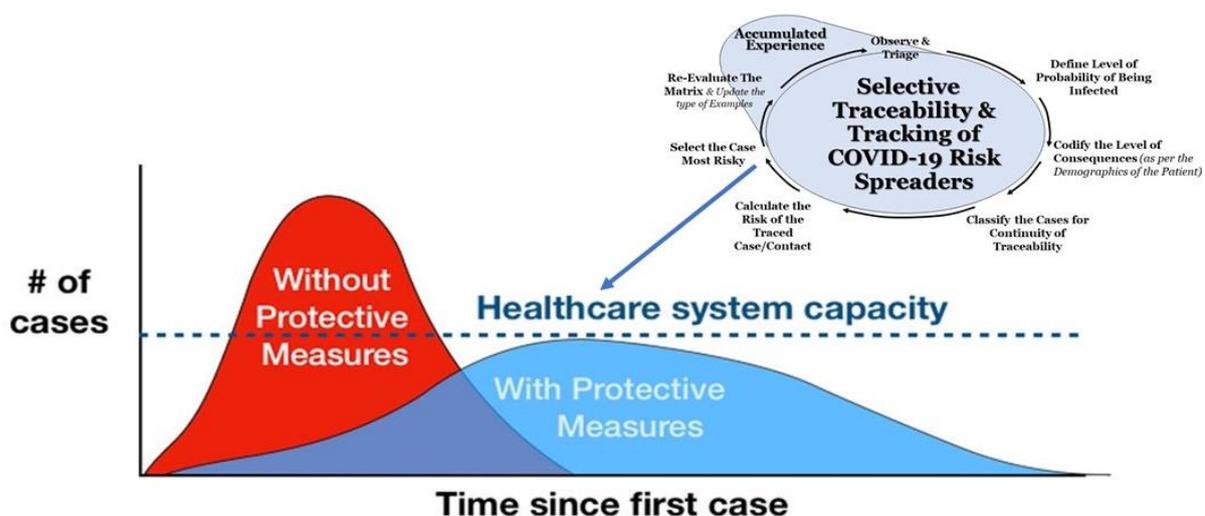
system would never be overwhelmed, if its cycles and revolving effectively. Also, the figure gives us a hint that if this practice embedded in the mindset of most of the physicians, especially the primary care or family physicians we would discover and isolate the suspected cases before they become super-spreaders or cause another virus breakout. New York Time (2020).

5.4. The Implication of This Paper

This paper gives a sense of empowerment and confidence during difficult times, or if the epidemic stays for a long time to be selective in who, how and when to ‘Isolate- Test- Treat- Trace’. This would help WHO and the concerned public health officials feel confident on what decisions they and their beneficiaries are making and would be able to defend it.

This paper is maintaining the sustained transformation towards normal life practices, however, with careful monitoring through effective evidence-based traceability techniques. The framework proposed to focus on long-term practical sustainability of traceability practices, without being dependent on the current monitoring by the apps, or the 100% sampling for all the doubted contacts, like sampling the overseas passengers, due to complicated practicality. Thus, one of the implications of this paper is that it eases the return back to the socio-economic life, and ensures the smooth livelihood without undermining the public health and safety at any time.

The framework and its tools, could help countries without the capability of high-volume testing as African countries, or developed countries at the beginning of the outbreak to trace the potential cases of risk and isolate, or quarantine them. This would help to identify the pandemic transmission chains.



Source: New York Times (2020) The ‘Flattening of the Curve’ part of the Figure is adopted from CDC/ the Economist.
<https://www.nytimes.com/2020/03/11/science/coronavirus-curve-mitigation-infection.html>

Accessed on: 15/3/2020

Figure (4). The Influence of the Sustainable Traceability Framework on optimising the Healthcare Facilities

5.5. Limitations of This Research

This paper avoided tackling the legal and the ethical issues regarding violation of privacy rights or breaching of confidential information that any sustainable traceability program would lead to. Also, the psychological part of the tracing for an individual was not covered, as the author believed it is beyond the scope of this paper.

Future research is recommended for the sustainable traceability of the new uprising jobs; as the delivery workers, for example, as supply chain changes. Also, specific work needs to be developed for tracing passengers that would start to increase again after the epidemic of the COVID-19 is gone, i.e. when it returns to be a pandemic. It is worth to mention that further research is needed in the area of risks that might come from infected items and processes rather than people only, which this paper did not cover.

5.6. Final Words

During crises like the coronavirus COVID-19 epidemic, we have to have different traceability approaches so that we can quote, recover and maintain links of the infected or their contacts. This paper shows how the world needs to develop further its traceability capacity and specifically from the continuous availability to any potential risk from both local and international sources.

The lessons from COVID-19 epidemic showed that it needs a mindset of progression, not perfection. This means we need to take continuous preparedness against the invisible enemy is more serious than being enemy for each other. i.e. We need to invest in readiness programs, including not limited to apps designs and risk mitigation implementation processes that would ensure we have the capacity of codifying, triaging, classifying and stratifying the infected or the potential threat from contacts. Buheji and Buhiji (2020).

Similar to the Covid-19 epidemic, the future foresight carries more challenging types of threats the world more inspiring and creative minds that put efforts and look for a good solution to go beyond tracking a spread of potential harm. Once we have the buy-in of these minds, to establish similar default systems like the proposed sustainable traceability program, we would not see any more the extent of risks and panic we are experiencing at the moment. We humans live with hope and hope needs determination and dedication for continuous improvement of today and the future.

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