Review Article

COVID-19 at the Community Level: What are the Countermeasures?

Damilola Ayowole[1], Vivian Ogbonna[2], Abimbola Amoo[3], Tosin Babarinde[4], Jacob Nwafor[5], Ugo Enebeli[2], Aliyu Sokomba[6], Oladimeji Adebayo[7], Olayinka Stephen Ilesanmi[8]

[1]Department of Medicine, Federal Medical Centre, Owo, [2]Department of Community Medicine, University of Port-Harcourt Teaching Hospital, Port-Harcourt, [3]Department of Medical Microbiology and Parasitology, University College Hospital, Ibadan, [4]Department of Oral Maxillofacial Surgery, University College Hospital, Ibadan, [5]Department of Staff Medical Services, University College Hospital, Ibadan, [6]Department of Community Medicine, Ahmadu Bello University Teaching Hospital, Zaria, [7]Department of Medicine, University College Hospital, Ibadan, Nigeria, [8]Department of Community Medicine, University of Ibadan/University College Hospital, Ibadan

Abstract

Although several efforts have been implemented to prevent and control the coronavirus disease 2019 (COVID-19) pandemic at the population level, varying outcomes have been reported in several quarters, despite the implementation of socio-behavioral methods commonly at the population level to stop the human-to-human transmission. We did a narrative review of relevant articles of identified countermeasures at the population level, for curbing the COVID-19 pandemic. The key findings were evidence measures such as physical distancing, quarantine, isolation, screening, active case detection, and risk communication if properly implemented. Other countermeasures identified were air disinfection and lockdown restrictions. Air disinfection has a potentially harmful effect on humans, while lockdown restrictions have been counterproductive in many settings. In conclusion, many of these public health measures are with peculiarities and needs to be contextualized to be effective in curbing the pandemic. Further research and regular assessments are needed on the countermeasures.

Keywords: Coronavirus disease 2019, pandemic, prevention, severe acute respiratory syndrome coronavirus 2

Introduction

Coronavirus Disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that emerged from Wuhan, China, on December 12, 2019; and rapidly became a public health emergency of international concern.[1-3] It is the third most highly pathogenic disease caused by a coronavirus strain in humans after the SARS and Middle East Respiratory Syndrome (MERS) coronaviruses, that have emerged in the past 20 years with attendant implications on global health, world economy and trade.[1,4,5]

The mode of transmission suggested animal-to-human as linked to the Wuhan seafood and live animal market.[6] Person-to-person transmission has since been implicated in its spread. With the person-to-person transmission, cross-border travels, workforce migration, and tourism have been shown to fuel the spread of this COVID-19. As of April 24, 2020, affected countries have 2.5 million confirmed cases; and many have local transmission within their borders. Similarly, seven countries have cases in excess of 100,000 infected persons.[7]

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In Nigeria, the transmission started with the first case, which was imported on February 28, 2020, and has cascaded into community transmission.[8]

The basic reproduction number R_0 of the causative organism, which is the transmissibility capacity, is around 3.28, which means about three persons will be infected from an index case.[3,9] This indicates its potential for sustained human-to-human transmission.[10] From the epi-centre in China, it currently affects more than 200 countries, territories, or areas. In February of 2020, less than 30 countries were affected. As at May 31, 2020, about 213 countries across the world have been affected, Nigeria inclusive with 9855 cases.[7] The key drivers of this rapid

Address for correspondence: Dr. Oladimeji Adebayo, University College Hospital, Ibadan, Nigeria. E-mail: doctorladi@yahoo.com

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spread are the transmissibility of the causative organism, increasing international travels, and the effectiveness of the control measures instituted.[2,11]

While the world searches for an effective vaccine and drug therapy, it appears the only means of intervention are the nonpharmaceutical interventions, which are essential socio-behavioral methods commonly implemented at the population level to stop the human-to-human transmission in addition to symptomatic management of cases.[12] While a key element of such intervention include border restrictions of travels and trades, closure of schools and workplaces, and stay at home orders. As the upward trend of COVID-19 pandemic became noticeable in China, travel restriction measures were put in place in a bid to reduce transmission; however, about two-thirds of all cases exported from China remain undetected and have found their way into neighboring countries.[11] It is, therefore, imperative that the measures identified are properly implemented across countries and territories for effective control of this burgeoning pandemic. As to date, a cure is not yet available, effective vaccine not yet ready, community spread is increasing in a very high proportion with an increase in the number of deaths.

The SARS was contained by prompt isolation of patients, syndromic surveillance, stringent enforcement of quarantine of all contacts, and in some areas, top-down enforcement of community quarantine even without effective therapy.[13] However, COVID-19 differs from SARS in terms of the longer infectious period, higher transmissibility, worse clinical severity, and broader community spread.[13] In 2003, the catch- and-isolate policy did curtail the outbreaks of SARS; but the tendency of this same approach to successfully curtail the community spread of COVID-19, which has already become a pandemic, need to be explored.[5,14] While this isolation and containment policy approach is being put to use in some countries, a number of these countries are being quarantined, with their boundaries and borders closed at gunpoint.[7]

Notwithstanding, the disease does not have a cure, vaccine not ready, community spread continues in very high proportion, and increasing mortality. This article narratively reviews relevant articles from Google Scholar and PubMed/Medline demonstrating evidence of strategies at the population level, aimed at curbing the COVID-19 pandemic.

Measures to Mitigate Coronavirus Disease 2019 Pandemic at Population Level

Many of such measures are traditional public health measures, although with peculiarities to match the current pandemic.

Physical Distancing/Social Distancing

Physical distancing is a concept of intervention at the broader community level to prevent the spread of the virus to uninfected individuals where infected persons are not yet identified and isolated. It is the geographical distance measured from one person to another and is the preferred phrase as people ought to still remain connected to improve mental well-being.[15] Social distance has previously been widely used instead of physical distancing.

COVID-19 is spread mainly among people who are in close distance within 1–2 m for a longer duration of >15 min. The transmission of the virus occurs when an infected person sneezes, talks or coughs, and droplets from their nose or mouth are launched into the atmosphere, and land in the mouths, nose of people close by as well as on fomites and surfaces.[16,17] The droplets from an infected person can also be inhaled through the nose and mouth into the lungs of another person.[16,17]

Moreover, there is the possibility of contacting COVID-19 by touching the surface of an object that has the viral particle and then touching the individual's own eyes, nose, or mouth. The COVID-19 virus can survive for hours or days on the surface of an object, depending on some factors such as regular washing or cleaning of the surfaces with disinfectant, humidity, and sunlight.[12]

This highlights the principle of physical distancing, which means keeping some space between a person and another person outside the household.[16] The measures include: (1) Staying at least 1.5–2 m (5–6 feet) from one another; (2) Avoiding mass gatherings in private or public places of more than 2–3 persons; (3) Staying away from crowded areas such as markets or religious gatherings; (4) Imposing regulations in terms of entrances and number of people present per square meter; (5) Maintaining the required distance between humans/occupants in indoor spaces comprising offices, meeting places and commercial spaces.[16] These measures are premised on evidence that COVID-19 is spread mainly among people who are in close distance within about 2 m for a longer duration. The transmission of the virus occurs when an infected patient sneezes, talks or coughs, and droplets from their nose or mouth are launched into the atmosphere, and land in the mouths, nose of people close by, as well as on fomites and surfaces.[16,17]

This is one of the preventive measures to avoid being exposed to the virus spread at the population level. This is a measure of preventing the spread of the virus by limiting close contact with anyone living outside an individual's household. Since infected asymptomatic or symptomatic patients can transmit the virus even before the diagnosis of COVID-19, it is, therefore, important to maintain the physical distance from others, especially people who are at risk of developing severe illness.[1]

Physical distancing policy was implemented in China and some other countries and was shown to limit the spread of COVID-19; however, physical distancing is poorly practiced in the Nigerian context, and measures to improve on it is desired and should be the duty of all, and not just to be enforced by security agencies.

Quarantine

Quarantine is the separation and restriction of movement of

persons, usually the close contacts of infected persons during the incubation period, with the intention of preventing the spread of disease.[13] It is often used in connection to disease and illness, preventing the movement of those who may have been exposed to communicable diseases but do not have a confirmed medical diagnosis.[13,15] It is premised on the effective contact tracing of the contact of the infected person.[13] It holds a great promise as a tool for containment of COVID-19, having been one of the most effective tools for controlling communicable disease outbreaks, particularly if there are prompt contact tracing and strict compliance to the quarantine measures.[15]

The concept of quarantine has been known since biblical times and is known to have been practiced throughout history in various places with the first documented use of the word with regards to leprosy in Venice, Italy in 1127.[15,18,19] However, it was subsequently used widely in response to the Black Death.[15,18] Currently, extensive quarantine has been applied during the COVID-19 pandemic starting with China, which was on strict terms.[15,18,19]

The recommended duration of quarantine for COVID-19 based on available information is up to 14 days from the time of exposure.

As a preventive measure, it has a broad range of psychological, economic, and social impact on the population such as loneliness, loss of employment, income and livelihood as well as fear of death.

Risk Communication and Social Mobilization

This entails real-time exchange of information, advice, and opinion between experts to enable everyone at risk to take informed decisions to mitigate the effect of the threat. It is built on credibility, trust, technical information, values, and expression of care. It despairs fake news.

There is a need to provide key information to the population. This aims to limit the risk of spreading the virus by direct or indirect contamination of others. The recommended information, education and communication material comprise (i) washing of hands for at least 20 s; (ii) sneezing into the elbow; (iii) avoiding touching of surfaces; (iv) contactless payments (avoid exchanging money); (v) wearing personal protective equipment (PPEs) such as masks, eye and hand protections; (vi) household waste disposal instructions on preventing contact with contaminated infectious materials by waste collectors and waste processing operators; (vii) worker protection in places where physical distancing is not feasible (e.g., placement of protective glass in supermarkets between cashier and customer); (viii) precautionary and sickness driven quarantine (family vs. individual); and (ix) targeted symptomatic screening on arrival or entrance such as obligatory temperature check or (large scale) testing.

Active Case Detection

Active case detection refers to the intentional and systematic search for cases by health workers in the community; and is an effective elimination strategy for serious communicable diseases of public health importance.[20,21] Its effectiveness has been proven, and it is currently serving as the second phase of mitigation for the on-ongoing COVID-19 pandemic. As countries desperately try to control the spread of the virus by testing suspected cases for the COVID-19 virus, there is still the possibility of missing a lot of cases. Asymptomatic infection occurs in about 80% of cases, with another 10% showing mild to moderate symptoms whom may resort to self-medication and may never come in direct contact with the health system.[22] Although asymptomatic, they still possess the ability to transmit the virus to other susceptible individuals.[23]

Another hidden population are those being managed for other similar (influenza-like illness, fever, etc.,) or dissimilar symptoms in hospitals and primary care. Therefore, a key aspect in the control of new cases is to actively seek out cases in the community. A protocol that seeks out and tests patients being managed or admitted for influenza-like illnesses in hospitals, or who develop symptoms of Acute Respiratory Infection while being managed for other illnesses, will identify more cases for appropriate mitigating measures like isolation to prevent further transmission. In Singapore, from January 31, 2020, the government started testing every patient both in primary care and in hospitals being managed for severe pneumonia for SARS-CoV-2 infection using a real-time polymerase chain reaction (RT-PCR) or serological diagnosis.[24,25] This was part of an on-going surveillance method to identify cases of COVID-19. Serological tests which identify the antibodies against SARS-CoV-2 are important as they can identify cases that have recovered and are no longer actively shedding the virus. This will enhance a comprehensive contact tracing which may have otherwise been missed with the use of only RT-PCR, which targets the viral RNA particles.

The Joint WHO-China survey on the COVID-19 pandemic reported a 0.47% peak incidence of positive test results conducted among patients in fever clinics in Guangdong as of January 30, which was 3 days after the peak of the epidemic curve (January 23–27, 2020). This rate declined to 0.12%, with an overall incidence rate of 0.14 out of the 32,000 patients screened in fever clinics in Guangdong.[21] These results show that active case search will yield most of its results during the active phase of an epidemic when there is established community transmission. If delayed, it may prolong the flattening of the epidemic curve as hidden cases may go undetected, thus sustaining transmission in the community. Nigeria's case detection rate is low due to logistics of testing.

Community active case-detection targets high-risk communities or hot spots for COVID-19. Usually, an initial triage is done using questionnaires to sieve out high-risk suspects for testing. This measure has been observed to escalate the rate of increase in the number of confirmed cases in countries where they have been adopted. The observed benefit of active case search is that it

identifies all potential sources of continuing community spread, in order to effectively halt the transmission of the COVID-19 virus.

Isolation

Isolation is defined as the separation of confirmed cases of an infectious disease from healthy individuals for the purpose of controlling the spread of the disease often until the individual is free of the infection and no longer communicable. It has been employed successfully in previous outbreaks, including SARS and MERS.[25] As a public health measure, its scientific basis is the prevention of any form of contact between active cases and susceptible population. When carried out in health-care settings, separate isolation wards are set up and maintained; usually, adequate ventilation with strict Infection Prevention Control protocols are adhered to. Isolation rooms may also be equipped with negative pressure to prevent aerosol particles from lingering in the air and causing infection.[13,15] As a standard public health intervention and working at the secondary level of prevention, it is currently being used in the control of the on-going SARS-CoV-2 pandemic ravaging the world.[15,26]

Lessons learnt from the previous pandemic of SARS has shown that for isolation to be effective, it has to be instituted early in the pathogenesis of the disease before peak viral shedding.[26] That is to say that early case detection is paramount for effective control by isolation. In the case of COVID-19 as opposed to SARS, the peak viral shedding usually occurs before the onset of symptoms with asymptomatic cases contributing significantly to the transmission of the virus.[24] Active surveillance will help in detecting cases early on, especially asymptomatic ones; and is pivotal for isolation efforts to succeed. Challenges impeding the effective use of isolation of COVID-19 cases in the containment of the pandemic include the short incubation period of COVID-19 (1–14 days) with a median incubation time of 5.3 days; the large proportion of asymptomatic cases; and the high rate of transmission.[22]

A modeling study in Singapore that used an influenza epidemic simulation model estimated that there was a reduced likelihood of human-to-human transmission of SARS-CoV-2 infection with effective isolation of infected cases and their family members.[26] They estimated a 94.8% reduction in the cumulative number of cases of SARS-CoV-2 by day 80 if isolation measures are instituted.[26] This controlling effect was further enhanced by the inclusion of additional public health measures such as school closure and workplace distancing.

The successful eradication of SARS in 2004 was based on the widespread use of public health containment measures to completely prevent human-to-human transmission of the virus.[27] These public health interventions, which included isolation of cases as a key component, is vital in the current control strategies of COVID-19 for successful eradication of an unrelenting virus that is currently ravaging the world.

Self-isolation

For people that are asymptomatic or with mild symptoms of COVID-19, hospitalization may not be necessary, and self-isolation or isolation-at-home may be recommended. Self-isolation refers to staying in a dedicated place set aside for this purpose, at home alone or staying in a single adequately ventilated room of a house setting with other persons. Preferably, the individual in self-isolation should use a separate toilet facility. Self-isolation can also be advised for close contacts of confirmed cases of COVID-19 while they await a diagnostic test or onset of symptoms. Returning travelers from countries or cities with a high number of COVID-19 cases are also expected to self-isolate at home; sometimes this is enforced in a government-controlled isolation center. The duration, which is usually for 14 days, is the documented maximum incubation period for COVID-19.[22] Self-isolation helps to avoid overwhelming the health system at a time when there are limited supplies of bed space, PPE, and health personnel to tackle the ever-increasing demands of the pandemic.

Rules to be observed when self-isolating include: Restriction of visitors; use of face masks when in a room with other people to protect them; no contact except with care givers; and proper hand hygiene. The principle behind self-isolation is the same as with isolation and should be observed with all the seriousness it deserves. However, its drawback, when conducted in a house setting, is that it is dependent on the will-power, strength of character, and behavior of the individuals in self-isolation. Effective risk communication should be given to the individual in self-isolation and the members of their household. It is important to educate them about the reasons for imposing this form of restriction and the consequences of any deviation from instructions to not only to themselves but to those close to them. Their contacts, especially if elderly and with other comorbidities, may be at risk of developing more severe symptoms of COVID-19.

People in self-isolation are advised to contact the health service if they start having symptoms for those who were previously asymptomatic, or when the individual with initially mild symptoms experiences worsening of symptoms. Signs of worsening of symptoms may include breathing difficulty or shortness of breath and extreme weakness. Despite the public health benefits of self-isolation, health authorities must also recognize the risk of increased domestic frictions, depression, and mental health changes and exacerbation of chronic psychiatric disorders in people under home-isolation.[28] There is, therefore, the need for an appropriate support system which must be rendered to individuals under self-isolation to avoid these often silent effects.

Lockdown

Lockdown, also known as "Cordon Sanitaire," refers to the restriction of movement in an area, and frequently include the shutdown of transportation with national or sub-national

border closures.[15,18] The objective of lockdown is to reduce or shut down the inter-mixing of unidentified infected persons with noninfected members of the public; additionally, during lockdowns, public areas can be disinfected and hospitals can prepare to handle the pandemic situation.[29] Lockdown in the context of community-wide containment is usually used when isolation and quarantine are deemed insufficient; however, it is has been recommended that such a restrictive intervention be limited to the actual level of risk in the community.

About a third of the world is under lockdown as a public health measure to curb the spread of the novel coronavirus.[30] China first and later Italy went into full lockdown due to the rapid spread of the COVID-19 virus.[31] Before the January implementation of full lockdown in the COVID-19 epicentre of Wuhan China, about 5 million persons had already left the city, and many of them were infected: This contributed to the further spread of the virus.[15] The international spread was evident later in February and by early March 2020, Italy announced its full lockdown.[32,33] Subsequently, many developed and developing countries including Nigeria also adopted lockdown measures; the government imposed and enforced its lockdown in Abuja, Lagos and Ogun states on the March 30, 2020, other States follow suit, but in more recent times, States in Nigeria are preparing to ease strict lockdown (stay-at-home) restrictions.

There are inherent challenges with the lockdown. Nevertheless, despite the reported ethical, psychological, social, and economic[33] challenges of lockdown, it has had a positive impact on the environment with improvements in air quality and drop in water pollutions in some parts of the world.[34,35] The drive for the use of this restrictive public health measure for COVID-19, however, is not for environmental gains. However derives mainly from the success achieved with SARS, which was caused by a similar coronavirus.[15] However, the argument remains that unless there are complete clarifications the pathogenicity of the SARS-CoV-2, the effectiveness of restrictive measures on its eradication (as happened with SARS-CoV-1) remains undetermined. What is clear at this time is that lockdowns reduce the exportation of cases and delay importation of cases, thus buying time to coordinate appropriate public health response to COVID-19.[36] Lock downs, unfortunately, respectively have generated some civil unrest and reduced compliance with infection prevention and control advice in some communities, and sometimes degenerated into societal violence especially when the basic needs of members of such societies are not adequately catered for through the provision of relief material to cushion the financial and economic implications promoted by the lockdown and movement restriction.

Mass Screening

Mass screening is the screening of a whole population or a sub-group and is offered to all irrespective of the individual risk of contracting the disease.[37] The basic objective of mass screening is to sort out persons likely to have a disease or at increased risk, from a population of apparently healthy persons, for supervision and treatment.[37]

The COVID-19 pandemic has placed mass screening as a ubiquitous tool in the global response to control its spread.[32] Manual thermal screening for fever, one of the symptoms of COVID-19, is being used at many points, including airports, train terminals, and supermarkets for mass screening.[38] In addition, newer technologies, including thermal image scanning and the use of microwave radar, may enhance mass screening.[39] Korea has gone further in its mass screening efforts to establish drive-through screening centers, wherein the "testees" are screened in the comfort of their cars.[40]

The fundamental limitation of mass screening is that many infected people are undetectable at the time of screening; these are people who are neither aware of their exposure status, nor have any symptom of the disease (e.g., fever or cough). Furthermore, variations in the symptoms and detectability, the imperfect performance of screening equipment and personnel, and even active evasion by the public are further challenges to mass screenings. Thus, it is estimated that mass screening will miss about half of infected people, even under the best-case assumptions.[32,38]

Since respiratory viruses like SARS-CoV-2 are difficult to detect by mass screening programs, it is recommended that mass screening should always be accompanied by other public health interventions for effective control of the novel coronavirus.[32]

Contact Tracing

Contact tracing is the identification of known contacts of an infectious positive case or person (contact), who are themselves at high risk of contracting the infection.[41] Contact tracing is a key measure of controlling or reducing the spread of disease.[42] A contact is a person who has interacted with a positive case or a person who has an infectious disease. A contact that has been exposed to the infectious agent might become sick or may spread the disease to others without any signs of the disease. The contact might have been exposed to an index case (originally infected person) while the index case was infectious; also one index case might have many contacts.

The contacts reduce the spreading of infection by isolating themselves, practicing hygiene measures. Public health authorities and organizations may carry-out contact tracing, with the aim of monitoring the disease impact on the community by adopting legal guidelines.[43] Contact tracing should commence if someone in a community or organization has a suspected, probable or confirmed case of COVID-19 infection by (1) Collecting information from the index case through phone calls; (2) Recording the infected person's contacts using Index Case Information Sheet; and (3) Communicating with people who may be in the contacts of the index case to gather information.[41]

Furthermore, it is also important to consider all routes of contracting the infection. The index case may have spread the disease to the contact; or the contact may have acquired the disease from the index case; also both the index and contact may have got the disease from the same source or independently of one another. Furthermore if the contact is sick and their disease is confirmed, then the contact becomes a case, whose contacts must then be traced.[43] An index case must be encouraged to perform their own contact tracing outside of their organization, notifying the general public, friends, and relatives of the possible exposure. Contacts may not need to observe 14-day isolation from the work period without providing medical investigation data to the local public health authorities.[6]

Community Wide Containment/Community Quarantine

Community quarantine also called community containment, is a national strategy designed to prevent the spread of COVID-19 infection by isolating the entire communities with a high number of confirmed cases of infection. This measure has been used in response to the Ebola outbreak in Liberia, Sierra Leon, and Guinea in 2014–2016; and also serves as an appropriate measure adopted by China, Spain, and Italy in the current COVID-19 pandemic.[15,18]

This strategy is proposed as a suppression measure to reduce the load on the health facilities and delay the spread of the virus in the community.[22] The community under quarantine is confined to areas where the virus is present and is being spread, and does not guarantee the stop of the spread of the virus within the community, neither does it prevent the already infected people from the COVID-19 disease nor prevent the spread of infection to more communities or other parts of the country.[19]

The decision to introduce community quarantine is based on real-time epidemiologic evidence within the community and outside the quarantined community, and it is determined by the national authorities in collaboration with the microbiologists, epidemiologists, and public health experts.[44] Furthermore, it will be important to consider the rate of disease spread, the geographical pattern, and social-economic impact on the community as these logistical implications are used in projecting the duration of quarantine based on the incubation period of the viral agent, which is currently estimated to be about 14 days.[45]

The community under quarantine also includes people of different social, cultural, and religious backgrounds, and these characteristics need to take into consideration when managing and planning quarantine.[46]

Air Disinfection

The COVID-19 virus is spread by respiratory droplets and contacts, which necessitated air disinfection in China.[47] Such practice of air disinfection of cities and communities, although widespread, has not been proven as an effective method for COVID-19 disease control and hence needs to be stopped or further researched, particularly as large quantities of alcohol and disinfectant are potentially harmful to humans.[47]

In conclusion, this paper reviewed COVID-19 at the population level and what the countermeasures are. COVID-19 is an emerging infectious disease of public health concern, efforts to control it requires evidence-based multi-pronged approach.

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