

Voluntary collective isolation as a best response to COVID-19 for indigenous populations? A case study and protocol from the Bolivian Amazon



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Indigenous communities worldwide share common features that make them especially vulnerable to the complications of and mortality from COVID-19. They also possess resilient attributes that can be leveraged to promote prevention efforts. How can indigenous communities best mitigate potential devastating effects of COVID-19? In Bolivia, where nearly half of all citizens claim indigenous origins, no specific guidelines have been outlined for indigenous communities inhabiting native communal territories. In this Public Health article, we describe collaborative efforts, as anthropologists, physicians, tribal leaders, and local officials, to develop and implement a multiphase COVID-19 prevention and containment plan focused on voluntary collective isolation and contact-tracing among Tsimane forager-horticulturalists in the Bolivian Amazon. Phase 1 involves education, outreach, and preparation, and phase 2 focuses on containment, patient management, and quarantine. Features of this plan might be exported and adapted to local circumstances elsewhere to prevent widespread mortality in indigenous communities.

Introduction

The world's 370 million indigenous people living in over 90 countries make up around 5% of the global population.¹ Their lifeways, language, and culture have long been threatened by the many facets of colonialism and globalisation, and their livelihoods and lives are now again at stake amid the COVID-19 pandemic. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused COVID-19 in more than 200 countries and territories, with the number of confirmed cases and deaths highest in the USA and Europe.² Indigenous communities worldwide share common characteristics that make them especially vulnerable to COVID-19. Indigenous populations have higher rates of extreme poverty, morbidity, and mortality than do their non-indigenous neighbours across the spectrum of low-income to high-income countries.³ These conditions place indigenous people at high risk of complications and death from COVID-19. Respiratory infections are already a major source of morbidity and mortality in many indigenous populations in low-income countries. As a stark indicator of what could potentially occur, the H1N1 influenza pandemic of 2009 resulted in 3–6 times higher mortality among indigenous people than among non-indigenous populations of the Americas and Pacific.⁴

As of May 7, 2020, Bolivia had 2081 confirmed COVID-19 cases and 102 deaths, largely confined to the Santa Cruz and La Paz provinces. The Bolivian Government's national response to COVID-19 began on March 12, 2020, and included border closure, suspension of interdepartmental and interprovince transport, and nationwide quarantine (Decreets 4196 and 4199). Testing has been restricted and focused primarily in urban centres. The Beni Department, Bolivia, home to over 18 indigenous populations, is mostly rural with its first confirmed case of COVID-19 reported on April 20, 2020. This lowland forest and savanna region

once bore witness to a large and sophisticated civilization and was identified as one of the five major centres for early plant domestication and the first to domesticate manioc and squash around 10 000 years ago.⁵ Despite the fact that almost half of Bolivians are considered to be of indigenous origin, no specific guidelines have been outlined for remote indigenous groups inhabiting native communal territories (Tierras Comunitarias de Origen).

In this article, we first highlight general aspects of indigenous populations relevant to the current COVID-19 pandemic, then review our specific experience in a collaborative effort to develop and implement a COVID-19 prevention plan among Bolivian forager-horticulturalists of the Beni Department.

Indigenous populations: vulnerabilities and resilience

Excess mortality from infectious disease has a long history among indigenous populations. Smallpox, measles, and other imported diseases eliminated up to 80% of native populations in the Americas following European contact.^{6,7} So far, COVID-19 has already heavily affected the Navajo nation in the USA, with more deaths in the Navajo nation than in the rest of New Mexico, USA, which has a population that is 13 times larger.⁸ At the same time, at least seven indigenous individuals in the Brazilian Amazon have tested positive⁹ and three have died, including a boy aged 15 years from the largest semi-isolated tribe in South America, the Yanomami. This case illustrates the potential for COVID-19 to affect remote communities. The boy, experiencing flu-like symptoms, travelled to the capital hospital of the distant Roraima state, Brazil, for medical attention; however, his diagnosis was delayed. Previous respiratory complications common among the Yanomami and other indigenous populations (eg, pulmonary tuberculosis or acute lower respiratory

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tract infections)¹⁰ can increase risk of death for patients with COVID-19. Teenagers in industrialised countries have otherwise exhibited minimal risk of death from COVID-19.¹¹

Indigenous populations have unique susceptibility to COVID-19 for several reasons. In addition to respiratory and other health conditions increasing the risk of COVID-19 mortality, indigenous communities often have minimal access to clean water, soap, personal protective equipment (PPE), and public sanitation.¹² Local medical services are underfunded for many urban indigenous communities and are scarce or non-existent for remote rural communities. Hospitals and clinics do not have capacity to meet the high demand for COVID-19 testing and treatment in the general population, let alone for indigenous communities located farther away¹³ who often experience stigma or discrimination. Long travel to regional hospitals or clinics entails additional risk of virus transmission on crowded public transportation or other commonly used travel routes. An inability to pay for medical services further hinders access when not covered under government insurance plans.

Local norms can also promote virus transmission. Collectivity is a core ethos pervading multiple aspects of daily life in many indigenous cultures, from extended family co-residence, communal labour and production, food sharing, and other group activities. This collectivity is key for long-term resilience but can hinder compliance with short-term physical distancing measures, compared with other populations with individualistic cultures and nucleated households.

Many indigenous groups in rural areas have developed important ties to markets and towns, especially where traditional subsistence livelihoods are vanishing. This market access, which is often provided by roads or navigable rivers, can be vital for food security, access to medicine, social security benefits, and other government-sponsored cash programmes, but it can also facilitate rapid viral transmission from densely populated regions. Additionally, as various industries and businesses employing indigenous communities shut down during the COVID-19 crisis, food insecurity has become a serious obstacle to maintaining livelihoods.¹⁴

Tribal elders (many of whom serve as tribal leaders) are at particularly high risk of COVID-19 fatality because of their age, particular comorbidities (eg, hypertension or diabetes), disability, and immunosenescence. Elders are vital for maintaining indigenous culture and language amid rapid globalisation, so their potential loss could result in cultural or linguistic extinction. These community members act as so-called walking libraries; language, ritual, and mythology specialists; role models and teachers; and caretakers in multigenerational households.

Furthermore, because indigenous people often inhabit protected territories rich in biodiversity and natural resources, intensive resource extraction (eg, logging or mining) poses threats to indigenous livelihoods and lives.

For example, illegal gold mining is believed to have been responsible for many Yanomami deaths related to infection in northern Brazil and Venezuela since the 1980s, including fatal measles and malaria infections as recently as 2019.^{15,16} Yanomami leaders now allege that their first COVID-19 fatality was due to exposure to infected gold miners.⁹ Illegal resource extraction might also be increasing during the pandemic because of decreased government surveillance and enforcement, resulting in even greater exploitation of indigenous territories and fatal clashes with indigenous communities than before the pandemic.¹³

Past tragic history and current vulnerability have heightened the fear of massive devastation from COVID-19 for indigenous communities around the world.^{13,14,17} Given the potential threats and obstacles, many indigenous communities have decided that the most viable option is to restrict or close their own borders, with action aimed largely at preventing viral transmission. Many groups have already restricted their borders on their own, especially people accustomed to lockdown during previous epidemics.¹⁴ For example, in response to COVID-19, Waswanipi Cree of central Quebec, Canada, sealed off community access to non-residents and require 14-day quarantine for any returning residents who left the community.¹⁷ Mapoon aborigines of Cape York Peninsula, Queensland, Australia, enacted more severe self-imposed travel restrictions, including the banning of all visitors and denial of return access to residents leaving temporarily.¹⁸ Hundreds of indigenous communities in Brazil, Peru, Colombia, and Ecuador have similarly blockaded their borders,¹⁹ including Shuar forager-horticulturalists of Ecuador.²⁰ Ecuador and Peru currently have the highest official per person infection rates of Latin America.²⁰ Other measures to isolate and protect the most vulnerable individuals are being actively proposed and discussed.²¹

Preventing pandemic spread in Beni Department, lowland Bolivia

The Tsimane of Bolivia are spread across over 100 villages, many of which are located along the Maniqui or Quiquibey rivers, or nearby interior forested regions. Their population size is around 16 000 individuals, with approximately 4% of individuals aged older than 60 years. Tsimane produce nearly all of their own food (>90% calories in the diet)²² and have no access to running water or sanitation. They have high infectious burden from diverse pathogens.²³⁻²⁵ Much morbidity and mortality is due to infections, particularly respiratory infections. Pulmonary tuberculosis remains widespread and bronchiectasis is very common. Tsimane life expectancy at birth was 43 years until the late 20th century.²⁶ Since the 1970s, roads have increased access of some communities to towns, and increased availability of motorised water and land transport in the past decade has facilitated frequent travel to towns, particularly to San Borja

(population around 45 000). Medical facilities are limited for Tsimane, for whom a mission-sponsored clinic located on the outskirts of San Borja provides some care, a hospital in San Borja provides basic attention and routine surgeries by general practitioners, and rudimentary health outposts are dispersed throughout Tsimane territory. Medical attention from specialists requires transportation to larger cities, including Trinidad, the Beni capital (approximately 6–8 h by road from San Borja). Tsimane thus represent a population that is highly susceptible to COVID-19 with few options for treatment.

The Tsimane Health and Life History Project (THLHP) has been working with Tsimane communities since 2002, studying health and ageing while providing primary health care and biomedical surveillance.^{27,28} We provide an overview of our experience working with the Tsimane Government and communities, and with local health and governmental officials in the San Borja municipality to help prevent SARS-CoV-2 from reaching Tsimane communities.

In general, our approach in developing a COVID-19 strategy is based on two principles. The first is that preventative measures before mass infection can greatly reduce the burden of morbidity and mortality. The second principle is that any effective plan must be a collaborative effort among all stakeholders and should involve the indigenous populations in the decision process. We divide the plan into two phases: phase 1, in which SARS-CoV-2 was spreading rapidly in Bolivia but before there were confirmed cases in the Beni Department; and phase 2, the current situation, as the pandemic spreads to the region in which the Tsimane live (table).

Phase 1: awareness and prevention

Coordination with tribal leadership representing indigenous populations

The Tsimane population has two governing councils, the Gran Consejo Tsimane and the Consejo Regional de Tsimane y Mosenen. Long standing formal agreements and goodwill between the THLHP and these governing councils to conduct research and provide primary health care to Tsimane villages help to establish trust and facilitate mutual collaboration to plan and execute the prevention response (appendix 4 pp 3–4).

Information provisioning

Our team includes ten Tsimane, all bilingual in Tsimane and Spanish languages. The first step was to educate our team and the health secretary for the Gran Consejo about SARS-CoV-2 (eg, its origin, transmission, symptoms), and the obstacles to obtaining effective treatment. Three THLHP physicians and project directors worked with Tsimane team members to translate and adapt US Centers for Disease Control informational posters into the Tsimane language.²⁹ Given that there are currently no known or suspected cases in the Tsimane population and that transportation was restricted by the Bolivian Government, the team along with

Gran Consejo members (all asymptomatic for any COVID-19 or flu-like symptoms for at least 2 weeks) travelled by motorcycle to around 60 villages to hold community meetings, starting March 25, 2020 (appendix 4 p 2). Such meetings had two goals; to inform community members about COVID-19 and to stimulate discussion of potential preventative responses (appendix 4 pp 5–6). Presentations included information about how SARS-CoV-2 is spreading worldwide, the incubation period and risks of contagion, the often asymptomatic nature of the virus, unique vulnerabilities of older people (aged >60 years) and individuals with other health conditions, the lack of a vaccine and available treatments, and the role of quarantine in preventing virus transmission. The challenges of particular traditional practices, such as communal sharing of a fermented manioc beer (locally known as *shocdye'*) was also discussed. There was also discussion of how SARS-CoV-2 might spread throughout the Tsimane population by market interactions and other encounters with outsiders.

Collective decision making

Like most other indigenous populations, the Tsimane have experience with local epidemics of communicable diseases.²⁶ Tsimane in all visited villages were quick to recognise disease risks and their own unique vulnerabilities. Historically, the traditional Tsimane response to epidemics was to flee and isolate deep in their territories and away from outsiders. As observed in a growing number of indigenous populations,^{17–19} the Tsimane population-wide consensus is that collective isolation is the most viable strategy for minimising COVID-19 exposure until vaccines or treatments become available.

Lively two-way discussions during community meetings focused on how to best accomplish collective isolation. One important element was preventing so-called *napo* (ie, non-Tsimane outsiders) from entering Tsimane territory and each village. Villages organised groups of volunteers to build and guard physical blockades against entry. Another important element was to regulate interactions of villagers with non-residents. Most meetings resulted in a village-level consensus that no one should leave the territory and go to an area with disease risk, unless there was an emergency. There was also an agreement regarding the need for a 14-day quarantine in several key entry points to the Tsimane territory for any villager who leaves and then returns to the village. The notion of quarantine was deemed similar to several traditional practices, such as the isolation and protection of post-partum mothers and their newborn infants. Much discussion focused on the need for also quarantining individuals presenting with symptoms and, in particular, the construction of huts out of local materials for quarantine living quarters. There was also much discussion about how to protect older community members, especially individuals with disabilities. In most communities, discussions concluded with a formal

See Online for appendix 4

	Implementation strategies	Local considerations
Phase 1		
Coordination of tribal leaders	Discussions about existing plans; assessing local awareness; requested assistance from non-tribal sources	Is there centralised tribal representation or a dispersed governing structure? Attitudes towards non-indigenous individuals? Relationships and trust with regional governments and health-related NGOs?
Education and awareness	Community meetings in native language; flyers; radio broadcasts; WhatsApp; social media	Communication modalities available; existing knowledge of COVID-19; understanding of disease transmission; language(s) spoken
Collective decision making	Community meetings; consideration of collective isolation; formation of committees to enforce decisions; documentation of collective decisions	Legal status of tribal territory and ability to collectively isolate; cultural practices about decision making; ability and use rights to produce own food
Coordination with regional government and public health authorities	Understanding of existing COVID-19 management strategies; needed assistance from non-tribal sources; communication and enforcement of community isolation decisions	Is there an existing containment plan? Is there a policy directed towards indigenous communities? Potential role of NGOs in plan and structure of decision process?
Purchase of and training in use of PPE	Understanding existing supply and shortages; sourcing supplies; sourcing funds for purchase; distribution to communities; instructional videos	Are there local or national stockpiles? Is PPE locally available? Are health-care workers trained in its use?
Medical care in territory for non-COVID-19 diseases to prevent exposure in hospital environment	Health posts; roving medical team; medicine support	Local medical infrastructure; availability of medication and diagnostic equipment; common morbidities and their symptom overlap with COVID-19
Transition between phase 1 and 2		
Isolation support	Safe supply chain of medication, tests, and basic necessities; blockades and enforcement	Territorial autonomy; subsistence autonomy vs need for markets; transportation and community access; supply chains in place?
Phase 2		
Case reporting to indigenous populations	Network of contacts within each village; social media groups; cell phone; amateur radio; financial support for communication	Availability of communication modalities; nature of interactions within and between communities
Case reporting to local authorities	Communication with local COVID-19 response team to investigate suspected cases	Local infrastructure for case investigation; existing human resources; trust between local population and authorities
Mapping of suspected and confirmed cases	Generate map of cases and affected households or communities; adjust containment plan to local hotspots	Availability of census and geographical information; fluidity of communication with local communities
Coordinate isolation responses	Radio, telephone, and in-person communication to isolate affected individuals or families from other families and to isolate unaffected communities from affected communities	All of the above considerations; geographical distribution of households and communities; obstacles for isolation at individual, family, and community levels
Testing and contact tracing	Investigate each case, how it entered community, and test all potentially affected individuals	Availability of test kits; human resources for case investigation; frequency of contacts among families and with outside world
Patient management	Isolation of patients who are less sick; periodic measurement of blood oxygen of symptomatic patients; high-flow oxygen support; prone patient positioning; antiviral and other treatments as they become available	All of the above considerations; changing best practices and availability of treatment modalities
NGOs=non-governmental organisations. PPE=personal protective equipment.		
Table: Implementation strategies and local considerations of essential elements for a COVID-19 prevention and containment plan		

meeting act that attendees either signed or fingerprinted, representing the collective agreements made during the meeting. Such acts constitute formal proof for government authorities about the collective decision making process.

Village meetings also resulted in requests by community members for assistance in accomplishing collective isolation. These requests included soap and salt to complement the foods that Tsimane produce locally; sufficient medicine for common ailments, so that Tsimane can avoid leaving their territory to seek medical attention; supplies for the quarantine quarters (eg, mosquito netting and eating utensils); and assistance with materials for making barriers (eg, locks and chains) to secure the physical barricades that were newly created to achieve village isolation. The decisions from these meetings formed the basis of the prevention plan for all villages.

Coordination with regional government and public health authorities

A critical element of phase 1 has been to coordinate with local police and military authorities enforcing the national

quarantine ordered by the government (eg, interprovincial travel ban), the local hospital and the COVID-19 response network, the governor of Beni, and Tsimane representatives in the National Assembly. This coordination enabled our team to receive government-approved permits to rapidly travel to Tsimane communities to hold meetings and to transport physicians, medicines, and PPE to the Tsimane territory from La Paz and Santa Cruz. The signed community meeting acts were shared with local authorities when seeking food assistance and enforcement of collective isolation.

The regional Beni Government has donated some food supplies directly to Tsimane villages. Our team is coordinating with the office of the Governor of Beni to augment their food distribution with our purchase of soap and salt for each village, as requested in community meetings. We are also equipping each village that constructs quarantine living quarters with mosquito netting and eating utensils, as requested by villagers, additionally with locks and chains where necessary.

Purchase of PPE for local distribution

As in much of the world, there is a shortage of PPE in Bolivia. We are currently purchasing N95 masks, goggles, and gloves to donate to the local San Borja hospital, health-care professionals, and THLHP personnel. Surgical masks and gloves will also be donated to each village as needed. Unavoidable shortages might require best practices for safe reuse of PPE. Training on appropriate use of PPE based on WHO guidelines will also be provided.

Provision of medical care for non-COVID-19 patients within Tsimane territory

One of the most pressing needs for accomplishing collective isolation is the provision of medical care for individuals with diseases other than COVID-19. Because of the nature of their environment and scarce public health infrastructure, the Tsimane are susceptible to a myriad of infectious diseases, including intestinal parasites, diarrhoeal diseases, and respiratory diseases. Such infections often require people to seek medical treatment at the San Borja hospital or to purchase medicines from San Borja pharmacies. To the extent possible, our goal is for most medical care to be provided at the five rural health posts supported by the government, with one attending primary care physician in a collaborative effort among team and government-paid physicians, so that villagers will not have to leave the territory and risk infection in town. We are also acquiring medicines in anticipation of phase 2, when travel to and from the territory will probably incur high risk of SARS-CoV-2 infection or be impossible because of inclement weather.

Summary of phase 1

Before engaging in phase 1, most Tsimane had little knowledge regarding COVID-19 risk. Now, they are actively involved in planning to prevent and contain its spread into their communities. We hope that these first steps will help prepare for the much more challenging phase 2.

Phase 2: COVID-19 containment and patient management

Phase 2 began when the first patients with COVID-19 were diagnosed and confirmed in the Beni region (April 20, 2020); although, at the time of writing, no cases have been confirmed in the San Borja municipality nearest to the Tsimane communities. Given the risk of spreading COVID-19 through travel, during phase 2 our main team has stopped visiting Tsimane villages. From our THLHP research station in San Borja, THLHP personnel will do contact-tracing in communities with suspected and confirmed COVID-19 cases using the Tsimane radio station (capable of reaching most Tsimane villages) and other modes of communication (eg, shortwave radio or cell phone). We will also establish two base stations within the Tsimane territory for treatment of medical problems other than COVID-19. Our team

will also continue to provide updated phase 1 information and help to coordinate local government and public health responses in Tsimane territory.

Case reporting to the Tsimane population

Through the Tsimane radio station, we will provide daily briefings and updates on confirmed and suspected COVID-19 cases in each village. We have begun by providing briefings about new cases and deaths within Bolivia. Once COVID-19 is detected in the Tsimane region, these briefings will become more detailed and include suggestions for strategic responses. In addition to the Tsimane radio station, our San Borja office will communicate with distant Tsimane communities by two-way radio and with nearby communities by cell phone.

Case reporting to local authorities

Tsimane will be able to use our office staff for reporting suspected cases in their villages. Team members who can speak Tsimane will be available to receive information about suspected cases from villages by telephone, radio, or word of mouth. Such cases, which may not be known to local health authorities given their remoteness, will be reported to the Bolivian COVID-19 response network authorities for investigation, possible testing, and treatment.

Link suspected and confirmed COVID-19 cases to geographic information system or census database

THLHP has collected household and global positioning data for most households in the 100 or so Tsimane communities. We will link reports on confirmed and suspected COVID-19 cases to this geographic information system database to track virus spread and potential centres of infection. This information will be used to coordinate isolation responses among affected and unaffected communities, while being careful not to stigmatise individuals or families affected by COVID-19; stigmatisation hampered Ebola efforts in sub-Saharan Africa^{30,31} and HIV treatment in the USA.³¹ To reduce stigmatisation of suspected or confirmed COVID-19 cases, we will emphasise inclusion and solidarity with COVID-19 cases in radio messages and other communications. This communication stresses that anyone is capable of being infected and that when an individual has recovered and been free of symptoms for 2 weeks, contagion risk is very low. Additionally, only with village unity can the community be best protected. Similar appeals by community leaders can reinforce and further legitimise these statements.

Coordinate isolation responses within affected and unaffected communities

Using geographic information system data and following up on suspected cases, we will use all communication modalities to help communities respond to spread of SARS-CoV-2. Suspicion or confirmation of COVID-19 cases in a community will trigger family-level and

individual-level physical distancing and quarantine, or isolation measures. Because many Tsimane families have distant horticultural gardens and can efficiently build rudimentary houses with forest materials, it is possible for each family to leave the village and self-isolate from other families. For families without suspected or confirmed cases, this self-isolation might be a preferred response to infections in or near residential clusters. During phase 1 meetings, we suggested that families prepare for such isolation, particularly if older members were present, and we addressed strategies for care and isolation of patients with COVID-19. We will support such families with detailed advice and provide culturally and linguistically specific print materials and radio communication on how to use PPE and successfully quarantine family members presenting symptoms.²⁹

For villages with no suspected or confirmed cases, it will be important to restrict visitation to and from other villages. Such villages will also be advised to prepare for family-level isolation in secondary houses.

Testing and contact-tracing

A system for local rapid-test of suspected COVID-19 cases represents a crucial tool in containment of viral spread. We are actively pursuing point-of-care molecular testing to help confirm diagnoses. In the context of collective isolation in which most villagers are not leaving their communities, contact-tracing and testing of household members is viable. A coordinated effort among our team and government health workers responsible for testing, adequate local biospecimen processing, our updated village census, and contact-tracers who speak Tsimane (located at both our base and within communities to avoid travel between town and communities), might be able to contain disease outbreaks before they spread to other villages. The development of this plan is still in process.

Patient management

Unlike many other infectious diseases, evidence-based treatment for SARS-CoV-2 is still under investigation worldwide. Effective supportive measures include supplemental oxygen, hydration, and the ability to intubate and mechanically ventilate, if needed. Use of antibacterial treatment might be needed for possible bacterial superinfection. With a 50–80% mortality rate for intubated patients in industrialised countries,³² intubation is likely to be futile in this setting without specialist support. The risks of hospitalisation include exposure to other patients with COVID-19 and potentially infected hospital personnel of an incoming Tsimane patient and accompanying relatives, who have the potential to bring the virus back to their communities on their return. At this time, for all but the most severely symptomatic patients, the disadvantages of being hospitalised to the patient and the community are likely to outweigh the benefits.

As the chief strategy for managing COVID-19 cases with inadequate oxygen saturation (assessed by available pulse oximeters), supplemental oxygen has the potential of being administered outside of the hospital at five health posts. 24 h oxygen delivery can be provided by a nasal cannula with oxygen reservoir, in conjunction with oxygen concentrators. This procedure would allow effective treatment, short of intubation, to be provided close to the patient's community in a much less congested space than would be the case in a hospital setting. For patients not requiring oxygen, individuals can isolate within their village. Conversations about treatment strategies will require direct involvement of community leaders and family members to reduce chances of patients refusing treatment. For any treatment refusals, isolation will be essential, combined with symptom relief with analgesics and hypoxia monitoring.

In the future, if effective COVID-19 treatments such as intravenous antiviral and immunomodulatory agents are found to be effective and are available, regional inpatient management might help to prevent disease progression and mitigate mortality.

Adapting prevention strategies to other indigenous populations

The risks, challenges, and options for strategic responses faced by indigenous communities share many features with those faced by populations throughout the world, because of characteristics of COVID-19 itself. However, there are some common circumstances among many indigenous, aboriginal, and tribal people that present different risks and opportunities.

With respect to risk, severely affected urban areas throughout the world are likely to exhaust medical supplies, laboratory facilities, and hospital beds, leaving few resources for indigenous populations. Similar issues for minorities and resource-limited communities have the potential to worsen health disparities.³³ At the same time, unique sources of resilience can be used to prevent widespread mortality in indigenous communities. The ability to produce subsistence foods daily is vital for collective isolation. Land and use rights by indigenous communities are, therefore, crucial to ensure reliance on subsistence-related activity. Tribal sovereignty recognised by the government is also an advantage for many indigenous populations. This sovereignty can facilitate making community decisions that can be enforced by government and tribal authorities, including restricting movement in and out of the territory. Cultural norms of strong family bonds and community meetings are a common venue for collective decision making. Furthermore, low population density facilitates both isolation and contact-tracing. These sources of resilience can be applied to the development of strategies for prevention and mitigation of COVID-19 mortality in indigenous populations.

The table provides a general framework for the essential elements, implementation strategies, and considerations of local context for prevention and containment plans in other indigenous populations. Ideally, phases 1 and 2 occur sequentially; however, they might need to be advanced simultaneously if COVID-19 is already present locally. Many other details will probably need to be adapted to local circumstances in other tribal settings. Assessing local knowledge and education about COVID-19 is fundamental. Another essential element is promoting and respecting active collective decision making by the communities themselves, involving all relevant stakeholders, such as community leaders and members, local government and public health authorities, and any other entities involved in managing the pandemic response. If communities decide to isolate collectively, economic, medical, and logistical support might be necessary to make isolation feasible. The acquisition and training in the use of PPE is another essential element, as is a plan for treatment of chronic or acute diseases other than COVID-19 to ensure that emergent cases are treated, while maintaining the isolation plan.

For phase 2, communication strategies should be in place to inform people about where cases have been suspected or confirmed, without creating stigma that might prevent individuals from seeking medical attention (appendix 4 pp 7–8).³¹ There should be strategies for preventing the spread of the virus to unaffected areas and families. Physical distancing can be applied on village, household, and individual levels as circumstances change and are adapted for specific rural and cultural contexts. Outside sources can aid with the provision of PPE to local health-care workers and to assist with the quarantine and isolation of patients. Testing and contact-tracing will greatly facilitate containment of cases, as reliable and portable tests become available. If oxygen support remains the most effective treatment, this procedure might be provided by innovative strategies at local health posts. Telemedicine support from incountry or distant specialists could be provided to assist regional health-care workers, especially as more is learned about potential therapies and best patient support practices as COVID-19 spreads globally. If intravenous therapies prove to be effective, such as antiviral drugs, immunomodulatory agents, or a combination of both, then opportunities for hospitalisation will become important.

Other aspects of phase 2 might also have to adapt to local conditions. The extent to which an indigenous population relies on goods purchased in markets might require changes in the isolation plan. One possible solution for market-reliant indigenous communities is to institute controlled markets near, yet outside, villages to avoid town visits or to prevent outside merchants from entering communities. This process is currently being implemented among the Moseten, a more acculturated indigenous group who are culturally and linguistically similar to the Tsimane. This solution

involves making arrangements with trusted merchants regarding the goods that villagers wish to sell and purchase, and about the controls to be put in place. On selected days, goods could be transported to designated areas with sellers and buyers maintaining physical distance and using PPE.

Conclusion: act now to prevent disaster

Our goal for this contribution is to promote general and adaptable strategies for mitigating the effects of the COVID-19 pandemic on indigenous populations. We surmise that there are many indigenous communities who have not benefitted from advanced preparation for this pandemic, and whose needs might be excluded from regional plans because of scarce resources and insufficient logistical and cultural support. We encourage wide and immediate discussion of mitigation strategies across multiple stakeholders. Websites, such as the UN's COVID-19 and indigenous peoples,³⁴ could act as a hub for relevant, up-to-date information on action plans around the world. The time to act is now, before COVID-19 creates devastation in indigenous populations.

Contributors

DER, JCA, RQG, MGC, RMM, and LMM were instrumental in organising and implementing the COVID-19 plan in the Tsimane territory. HSK and MDG conceived the idea of the paper. MDG, HSK, JS, BCT, DER, SA, TK, GST, and DEM drafted the paper. All authors contributed ideas and comments, revised the paper, and approved the final version.

Declaration of interests

All authors declare no competing interests.

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