A dangerous measles future looms beyond the COVID-19 pandemic

To the Editor — Children are the invisible victims of the COVID-19 pandemic. Although they have a low risk of severe COVID-19 disease and death, they are suffering disproportionate harm from non-pharmaceutical public-health measures, including deleterious educational effects of school closures, and decreased social care, school feeding programs and health-service attendance[1]. Of grave concern are the profoundly negative effects of the pandemic on childhood immunization coverage. All six World Health Organization Regions have reported disrupted immunization activities, with major adverse effects on routine immunization, mass vaccination campaigns (101 were cancelled in 56 countries during the first six months of the pandemic), outreach services and surveillance[2].

One deadly, highly infectious virus—measles—is unforgiving of immunity gaps and is certain to resurge after the COVID-19 pandemic, with a resultant catastrophic impact on young lives. The precarious measles immunity gaps resulting from suspended immunization activities and delayed campaigns are an ominous precursor to a measles resurgence. Increased malnutrition, due to effects of this pandemic on food supplies for impoverished children, and interruption of vitamin A supplementation during campaigns, may lead to increased measles-related deaths.

The recently published global report card on measles-elimination progress attempts to paint a positive picture, celebrating the increase in global first-dose measles vaccine coverage from 72% to 86% during 2000–2019; a concurrent increase in global second-dose measles vaccine coverage from 18% in 2000 to 71% in 2019; and the estimated 25.5 million deaths from measles averted during this time period due to this increased coverage[3].

A thorough data review, however, portends a grim future for measles. For the past decade, global first-dose measles-vaccine coverage stagnated at 85%, which has left nearly 20 million children in every annual birth cohort unprotected against measles. Second-dose coverage is inadequate to guarantee enduring immunity, and coverage is highly heterogeneous within and between countries. The inequitable risk of measles is perpetuated through immunization campaigns that regularly fail to reach children who have never received a vaccine against measles.

Measles virus is the most infectious virus on the planet. Its reproduction number of 12–18 (the average cases one case generates over the course of that case's infectious period in a susceptible population) far exceeds that of other emerging viruses, including SARS-CoV-2 (which has a reproduction number of 2.5–3.5)[4]. Given this incredible transmissibility and the annual accumulation of immunity gaps, the measles resurgence that commenced during 2017 and affected countries in every World Health Organization Region during 2018 and 2019 was predictable. This epidemic led to an appalling, preventable death toll (Table 1). Within just four years, there was an increase of 130% in estimated deaths attributed directly to measles. Those deaths do not capture delayed fatalities from subacute sclerosing panencephalitis due to persistent infection with measles virus, or deaths resulting from the array of viral and bacterial infections that exploit measles virus infection–induced 'immune amnesia'[5].

Table 1 | Estimated global annual measles deaths, 2016–2019

Year	Estimated total global measles deaths
2016	89,780
2017	109,638
2018	142,000
2019	207,500

Source: World Health Organization, as published in their annual 'Progress towards regional measles elimination' reports in the *Weekly Epidemiological Record*[1–10].

The COVID-19 pandemic distracted attention from the worst global measles pandemic of this century. The decreased measles case reporting in 2020 is falsely reassuring and was occasioned by a combination of immunity after the large-scale 2018–2019 outbreaks; COVID-19 pandemic–affected sub-optimal surveillance quality; decreased international travel; and a temporary reprieve that resulted from measures against COVID-19 that limited human contact. However, in reality, existing measles-immunity gaps remain, and the impact of COVID-19 on both routine immunization and campaigns cancelled in the countries at highest risk will provide the perfect conditions for a post-pandemic measles catastrophe, unless appropriate action is taken now.

Countries must prioritize 'catch-up' vaccination so that children who have missed out are not left vulnerable. Ensuring the confidence and safety of vaccinators demands appropriate infection-control measures, and these essential workers should be near the front of the COVID-19 vaccination queue. The rollout of vaccines against COVID-19 should include strategies to minimize further detrimental impacts on childhood immunization. Safety monitoring after approval of vaccines against COVID-19 must be robust, as loss of confidence in these vaccines could foment general vaccine hesitancy, with great harm to childhood immunization coverage.

All countries and global partners must prepare for expected measles outbreaks and apply 'prevention, preparedness, response and recovery' emergency-management principles[6]. When outbreaks occur, they should be investigated to elucidate and define immunity-gap demography for targeted strengthening of immunization services.

The COVID-19 pandemic offers a platform for accelerating progress toward the elimination of measles. New tools that have assisted in contact tracing could be repurposed to enhance measles surveillance, while novel vaccine-delivery innovations under development, including microarray patches, slow-release vaccine preparations and enhanced thermostability, could contribute to reaching every child with potent measles vaccines.

Despite the current all-consuming focus on the novel SARS-CoV-2 coronavirus, the ancient killer virus measles must not be neglected. The tragic avalanche of deaths from measles in 2018 and 2019 provides compelling evidence that the world cannot 'mark time' with measles. The COVID-19 pandemic has delivered a critical immunity-gap legacy, particularly in many vulnerable countries, which demands urgent action to reverse a pending measles catastrophe. ❐

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Competing interests

The authors declare no competing interests.

Check for updates

Time to evaluate COVID-19 contact-tracing apps

To the Editor—Digital contact tracing is a public-health intervention. Real-time monitoring and evaluation of the effectiveness of app-based contact tracing is key for improvement and public trust.

SARS-CoV-2 is likely to become endemic in many parts of the world, and there is still no certainty about how quickly vaccination will become available or how long its protection will last. For the foreseeable future, most countries will rely on a combination of various measures, including vaccination, social distancing, mask wearing and contact tracing.

Digital contact tracing via smartphone apps was established as a new public-health intervention in many countries in 2020. Most of these apps are now at a stage at which they need to be evaluated as public-health tools. We present here five key epidemiological and public-health requirements for COVID-19 contact-tracing apps and their evaluation.

1. Integration with local health policy. App notifications should be consistent with local health policies. The app should be integrated into access to testing, medical care and advice on isolation, and should work in conjunction with conventional contact tracing where available[1]. Apps should be interoperable across countries, as envisaged by the European Commission's eHealth Network.

2. High user uptake and adherence. Contact-tracing apps can reduce transmission at low levels of uptake, including for those without smartphones[2]. However, large numbers of users increase effectiveness[3,4]. An effective communication strategy that explains the apps' role and addresses privacy concerns is essential for increasing adoption[5]. Design, implementation and deployment should make the apps accessible to harder-to-reach communities. Adherence to quarantine should be encouraged and supported.

3. Quarantine infectious people as accurately as possible. The purpose of contact tracing is to quarantine as many potentially infectious people as possible, but to minimize the time spent in quarantine by uninfected people. To achieve optimal performance, apps' algorithms must be 'tunable', to adjust to the epidemic as it evolves[6].

4. Rapid notification. The time between the onset of symptoms in an index case and the quarantine of their contacts is of key importance in COVID-19 contact tracing[7,8]. Where a design feature introduces a delay, it needs to be outweighed by gains in, for example, specificity, uptake or adherence. If the delays exceed the period during which most contacts transmit the disease, the app will fail to reduce transmission.

5. Ability to evaluate effectiveness transparently. The public must be provided with evidence that notifications are based on the best available data. The tracing algorithm should therefore be transparent, auditable, under oversight and subject to review. Aggregated data (not linked to individual people) are essential for evaluation of and improvement in the performance of the app. Data on local uptake at a sufficiently coarse-grained spatial resolution are equally key. As apps in Europe do not 'geolocate' people, this additional information can be provided by the user or through surveys. Real-time monitoring should be performed whenever possible.

A proof-of-principle evaluation is available for the Swiss app[9]. More detailed analysis on the epidemiological effectiveness of contact-tracing apps is needed. For example, index cases seeking healthcare could be asked if they routinely use the app; if so, interviews with contacts identified by traditional tracing would allow assessment of the secondary attack rate among people who were notified. Surveys, epidemiological analyses[10] and experimental studies such as the Radar COVID pilot in Spain can offer further evaluation.

Digital contact tracing is a sustainable measure that can reduce levels of COVID-19 transmission. A rigorous assessment of its effectiveness allows public-health benefits to be weighed against unwanted effects for individual people and society. Stringent evaluation is needed to develop contact-tracing apps into an accepted and ethical tool for future outbreaks of other infectious diseases. ❐

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