International Journal of Infectious Diseases 83 (2019) 95–97

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Perspective

Is the global measles resurgence a "public health emergency of international concern"?

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ARTICLE INFO

Article history:
Received 16 April 2019

Corresponding Editor: Eskild Petersen, Aarhus, Denmark

The 2005 revision of the International Health Regulations (IHR) came into force on 15 June 2007 and is legally binding on 196 countries, including all the Member States of World Health Organization (WHO). In the IHR, a public health emergency of international concern (PHEIC) is defined as: "an extraordinary event that may constitute a public health risk to other countries through international spread of disease and may require an international coordinated response." (World Health Organization, 2005). The IHR requires that countries notify the WHO of any public health event that meets any two of the following four criteria: Is the public health impact of this event potentially serious?; Is this event unusual or unexpected?; Is there the potential for international spread?; or Is there the potential for travel and trade restrictions?

The purpose of declaring a PHEIC is to focus attention on those acute public health risks that have the potential to cross borders and threaten people worldwide, and "require coordinated mobilisation of extraordinary resources by the international community" for prevention and response. The decision to declare a PHEIC rests with the WHO Director-General.

To date four PHEICs have been declared; the: 2009 H1N1 influenza pandemic declaration; 2014 polio declaration; 2014 Ebola declaration with the outbreak in West Africa; and 2016 Zika virus declaration. The polio PHEIC declaration stands apart as poliovirus is certainly not a novel or emerging pathogen, but it sets an interesting and laudable precedent. The PHEIC issued on 5 May 2014 references the resurgence of polio after its near-eradication, deeming this an "extraordinary event and a public health risk to other States for which a coordinated international response is essential" (World Health Organization, 2014). This is the only PHEIC that remains in effect, five years after it was first declared.

How does the global measles situation measure up against the four PHEIC criteria considering the poliovirus precedent?

Firstly, *is the public health impact of this event potentially serious*? There was considerable fanfare following the release of the 2016 estimated global measles deaths. In a joint press statement, the United States CDC, GAVI, UNICEF and WHO, lauded the 84% decline in measles deaths from 550,000 in 2000 to 89,780 in 2016, the first time that there had been less than 100,000 measles deaths recorded globally in a particular year (World Health Organization, 2017). Tragically the 2017 figures are far less rosy, with 109,638 deaths reported due to measles (Dabbagh et al., 2018); almost 20,000 additional deaths over 2016, an increase of 22%! This upsurge in deaths is unrelenting. It suggests that current strategies are either ineffective or ineffectually implemented. This is an enormous *public health impact* and undoubtedly *serious*.

Secondly, *is this event unusual or unexpected*?

A global expert consultation in 2010 concluded that measles eradication was technically and programmatically feasible with existing tools and should be pursued (World Health Organization, 2011). At the World Health Assembly in 2012, 198 countries committed to achieving interruption of measles virus circulation in four World Health Organization (WHO) Regions by 2015 and in five Regions by 2020 (Global Vaccine Action Plan, 2012). There was encouraging progress with the Americas verified as having interrupted endemic measles transmission in 2016, and elimination verified in 37 (of 53) European, 7 (of 27) Western Pacific, and 4 (of 11) South East Asian countries by the end of 2018.

However, four Regions (the Americas, Europe, South East Asia and Eastern Mediterranean) experienced massive measles

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https://doi.org/10.1016/j.ijid.2019.04.016

outbreaks in 2017. The Americas was the only Region to have achieved measles elimination and was celebrating that accomplishment in 2016, the same year that measles deaths reached a nadir. However, the region lost that status in 2017 with re-established transmission in Venezuela and Brazil as well as measles outbreaks in many other countries throughout 2018. The Americas have led the world in being the first Region to achieve smallpox, polio and measles elimination. This failure to sustain measles elimination stands in stark contrast to the previous achievements, underlining the current crisis. In the European Region both Germany and Russia re-established measles transmission for more than 12 months after previously interrupting transmission for 24 months, and Europe experienced record numbers of measles cases with 72 deaths in 2018 (EURO, 2019).

The UNICEF announcement that global measles cases had increased by 48.1% between 2017 and 2018, with 98 countries reporting measles cases in 2018 compared to 2017 is profoundly alarming (UNICEF, 2019). Thus it is hard to argue that *this event* is not extraordinarily *unusual* and *unexpected.*

Thirdly, *is there the potential for international spread?* There is probably no better recent illustration of the ability of measles virus to rapidly spread globally than the 2014 outbreak in the Philippines. This outbreak saw the B3 measles genotype seeded into the vast majority of countries contributing to the Measles Nucleotide Surveillance (MeaNS) database. The 2019 Philippines B3 and Thailand D8 measles outbreaks are providing a startling déjà vu experience with all countries that have been verified to have eliminated measles in the Western Pacific Region currently being inundated with importations. Similarly, the outbreak in Venezuela that started in 2017 spread to surrounding countries, with the worst impact in Brazil where PAHO reported 10,334 confirmed cases and 12 deaths in a little over a year, including amongst vulnerable Indigenous communities (PAHO, 2019). Outbreaks have flared constantly since then, affecting 12 countries of the Americas in 2018.

Measles is uniquely transmissible. This is graphically illustrated by comparing measles' basis reproduction number (R_0), or the number of secondary cases on average resulting from the introduction of an infectious case into a fully susceptible population, with those of the specific infectious diseases previously declared as PHEICs. Although population density, birth rates and opportunities for transmission result in some variation between countries, the R_0 for measles is generally considered to be about 16 (Guerra et al., 2017). In comparison, polio has an R_0 of 6.0, H1N1 2009 of 1.3, Ebola of 1.5, and Zika virus of 2.1 (van den Driessche, 2017). Measles' phenomenal transmissibility coupled with the unbridled volume and speed of international travel, and the inadequately immunised status of many international travellers, guarantees not only a *potential* but a reality of vast *international measles spread* as currently being experienced.

Fourthly, *is there the potential for travel and trade restric*tions? It is hard to imagine that any government would impose travel or trade restrictions on the basis of current measles epidemiology, although there is clear recognition by some verified countries that international workers, business and recreational travellers, and economic migrants are a major source of virus importation (WPRO, 2018; EURO, 2018). There have even been suggestions recently by some countries that international travellers should provide proof of measles vaccination or proof of immunity as an entry or visa requirement.

A key characteristic of a PHEIC is the requirement for extraordinary resources. The cost of firefighting measles is extremely high when compared with the cost of prevention (Sundaram et al., 2019; Ramsay et al., 2019). Indeed by conventional economic metrics, it is not cost-effective to respond to measles outbreaks in the way that is recommended in elimination settings (Gastañaduy et al., 2018). However, this level of response is justified by the need to sustain elimination for the good of everyone, but relies on countries co-operating with each other and having the political support to make it happen. The situation in the Americas and Europe dramatically illustrates the result of a few countries dropping the ball – everyone suffers the colossal direct and opportunistic health costs, not to mention personal suffering, because other countries have gifted them measles outbreaks. The IHR is the best, and perhaps only, tool for dealing with this situation effectively, and the question arises, Why has measles not already been declared a PHEIC? What is constraining global public health leaders and why does measles command so little support from global donors, the United Nations and national governments when compared with other public health crises?

The public health urgency of the current global measles situation has been recognised by technical experts involved in all aspects of measles elimination. The stagnation of measles first dose coverage at approximately 85% for the past eight years is dismally less than the 95% homogeneous coverage of each birth cohort recommended by SAGE. Globally, 20.8 million infants did not receive measles vaccine through routine immunization services in 2017. The inadequacy of measles surveillance in many countries has further severely hampered progress towards elimination goals (SAGE, 2018). What we observe is the predictable result of the system we have created; interludes of relative tranquillity followed by massive measles outbreaks, often affecting older age groups than were historically impacted, which consume huge amounts of public health resources and undermine confidence in immunization.

In a recent call to action, the six chairpersons of Regional Verification Commissions for Measles and Rubella elimination discussed the compelling epidemiological, economic and ethical arguments for setting a global measles eradication goal and strongly advocated that it was urgent that exceptional coordinated efforts were made to ensure a world where no child dies of measles (Durrheim et al., 2019).

So is a PHEIC declaration justified in response to the global measles resurgence? Three of four diagnostic criteria appear satisfied and the current deteriorating situation is placing many young lives at grave risk. A PHEIC declaration could: reenergize the global community to urgently strengthen health systems to ensure that every child born is reached with two potent doses of measles-containing vaccine; rapidly stimulate communication innovation to effectively engage migrants and travellers on the risks of measles as well as the benefits and safety of immunisation; refocus weary donors on the incredible return that increased investment in measles immunisation and accelerated elimination achievement would deliver; and release emergency funding from the Pandemic Emergency Financing Facility of the World Bank Group (Gostin and Katz, 2016).

Should "extraordinary resources" be mobilised by the international community to respond to this public health risk that has the potential to cross borders and threaten people worldwide? If we follow the advice that Plato put in the mouth of Socrates, "we must go wherever the wind of the argument carries us." (Plato, 1974) Thus the answer must be "yes" – measles is a *de facto* PHEIC – it should be declared!.

Conflict of interest

No conflict of interest to declare.

Funding source

None.

Ethical approval

Approval was not required.

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