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Surveillance and response: Tools and approaches for the elimination stage of neglected tropical diseases

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ABSTRACT

The presentation of the World Health Organization (WHO)'s roadmap for neglected tropical diseases (NTDs) in January 2012 raised optimism that many NTDs can indeed be eliminated. To make this happen, the endemic, often low-income countries with still heavy NTD burdens must substantially strengthen their health systems. In particular, they need not only to apply validated, highly sensitive diagnostic tools and sustainable effective control approaches for treatment and transmission control, but also to participate in the development and use of surveillance–response schemes to ensure that progress made also is consolidated and sustained. Surveillance followed-up by public health actions consisting of response packages tailored to interruption of transmission in different settings will help to effectively achieve the disease control/elimination goals by 2020, as anticipated by the WHO roadmap. Risk-mapping geared at detection of transmission hotspots by means of geospatial and other dynamic approaches facilitates decision-making at the technical as well as the political level. Surveillance should thus be conceived and developed as an intervention approach and at the same time function as an early warning system for the potential re-emergence of endemic infections as well as for new, rapidly spread epidemics and pandemics.

1. Introduction

Disease control marks the result of deliberate efforts to reduce disease (e.g. incidence, prevalence, morbidity or mortality) to a level that is locally acceptable, while elimination refers to the interruption of transmission in a defined geographical area. The meaning of the latter term should not be mixed up with eradication, which describes the permanent, global cessation of a disease and its causative agent (Hopkins, 2013; Molyneux et al., 2004), something that has so far only been achieved for two diseases, namely human smallpox in 1980 (Fenner, 1982) and cattle plague (rinderpest) in 2011 (de Swart et al., 2012).

One might intuitively think that elimination should be straightforward as soon as a disease control programme has the "end game" in sight (Bockarie et al., 2013). However, despite effective control measures and the ongoing development of living conditions, including improved access to sanitation, clean water and treatment aimed to reduce the impact of diseases, rapidly rising populations and high mobility of people, together with the potential for a future warmer climate, may increase the risk of spreading infectious agents (McMichael, 2013). Indeed, escalating numbers of vectors/intermediate hosts would put transmission of vector-borne infections into high gear with vastly enhanced risks for human infection as a result. Thus, the need to sustain what has been achieved becomes increasingly important, and it is mandatory that surveillance and early warning systems (EWS) should not only be reliable but indeed infallible.

Endemic infections have been subjected to control activities for the better part of the last century, in particular targeting high-risk

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areas where essentially whole neighbourhoods are infected and where high-intensity disease contribute to major public health burdens. Naturally, the degree of success achieved by control has varied and even when substantial progress has been made, it has often been difficult to sustain. However, the time to move from control towards elimination has come and discussions are increasingly focused on how to reach sustained elimination of disease transmission (Knopp et al., 2013b; Rollinson et al., 2013). The current overall aim is the steady reduction of prevalence and heavy intensity infections of the major, mainly parasitic, endemic NTDs down to the level of elimination of these diseases as a public health problem and finally to achieve the interruption of transmission. The move towards elimination entails a major paradigm shift and activities must start early on to be successful as transmission must be tightly controlled for a considerable amount of time.

2. The London Declaration and the World Health Organization roadmap

The three decades without re-emergence of smallpox since the official declaration of its eradication by the World Health Organization (WHO) (Fenner, 1982) give hope to achieve sustained progress also with respect to the elimination goal for the NTDs. However, tangible progress towards elimination of disease transmission has so far – with the exception of polio (Lee et al., 2012) – only been achieved for one NTD, namely dracunculiasis (CDC, 2012; WHO, 2014). In this situation, the London Declaration (http://wellcometrust.wordpress.com/2012/01/31/neglected-tropical-diseases-the-london-declaration/) strikes a chord in showing that governments, non-governmental organisations (NGOs), philanthropy, international coalitions, private donor foundations and pharmaceutical companies can come together for the common good. A recent series of meetings culminated in the signing of a mutually binding declaration to combat the most common NTDs in the world based on the "WHO Roadmap for Accelerating Work to Overcome the Global Impact of the NTDs" approved in 2011 by its strategic and technical advisory group (STAG) for NTDs (http://www.who.int/neglected_diseases/NTD_RoadMap_2012_Fullversion.pdf). The commitment to control or eliminate as many as 17 NTDs by 2020 offers a charter towards a healthier life and a better future for the world's poorest communities. In addition, a growing number of countries has adopted malaria elimination as a goal in response to the global malaria elimination programme (Feachem et al., 2010; Najera et al., 2011; RBM, 2008; Roberts and Enserin, 2007). This and the continued, strong support by the Director-General of the WHO are reinforcing work towards local elimination of some major NTDs as well as contributing to directing the global eradication of others (Anderson et al., 2012; Lee et al., 2012).

3. Surveillance–response systems

Dedicated surveillance consists of a set of monitoring systems, each consisting of the continuing, systematic collection and analysis of data dedicated and adapted for one specific disease (http://www.who.int/csr/labepidemiology/projects/diseasesurv/en/). The purpose is discovery, investigation and interruption of continuing transmission, through well-designed public health response packages that include prevention of infection and disease management. Near real-time dissemination of surveillance results should improve planning, implementation and evaluation of public health practice (Lukwago et al., 2012). An effective surveillance system enables programme managers to identify at-risk areas and/or affected population groups. It also visualises trends for infections (both in humans and in animals) that require intervention and support assessment of the efficiency and impact of control measures where needed (Bergquist and Tanner, 2010; Tambo et al., 2014). For example, rigorous monitoring of schistosomiasis in Japan was not discontinued, since infective intermediate host snails remained long after the disease in humans was officially declared to have been eliminated in the country in 1996 (Ebisawa, 1998). It should also be noted that serious pathology caused by chronic schistosomiasis will be with us for a generation after disease transmission has been overcome (Giboda and Bergquist, 2000).

Elimination of transmission should not be attempted until the surveillance–response systems needed to track the disease in question are in place. This recommendation emphasises the status of surveillance as an intervention tool in the disease elimination stage (Alonso et al., 2011). A surveillance–response system is an important component in activities leading up to elimination as evidenced from the work on malaria in Zanzibar, United Republic of Tanzania (Sabot et al., 2010; Tatem et al., 2009) and in the People's Republic of China (P.R. China) (Yang et al., 2012a). Kelly et al. (2011) have published an eminent example of the use of geographical information systems (GIS) for the surveillance for malaria elimination that should also be consulted. Lymphatic filariasis, for example, could not have been eliminated in P.R. China without an effective surveillance–response system (Sudomo et al., 2010). Early detection of unusual events is particularly important for effective and timely intervention and it is critical for the guidance of the selection of appropriate corrective measures to reduce transmission (Tambo et al., 2014). The shift of focus from mortality and morbidity control to elimination of disease transmission signifies the important move from general control to elimination and denotes the time for phasing in of a surveillance–response system. After transition to transmission control, emphasis should be placed on:

- standard definitions for disease identification and reporting;
- detection, examination and confirmation of suspected outbreaks and investigation of pockets of ongoing, newly established or re-established transmission;
- analysis of collected data for monitoring and outbreak investigations; and
- selection and implementation of appropriate response-packages tailored to the particular features of given transmission hotspots.

A surveillance–response system is based on a set of minimal, essential, spatiotemporal data and the need to capture existing, or newly re-introduced infections, identification of trends in disease incidence and prevalence as well as detection of drug resistance. The scientific challenge of establishing surveillance–response systems lies in the creation and validation of (i) the minimal, essential data required, and – equally important – (ii) the minimal, effective sampling frame in time and space. These basic requirements would make the best use of modelling by assisting the definition of the minimal, essential datasets with respect to data and sampling. Indeed, seen in this perspective, this approach would be a most timely application also for relatively unknown infectious diseases, e.g. the Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever (Frieden et al., 2014). The reports by the European Centre for Disease Prevention and Control (ECDC) on the current effort to limit the latest EVD outbreak in West Africa (ECDC, 2014), indicate that currently available epidemiological information must be considered as insufficient to fully assess the extent and dynamics of the epidemic.

Environmental changes and the variation of social patterns such as rural-urban migration, climate change and shifting disease patterns should also be taken into account. The latter is important for the design of the surveillance approach and in truth imperative for