**Lancet Viewpoint**

**Certifying Guinea Worm Eradication: current challenges**

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The Guinea Worm Eradication Programme (GWEP) is, along with polio, one of two active eradication programmes endorsed by the World Health Assembly (WHA), whilst to date smallpox is the only human infection to have been eradicated 1. Guinea Worm (GW) or dracunculiasis caused by *Dracunculus medinensis* infection is classically acquired by the ingestion of infected copepod water-fleas of the genera *Cyclops* and *Mesocyclops* or, as has recently been described, by consuming viable infective larvae in fish or other paratenic hosts 2,3 . Both polio and Guinea Worm programmes have made great progress but as they reach the “end game” each face major challenges to meet the stringent criteria of certifying the global absence of transmission of the pathogen. The numbers of incident cases of Guinea Worm have declined since the late 1980’s from an estimated 3.6 million cases to 53 human cases reported in 2019 4,5. This Viewpoint summarises the challenges facing the GWEP with respect to certification of zero global incidence following the findings of animal infections, particularly in dogs in Chad 3, 6,7,8 9. . The overall epidemiological situation in 2019 is summarised by WHO 5 .

The strategy used to defeat GW has been based on public health measures in the absence of any drug, vaccine or pre-patent diagnostic. These interventions are summarized in Box 1 4,6 . Such approaches have been highly successful, with sixteen countries having been certified as free of transmission of *D. medinensis* ( Table 1) and only five countries remaining endemic : Angola, Chad, Ethiopia, Mali and South Sudan (Map) 5 . The Democratic Republic of Congo (DRC) and Sudan remain to be certified because, although there has been no evidence of cases for many years, these countries need to provide robust evidence to satisfy the criteria for certification established by WHO and the International Commission for the Certification of Dracunculiasis Eradication (ICCDDE). Countries must have achieved a minimum 3 years without any reported human cases or reported infections in animals before certification may be considered. Maintaining surveillance in certified countries is essential until global certification has been declared by the WHA on the recomendation of the ICCDE, the same process as was applied to smallpox in 1980.

**BOX 1 Interventions for Guinea Worm**

Provision of safe drinking water-boreholes, protected supplies and ensure borehole maintenance

Filtration of potentially contaminated water promoted through health education

regular surveillance and reporting from health facilities is monitored in post certification countries and those yet to be certified

Case containment is maintained, with provision of patient care, tracking, tracing and identifying sources of contamination

Continued provision of health education to prevent any infected person contaminating a water source

Aggressive implementation of chemical control by temephos to kill copepods in potentially infected water bodies

Provision of a monetary reward promulgated via media and communication methods

Establishment of rumour registers follow up any rumours within 24 hours

Maintainenance of post certification surveillance in certified countries

Introduction of a Global Reward

One of the major challenges of global certification will be to determine how the ICCDE can work in countries experiencing civil unrest or insecurity threats. Currently areas of a given endemic country are “off limits” for UN sanctioned travel and deemed unsafe for activities associated with the traditional authority of government, international organizations or NGDOs. These include areas that were historically endemic for Guinea Worm but in need of detailed scrutiny by the national authorities and the independent Certification Teams if the information contained in the National Report is to be validated. Such security concerns currently apply to areas in DRC, Mali and Sudan.

At this critical stage of the eradication programme focus must be placed on the certification of the absence of infection in animals, as the key priority. In particular, the River Chari basin in Chad poses logistic, social and resource challenges over the length of the river system of some 1000m km from the border with the Central African Republic (CAR) to near N’Djamena. The risk of infected dogs initiating transmission in CAR, where insecurity is a major impediment to any health activities, is a concern given this country was certified free of transmission in 2006; should of transmission be re-established then further delays in the eventual global certification will ensue. Other countries which border Chad-Cameroon, Niger, Nigeria-, which were previously certified as free of *D. medinensis* transmission need heightened surveillance in border areas. Already a confirmed human case has been reported in Cameroon, a few kilometres from the Chad border 5 and is considered an imported case. Infections of *D. medinensis* in dogs have risen in Chad since the first dog infections were recorded in 2012 with over 1900 confirmed infections in dogs in 2019 5,9.

These increases have occurred despite strenuous efforts of the Ministry of Health of Chad, The Carter Center and WHO to arrest transmission through intensive surveillance and preventive measures, including rewards, case containment through tethering of dogs, and burying of fish entrails, given the finding that dogs may be acquiring infections from consumption of fish and fingerlings acting as paratenic hosts 3,7,9 . The application of Temephos (abate) has also been more aggressively applied to water bodies in villages reporting high numbers of infected dogs since 2018. In Chad, *D. medinensis* infection has also been confirmed in a small number of domestic cats and a wild felid (*Felis sylvestris*) 7.

Animal infections have also been recorded in Ethiopia and Mali. In Ethiopia, in addition to dogs, small numbers of baboons (*Papio anubis)* have been found infected whilst in Mali, dog and cat infections have been reported over the past 4 years in the Segou Region; Mali disappointingly reported its first human case for 4 years in early 2020 10.

The detection of a second human case in Angola in 2019, together with a confirmed dog infection, means that the whole country must now be certified free of transmission representing a major challenge in such a large country which previously had never been considered endemic.

The detection of animal infections and emergence of human cases in new areas exemplify the diverse “last mile” challenges of eradication programmes and demonstrates we should “expect the unexpected”.

 Certification requires robust evidence that gives sufficient confidence to declare that infection is absent, essentially “proving a negative”. This is particularly challenging in some of the most resource constrained health systems in the most insecure and remote parts of Africa. The time- lines to certification of Guinea worm eradication have been repeatedly pushed into the future even before animal infections were identified but such infections have become a “game changer” for the ICCDE certification process. Clearly a further question arises as to the impact of the emergence of Covid -19 on the GWEP, both in the short and medium term. While the restrictions arising from Covid-19 pose operational challenges for GWEP, opportunities also arise for cross-cutting benefits. For example, core capabilities established through action on GW, including case detection and case containment, are exactly those required for containment of Covid-19.11

Realism must be injected into the end game. New tools, especially for dealing with animal infections, need to be developed, and ways to most effectively use them need to be tested, standardized and deployed. The research required is urgent given the new target published in the draft WHO Road Map for Guinea Worm eradication is 2030 12 . Operationalization of research, at scale in insecure settings, resourcing the end-game and initiating the certification process in a decadal horizon is the challenge.

A further challenge, is how to certify best that in the absence of human cases, there are no infections remaining in domestic or wild animals. The burden of proof will lie in verifying that no infections exist in dogs, which in Chad, constitute the major reservoir 7,8,9 and are likely to be valuable sentinel hosts for surveillance in other countries. Research will be needed for development of robust protocols that will provide ICCDE the confidence to assert cessation of all transmission has occurred. One approach which may prove especially useful for certification is a robust serologic assay to detect infections in dogs 13. Ideally, the assay will detect early infections before patency, which is between 12-14 months after ingestion of infected copepods or viable larvae in paratenic hosts. Such an assay, once sensitivity and specificity are established, could be utilized to screen dogs to verify that no transmission or exposure is ongoing. The challenges will be to operationalise and validate any methodology to give confidence that such a test has been used at an adequate level and representative scale. Sensitive and specific serological tests in selected human populations can also assist in the national certification exercise. An additional approach would be a “pond side” test to detect *D. medinensis* infected copepods in water sources which, in the absence of human cases, would indicate the likely circulation of infection in animals 14.

Recent unverified reports of cases of dracunculiasis in Vietnam and Kerala, India exemplify that eradication is a global outcome needing a high level of global awareness; each rumour needs to be rigorously investigated; as with smallpox, a Global reward should be instigated for reporting any verified case 15. Global certification currently remains feasible, but given the challenges described it will be more difficult than heretofore. It would be responsible and appropriate to consider a “Plan B” scenario which recognize animal transmission as a separate challenge, reducing human infections to zero by the proven interventions (Box 1) whilst expecting occasional spillovers into the human population from animal sources. With effective surveillance could we accept “success” if we had zero human cases for three years accepting animal sources will likely pose a minimal risk to humans ? In the meantime, we should invest in targeted research and strengthen surveillance systems, potentially linking Guinea worm surveillance more closely with other One Health and zoonotic disease surveillance systems.

In considering end-game challenges, we should not ignore the enormous public gains over the past three decades. The GWEP has succeeded in reducing incidence of infection by well over 99% of pre-programme levels with only a small number of human cases in only three countries as of the end of 2019. The programme has generated enormous societal and public health benefits, increasing access to safe water, reducing disability, enhancing food security in marginal lands, strengthening national surveillance systems and establishing effective partnerships. The GWEP has been demonstrated to be cost effective and to have contributed to a significantly to averting disability over three decades.16, 17. The undoubted successes of GWEP demonstrate that multiple, simple interventions consistently applied are effective in controlling the human infection. The absence of any new infections in the sixteen countries certified to date (Table) (human or animal) has generated confidence that the certification process is robust. However, as we seek to eradicate *D. medinensis* we should continue to expect surprises. The “last mile” is always the most difficult as both polio and the Guinea Worm programmes are experiencing.

**Contributors**

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**Declaration of Interests**

The authors declare they have no competing interests as members of the International Commission for the Certification of Dracunculiasis Eradication an independent body whose members are appointed by the Director General of WHO.

The views expressed in this article are those of the authors and do not necessarily represent the official position of their listed organizations or WHO.

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