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## Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Charlier J, Barkema HW, Becher P, et al. Disease control tools to secure animal and public health in a densely populated world. *Lancet Planet Health* 2022; **6:** e812–24.

**Supplementary appendix - Disease control tools to secure animal and public health in a densely populated world, Charlier et al.**

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**Box 1. The DISCONTOOLS prioritisation model.**

The DISCONTOOLS prioritisation model was developed to support scientists and research funders in comparing disease knowledge, impacts and gaps across diseases and thus prioritising research activities. The full model is described by O'Brien et al. [14]. In short, disease specific expert groups attributed scores to 6 criteria covering (i) disease knowledge, (ii) impact on animal health and welfare, (iii) impact on public health, (iv) impact on wider society, (v) impact on trade and (vi) control tools. Each criterion is defined by a number of sublevels. A 5-tiered scoring system was applied, with a scoring scale from 0 to 4 for the first 5 criteria and from -2 to 2 for the criterion "control tools". The higher the score, the greater the impact of the disease. Negative scores for control tools indicate that for the given disease one or more appropriate control tools are available, thus decreasing the overall rank of the disease. A separate "gap analysis" scoring model is performed to evaluate the availability and quality of the control tools (diagnostics, vaccines, pharmaceuticals) in more detail. It applies the same scale of -2 to 2, as above. The model is available since 2014 and experience has demonstrated that there is no ultimate prioritisation of diseases. Outcomes will depend on the objectives of the users of prioritisation models, criteria used, geographical context and disease definitions [121]. Some diseases can be considered as large disease complexes involving different pathogens and host species while others are narrowly defined and may thus not rank high overall, but be of critical importance in specific host species or production sectors. Moreover, other factors such as co-infections can significantly influence disease impact [122], but are difficult to grasp in prioritisation models.

**Box 2. Societal drivers of uptake of disease control tools**

The response to the COVID-19 pandemic, which saw the emergence of COVID-conspiracy theorists and anti-vaxxers (people who oppose vaccination), has clearly demonstrated that disease control is not just about evidence-based tools or scientific explanations for disease occurrence and transmission. The situation is compounded by the fact that many diseases are syndromic (e.g., respiratory disease, mastitis, diarrhoea, abortion) whereas many vaccines are pathogen specific (e.g., *Brucella*, *Coxiella*, or *Toxoplasma*, all of which may cause abortion in small ruminants). Thus, a vaccine that is successful at pathogen level may be perceived as a failure at syndromic level, which is the level observed by farmers, and this may discourage uptake.

Language around disease and disease control tools may also create confusion [123]. For example, in some languages there is no clear distinction between treatment (curative) and vaccination (preventative), and in countries where vaccines are largely deployed in response to outbreaks, as is often the case for anthrax in East Africa for example, the order of events (disease first, vaccination next), can make it difficult to explain the distinction between treatment, which is generally re-active (after disease occurs) and vaccination, which is meant to be pro-active (before disease occurs). In addition to terminology around disease control methods, scientific language around disease aetiology may be understood differently by different stakeholders. For example, among Maasai pastoralists, the word that roughly translates into brucellosis is understood syndromically, relating to fever in humans, making it difficult to know with confidence whether people refer to a specific pathogen or a disease manifestation when discussing the topic. Likewise, in southeast Asia, where foodborne disease caused by *Streptococcus agalactiae* from fish has been recognized in recent years, the term “cooking” was understood as “heat treatment” by Western scientists but as “food preparation” by local communities, a crucial distinction in terms of a control of a heat-sensitive foodborne pathogen.

Where effective disease control tools exist, e.g., vaccination of cattle to reduce shedding of *E. coli* O157, uptake can be limited because the costs and benefits accrue in different stakeholder sectors,

i.e., in farming and public health, respectively [35]. Other economic hurdles to development and uptake of disease control tools are linked to regulatory issues, whereby costs of going through an approval process in every target jurisdiction, combined with the socio-economic status of intended end-users, may act as disincentive for investment. Such market failures are increasingly recognized and can be addressed, both at regulatory level (e.g., harmonisation of approval processes), and at financial level (e.g., public-private partnerships, or global vaccine supplies as set up for COVID-19) [124]. For diseases where numerous management and control tools already exist, e.g., mastitis in dairy cattle, considerable effort has been invested in understanding the barriers and drivers behind uptake of evidence-based advice, including consideration of the role of individual farmers, interactions between farmers and veterinarians, and processes at professional or societal level [32]. Detailed review of sociological, anthropological, economic, and other factors affecting uptake of disease control tools are beyond the scope of the current review, but the authors acknowledge the importance of interdisciplinary approaches to ensure both the development and uptake of disease control tools.

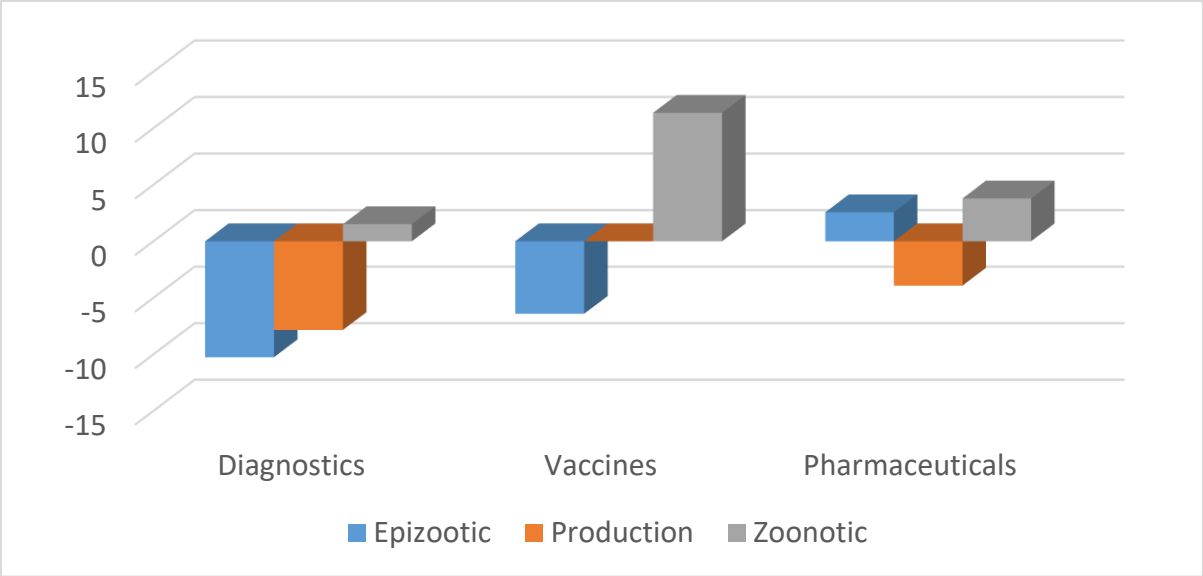


**Figure 1 appendix.** Mean prioritisation score over all diseases for appropriate control tools. Positive scores indicate a relative lack of appropriate control tools.