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It's an ill wind: is there life after AIDS and tsetse flies?

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In 1976, just over 40 years ago, Glyn Vale carried out an audacious experiment at Rekomitjie Research Station in the Zambezi Valley of Zimbabwe. He got the considerable workforce at the Station to construct a subterranean cavern, large enough to house comfortably the Station's entire livestock herd used in research into the biology of tsetse flies (*Glossina* spp) and the trypanosomes they transmit. The herd consisted of 37 cattle, 22 goats, 43 sheep, a donkey and a buffalo – totalling 11 500 kg of livestock. The (exceedingly ripe) odour from this herd was expelled from the pit using a 220 volt fan. The idea was to establish a relationship between the amounts of host-odour dispensed, gauged by the mass of livestock in the cavern, and the number of tsetse captured in a trap placed at the vent. On the first afternoon, when the experiment was run with the full herd as bait, we captured more than 13,000 tsetse in a 3-hour session (1).

I vividly recall the excitement that I felt with Glyn when we saw the trap crammed with tsetse, and realised the implication of the experiment. If we could identify the olfactory attractants involved they could be used in bait systems to control tsetse, or even to eradicate the flies. We would then have a simple, affordable, and ecologically clean method for controlling tsetse. Imagine my surprise, therefore, when I saw a number of the Government-employed technicians – who had made the whole experiment possible – sitting with their heads in their hands, as if they were feeling very ill indeed. I enquired about the problem and one of the technicians simply pointed to the trap full of flies and said sadly: “But what will I do for a job when all of the tsetse flies are gone?”

It was fruitless for me to trot out the knee-jerk platitudes, which appear at the start of virtually every paper on tsetse and trypanosomiasis: 60 million people continuously exposed to the risk of human trypanosomiasis; estimated prevalence of 300,000 cases may be an order of magnitude too low; animal trypanosomiasis regarded as the single greatest health constraint to increased livestock production in sub-Saharan Africa; direct annual production losses in cattle are estimated at USD 600–1200 million. Tsetse can thus be seen as a major cause of disease, hunger and poverty in Africa. Our men were not terribly moved by these arguments. For them the flies were perhaps a secondary source of disease and poverty, but, primarily, tsetse represented a source of income, school fees, jobs, livelihood....

The story came to mind when thinking about the future of a far more serious scourge currently afflicting Africa: HIV and AIDS. The death and misery attributable to HIV entirely eclipse the effects of all other diseases in southern and eastern Africa: in 2015 UNAIDS estimated that there were nearly half a million HIV-related deaths, and nearly a million new HIV cases (2). More worryingly, whereas global AIDS deaths were down by about 30% on the 2010 figure, the numbers of new infections showed only a 5% decrease over the 5-year period and the decline does not appear to be statistically significant. And this despite the fact that the world is spending more than US\$15 billion a year on HIV, a figure that UNAIDS says needs to increase to about US\$20 billion annually by 2020 and stay close to that level of spending until 2030.

But wait a minute: can this really be true? Are we really spending US\$15 billion a year on HIV and not making any appreciable dent in the number of new HIV cases? Well, yes, if we believe the estimates that emerge from the UNAIDS Spectrum projections. Other modelling exercises, however, give a rather more positive spin on proceedings. Johnson *et al.* (2017), using the ‘Thembisa’ model, suggest that HIV incidence in South Africa dropped by almost 50% between 2010 and 2015 (3), and Williams *et al.* (2017) suggest that the successful roll-out of ART has been associated with a 72% reduction in HIV incidence in adults from 1996 to 2016 (4). The latter study suggested that introduction of an Expanded Treatment and Prevention (ETP) strategy in South Africa, with increased testing rates and immediate initiation of ART for cases diagnosed as HIV positive, could see HIV incidence reduced to <0.1% by 2030. No such scenario seems possible given the UNAIDS estimates of the recent trajectory of HIV incidence.

Why are we seeing such discrepancies between these various modelling approaches? ‘Thembisa’ means ‘give hope’ in Xhosa and Zulu and Johnson’s model does indeed give hope that we are heading in the right direction. According to UNAIDS there is little or no prospect of an end to the HIV epidemic – despite the vast amounts of money being spent. We urgently need to know which view is correct.

The only thing that the various studies have in common is that we will be faced for the foreseeable future with astronomical demands for funding to deal with HIV. This is a ghastly disease we are dealing with. But, with a promise of US\$15 - 20 billion to be spent every year from now until 2030

(at least), it is also very big business. Massive numbers of people around the world find employment in dealing with the problem: it is huge business for the purveyors of drugs, and for many other companies besides. No worker in the HIV world, I hope, would actually want to see a lengthy protraction of the epidemic. Nonetheless, like my technicians in the tsetse world 40 years ago, many clearly get nervous about what they are going to do when the funds dry up.

As a whimsical postscript to this sombre tale I do have to note that my man at Rekomitjie Research Station, who was so worried about us trapping out all of the tsetse in the Zambezi Valley, was worried about quite the wrong thing. Although we caught more than 140,000 tsetse over a 3-month period in late 1976, the tsetse populations had bounced back and were as robust as ever within a few months. The threat to the flies came from a quite different quarter. Since 1979 the mean temperature during the hot dry season in the Zambezi Valley has increased by about 2.5⁰C and the Zambezi Valley is becoming too hot for tsetse, to the point that *G. pallidipes* is on the verge of local extinction, with no need for any control measures at all (5). As far

as I am aware, however, there is no reason to hope that climate change will provide any similarly cost-effective solution to the HIV problem.

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