Return on investment of private sector malaria control at a large sugar facility in Southern Mozambique

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Abstract

This paper provides new empirical evidence regarding the return on investment of privately managed malaria control activities (indoor residual spraying with pesticides) on worker absenteeism in Mozambique. We analyze 4 years of malaria control and worker health and absenteeism data from a large sugar processing facility in Mozambique. We find that the benefits outweight the costs (ie, there is a positive return on investment) even when the consideration of benefits is limited to those directly accrued by the company. These findings suggest that the private sector may have an important role to play in malaria control in endemic areas.

Research Highlights

- Large, individual-level worker absenteeism data from malaria endemic zone
- Quantifies effect of indoor residual spraying on absenteeism
- Estimates cost-effectiveness of malaria control from investment standpoint
- Results suggest that private sector could play a significant role in malaria elimination

Keywords

Malaria; Investment; Health; Productivity; Agriculture; Absenteeism

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Introduction

Malaria has a large economic impact on endemic societies. By affecting saving, investment (Shretta et al., 2016), risk perception, productivity, absenteeism (Nonvignon et al., 2016), human capital accumulation (Castel-Branco, 2014), mortality, and costs of care (Sachs and Malaney, 2002), malaria likely has a negative effect on GDP and growth (McCarthy et al., 2000) (Orem et al., 2012). Because of the relative affordability of most intereventions and the enormous societal costs of malaria, most forms of malaria control are cost-effective when a public welfare perspective is assumed, such as when a government provides the financing (White et al., 2011) (Purdy et al., 2013) (Howard et al., 2017).

From the persepctive of the private sector, however, investing in malaria control is not so clear-cut. Public health interventions targetting malaria - and their corresponding cost-effectiveness evaluations - most often focus on impacts pertaining to public welfare, such as an increase in life years adjusted for disability or quality (Goodman et al., 1999) (Shretta et al., 2016) (Lee et al., 2017) (Hanson, 2004). Though population-level health is certainly of importance to businesses, and improvements in health incidentally improve the economy at all levels (Brundtland, 1999) (Bloom and Canning, 2008) (Vecchi et al., 2013), these improvements may be too disperse or long-term to incentivize private sector involvement in health campaigns.

100% of the Mozambican population are at risk of malaria, living in what the WHO classifies as a "high transmission" area (Moonasar et al., 2016). Annually, Mozambique has more than 8 million clinical malaria cases (an annual incidence of approximately 300 per 1,000 residents), with an estimated 14,000 deaths. Malaria accounts for 29% of all deaths, and 42% of deaths among those under five years of age (INE, 2011). Since 2013, Mozambique has seen a gradual increase in the incidence of malaria (Moonasar et al., 2016). 100% of the malaria in Mozambique is of the Plasmodium falciparum species, with Anopheles funestus, gambiae, and arabiensis as the primary mosquito vectors of the disease (WHO, 2015).

A significant sector of the economy in Mozambique is dominated by a full large-scale foreing direct investment projects (Robbins and Perkins, 2012), and the role of the private sector in health generally, and malaria specifically, is unequivocally important. Large agriculture and extractive industry firms take up wide swaths of land and employ hundreds of thousands (German et al., 2013). The Mozambican state has encouraged large-scale entreprise with the aim of general economic development (Buur et al., 2012). And where large firms exist, they often take on social roles such as housing and health care (Winkler, 2013). At times, this role is necessary from a purely practical standpoint; in other cases, it is employed under the guise of "corporate social responsibility" (Azemar and Desbordes, 2009). Regardless of the language used, it is clear that private industry plays an important role in public health in Mozambique (Robbins and Perkins, 2012) (Castel-Branco, 2014).

Several cases exist of foreign firms engaging in large-scale malaria control campaigns (Mouzin and al., 2011) (Han, 2015) (Bennett et al., 2017) (Kaula et al., 2017). But these studies generally consider population health as the outcome measure of interest, rather than worker absenteeism or productivity. Similarly, they often neglect to differentiate between those clinical costs which are absorbed by the local health system versus those which are absorbed by the firm itself. In the literature, making the "investment case" for malaria control or elimination generally implies that the investor is the public sector, and takes into account those costs and benefits which are applicable from a public welfare point of view (Shretta et al., 2017); though appropriate in most cases (the government or institutions interested in public welfare primarily being the primary malaria control agents in most locations), the findings of these studies are rarely applicable to the private sector. In the case of a private firm not interested in "corporate social responsibility", it is not clear whether investing in malaria control would be profitable or not. This lack of clarity not only discourages investment, but also makes it difficult for governments to pinpoint the correct of amount of subsidy (if applicable) to encourage private sector scale-up in malaria control.

To address the question of the profitability of malaria control activities from the standpoint of a private firm, we analyze data during a 7 year period from a private sugar facility in Southern Mozambique. We assess the effect of indoor residual spraying (IRS) on the absenteeism and health of workers, and demonstrate that the firm's engagement in malaria control not only improved worker health, but also generated a positive return on investment.

The structure of the paper is as follows. After a brief review of the existing literature on the subject of private sector investment in malaria control and its effects on worker productivity, we provide an overview of the sugar company under study, and the epidemiology of malaria in the nearby area, as well as in Mozambique as a whole. We then give an overview of the data collected, and outline the theoretical and methdological assumptions that underly our analysis. In the results, we show the effectiveness of the company's malaria control program in reducing absences, and translate this reduction into cost savings. Our robustness checks consist of . Our discussion covers potential implications from this study in terms of policy and investment, as well as the paper's limitations.

Add some stuff here

Background Literature

Will add 3-5 paragraphs of background lit review

Our study adds to the existing literature in several ways.

Will add details here.

Study area

Details on Maragra:

Maragra Açucar SA (henceforth referred to as "Maragra").

Details on Manhica

Details on Mozambique

Methods

Data collection

In collaboration with the sugar processing facility, we collected data for the period from January 2010 through December 2016. Data came from four sources: (i) the Human Resources' roster of worker details and absences, (ii) the facility's on-site clinic's medical and laboratory records, (iii) the facility's on-site malaria control program's records pertaining to the dates, chemicals, and location of IRS activities, and (iv) interviews with company employees pertaining to costs, data limitations, etc. Digitization and collection of data took place during the period from March 2016 through May 2017. Supplementary data pertaining to worker characteristics was obtained from through the Centro de Investigação em Saude de Manhiça's (CISM) demographic census, which covered workers from the district, but not those who migrated from other parts of the country (Nhacolo et al., 2006).

Data pertaining to district-wide malaria incidence was obtained from Mozambique's Boletim Epidemiológico Semanal (BES), which is the system by which the National Malaria Control Program monitors incidence at the district level throghout the entire country, and reports the number of confirmed weekly malaria cases at government health facilities. Using these case numbers, combined with population estimates from the National Statistical Institute (INE), we estimate each day's annualized weekly malaria incidence rate (cases per 1000 population at risk), interpolated from the weekly figures. We retrieved weather data for all Mozambican stations from NOAA. We estimated the meteorological conditions at the centroid of Manhiça using a simple interpolation method whereby the district's weather conditions were estimated to be a function of all Mozambican weather stations' reported conditions, inversely weighted by kilometers from district centroid.

Maragra regularly employs IRS at on-site worker households in order to reduce those workers' (and their families') risk of malaria infection. Workers living off-site (our control group) also may have received IRS at some point during the study period (from government programs). Even though we do not have reliable person-level data on IRS carried out by the government, off-site workers are a suitable control in the sense that they represent "business as usual" (ie, what would happen if the company carried out no IRS and relied solely on public interventions). Using company HR and clinical records, we were able to identify absences and episodes of clinical malaria among all workers, as well as identify the time since the most recent IRS episode before the onsent of absence or illness.

Worker characteristics, illness and absenteeism data, along with IRS activity data, were systematically stored, collected, and used at the individual level by Maragra, and therefore of generally high quality. Because cost data was less systematically collected by Maragra, and because many costs could not be precisely quantified due to the abundance of in-kind and cross-departmental expenditures, we had to rely on rough estimations based on a mix of interviews, reciepts, and interpolations. Since our program cost data is not as reliable as our worker characteristic and outcome data, we were conservative in our estimates, and generally tried to err on the side of program activities and materials costing more than what was reported, when doubt was aired. Cost data consisted of three types: (i) wages of malaria control employees, (ii) transporation and vehicle costs for IRS teams, and (iii) acquisition costs of purchasing IRS chemicals for fumigation (ACT and DDT), the latter two being combined into malaria control "programme" costs.

Conceptual framework and identification strategy

We sought to understand the effect of IRS on individual workers' likelihood of absence from work as well as their likelihood of clinical malaria. To estimate this effect, we estimated separate models for absence and illness. We employed interrupted time series (Lopez Bernal et al., 2016) and a linear probability approach using the following econometric model.

$$\hat{Y_{it}} = \beta_0 + (\beta_1)(\text{Season}_t) + (\beta_2 IRS * \beta_3 IRS_t) + ... + \epsilon$$

$\hat{Y}$ is the rate of absence. β_1 represents the clinical malaria incidence at that time in the entire district of Manhiça. Our demographic confounders (represented by ...) are sex, age, and worker department (field, factory, or administrative). Our intervention was not a simple yes/no, but rather the product of whether the residence of the worker in question was treated in the last year, and, if so, the time since treatment (represented above as the interaction term, where where $_t$ represents time elapsed since commencement of the most recent IRS campaign). We define the malaria season as any time during which the clinical incidence of malaria in the district of Manhiça was at or greater than the median clinical incidence of malaria for the entire study period. These weeks are flagged as red in Figure 1, Panel A. By using clinical incidence of the area of residence of the workers (as opposed to more typical proxies for malaria risk, such as only rainy vs. non rainy season), our seasonality estimate is a closer approximation of true malaria risk, incorporating lagged effects such as the incubation period of the parasite, as well as any inherent non-linear effects of weather. In addition, we adjust for daily precipitation

Estimating return on investment

Our formula for return on investment can be described in a straightforward fashion…

$$R = \frac{P_w - S_{wa} - S_{wc}}{P_w}$$

…where R is the return on investment, P is the malaria control program's total operating cost, w refers to costs at the per-worker level, a refers to savings through avoided absences, and \$ c \$ refers to savings through avoided clinical encounters. We define the malaria control program as "profitable" from an investment standpoint if ROI is greater than 100%, ie if the savings associated with the estimated effect of IRS is greater than the costs of the program's administration.

Reproducibility and ethical approval

All data processing and analysis were carried out in R (R Core Team, 2017) and all analysis code is freely available online (Brew, 2017). Ethical approval for this project was obtained from the Institutional Ethics Review Board for Health at the CISM prior to data collection.

Descriptive statistics

Age, types of workers, bla bla bla.

Will add a table here and some overview

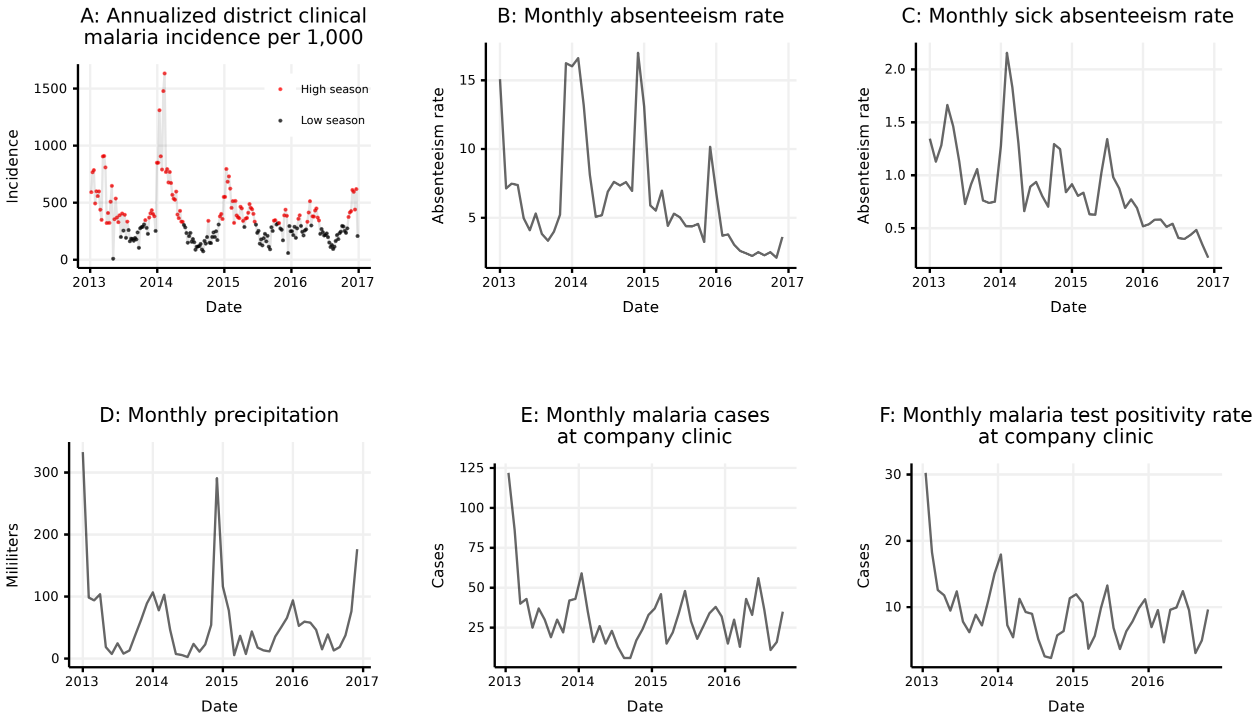

Figure 1: Clinical malaria (district of Manhiça), all-cause absenteeism among Maragra workers, sick absenteeism among Maragra workers, estimated rainfall, positive cases at company clinic, and test positivity rate at company clinic

Results

In Southern Mozambique, malaria peaks during the summer months (December through March) most years (Figure 1, panel A), and worker absenteeism rates track malaria incidence closely, following the same seasonal patterns (Figure 1, panel B). Both all-cause absenteeism and sick absenteeism have declined in recent years at Maragra (Figure 1, panel C), with the latter declining at a faster rate than the former. The fact that the rate of confirmed cases at the company clinic is largely non-seasonal (Figure 1, panels E and F) suggests that a significant portion of workers either seek care for malaria elsewhere (for example, government health posts, of which several are nearby and in some many cases closer to workers' residence than the company clinic) or do not seek care during malaria infection. Accordingly, we focus our analysis on all-cause absenteeism rather than sickness absenteeism or malaria diagnostics, with the assumption that much of illness is captured by absenteeism but not by the clinical data.

Fumigations: During the period from January 1st, 2012 through December 31st, 2016, the Maragra Malaria Control Unit carried out 11,567 episodes of fumigation of residential "agregados" (household combinations), for a total of 13,937 building-fumigation combinations. The total number of unique agregados sprayed during this period was 4,045. Among the 3,362 workers for whom we have reliable absenteeism and residential data, 692 had their homes fumigated at least once (the majority of workers live off of the facility).

Absences: We observed 1,759,100 unique worker-days among the 3,362 workers. The all-period average absenteeism rate was 5.56%, though this rate varied widely as a function of worker department, sex, residence, and season (table 1).

Costs: The malaria control program at Maragra has an annual operating budget of approximately XX, which includes the purchase of insecticide, the wages of IRS sprayers and drivers, transportation, record-keeping, and general administrative costs. Assuming linearity in costs, the program spends approximately XX per agregado sprayed. With each agregado containing an average of 2.2 workers, this translates to a cost of XX per worker protected per season. Much of the benefit of IRS goes to non-worker residents of sprayed agregados (who constitute a majority), but this benefit is purposefully ignored for this analysis.

Variable		2013	2014	2015	2016
Malaria season	Low	5.2%	7%	5.4%	3.3%
	High	8.2%	12.8%	6.3%	2.7%
Worker type	Field worker	4.4%	7.6%	3.9%	1.7%
	Not field worker	10.7%	12.4%	11.5%	9.6%
Contract	Permanent	12.1%	12.6%	12%	10.2%
	Temporary	0.1%	5%	2.3%	0.5%
Sex	F	4%	8.1%	4.4%	1.9%
	M	8.1%	10%	6.5%	3.7%
Residence	Off site	6.4%	9.6%	5.9%	3%
	On site	9.4%	9.7%	6.1%	3.1%
Precipitation	Dry	5.4%	7.7%	4.8%	2.4%
	Rainy	7.9%	10.6%	7%	3.3%

Table 1: Absenteeism rate by year and worker characteristics

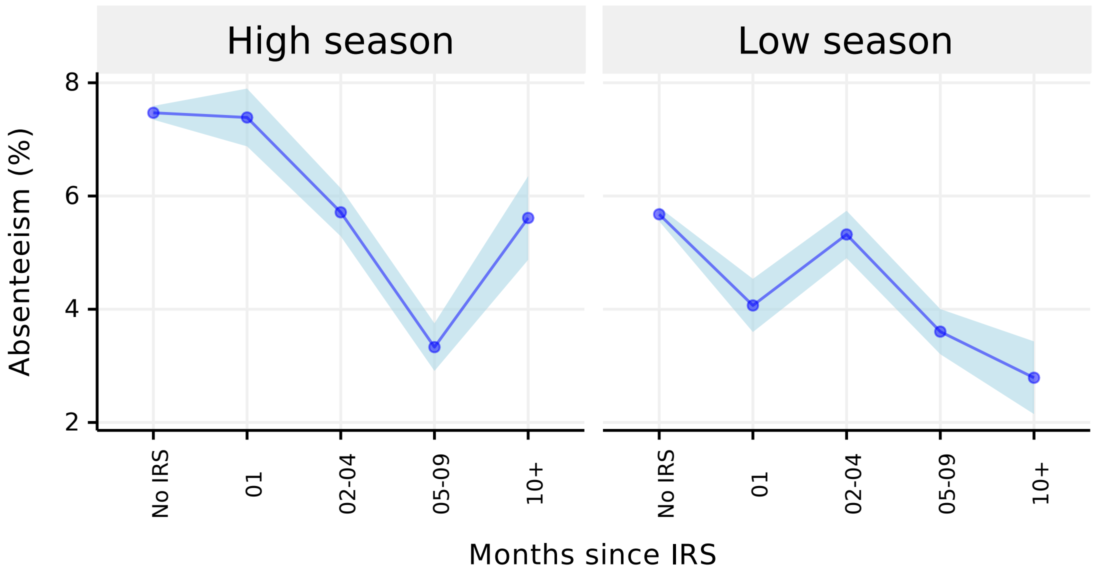

Figure 2: Estimated effect of IRS on absenteeism by season

Given the likelihood that clinical data does not fully capture all malaria cases, we do not quantify the costs of malaria infection to the company. Rather, we first estimate the reduction in absenteeism attributible to IRS, and then quantify the savings associated with prevented absences. Additionally, we calculate the clinical savings of IRS by first estimating the share of absences which are associated with an episode of clinical malaria, and then applying the clinical cost per case to the equivalent share of prevented absences. We intentionally ignore the savings accrued by the public health system, as well as the likely utility gains in secondary realms such as school absenteeism, producitivity, etc.

Effect of IRS on absenteeism: IRS is associated with a year-long, significant reduction in absenteeism during the malaria season (figure 2). As one would expect if the mechanism by which IRS reduces absence is through reduced malaria infection, the effect of IRS during the low transmission season is significant, but far less substantial in effect size.

We create 4 worker fixed effects models. Different models for field vs not field, permanent vs temporary.

Return on investment

Details here on ROI calculation outcomes

Not done yet. In conversation with Eduardo from MC about getting more accurate costs

Table 2: Models with worker fixed effects

Term	Estimate
Permanent field worker	
Off site	9.142 (P<0.001)
On site	11.424 (P<0.001)
Malaria season	3.424 (P<0.001)
Months since IRS: 01	3.831 (P<0.001)
Months since IRS: 02-04	4.199 (P<0.001)
Months since IRS: 05-09	-3.194 (P<0.001)
Months since IRS: 10+	-5.794 (P<0.001)
Malaria season:Months since IRS: 01	-4.534 (P<0.001)
Malaria season:Months since IRS: 02-04	-8.392 (P<0.001)
Malaria season:Months since IRS: 05-09	-3.85 (P<0.001)
Malaria season:Months since IRS: 10+	4.504 (P=0.002)
Permanent not field worker	
Off site	10.862 (P<0.001)
On site	9.555 (P<0.001)
Malaria season	2.077 (P<0.001)
Months since IRS: 01	-2.083 (P<0.001)
Months since IRS: 02-04	3.904 (P<0.001)
Months since IRS: 05-09	-0.834 (P=0.084)
Months since IRS: 10+	-0.268 (P=0.742)
Malaria season:Months since IRS: 01	2.735 (P<0.001)
Malaria season:Months since IRS: 02-04	-5.768 (P<0.001)
Malaria season:Months since IRS: 05-09	-2.441 (P<0.001)
Malaria season:Months since IRS: 10+	4.497 (P<0.001)
Temporary field worker	
Off site	0.985 (P<0.001)
On site	1.078 (P<0.001)
Malaria season	-0.017 (P=0.461)
Months since IRS: 01	-0.4 (P<0.001)
Months since IRS: 02-04	-0.547 (P<0.001)
Months since IRS: 05-09	-0.554 (P<0.001)
Months since IRS: 10+	-0.992 (P<0.001)
Malaria season:Months since IRS: 01	-0.092 (P=0.62)
Malaria season:Months since IRS: 02-04	0.172 (P=0.256)
Malaria season:Months since IRS: 05-09	0.062 (P=0.657)
Malaria season:Months since IRS: 10+	0.068 (P=0.771)
Temporary not field worker	
Off site	4.136 (P<0.001)
On site	3.834 (P<0.001)
Malaria season	-0.292 (P=0.16)
Months since IRS: 01	-1.456 (P=0.389)
Months since IRS: 02-04	0.608 (P=0.574)
Months since IRS: 05-09	-0.869 (P=0.405)
Months since IRS: 10+	10.583 (P<0.001)
Malaria season:Months since IRS: 01	6.045 (P=0.002)
Malaria season:Months since IRS: 02-04	0.604 (P=0.667)
Malaria season:Months since IRS: 05-09	-1.482 (P=0.284)
Malaria season:Months since IRS: 10+	-10.636 (P<0.001)

Robustness and generalizability

Two principal concerns call into question the results of our analysis. First, the application of IRS to a workers house may be endogenous. To check for this bla bla bla . The second concern is that our quantification of consists is distorted by the fact that we treat IRS operations as essentially linear in nature, when in reality economies of scale, in-kind purchases and other factors likely make the true cost-per-spraying convex.

As per Menno's suggestion, will add details here pertaining to whether IRS predicts absenteeism before it is applied

Will address this with some sensitivity analysis

Discussion

Overall stuff

Limitations

Implications

References

Azemar, C., Desbordes, R., 2009. Public governance, health and foreign direct investment in sub-saharan africa. Journal of African Economies 18, 667–709. https://doi.org/10.1093/jae/ejn028

Bennett, A., Avanceña, A.L.V., Wegbreit, J., Cotter, C., Roberts, K., Gosling, R., 2017. Engaging the private sector in malaria surveillance: A review of strategies and recommendations for elimination settings. Malaria Journal 16. https://doi.org/10.1186/s12936-017-1901-1

Bloom, D., Canning, D., 2008. Population Health and Economic Growth 1–25.

Brew, J., 2017. Malaria and sugar: An in-depth examination of the effect of malaria control activities on the health and productivity of maragra sugarcane factory workers. GitHub repository.

Brundtland, G.H., 1999. WHO on Health and Economic Productivity 25, 396–402.

Buur, L., Tembe, C.M., Baloi, O., 2012. The white gold: The role of government and state in rehabilitating the sugar industry in mozambique. Journal of Development Studies 48, 349–362. https://doi.org/10.1080/00220388.2011.635200

Castel-Branco, C.N., 2014. Growth, capital accumulation and economic porosity in mozambique: Social losses, private gains. Review of African Political Economy 41, S26–S48. https://doi.org/10.1080/03056244.2014.976363

German, L., Schoneveld, G., Mwangi, E., 2013. Contemporary processes of large-scale land acquisition in sub-saharan africa: Legal deficiency or elite capture of the rule of law? World Development 48, 1–18. https://doi.org/10.1016/j.worlddev.2013.03.006

Goodman, C., Coleman, P., Mills, A., 1999. Cost-effectiveness of malaria control in sub-saharan africa. The Lancet 354, 378–385. https://doi.org/10.1016/s0140-6736(99)02141-8

Han, L., 2015. Malaria in Mozambique: trialling payment by results.

Hanson, K., 2004. Public and private roles in malaria control: The contributions of economic analysis. The American Journal of Tropical Medicine and Hygiene 71, 168–173.

Howard, N., Guinness, L., Rowland, M., Durrani, N., Hansen, K.S., 2017. Cost-effectiveness of adding indoor residual spraying to case management in afghan refugee settlements in northwest pakistan during a prolonged malaria epidemic. PLOS Neglected Tropical Diseases 11, e0005935. https://doi.org/10.1371/journal.pntd.0005935

INE, 2011. Demographic health survey.

Kaula, H., Buyungo, P., Opigo, J., 2017. Private sector role, readiness and performance for malaria case management in uganda, 2015. Malaria Journal 16. https://doi.org/10.1186/s12936-017-1824-x

Lee, B.Y., Zenkov, E., Chatterjee, C., Candrinho, B., Zhang, S., Colborn, J., Briët, O.J.T., Brown, S.T., Mendis, C., Bartsch, S.M., Viisainen, K., DePasse, J.V., Stone, N.T.B., 2017. The economic value of long-lasting insecticidal nets and indoor residual spraying implementation in mozambique. The American Journal of Tropical Medicine and Hygiene 96, 1430–1440. https://doi.org/10.4269/ajtmh.16-0744

Lopez Bernal, J., Cummins, S., Gasparrini, A., 2016. Interrupted time series regression for the evaluation of public health interventions: A tutorial. International Journal of Epidemiology dyw098. https://doi.org/10.1093/ije/dyw098

McCarthy, D., Wolf, H., Wu, Y., 2000. The growth costs of malaria. https://doi.org/10.3386/w7541

Moonasar, D., Maharaj, R., Kunene, S., Candrinho, B., Saute, F., Ntshalintshali, N., Morris, N., 2016. Towards malaria elimination in the mosaswa (mozambique, south africa and swaziland) region. Malaria Journal 15. https://doi.org/10.1186/s12936-016-1470-8

Mouzin, E., al., E., 2011. Business Investing in Malaria Control: Economic Returns and a Healthy Workforce for Africa. Progress & Impact series.

Nhacolo, A.Q., Nhalungo, D.A., Sacoor, C.N., Aponte, J.J., Thompson, R., Alonso, P., 2006. Levels and trends of demographic indices in southern rural mozambique: Evidence from demographic surveillance in manhiça district. BMC Public Health 6. https://doi.org/10.1186/1471-2458-6-291

Nonvignon, J., Aryeetey, G.C., Malm, K.L., Agyemang, S.A., Aubyn, V.N.A., Peprah, N.Y., Bart-Plange, C.N., Aikins, M., 2016. Economic burden of malaria on businesses in ghana: A case for private sector investment in malaria control. Malaria Journal 15. https://doi.org/10.1186/s12936-016-1506-0

Orem, J., Kirigia, J., Azairwe, R., Kasirye, I., Walker, O., 2012. Impact of malaria morbidity on gross domestic product in uganda. International Archives of Medicine 5, 12. https://doi.org/10.1186/1755-7682-5-12

Purdy, M., Rublin, D., Wei, K., Robinson, M., 2013. The economic case for combating malaria. The American Journal of Tropical Medicine and Hygiene 89, 819–823. https://doi.org/10.4269/ajtmh.12-0689

R Core Team, 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Robbins, G., Perkins, D., 2012. Mining fdi and infrastructure development on africa's east coast: Examining the recent experience of tanzania and mozambique. Journal of International Development 24, 220–236. https://doi.org/10.1002/jid.2817

Sachs, J., Malaney, P., 2002. The economic and social burden of malaria. Nature 415, 680–685. https://doi.org/10.1038/415680a

Shretta, R., Avanceña, A.L.V., Hatefi, A., 2016. The economics of malaria control and elimination: A systematic review. Malaria Journal 15. https://doi.org/10.1186/s12936-016-1635-5

Shretta, R., Baral, R., Avanceña, A.L.V., Fox, K., Dannoruwa, A.P., Jayanetti, R., Jeyakumaran, A., Hasantha, R., Peris, L., Premaratne, R., 2017. An investment case to prevent the reintroduction of malaria in sri lanka. The American Journal of Tropical Medicine and Hygiene 16–0209. https://doi.org/10.4269/ajtmh.16-0209

Vecchi, V., Hellowell, M., Gatti, S., 2013. Does the private sector receive an excessive return from investments in health care infrastructure projects? Evidence from the uk. Health Policy 110, 243–270. https://doi.org/10.1016/j.healthpol.2012.12.010

White, M.T., Conteh, L., Cibulskis, R., Ghani, A.C., 2011. Costs and cost-effectiveness of malaria control interventions - a systematic review. Malaria Journal 10, 337. https://doi.org/10.1186/1475-2875-10-337

WHO, 2015. Malaria profile: Mozambique.

Winkler, D., 2013. Potential and Actual FDI Spillovers in Global Value Chains.