

THE LANCET

Supplementary webappendix

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

Supplement to: Feachem RGA, Phillips AA, Hwang J, et al. Shrinking the malaria map: progress and prospects. *Lancet* 2010; published online Oct 29.
DOI:10.1016/S0140-6736(10)61270-6.

Web appendix

Contents

1. Goals and progress for the 32 malaria-eliminating countries
 - 1.1 Methods
 - 1.1.1 Table
 - 1.2 References

2. Comparing yesterday's and today's malaria-eliminating countries
 - 2.1 Methods
 - 2.2 List of search terms used
 - 2.3 List of search engines and online catalogues used
 - 2.4 Malaria elimination programs by year and real-GDP per capita
 - 2.4.1 Figure
 - 2.5 Malaria elimination programs by year and physician per 1000 persons
 - 2.5.1 Figure
 - 2.6 Table – Tabular data for the 50 historically successful and 49 historically unsuccessful malaria elimination programs, and the 32 current malaria-eliminating countries
 - 2.7 References

1. Goals and Progress for the 32 Malaria-Eliminating Countries

1.1 Methods

A review of country-level data was conducted to compile evidence in the process of categorizing the 32 malaria-eliminating countries. Information was gathered using the World Health Organization (WHO) World Malaria Report 2009, Malaria Elimination Group meeting presentations, Asia Pacific Malaria Elimination Network meeting presentations, Pacific Malaria Initiative Support Center meeting reports, internet search engines (Google Scholar, PubMed Central) searching specific country names, the WHO, AFRO, EMRO, EURO, PAHO, SEARO and WPRO websites, and the Global Fund to Fight AIDS, Tuberculosis and Malaria grant portfolio database. Feasibility rankings from paper two of this Series were strongly considered in this process as well.

Table 1.1.1: Goals and Progress for the 32 Malaria-Eliminating Countries	
Country	Malaria Elimination: Goals and Progress
Algeria	Algeria is considered by the World Health Organization (WHO) to be in the elimination phase and lies on the northernmost endemic margin of transmission. Thirty or fewer cases are reported annually and transmission is limited to small foci in oases with isolated outbreaks occurring in the southernmost areas of the country. ^{1,2}
Argentina	Argentina is considered by WHO to be in the pre-elimination phase and lies on the southernmost endemic margin of transmission. Argentina reported only 130 cases in 2008, occurring primarily along the northern border with Bolivia and Paraguay, and currently has programs underway to eliminate malaria. ^{1,3,4}
Azerbaijan	Azerbaijan is considered by WHO to be in the elimination phase and lies on the northernmost endemic margin of transmission. Azerbaijan began its elimination program in 2007 and reported 73 cases of malaria in 2008. ¹ Azerbaijan has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ^{5,6}
Bhutan ^a	Bhutan reported 960 cases in 2009, occurring primarily along the southern border with India. ⁷ Bhutan is a collaborating country in the Asia Pacific Malaria Elimination Network (APMEN) ⁸ and is currently developing an elimination strategy. ⁹ Bhutan has targeted one-third of its administrative districts for elimination by 2018. ⁹
Botswana	Botswana has experienced an 85% reduction in reported cases between 2000 and 2008 from 8,000 cases to 1,201 cases, and is currently working to achieve elimination by 2015. ^{1,10} Local malaria transmission occurs primarily in the northern half of the country. ¹¹ Botswana lies on the southernmost endemic margin of transmission and is a front-line country of the Elimination Eight (E8). ^{12,13}
Cape Verde	Cape Verde is an island nation with just 35 reported cases in 2008, with remaining cases occurring on only one of nine inhabited islands. ¹ Cape Verde is currently reorienting its national malaria strategic plan towards elimination with the goal to eliminate by 2015. ¹⁰
China	China lies on the northernmost endemic margin of transmission and has made significant progress in spatially progressive elimination. ¹⁴ China is a collaborating country in APMEN ⁸ and has a national elimination goal set for 2020. ¹⁵

Costa Rica	Costa Rica is currently pursuing spatially progressive elimination and has experienced a 50% reduction in reported cases between 2000 and 2008 from 1,879 cases to 966 cases with 80% of its remaining cases occurring in the eastern Caribbean low-land areas. ^{1,16} Costa Rica is working to eliminate malaria from all low-risk localities by 2015. ¹⁷
Dominican Republic	The Dominican Republic is an island nation that lies on the northernmost endemic margin of transmission and is currently working towards elimination. ¹⁸ In 2008, the Dominican Republic reported only 1,262 cases ¹ with a majority of cases occurring along the western border with Haiti and in the southern port cities. ¹⁹ The Carter Center, the Dominican Republic and Haiti are partnering to eliminate malaria by 2020 from the island of Hispaniola. ²⁰
DPRK (North Korea)	North Korea is considered by WHO to be in the pre-elimination phase and lies on the northernmost endemic margin of transmission. ¹ Current transmission levels are low and cases are primarily found in soldiers stationed at the Korean Demilitarized Zone (DMZ) near the southern border. ²¹ North Korea is a collaborating country in APMEN ⁸ and currently has programs underway to eliminate malaria. ⁵
El Salvador	El Salvador is considered by WHO to be in the pre-elimination phase and is currently pursuing spatially progressive elimination. ^{1,17} El Salvador has experienced a 95% reduction in reported cases between 2000 and 2008 from 745 cases to 33 cases. ^{1,5} El Salvador is working to eliminate malaria from all low-risk localities by 2015. ¹⁷
Georgia	Georgia is considered by WHO to be in the elimination phase and lies at the northernmost endemic margin of transmission. ¹ Georgia currently experiences very low malaria transmission with only 6 reported cases in 2008, with remaining cases concentrated in the eastern region along the border with Azerbaijan. ^{1,22} Georgia is currently implementing a nationwide malaria elimination program and has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ^{5,6}
Iran	Iran is considered by WHO to be in the pre-elimination phase and began its elimination program in 2004. ¹ Iran has experienced a 70% reduction in reported cases between 2000 and 2008 from 19,716 cases to 5,955 cases ¹ with remaining cases occurring along the borders with Afghanistan and Pakistan. ²³ Iran plans to eliminate malaria by 2015. ⁴
Iraq ^b	Iraq is considered by WHO to be in the elimination phase and began its elimination program in 2005. ¹ Iraq currently experiences very low malaria transmission with only six cases reported in 2008, with remaining cases occurring primarily along the northern border with Turkey. ^{1,24}
Kyrgyzstan	Kyrgyzstan is considered by WHO to be in the elimination phase and lies on the northernmost endemic margin of transmission. ¹ Kyrgyzstan experiences very low malaria transmission with only 18 cases

	reported in 2008, with remaining cases occurring primarily along the southwestern border with Tajikistan. ²⁵ Kyrgyzstan began its elimination program in 2006 and has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ^{5,6}
Malaysia	Malaysia is considered by WHO to be in the pre-elimination phase ¹ . Malaysia has experienced a 40% reduction in reported cases between 2000 and 2008 from 12,700 cases to 7,400 cases. ²⁶ East Malaysia, which shares a lengthy border with Indonesia, is responsible for over 80% of total malaria transmission. ¹ Malaysia is a collaborating country in APMEN ⁸ and has set a goal to eliminate malaria from Peninsular Malaysia by 2015 and from East Malaysia by 2020. ²⁶
Mexico	Mexico is considered by WHO to be in the pre-elimination phase and lies on the northernmost endemic margin of transmission. Mexico has experienced a 70% reduction in reported cases between 2000 and 2008 from 7,390 cases to 2,357 cases, with a majority of cases occurring along the southern border with Guatemala. ^{1,17}
Namibia ^c	Namibia lies on the southernmost endemic margin of transmission and has experienced a nearly 90% reduction in reported cases between 2001 and 2008 from 41,000 cases to 5,000 cases, with a majority of cases occurring primarily along the northern border with Angola. ^{1,27} Namibia is a front-line country of the E8 ^{12,13} and is currently working to achieve elimination by 2015. ¹⁰
Panama	Panama is currently pursuing spatially progressive elimination and has experienced a nearly 30% reduction in reported cases between 2000 and 2008 from 1,036 cases to 744 cases ¹ with more than 75% of cases occurring along the southeastern border with Columbia. ²⁸
Paraguay	Paraguay is considered by WHO to be in the pre-elimination phase and is currently working towards elimination. ¹ Paraguay has experienced an 80% reduction in reported cases between 2000 and 2008 from 6,853 cases to 1,341 cases ^{1,5} with more than 97% of cases occurring along the northeastern border with Brazil. ²⁹
Philippines	The Philippines is currently pursuing spatially progressive elimination and has successfully eliminated malaria in 25% of its provinces. ³⁰ The Philippines is a collaborating country in APMEN ⁸ and has a goal of national elimination by 2020. ³¹
Republic of Korea (South Korea)	South Korea is considered by WHO to be in the elimination phase and lies at the northernmost endemic margin of transmission. ¹ Transmission is concentrated in northern South Korea near the DMZ, occurring primarily in soldiers. ³² South Korea is a collaborating country in APMEN ⁸ and currently has programs underway to eliminate malaria by 2015. ^{5,33}

São Tomé and Príncipe	São Tomé and Príncipe is an island nation that has experienced a 95% reduction in reported cases between 2000 and 2008 from 31,975 cases to 1,572 cases. ^{1, 34, 35} São Tomé and Príncipe is currently working to achieve elimination by 2015. ¹⁰
Saudi Arabia	Saudi Arabia is considered by WHO to be in the elimination phase and began its elimination program in 2003. ¹ Saudi Arabia experienced a 90% reduction in reported cases between 1999 and 2008 from 13,166 cases to 1,491 cases with a majority of cases occurring along the southern border with Yemen. ^{1, 36} Saudi Arabia and other neighboring Arabian States are working to eliminate malaria from the Arabian Peninsula by 2020. ^{4, 37}
Solomon Islands ^d	The Solomon Islands lie on the southernmost endemic margin of transmission and are pursuing spatially progressive elimination with a goal for elimination in Temotu and Santa Isabel Provinces by 2016. ³⁸ Isabel Province has experienced a 96% reduction in reported cases between 2003 and 2009. ³⁹ The Solomon Islands is a collaborating country in APMEN ⁸ and has a national strategic plan for elimination. ⁴⁰
South Africa ^e	South Africa lies on the southernmost endemic margin of transmission and has experienced a nearly 90% reduction in reported cases between 2000 and 2008 from 64,000 cases to 8,000 cases, with remaining cases occurring primarily in the Limpopo Province along the border with Mozambique and Zimbabwe. ^{1, 27} South Africa is a front-line country of the E8 ^{12, 13} and is currently working to achieve elimination by 2015. ¹⁰
Sri Lanka	Sri Lanka is considered by WHO to be in the pre-elimination phase. Sri Lanka has experienced a 99% reduction in reported cases between 2000 and 2008 from more than 200,000 cases to less than 700 cases. ^{1, 41} Transmission in 2009 occurred predominately in four previously conflict-affected districts in the north with more than 80% of cases occurring in soldiers. Sri Lanka is a collaborating country in APMEN ⁸ and is currently working to achieve elimination by 2014. ⁴²
Swaziland	Swaziland lies on the southernmost endemic margin of transmission and has experienced a 95% reduction in reported cases between 2001 and 2008 from 1,395 cases to only 58 cases, with remaining cases occurring primarily in the Lubombo Province along the border with Mozambique. Swaziland is a front-line country of the E8. ^{12, 13} Swaziland has a national strategic plan for elimination and is currently working to achieve elimination by 2015. ⁴³
Tajikistan ^f	Tajikistan is considered by WHO to be in the elimination phase and lies on the northernmost endemic margin of transmission. ⁴ Tajikistan has experienced a 98% reduction in reported cases between 2000 and 2008 from 19,064 cases to 318 cases with remaining cases occurring along the southern border

	with Afghanistan. ^{1,44} Tajikistan has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ⁶
Turkey	Turkey is considered by WHO to be in the elimination phase and lies on the northernmost endemic margin of transmission. ¹ Turkey has experienced a 98% reduction in reported cases between 2000 and 2008 from 9,465 cases to 136 cases with remaining cases occurring in the southeast region. ^{1, 45} Turkey began its elimination program in 2008 and has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ^{5, 6}
Uzbekistan	Uzbekistan is considered by WHO to be in the elimination phase and lies on the northernmost endemic margin of transmission. ¹ Uzbekistan has experienced an 80% reduction in reported cases between 2000 and 2008 from 126 cases to 27 cases with remaining cases occurring along the southern and eastern borders with Afghanistan, Kyrgyzstan, and Tajikistan. ^{1, 46} Uzbekistan began its elimination program in 2008 and has signed "The Tashkent Declaration" with the goal to eliminate malaria in the region by 2015. ^{5, 6}
Vanuatu	Vanuatu lies on the southernmost endemic margin of transmission and has set a goal for elimination in the Tafea Province by 2016. ⁴⁷ Along with more than an 80% reduction in annual incidence from 2003 to 2009, ⁴⁸ Vanuatu has made significant progress in spatially progressive elimination by successfully eliminating transmission on Aneityum Island. ³⁸ Vanuatu is a collaborating country in APMEN ⁸ and has a national strategic plan for elimination. ⁴⁷

Table 1.1.1: a. Low *P_v* Operational Feasibility; b. Low *P_v* Operational Feasibility; c. Low *P_f* Technical Feasibility; d. Low *P_f* Operational, *P_v* Operational, *P_f* All Feasibility; e. Low *P_f* Technical Feasibility; f. Low *P_v* Operational Feasibility. * Rankings correspond with the relative feasibility assessment data presented in Paper Two of this series.⁴⁹ The 'Low' classification was derived by dividing the rankings of each country for the four feasibility categories (*P_f* Technical, *P_f* Operational, *P_f* All, and *P_v* Operational) into thirds: the top third (high), the middle third (middle), and the bottom third (low).

1.2 References

- [1] WHO. World Malaria Report 2009. Geneva: World Health Organization; 2009.
- [2] Boubidi SC, Gassen I, Khechache Y, et al. Plasmodium falciparum Malaria, Southern Algeria, 2007. *Emerg Infect Dis* 2010; **16**: 301-3.
- [3] Dantur Juri M, Zaidenberg M, Claps G, Santana M, Almiron W. Malaria transmission in two localities in north-western Argentina. *Malar J* 2009; **8**: 18.
- [4] WHO. Informal consultation on malaria elimination: setting up the WHO agenda. Geneva: World Health Organization; 2006.
- [5] WHO. Global malaria control and elimination: report of a technical review. Global Malaria Control and Elimination Meeting. Geneva: World Health Organization; 2008.
- [6] WHO/EURO. The Tashkent Declaration: "The Move from Malaria Control to Elimination" in the WHO European Region. World Health Organization Regional Office for Europe; 2006.
- [7] Bhutan - Round 7 Global Fund Proposal - Malaria. 2007. <http://portfolio.theglobalfund.org/Grant/Index/BTN-708-G05-M?lang=en>. (accessed on April 2, 2010).
- [8] APMEN. Asia Pacific Malaria Elimination Network. www.apmen.org. (accessed on February 3, 2010).
- [9] Lhazeen K. Updates on malaria elimination in Bhutan. Presentation at the 2nd Asia Pacific Malaria Elimination Network Meeting. Kandy, Sri Lanka: Vector-borne Disease Control Programme; 2010. <http://apmen.org/storage/apmen-ii/01Lhazeen.pdf> (accessed on March 3, 2010).
- [10] African Union. Fight Malaria: Africa goes from control to elimination by 2010. Advocacy Strategy Document. Johannesburg, South Africa: African Union; 2007 April 9-13.
- [11] MAP. The spatial distribution of Plasmodium falciparum malaria endemicity in Botswana. Malaria Atlas Project, 2009. http://www.map.ox.ac.uk/media/maps/pdf/mean/BWA_mean.pdf. (accessed on August 2, 2010).
- [12] The Elimination Eight (E8) Regional Initiative. The Global Health Group. <http://www.globalhealthsciences.ucsf.edu/GHG/elimination-eight.aspx>. (accessed on February 3, 2010).
- [13] Eight countries launch cross-border effort to eliminate malaria. 2009. http://globalhealthsciences.ucsf.edu/pdf/e8_press_release_mar0309.pdf. (accessed on March 5, 2010).

- [14] Tang L. China's elimination strategy. Presentation at the 4th Malaria Elimination Group meeting. Hainan, China: National Institute of Parasitic Diseases, China CDC; 2009.
- [15] China's National Malaria Elimination Strategy 2010 - 2020 (Preliminary). Chinese National Institute of Parasitic Diseases; 2010.
- [16] PAHO. Costa Rica - Informe de la Situacion del Paludismo en las Americas: Pan American Health Organization; 2008.
- [17] Rodriguez MH. Improving Malaria Control Towards Elimination in Mesoamerica. Presentation at the 4th Malaria Elimination Group meeting. Hainan, China; 2009.
- [18] Summary of the Ninth Meeting of the ITFDE (II). 2006.
<http://www.cartercenter.org/documents/2435.pdf>. (accessed on March 25, 2010).
- [19] PAHO. Dominican Republic - Informe de la Situacion del Paludismo en las Americas: Pan American Health Organization; 2008.
- [20] Carter launches US\$19.9M Dominican-Haiti program to eradicate malaria. Dominican Today, 2009. <http://www.dominicantoday.com/dr/local/2009/10/8/33489/Carter-launches-US199M-Dominican-Haiti-program-to-eradicate-malaria>. (accessed on February 15, 2010).
- [21] Malaria situation in SEAR countries. World Health Organization Regional Office for South-East Asia 2008. http://www.searo.who.int/en/Section10/Section21/Section340_4020.htm. (accessed on February 15, 2010).
- [22] Georgia - Round 6 Global Fund proposal: Consolidation of the results achieved: containing further an epidemic of malaria. The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2007. <http://portfolio.theglobalfund.org/Grant/Index/GEO-607-G04-M?lang=en>. (accessed on August 2, 2010).
- [23] Iran - Round 7 Global Fund proposal: Malaria intensified control in high burden provinces of South Eastern Iran. The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2008. <http://portfolio.theglobalfund.org/Grant/Index/IRN-708-G02-M?lang=en>. (accessed on August 2, 2010).
- [24] Epidemiological situation: Iraq. World Health Organization Office of the Eastern Mediterranean Region. <http://www.emro.who.int/rbm/CountryProfiles-irq.htm>. (accessed on February 15, 2010).
- [25] Kyrgyzstan - Round 8 Global Fund proposal: Cessation of local transmission and transition to elimination of malaria in the Kyrgyz Republic. The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2010. <http://portfolio.theglobalfund.org/Grant/Index/KGZ-809-G06-M?lang=en>. (accessed on August 2, 2010).
- [26] Rahim AA. Updates on Malaria Control Activities in Malaysia. Presentation at the 2nd Asia Pacific Malaria Elimination Meeting. Kandy, Sri Lanka; 2010.

- [27] Hay SI, Guerra CA, Gething PW, et al. A world malaria map: Plasmodium falciparum endemicity in 2007. *PLoS Med* 2009;6:e1000048.
- [28] PAHO. Panama - Informe de la Situacion del Paludismo en las Americas: Pan American Health Organization; 2008.
- [29] PAHO. Paraguay - Informe de la Situacion del Paludismo en las Americas: Pan American Health Organization; 2008.
- [30] Philippines: Six provinces declared malaria-free. IRIN News, 2008. <http://www.irinnews.org/Report.aspx?ReportId=77917>. (accessed on February 15, 2010).
- [31] 13th ACTMalaria Executive Board & Partners Meeting (meeting presentation); 2009.
- [32] Yeom JS, Kim TS, Oh S, et al. Plasmodium vivax malaria in the Republic of Korea during 2004-2005: changing patterns of infection. *Am J Trop Med Hyg* 2007; **76**: 865-8.
- [33] Lee Han-Sung. Malaria in the Republic of Korea. Presentation at the 2nd Asia Pacific Malaria Elimination Meeting. Kandy, Sri Lanka; 2010. <http://apmen.org/storage/apmen-ii/03Lee.pdf> (accessed on March 3, 2010).
- [34] Lee PW, Liu CT, Rampao HS, do Rosario VE, Shaio MF. Pre-elimination of malaria on the island of Principe. *Malar J* 2010; **9**: 26.
- [35] Teklehaimanot HD, Teklehaimanot A, Kiszewski A, Rampao HS, Sachs JD. Malaria in Sao Tome and Principe: on the brink of elimination after three years of effective antimalarial measures. *Am J Trop Med Hyg* 2009; **80**: 133-40.
- [36] The spatial distribution of Plasmodium falciparum malaria endemicity in Saudi Arabia. 2009. http://www.map.ox.ac.uk/media/maps/pdf/mean/SAU_mean.pdf. (accessed on August 2, 2010).
- [37] WHO/EMRO. Malaria elimination in the Eastern Mediterranean Region: vision, requirements and strategic outline: World Health Organization Regional Office for the Eastern Mediterranean; 2008.
- [38] PacMISC. Towards Progressive Malaria Elimination in the SW Pacific: National Malaria Elimination Strategy Guidance Document, Solomon Islands and Vanuatu: Pacific Malaria Initiative Support Center; 2009 .
- [39] PacMI. Fifth Malaria Reference Group Meeting: Report of the Meeting. Brisbane, Australia: Pacific Malaria Initiative; 2010.
- [40] National Malaria Strategic Vision 2007-2016. Solomon Islands; 2007: 24.
- [41] Rajakaruna RS, Alifrangis M, Amerasinghe PH, Konradsen F. Pre-elimination stage of malaria in Sri Lanka: assessing the level of hidden parasites in the population. *Malar J* 2010; **9**: 25.
- [42] Galappaththy GNL. Case Study: Sri Lanka. Presentation at the 2nd Asia Pacific Malaria Elimination Network meeting. Kandy, Sri Lanka: National Malaria Control Programme; 2010.

- [43] Swaziland - Round 8 Global Fund Proposal The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2008. <http://portfolio.theglobalfund.org/Country/Index/SWZ?lang=en>. (accessed on March 25, 2010).
- [44] Tajikistan - Round 5 Global Fund proposal: Malaria control in Tajikistan. The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2006. <http://portfolio.theglobalfund.org/Grant/Index/TAJ-506-G04-M?lang=en>. (accessed on August 2, 2010).
- [45] Malaria in Turkey. Ministry of Health. <http://www.saglik.gov.tr/EN/BelgeGoster.aspx?17A16AE30572D313AAF6AA849816B2EFB0B2BEF9CE0ECC93>. (accessed on August 2, 2010).
- [46] Uzbekistan - Round 8 Global Fund proposal - Strengthening of the achieved results and supporting measures on elimination of malaria in Uzbekistan. The Global Fund to Fight AIDS, Tuberculosis and Malaria, 2009. <http://portfolio.theglobalfund.org/Grant/Index/UZB-809-G04-M?lang=en>. (accessed on August 2, 2010).
- [47] National Malaria Strategic Vision 2007-2016. Vanuatu; 2007:17.
- [48] Vestergaard L. From passive to active case detection for malaria elimination in Vanuatu Presentation at the 2nd Asia Pacific Malaria Elimination Network Meeting. Kandy, Sri Lanka: Malaria and Other Vectorborne and Parasitic Diseases (MVP); 2010.
- [49] Tatem AJ, Smith DL, Gething PW, Kabaria CW, Snow RW, Hay SI. Ranking Elimination Feasibility Among Malaria Endemic Countries. *Lancet* 2010.

2. Comparing Yesterday's and Today's Malaria-Eliminating Countries

2.1 Methods

A thorough literature review was used to compile a list of 50 historically successful and 49 historically unsuccessful malaria elimination programs (MEPs), and the 32 current malaria-eliminating countries. More than 99 national MEPs were identified in the literature review, however, some programs did not operationalize elimination as a policy (examples include Cambodia, Egypt, Saudi Arabia and Vietnam). Such programs were excluded from the analysis. Many faltering elimination programs unofficially reverted to control strategies while maintaining the language of elimination in public documents for years after the operational shift occurred. This generally entailed the abandonment of costly measures such as local foci monitoring and individual case-management. Programs were defined as unsuccessful if local transmission was never interrupted and the program either terminated, reverted to a control strategy, or was documented as financially, technically, or administratively unable to continue pursuing elimination beyond a certain date. Successful programs were defined as those where local transmission was interrupted and no local cases were reported for a period of years.

2.2 List of search terms used

The literature review used search terms: “malaria”, “eradication”, “elimination”, “national control program”, “national control programme”, “MEP”, “NMCP”, “NCP”, “local transmission”, “transmission interrupted”, specific country names, specific years associated with programs, specific article titles and author names taken from bibliographies.

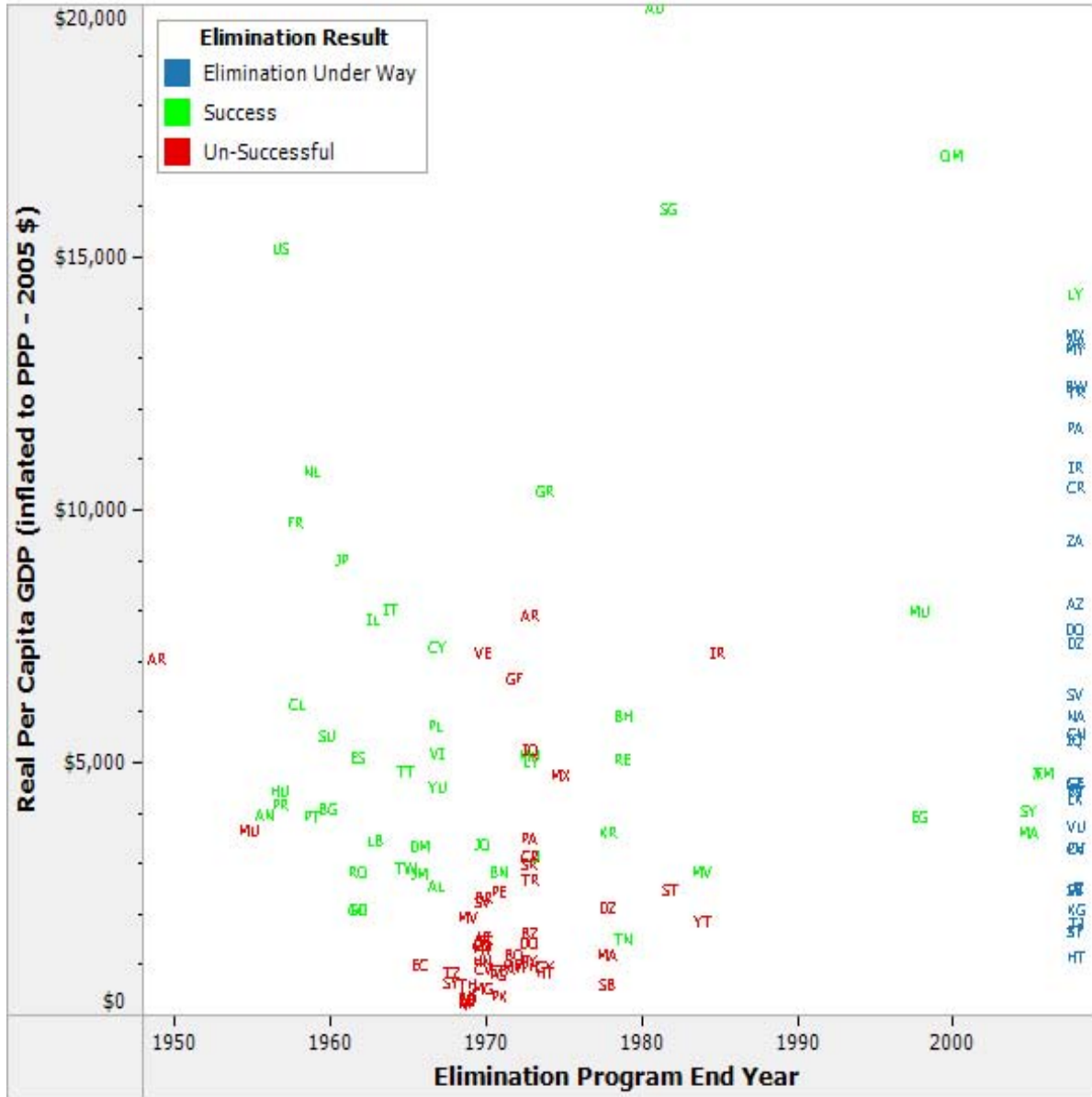
2.3 List of search engines and online catalogues used

The following search engines and research databases were used: EBSCO-Academic Search Premier, ProQuest Research Library, Elsevier – ScienceDirect, Wiley Interscience, Springer-LINK, Google Scholar, PubMed Central, Public Library Of Science (PLoS), BioMed Central, Washington Regional Library Consortium ‘Aladin’ Catalogue, the WHO, AFRO, EMRO, EURO, PAHO, SEARO AND WPRO websites and historical archives, and the Roll Back Malaria online document library.

2.4 Malaria elimination programs by year and real-GDP per capita

From 1969 to 2008, the real-per-capita gross domestic product (GDP) of countries was determined using the World Development Indicators Database series for real-per-capita-GDP measured in 2000 and 2005 - international-purchasing power parity (PPP)-dollars. For years prior to 1969 and for territories not included in the WDI series, the Organization for Economic Co-operation and Development (OECD) 2009 World Economy Historical Statistics dataset and the 1995 edition of the OECD World Economy: Historical Statistics were used to determine the real-per-capita GDP of each country. Real-per-capita-GDP figures are all measured for the year in which the program ended. GDP units have been inflated to 2005-international-PPP-dollars using the IMF's 2009 World Economic Outlook Database GDP deflator values so that purchasing power can be compared across time.

Figure 2.4.1. Elimination Program End Year vs. Real Per Capita GDP (inflated to PPP – 2005 \$). Countries are labeled with their 2-letter ISO country code (see Table 2.6 for country code information).

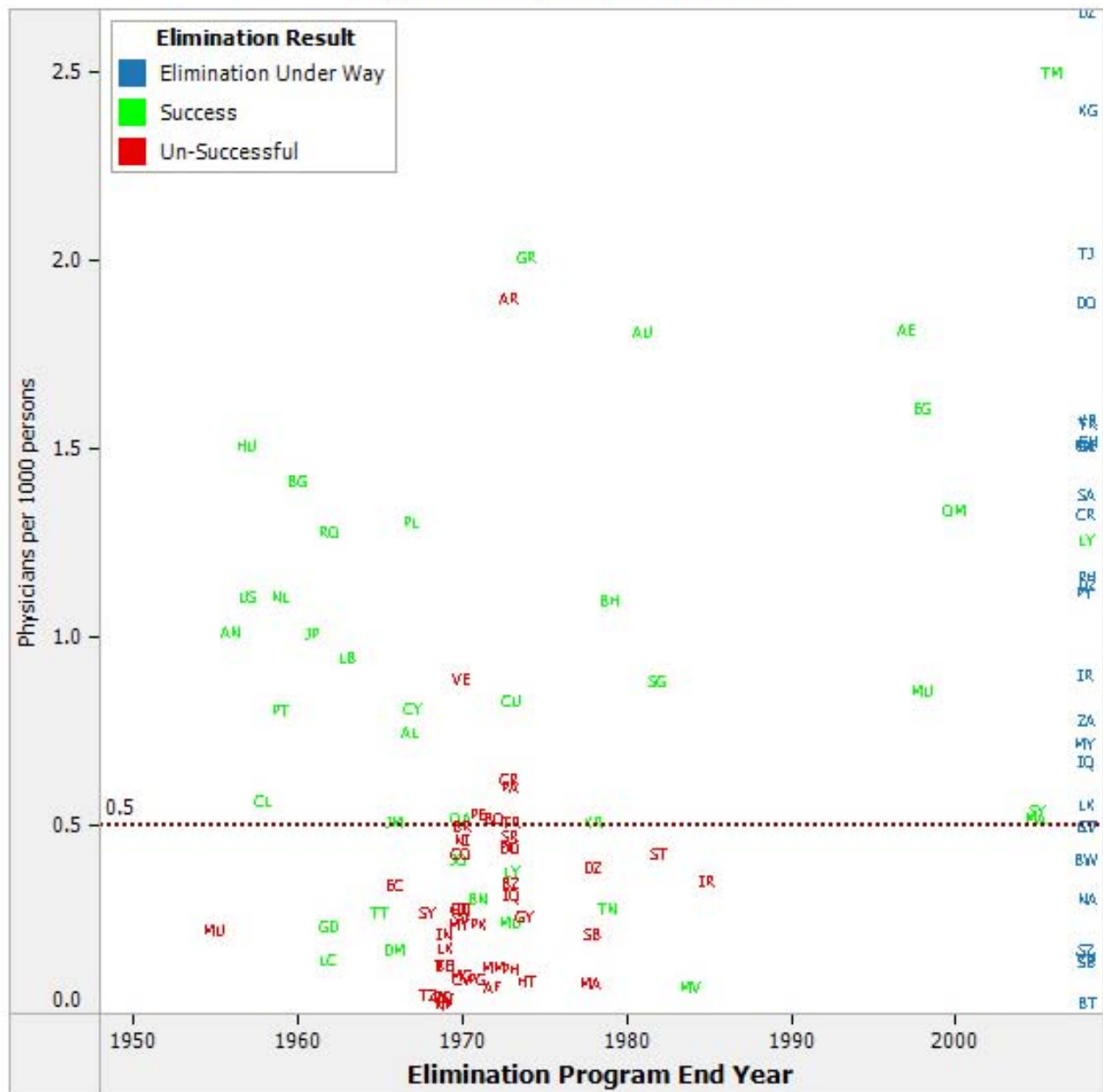


Elimination Program End Year vs. Real Per Capita GDP (inflated to PPP - 2005 \$). Countries are labelled with their 2-letter ISO country code.

2.5 Malaria elimination programs by year and physicians per 1000 persons

Although the authors are aware that physicians-per-thousand-persons is not an ideal proxy indicator for health system status, this indicator was used because it is the only cross-country measure of health system status available over the long historical time frame of this data set. Physicians-per-thousand-persons was determined from the World Development Indicator Database series. As this indicator is recorded infrequently for many of the countries concerned, the nearest available value was used.

Figure 2.5.1. Elimination Program End Year vs. Physicians per 1000 persons. Countries are labeled with their 2-letter ISO country code (see Table 2.6 for country code information).



Elimination Program End Year vs. Physicians per 1000 persons. Countries are labelled with their 2-letter ISO country code.

Table 2.6. Tabular data for the 50 historically successful and 49 historically unsuccessful malaria elimination programs, and the 32 current malaria-eliminating countries.

Country	ISO Country Code	MEP End Year	Real Per Capita GDP at time of elimination program (end year inflated to PPP - 2005 \$)	Physicians per 1000 persons at time of elimination program (end year)	Elimination Result
Algeria	DZ	2008	\$7,310	1.130	Under Way
Argentina	AR	2008	\$13,248	-----	Under Way
Azerbaijan	AZ	2008	\$8,102	3.630	Under Way
Bhutan	BT	2008	\$4,395	0.020	Under Way
Botswana	BW	2008	\$12,378	0.400	Under Way
Cape Verde	CV	2008	\$3,239	0.490	Under Way
China	CN	2008	\$5,511	1.510	Under Way
Costa Rica	CR	2008	\$10,390	1.320	Under Way
Dominican Republic	DO	2008	\$7,595	1.880	Under Way
El Salvador	SV	2008	\$6,280	1.500	Under Way
Georgia	GE	2008	\$4,526	4.650	Under Way
Iran	IR	2008	\$10,783	0.890	Under Way
Iraq	IQ	2008	\$5,388	0.660	Under Way
Kyrgyz Republic	KG	2008	\$2,023	2.390	Under Way
Malaysia	MY	2008	\$13,139	0.710	Under Way
Mexico	MX	2008	\$13,407	1.500	Under Way
Namibia	NA	2008	\$5,863	0.300	Under Way
North Korea	KP	2008	\$1,666	3.290	Under Way
Panama	PA	2008	\$11,558	1.500	Under Way
Paraguay	PY	2008	\$4,353	1.110	Under Way
Philippines	PH	2008	\$3,244	1.150	Under Way
São Tomé and Príncipe	ST	2008	\$1,607	0.490	Under Way
Saudi Arabia	SA	2008	\$22,110	1.370	Under Way

Solomon Islands	SB	2008	\$2,413	0.130	Under Way
South Africa	ZA	2008	\$9,343	0.770	Under Way
South Korea	KR	2008	\$25,498	1.570	Under Way
Sri Lanka	LK	2008	\$4,215	0.550	Under Way
Swaziland	SZ	2008	\$4,555	0.160	Under Way
Tajikistan	TJ	2008	\$1,761	2.010	Under Way
Turkey	TR	2008	\$12,264	1.560	Under Way
Uzbekistan	UZ	2008	\$2,455	2.650	Under Way
Vanuatu	VU	2008	\$3,677	0.140	Under Way
Netherland Antilles	AN	1956	\$3,930	1.007	Success
Hungary	HU	1957	\$4,389	1.500	Success
Puerto Rico	PR	1957	\$4,111	-----	Success
United States	US	1957	\$15,123	1.100	Success
Chile	CL	1958	\$6,082	0.559	Success
France (Corsica)	FR	1958	\$9,677	-----	Success
Netherlands	NL	1959	\$10,715	1.100	Success
Portugal	PT	1959	\$3,869	0.800	Success
Bulgaria	BG	1960	\$4,032	1.405	Success
USSR	SU	1960	\$5,464	-----	Success
Japan	JP	1961	\$8,934	1.000	Success
Grenada	GD	1962	\$2,039	0.222	Success
Romania	RO	1962	\$2,780	1.269	Success
Saint Lucia	LC	1962	\$2,034	0.139	Success
Spain	ES	1962	\$5,063	-----	Success
Israel	IL	1963	\$7,783	2.500	Success
Lebanon	LB	1963	\$3,405	0.938	Success
Italy	IT	1964	\$7,970	-----	Success
Taiwan	TW	1965	\$2,848	-----	Success
Trinidad and Tobago	TT	1965	\$4,754	0.262	Success

Dominica	DM	1966	\$3,274	0.161	Success
Jamaica	JM	1966	\$2,737	0.502	Success
Albania	AL	1967	\$2,498	0.739	Success
Cyprus	CY	1967	\$7,238	0.802	Success
Poland	PL	1967	\$5,682	1.300	Success
Virgin Islands (US)	VI	1967	\$5,118	-----	Success
Yugoslavia	YU	1967	\$4,476	-----	Success
Jordan	JO	1970	\$3,318	0.404	Success
Qatar	QA	1970	\$45,923	0.513	Success
Brunei	BN	1971	\$2,769	0.300	Success
Cuba	CU	1973	\$3,109	0.822	Success
Libya	LY	1973	\$4,954	0.368	Success
Mauritius	MU	1973	\$5,096	0.235	Success
Greece	GR	1974	\$10,328	2.000	Success
South Korea	KR	1978	\$3,570	0.500	Success
Bahrain	BH	1979	\$5,847	1.087	Success
Reunion	RE	1979	\$5,006	-----	Success
Tunisia	TN	1979	\$1,460	0.271	Success
Australia	AU	1981	\$19,884	1.800	Success
Singapore	SG	1982	\$15,894	0.877	Success
Maldives	MV	1984	\$2,769	0.065	Success
United Arab Emirates	AE	1997	\$43,909	1.810	Success
Egypt	EG	1998	\$3,877	1.600	Success
Mauritius	MU	1998	\$7,925	0.850	Success
Oman	OM	2000	\$16,950	1.330	Success
Morocco	MA	2005	\$3,554	0.510	Success
Syria	SY	2005	\$4,002	0.530	Success
Armenia	AM	2006	\$4,728	3.700	Success
Turkmenistan	TM	2006	\$4,753	2.490	Success

Libya	LY	2008	\$14,237	1-250	Success
Argentina	AR	1949	\$6,990	-----	Un-Successful
Mauritius	MU	1955	\$3,582	0-215	Un-Successful
Ecuador	EC	1966	\$952	0-335	Un-Successful
Syria	SY	1968	\$611	0-259	Un-Successful
Tanzania (Zanzibar)	TZ	1968	\$777	0-044	Un-Successful
Bangladesh	BD	1969	\$297	0-119	Un-Successful
India	IN	1969	\$235	0-205	Un-Successful
Indonesia	ID	1969	\$251	0-037	Un-Successful
Maldives	MV	1969	\$1,870	0-033	Un-Successful
Nepal	NP	1969	\$160	0-019	Un-Successful
Sri Lanka	LK	1969	\$376	0-169	Un-Successful
Thailand	TH	1969	\$538	0-121	Un-Successful
Brazil	BR	1970	\$2,262	0-492	Un-Successful
Cape Verde	CV	1970	\$857	0-082	Un-Successful
Colombia	CO	1970	\$1,350	0-420	Un-Successful
El Salvador	SV	1970	\$2,185	0-243	Un-Successful
Guatemala	GT	1970	\$1,422	0-274	Un-Successful
Honduras	HN	1970	\$1,005	0-269	Un-Successful
Madagascar	MG	1970	\$458	0-097	Un-

					Successful
Malaysia (Sabah)	MY	1970	\$1,247	0.232	Un-Successful
Nicaragua	NI	1970	\$1,474	0.453	Un-Successful
Venezuela	VE	1970	\$7,097	0.883	Un-Successful
Ethiopia	ET	1971	\$840	0.012	Un-Successful
Pakistan	PK	1971	\$314	0.232	Un-Successful
Papua New Guinea	PG	1971	\$747	0.086	Un-Successful
Peru	PE	1971	\$2,376	0.521	Un-Successful
Afghanistan	AF	1972	\$872	0.065	Un-Successful
Bolivia	BO	1972	\$1,134	0.509	Un-Successful
Burma	MM	1972	\$890	0.114	Un-Successful
French Guiana	GF	1972	\$6,611	-----	Un-Successful
Argentina	AR	1973	\$7,853	1.892	Un-Successful
Belize (British Honduras)	BZ	1973	\$1,567	0.342	Un-Successful
Costa Rica	CR	1973	\$3,106	0.614	Un-Successful
Dominican Republic	DO	1973	\$1,377	0.435	Un-Successful
Iraq	IQ	1973	\$5,198	0.309	Un-Successful
Panama	PA	1973	\$3,450	0.597	Un-Successful
Paraguay	PY	1973	\$1,039	0.439	Un-Successful
Philippines	PH	1973	\$922	0.113	Un-

					Successful
Surinam	SR	1973	\$2,944	0.465	Un-Successful
Turkey	TR	1973	\$2,616	0.500	Un-Successful
Guyana (British Guiana)	GY	1974	\$919	0.249	Un-Successful
Haiti	HT	1974	\$795	0.081	Un-Successful
Mexico	MX	1975	\$4,689	-----	Un-Successful
Algeria	DZ	1978	\$2,089	0.380	Un-Successful
Morocco	MA	1978	\$1,133	0.076	Un-Successful
Solomon Islands	SB	1978	\$556	0.205	Un-Successful
Sao Tome and Principe	ST	1982	\$2,430	0.419	Un-Successful
Mayotte	YT	1984	\$1,791	-----	Un-Successful
Iran	IR	1985	\$7,131	0.347	Un-Successful

2.7 References

African Union. 2007. Fight Malaria: Africa Goes from Control to Elimination by 2010. Advocacy Strategy Document, African Union Launch of the Africa Malaria Elimination Campaign during the 3rd Session of the AU Conference of Ministers of Health; 2007 April 9-13; Johannesburg, South Africa: 3.

Brown A, Haworth J, Zahar A. Malaria Eradication and Control From a Global Standpoint. *Journal of Medical Entomology* 1976; **13**:1-25.

Bryan J, Foley D, Sutherst R. Malaria transmission and climate change in Australia. *The Medical Journal of Australia* 1996; **164**: 345-347.

Carter E. God Bless General Peron: DDT and the Endgame of Malaria Eradication in Argentina in the 1940s. *Journal of the History of Medicine and Allied Sciences* 2009; **64**: 78-122.

Cedeño J. Rainfall and flooding in the Guayas river basin and its effect on the incidence of malaria 1982 to 1985. *Disasters* 1986; **10**: 107-111.

CIA World Fact Book (2008). Central Intelligence Agency: Washington. Available at: <https://www.cia.gov/library/publications/the-world-factbook/index.html>.

Coura J, Suárez-Mutis M, Ladeia-Andrade S. A new challenge for malaria control in Brazil: asymptomatic Plasmodium infection - A Review. *Departamento de Medicina Tropical, Instituto Oswaldo Cruz- Fiocruz* 2006; **101**: 233.

Cueto M. Cold War. Deadly Fevers: Malaria Eradication in Mexico, 1955–1975. Washington D.C.: Woodrow Wilson Center Press and Baltimore: Johns Hopkins University Press; 2007: 154.

Deressa W, Dereje O, Chibsa S. The Retirement of Malaria Control Workers as a Critical Problem for Vector Control in Oromia, Ethiopia. *Ethiopian Journal of Health and Development* 2003; **17**:79-83.

Espino F, Beltran M, Carisma B. Malaria control through municipalities in the Philippines: struggling with the mandate of decentralized health programme management. *The International Journal of Health Planning and Management* 2004; **19**: S155-S166.

Gagnon A, Smoyer-Tomic K, Bush A. The El Niño Southern Oscillation and malaria epidemics in South America. *International Journal of Biometeorology* 2002; **46**: 81–89.

Garcia-Martin G. Status of Malaria Eradication in the Americas. *The American Society of Tropical Medicine and Hygiene* 1972; **21**: 617.

Gigliolo G, Chen W, Howell P, Marchant D. Malaria Eradication under Continental Conditions in Guyana. *W.I. Medical Journal* 1974; **25**; 33.

Gramiccia G, Beales P. The recent history of malaria control and eradication. In: *Malaria Principles and Practice of Malariology*. Volume 2. Edited by: W. H. Wernsdorfer and I. McGregor. Edinburgh, Churchill Livingstone; 1988: 1335-1378.

Hagmann R, Charlwood D, Gil V, Ferreira C, Rosário V, Smith T. Malaria and its possible control on the island of Príncipe. *Malar J* 2003; **2**: 15.

Hammadi D, Boubidi SC, Chaib SE, Saber A, Khechache Y, Gasmi M, Harrat Z. Malaria in Algerian Sahara. *Bull Soc Pathol Exot* 2009; **102**: 185-92.

Hay et al. Measuring Malaria Endemicity from Intense to Interrupted Transmission. *Lancet Infectious Disease* 2008; **8**: 369-378.

In-Sok Y. The Return of Malaria in Modern Korea. In: Session 46, XIV International Economic History Congress; Helinski: 2006.

International Monetary Fund. World Economic Outlook, April 2008 Edition. <http://www.imf.org/external/pubs/ft/weo/2008/01/weodata/index.aspx>. (accessed on March 2009).

Julvez J, Galtier J, Mouchet J. Integrated Malaria Control Achieves Results in Mayotte. *World Health Forum* 1989; **10**: 213-218.

Kano S, M Kimura. Trends in malaria cases in Japan. *Acta Tropica* 2004; **89**:271-278.

Kleinschmidt I, Torrez M, Schwabe C, Benavente L, Seocharan I, Jituboh D, Nseng G, Sharpe B. Influencing the Effectiveness of Malaria Control in Bioko Island, Equatorial Guinea. *Am J Trop Med Hyg* 2007; **76**: 1027–1032.

- Kraza I, EMRO. Roll Back Malaria Presentation: Malaria in Libyan Jamahirya. Damascus: June 2005. Available at: http://www.emro.who.int/rbm/presentations/LIBYA_DAM_2005.ppt. (accessed March 2009).
- Maddison A. The World Economy: Historical Statistics. OECD Development Centre; Paris, France: 2003. <http://www.ggdc.net/maddison> (accessed March 2009).
- Malaria Elimination Initiative. Global Health Group. San Francisco: University of California, San Francisco. <http://www.malariaeliminationgroup.org/resources/elimination-countries> (accessed March 2009).
- Mauritius Ministry of Health. History of Malaria in Mauritius. Beau Bassin, Mauritius: Mauritius Ministry of Health. January 28th, 2008. Available at: <http://www.gov.mu/portal/goc/moh/file/mal-history.pdf>.
- Morocco Ministry of Health & WHO – EMRO. Malaria Elimination Strategy in Morocco. Geneva, Switzerland: WHO, 2007. Available at: <http://www.emro.who.int/RBM/MoroccoStrategicPlanEn.pdf>
- Oaks S, Mitchell V, Pearson G, Carpenter C, editors. Malaria: Obstacles and Opportunities, A Report of the Committee for the Study on Malaria Prevention and Control: Status Review and Alternative Strategies. Institute of Medicine, Division of International Health: National Academies of Sciences, Washington DC; 1991:44.
- Opeskin B. Malaria in Pacific Populations. *Journal of Population Research* 2009; **26**: 189.
- Otten M, Aregawi M, Were W, Karema C, Medin A, Bekele W, Jima D, Gausi K, Komatsu R, Korenromp E, Daniel Low-Beer D, Grabowsky M. Initial evidence of reduction of malaria cases and deaths in Rwanda and Ethiopia due to rapid scale-up of malaria prevention and treatment. *Malaria Journal* 2009; **8**:14.
- PAHO. Review of Mortality and Morbidity in English Speaking Caribbean. Epidemiological Bulletin of PAHO 1981; **2**: 3 (table 1).
- PAHO. Chapter 6: Prevencion, Erradicacion y Control de Enfermedades Transmisiblies. In: Cien Anos de Cooperacion al Peru 1902 – 2002; 2003: 161.
- Roberts D, Vanzie E, Bangs M, Grieco J, Lenares H, Hshieh P, Rejmankova E, Manguin S, Andre R, Polanco J. Role of residual spraying for malaria control in Belize. *Journal of Vector Ecology* 2002; **63**.
- Scholtens R, Kaiser R, Langmuir A. An epidemiologic examination of the strategy of malaria eradication. *Int J Epid* 1972; **1**: 15–24.
- Schwartz E, Pene H, Issa S, Golenser J. An Overview of the Malaria Situation in Zanzibar. *Journal of Community Health* 1997; **22**: 37.
- Taleo K, George-Kalkoa M, Yamar S, Kobayakawa T, Bjorkman A. Malaria eradication on islands. *Lancet* 2000; **356**: 1560.
- WHO. Malaria Eradication and Other anti-Malaria Activities. *WHO Chronicle* 1973; **27**: 516-524.
- WHO. Global Malaria Control and Elimination: report of a technical review. World Health Organization: Geneva, Switzerland, 17 - 18 January, 2008: 20.

WHO, UNICEF. World Malaria Report 2005. Monitoring and Evaluation Country Profile: Iran (Islamic Republic of). Available at: <http://rbm.who.int/wmr2005/profiles/iran.pdf>

WHO – AFRO. Implementation of Indoor Residual Spraying of Insecticides for Malaria Control in the WHO African Region Report. Vector Biology and Control Unit, Division of Healthy Environments and Sustainable Development, World Health Organization for Africa: November 2007.

WHO. Table 3: World Health Organization Official Register of Places Where Malaria Eradication Has Been Achieved. *World Health Statistics Quarterly* 1984; **37**: 146.

WHO - SEAR. Malaria Situation in SEAR Countries: Maldives Country Profile. Regional Office for South-East Asia; 14 January 2009.

http://www.searo.who.int/EN/Section10/Section21/Section340_4023.htm.

WHO – EMRO. Collaborative Program on Disease Surveillance 2004: WHO Country Office in Jordan.

<http://www.emro.who.int/jordan/CollaborativeProg-DiseaseSurveillance.htm>.

WHO and UNICEF. World Malaria Report 2005. Monitoring and Evaluation Country Profile: Republic of Korea 2005. <http://rbm.who.int/wmr2005/profiles/republicofkorea.pdf>.

WHO. Informal Consultation on Malaria Elimination: Setting up the WHO Agenda. 25-26 February 2006; Tunis: 56. <http://apps.who.int/malaria/docs/malariaeliminationagenda.pdf>.

WHO. Republic of Mauritius: Country Cooperation Strategy 2004-2007; 16.

http://www.who.int/countryfocus/cooperation_strategy/ccs_mus_en.pdf.

World Bank. World Development Indicators 2008 Database. www.data.worldbank.org. (accessed on: February 1, 2009).

Yekutieli P. Eradication of Infectious Diseases: A Critical Study. New York: Karger; 1980, 71.

Zigas V, Rodriguez R. Problems Facing Malaria Eradication Program in the Territory of Papua and New Guinea. *Tropical and Geographical Medicine* 1972; **24**: 95-99.