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The "dynamic epidemiology" of malaria elimination in El Salvador: the role of program decentralization, stratification, and timely treatment in the rapid and durable decline in malaria incidence since the early 1980s

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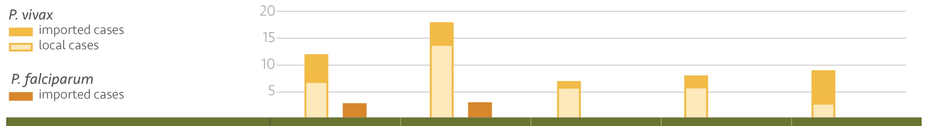
Background

El Salvador is currently considered to be in the elimination stage, with only nine cases of *Plasmodium vivax* reported in 2015 among its population of 6.1 million (6 imported, 3 autochthonous). The last case of locally transmitted *P. falciparum* in El Salvador was recorded in 1995, and the last recorded death occurred in 1984.

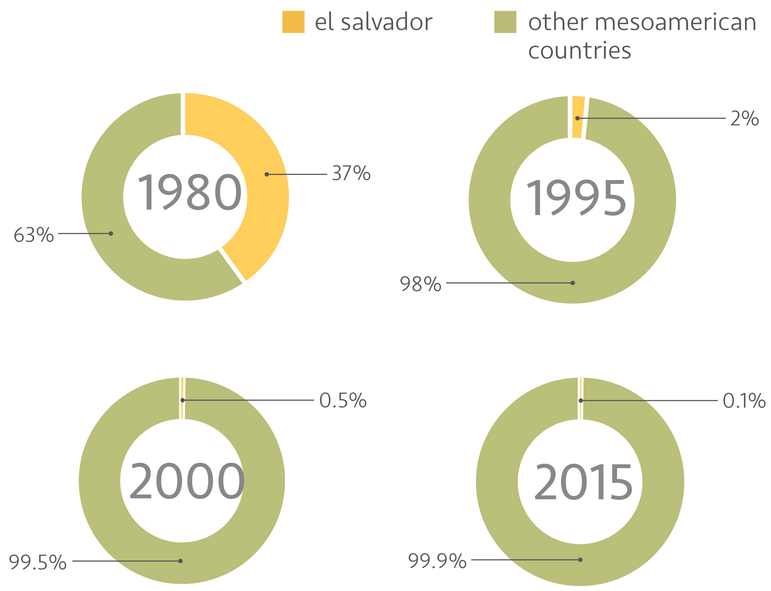
Figure 1. Classification of malaria cases in El Salvador, 2011–2015
Data provided by the National Vector Control Program, El Salvador



	2011	2012	2013	2014	2015
p. vivax	12	18	7	8	9
p. falciparum	3	3	0	0	0
total recorded cases	**15**	**21**	**7**	**8**	**9**

In 1980, the country contributed 37% of all reported cases in the region; today, it contributes less than 0.1%.

Figure 2. Proportion of El Salvador's contribution to malaria cases in Mesoamerica



El Salvador's divergence from the malaria trajectory of its neighbors began in the early 1980s. Yet El Salvador and its neighbors share a similar climate, malaria vector characteristics, topography, and, until the early 1980s, experienced similar cyclical patterns of malaria transmission.

Figure 3. Confirmed malaria cases in El Salvador, Guatemala, and Honduras, 1961–2014

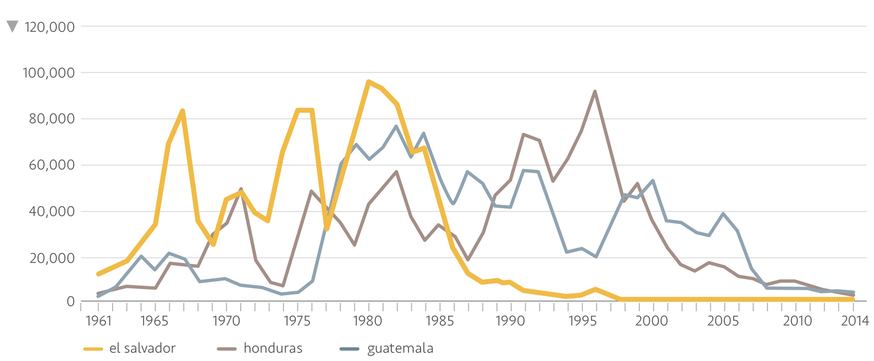
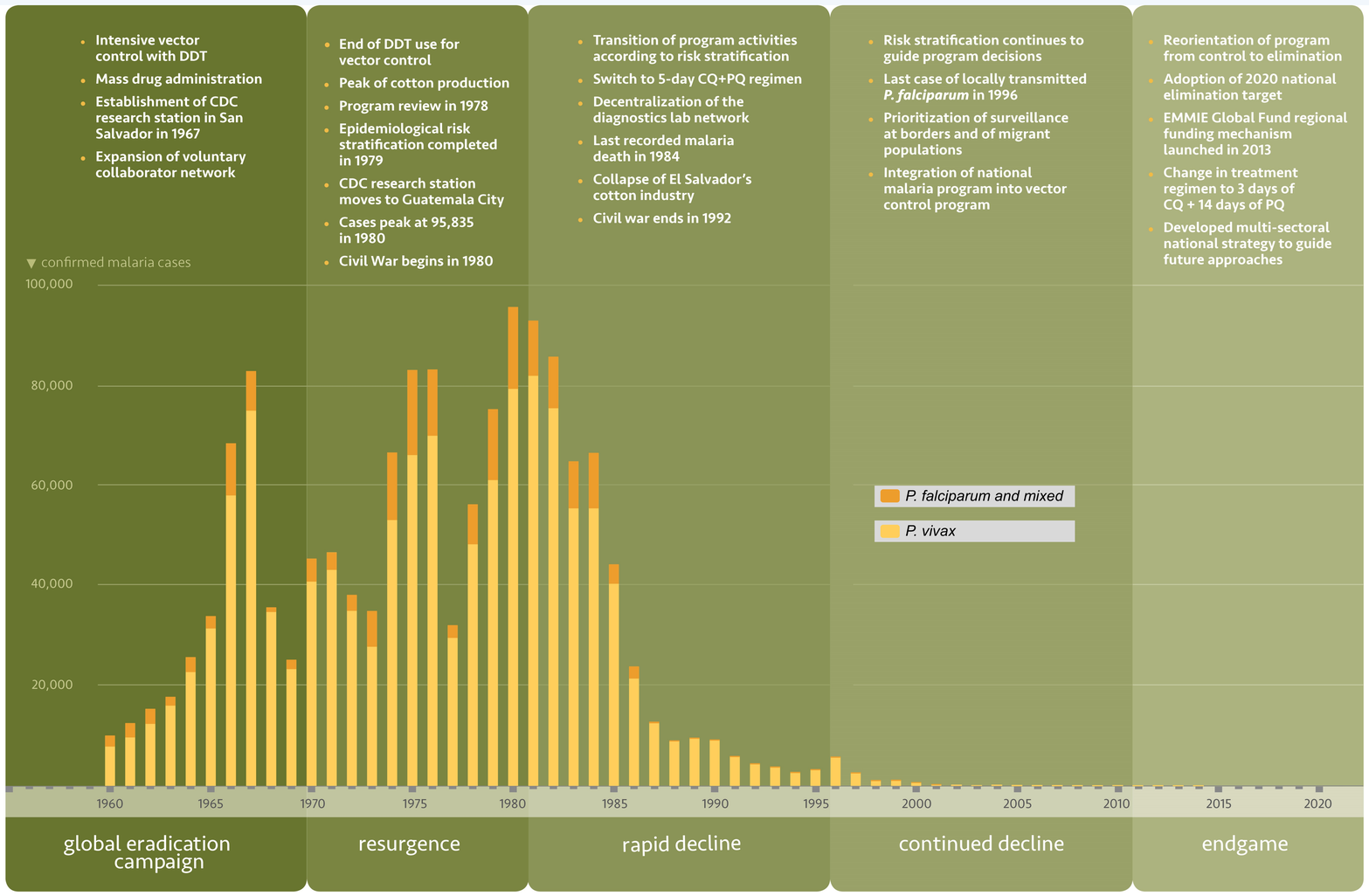


Figure 4. El Salvador malaria reported cases and correlating time periods



Methods

Researchers compiled data from peer-reviewed and secondary literature, as well as documentation from district-level and national malaria efforts. Information on program strategies, intensity of activities, treatment guidelines, surveillance systems, stratification methodologies, and programmatic timelines were compiled through interviews. Review of these data resulted in an analysis of possible factors contributing to the decline in El Salvador's malaria incidence.

Results

El Salvador's decentralization of the malaria program, early regional stratification by risk, and evidence-based, stratum-specific program actions resulted in the timely and targeted allocation of resources toward vector control, surveillance, case detection, and treatment. Weekly reporting by health workers and volunteer collaborators—distributed throughout the country by strata, and informed via digital information systems—enabled local malaria teams to provide rapid, adaptive, and data-based responses in a locally focused manner, leading to the description of the program in El Salvador in the 1980s and 1990s as "dynamic epidemiology."

- **Malaria program stratification:** the National Malaria Program worked to determine the distribution and frequency of malaria cases by geographic location, allowing the program to stratify the country primarily by altitude and monthly annual parasite index (API) averages.
- **Malaria program decentralization:** the national program recognized the need to decentralize the diagnostic laboratory system, increase the number of laboratories, and empower local decision-making to improve slide turnaround time.
- **Voluntary collaborator (VC) network:** the VC network, a community health and disease surveillance platform, became an integral part of El Salvador's success in case management and surveillance by collecting blood smears, providing diagnosis and treatment for malaria in the communities they served, and becoming trusted providers in their communities.
- **Surveillance, reporting, and digital information systems:** epidemiological data were entered manually into the surveillance system to provide reports, which were accessed and evaluated to guide control efforts. Equipped with this data, local leaders could respond to changes in a timely manner with increased surveillance and vector control activities.
- **Passive and active detection:** El Salvador employed a combination of passive (visits to VCs, health centers, and hospitals) and active (home visits to provide treatment to those with recent fever) case detection.
- **Surveillance strategies:** when a case is suspected, a blood smear is taken and analyzed within 24 hours; when a positive case is diagnosed, vector control coordinators organize a response with VCs and local health teams within 24 hours.
- **National funding environment:** malaria activities benefited from stable domestic financing, even as malaria case numbers dropped and external donors withdrew support.