when deployed and used directly in endemic areas to facilitate real-time population surveillance. However, this introduces additional challenges to develop robust and facile assays that work in a variety of settings with minimal training and at low-cost.

Methods: To address this need, we have developed a 'molecular barcode' method based on a set of single-nucleotide polymorphisms (SNPs) that allow us to 'fingerprint' individual malaria parasites. This method has been successfully deployed in field sites in Senegal, Malawi, and Zambia that have reduced transmission and are moving towards pre-elimination status. The molecular barcode has revealed several important features of the malaria parasite population that may be useful genomic signatures of progress towards elimination.

Findings: First, following increased control efforts including widespread distribution of insecticide-treated bednets and access to artemisinin combination therapy, we observed a trend towards increasing instances of parasites with identical molecular barcodes. Increased clonality is a marker for increased self-fertilization instead of outcrossing events that would increase parasite diversity. Second, this reduced population diversity is related to decreased effective population size, another marker of the genetic health of a population. The dramatic decrease from previously reported effective population sizes in the millions to less than 100 in West Africa marks a clear and dramatic perturbation in the parasite population. Third, the molecular barcode showed a reduced complexity of infection, indicative of a reduced transmission burden in the region. Finally, the ability to track individual parasites infecting a single patient offers the ability to differentiate between drug treatment failure and new infections. In Senegal, we have observed highly related parasites and are beginning to track them in space and time.

Interpretation: Thus, we have developed an economical and facile tool with the potential to inform real-time effectiveness of policy changes and control programs on the parasite population. Its robust performance in a variety of settings offers real utility for evaluating progress towards malaria eradication and elimination.

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Geographic information systems (GIS) in global public health: A sierra leone case study

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Program/Project Purpose: A Geographic Information System (GIS) provides public health personnel and policymakers the tools to create maps, conduct analysis, and identify relationships that are otherwise missed. Through visual and spatial analysis, GIS enables health leaders to see and appreciate gaps in health capacity and compute important spatial metrics that can inform future planning. The aim of this project was to demonstrate GIS capabilities and its value in global public health through a case analysis of the Basic Package of Essential Services (BPES) and governmental emergency surgical care in Sierra Leone.

Structure/Method/Design: Using geographic information for Community Health Clinics (CHC), Community Health Posts (CHP), and Maternal/Child Health Posts (MCHP) and recent population data, we used spatial statistics to calculate the coverage of the BPES in Sierra Leone. Additionally, we analyzed the planned and actual emergency surgical care provided by governmental hospitals. Actual emergency surgical care was based upon a surgical capability assessment published in 2009. For this analysis, government hospitals were considered capable of providing rudimentary emergency surgical care if they had the following: at least one surgeon and one anesthesia professional (physician or nurse), the ability to place a chest tube and treat closed fractures, and the ability to deliver intravenous fluid.

Outcomes & Evaluation: Based on the current clinic and health post locations, 93% of the Sierra Leone population has coverage in accordance with the BPES. Similarly, government hospitals provide care within 30 miles of 92% of the population. MCHPs were, on average 3.6 miles from each other, CHPs were 6.35 miles and CHC were 6.75 miles from each other. Government hospitals were 24.7 miles apart. Based on direct assessment of the surgical capabilities of governmental hospitals, only two of the 17 government hospitals had rudimentary emergency surgical capability based on the criteria established for this analysis. Based on these definitions, only 28% of the population was within 30 miles of these two hospitals.

Going Forward: Combining geospatial health planning data with population and data acquired from recent capability assessments highlights capability gaps and can guide future health development. GIS not only provides analysis that incorporates geospatial factors, it provides a method of displaying data in a meaningful way. Global health planners and practitioners should incorporate GIS tools into their planning and capture geospatial data as part of their outcome metrics.

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The use of an mHealth strategy to detect and treat cervical cancer in Tanzania

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Background: Every year, almost 500 000 women develop cervical cancer and 274 000 die from the disease worldwide. About 80% of cervical cancer deaths occur in developing countries. Most women seen in Tanzania are diagnosed with cervical cancer at advanced stage when treatment options are limited. Currently, VIA (Visual Inspection with Acetic acid) is the most common method for cervical cancer screening in Tanzania. Established pap smear and colposcopy programs are extremely limited and unaffordable to the average woman. Despite this, cervical screening has been conducted as an opportunistic service in few facilities that receive support from other national and international stakeholders. Visual inspection under acetic acid supplemented by iphone-based digital cervicography and digital SMS image transfer provides an opportunity for the most effective and feasible approach for cervical cancer screening in Tanzania. However, lack of knowledge and skills for cervical cancer screening remains to be a critical factor in the implementation of these services. Our aim was to