

coverage and quality of critical interventions. A key constraint in many low resource settings is the lack of available health facilities capable of delivering critical MNCH interventions, leading to large investments in expanding physical infrastructure and human resources. Efficient allocation of resources requires information about the existing availability of services and key gaps in service configuration. However, this information is not often available. The University of Manitoba's Centre for Global Public Health is implementing a Technical Support Unit embedded within the Government of Uttar Pradesh (GoUP) to provide support for the planning and implementation of MNCH programs under the National Health Mission. There is a specific focus on 25 high priority districts (population approximately 60 million), which contribute disproportionately to maternal, neonatal and infant mortality. To improve the GoUP's planning and scale-up of the availability of MNCH services, we mapped facilities in the public and private sectors to assess availability, identify gaps and develop a planning roadmap for efficiently increasing service availability through the National Health Mission.

Methods: We conducted a rapid, large scale mapping and assessment of health facilities in the public and private sectors in 25 high priority districts of Uttar Pradesh in India. The mapping tools were designed to capture details of population, physical infrastructure, staff, drugs, equipment, supplies, services (antenatal care, delivery, postpartum, postnatal, abortion, newborn and child health), certain service statistics and use of facilities' untied funds. The mapping occurred over a three month period and covered a total of 7,560 public facilities (90% response rate) and 1,150 private facilities (63% of those identified as providing delivery care). Consent was obtained from the primary respondents at the facilities.

Findings: The mapping found that only 44% of an estimated 429,315 deliveries occurred in public facilities (39%) or identified private facilities (5%). The large majority of deliveries in public facilities occurred in block (sub-district) level facilities (52%) or district hospitals (15%). There were large gaps in the availability of delivery points, general infrastructure, human resources, equipment, drugs and supplies in the public sector at all levels of care, with large disparities between and within the 25 districts.

Interpretation: Facility mapping data were used to develop a strategic plan to expand service delivery points across the state and within each district, through a mix of enhancing the signal functions of existing facilities and activating dormant delivery points. This planning was incorporated into the National Health Mission project implementation plans at the district and state levels, and these plans are being tracked through ongoing assessments of the expansion of service availability.

Funding: Bill & Melinda Gates Foundation.

Abstract #: 01ITIS027

The innovations initiative: Technological approaches for addressing maternal, newborn and child health

L. Vesel¹, J. Otieno², J. Fotso²; ¹Concern Worldwide US, Newton, MA/US, ²Concern Worldwide US, New York, NY/US

Program/Project Purpose: As the use of technologies in public health becomes increasingly acceptable and feasible, it is essential that their application reflects the needs of specific target populations and incorporates multidisciplinary approaches. Innovations for Maternal, Newborn & Child Health (MNCH), running from 2009 to 2016 in five countries in Sub-Saharan Africa and South Asia, is a novel initiative that tests creative solutions to understand and overcome barriers to MNCH

services. Two projects, Health Center by Phone (CCPF) in Malawi and Care Community Hub (CCH) in Ghana, exemplify the potential of mobile health technologies (mHealth) to address obstacles to health service access and delivery. We will present the findings and scalability of CC PF and the design and potential of CCH.

Structure/Method/Design: CC PF, recently completed, consisted of a facility-based toll-free hotline and text message reminders to connect women, caretakers and children to health workers via mobile phones. The intervention targeted a catchment population of four health centers in the Balaka region of Malawi, providing 35,000 pregnant women and 25,000 children access to the services. CCH, recently launched, aims to improve motivation, job satisfaction and professional development among frontline health workers through a mobile application. The intervention districts were selected based on collaboration with the Ghana Health Service and the Grameen Foundation to incorporate the CCH in the contexts of their current programs. All health workers in the selected districts were enrolled.

Outcomes & Evaluation: A positive effect of CC PF was observed on aggregate home-based care practices for MNCH and facility-based care for mothers. There was a negative effect on aggregate facility-based care for children, resulting from a substantial reduction in visits for fever, thereby reducing facilities' burden for symptoms that could be treated at home. CCH employed a human-centered design whereby the targeted end-users developed the content of the mobile application. It includes six concepts to support nurses to develop professionally, provide quality care, connect with others, manage work, improve well-being and feel appreciated.

Going Forward: The Innovations approach, illustrated through these pilots, provides invaluable insight for implementers and policymakers on mHealth to improve the quality of MNCH delivery and outcomes. CC PF has demonstrated that mHealth can work to improve MNCH even in low resource settings. CCH has highlighted the importance of context, community ownership and capacity in the design of technological interventions and their sustainability.

Funding: The Bill & Melinda Gates Foundation.

Abstract #: 01ITIS028

Genotyping malaria parasites to understand malaria transmission

S.K. Volkman¹, R. Daniels², H. Chang³, D.C. Park⁴, D.E. Neafsey⁴, S.F. Schaffner⁴, A.K. Lukens⁴, S. Mboup⁵, P.C. Sabeti⁶, D.F. Wirth³, D.L. Hartl⁷; ¹Simmons College, Harvard School of Public Health, Boston, MA/US, ²Harvard University, Boston, MA/US, ³Harvard School of Public Health, Boston, MA/US, ⁴Broad Institute, Cambridge, MA/US, ⁵University of Cheikh Anta Diop, Dakar, Senegal, ⁶Harvard University, Broad Institute, Cambridge, MA/US, ⁷Harvard University, Cambridge, MA/US

Background: Despite decades of control efforts, malaria remains a global burden, with more than 600,000 deaths annually, and more than half of the world's population at risk for infection. The renaissance of genomic research has offered public health programs new opportunities to better address malaria elimination and eradication. Current efforts call for identification of specific epidemiological break points, for which genetic analysis can offer more specific guidance about the status of the parasite population in response to control efforts. Genetic tools for elimination allow sensitive identification of malaria reservoirs and hot-spots even among populations with asymptomatic disease. These tools can also track the emergence and spread of drug resistance in response to selection pressures. Furthermore, these strategies can be used to identify and track individual malaria parasites. These approaches are most useful

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 out-crossing 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.

Funding: The Bill and Melinda Gates Foundation.

Abstract #: 011TIS029

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

R. Wilson¹, R. Groen², S. Yambasu³, T. Kamara⁴, A. Kushner⁵, K. Remick¹, P. Masuoka⁶; ¹Walter Reed National Military Medical Center, Bethesda, MD/US, ²Department of Gynecology and Obstetrics, Johns Hopkins Hospital, Baltimore, MD, USA, ³Statistics Sierra Leone, Freetown, Sierra Leone, ⁴Department of Surgery, Connaught Hospital, Freetown, Sierra Leone, ⁵Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD/US, ⁶Henry M. Jackson Foundation, Bethesda, MD/US

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.

Funding: The views and opinions expressed in this paper do not necessarily represent the official policy of the United States, Department of Defense, the United States Army, Walter Reed National Military Medical Center, Uniformed Services University of the Health Sciences, Johns Hopkins University, The Republic of Sierra Leone, or Statistics Sierra Leone.

Abstract #: 011TIS030

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

K. Yeates¹, J. Sleeth¹, K. Heus², G. Macheku³, A. Msuya⁴, J. Ondondo⁵, O. Achieng Oneko⁶; ¹Queen's University, Kingston, ON/CA, ²Pamoja Tunaweza Research Centre, Moshi, Tanzania, ³Mawenzi Hospital, Moshi, Tanzania, ⁴Arumeru District Hospital, Arusha, Tanzania, ⁵Kilimanjaro Christian Medical College, Moshi, Tanzania, ⁶Kilimanjaro Christian Medical University College, Moshi, Tanzania

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