Designing a malaria intervention supply chain: a case study

Business

Designing a Malaria Intervention Supply Chain: A Case Study Directions: Read the following background information on malaria interventions in Africa which has been excerpted from (Cataldi et al. 2009).

Then, answer the questions at the end of the document prior to our in-class discussion. 1. Introduction Malaria is a vector-borne disease transmitted by infected female Anopheles mosquitoes. Though this crippling disease is both preventable and curable, 300 to 500 million cases are reported each year, resulting in over 1 million deaths (Thomson et al. 2006).

The majority of deaths occur in young children and pregnant women living in sub-Saharan Africa.

Treatment options have become increasingly inapplicable, especially in sub-Saharan Africa. Widespread drug-resistance has developed toward the inexpensive and readily-available medications, such as chloroquine (Cox et al. 1999). Alternative medications available in Africa today have become too expensive for individuals and governments to afford. In addition, many individuals in Africa have limited or no access to a medical facility in their region, or may simply refuse to seek treatment.

Thus prevention rather than treatment has become the focus across much of Africa. Rather than treating individuals already infected with malaria, the objective of vector control for prevention is to reduce the number and rates of infection by controlling the infected mosquitoes, thereby preventing biting and effectively lowering transmission rates. Successful implementation of a large-scale intervention effort requires participation locally and nationally, extensive information, as well as stable funding and resources.

Two of the predominant prevention methods include the use of Long-Lasting Insecticide-Treated Bed Nets (LLINs) and Indoor Residual Spraying (IRS). LLINs are draped over sleeping areas, providing a physical barrier to the user at night when mosquitoes are most active. The nets are treated with insecticides, which both repel and kill mosquitoes if they land on the net.

Proper use of the nets is essential for the success of this intervention method, and educating recipients on proper use is often required. IRS is performed by trained sprayers who apply trace amounts of insecticides to wall and ceiling surfaces in households.

The insecticide acts as a repellent, but is also lethal to mosquitoes when they land on sprayed surfaces. Households must be retreated with IRS periodically depending on the effective lifetime of the chemical used (e. g.

, a spraying of DDT typically lasts for six months). 2. Malaria Background 2. 1 Malaria Prediction in Africa In response to the malaria threat in Africa, collaborations such as Mapping Malaria Risk in Africa (MARA) have developed methods to quantify and project malaria risk based on a number of climatic and environmental factors.

Studies conducted by MARA researchers concluded that rainfall and temperature were the dominant indicators of malaria risk at the continental level in Africa (Craig et al.

1999). For example, generally, temperatures below 18°C or above 32°C and rainfall less than 80 mm per month were found to be unsuitable conditions for malaria transmission. The MARA project provides maps for each country in Africa that include projections of risk in an average year on a scale from 0,

indicating no risk, to 1, indicating 100% risk, as well as the first and last months of the expected high-transmission season, as displayed in Figures 1, 2, and 3 in Section 4. 2. 2 Background on Malaria Interventions Though continuous and total prevention coverage of every area at risk for malaria would be ideal, it is rarely feasible on a large scale in resource-poor environments. Intervention campaigns are often limited by strict financial budgets and regional infrastructure.

Thus, decision making for the deployment of a malaria intervention in Africa must include: ? what regions to target; ? when to intervene in a region; ? how many resources to allocate to a region. Deployment is often performed at the discretion of a country’s ministry of health.

This often leads to arbitrary distribution based solely upon the intuition and experience of decision makers in the field. The manner in which interventions are deployed can significantly impact their effectiveness. For example, not knowing what areas have already been effectively covered could also lead groups to deploy unnecessary interventions in some regions, thereby not covering other regions that would have benefited from those resources.

The overuse of insecticides may even promote drug-resistance in mosquitoes, potentially worsening malaria transmission in a region.

In addition, the importance of scheduling interventions relative to season start times is often not fully considered, resulting further in sub-optimal intervention deployment. 3. Models and Solution Approaches Given a budget and available resources for intervention, a potential modeling objective is to

maximize the expected coverage of the population at risk of malaria across time and geography. The decisions to be included in a model are the following: ? where to open distribution centers; ? what zones each DC should serve; ? when to deploy an intervention in each zone; how many people to protect in each zone; ? how many resources to base at DCs; ? how many resources to allocate to each zone. We will discuss more details about modeling this problem in class and whether you can do better with a math model than with “ gut-feeling” heuristics.

In the meantime, try to think about the key tradeoffs and constraints in budgeting and planning for a country-wide malaria intervention. 3 4. Figures Figure 1: Projection of malaria risk (scale from 0 to 1) in Africa Figure 2: First month of expected high malaria transmission in Africa 4