MARKET DYNAMICS PROGRAM

Small changes, big savings

Changes in shelf life and box size have the potential to drastically reduce wastage

PATH

National malaria control programs (NMCPs) are frequently faced with making decisions that require trade-offs in order to best allocate scarce resources to control and eliminate malaria. With limited budgets, NMCPs need to choose how to fund staff, research, operations, essential drugs and diagnostics, and many other items in a manner that maximizes the potential impact on reducing malaria.

An example of a trade-off decision is choosing between products with variable attributes, such as performance, price, shelf life, and package size. For example, imagine your only option was to buy in bulk when you just needed travel-sized, or to purchase milk that you know will expire before you can finish it. A mismatch between product characteristics and NMCP need will result in overspending and opportunity costs because those wasted funds could have been used elsewhere.

A mismatch between product characteristics and NMCP need will result in overspending and opportunity costs.

In the best of circumstances, manufacturers and distributors make decisions regarding product characteristics with the consumer in mind. After all, this helps to ensure sales. However, these decisions are often based on previous production practices, costs, or assumptions about consumers—including a focus on the priorities of large customers. The downstream consequences of these decisions can result in limited options for NMCPs, overspending, and potentially a reluctance to adopt products to avoid wasting resources. In some situations, an NMCP may be able to substitute products from different manufacturers that better fit their needs, but this will incur a switching cost.

To understand the potential downstream consequences for NMCPs of upstream decisions made during the product development process, we analyzed two examples related to diagnostics used in malaria case management, one seemingly minor—pack size—and the other, more obviously important—shelf life. The diagnostic at the center of these analyses is used in identification of a genetic disorder called glucose-6-phosphate dehydrogenase (G6PD) deficiency. The liver-stage treatment for *Plasmodium vivax* malaria infections is harmful to people with G6PD deficiency. Therefore, according to the World Health Organization, all *P. vivax* patients should be tested for G6PD deficiency to safely guide treatment of the infection.

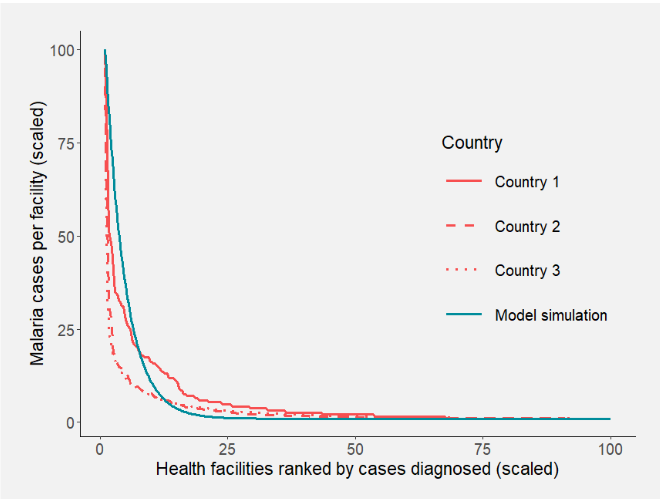
Modeling real-world problems

Based on discussions with NMCPs and analysis of actual data from different countries, we identified the health system attributes that explain why products that come in different pack sizes and have different shelf lives are wasted. A critical attribute is the number of malaria cases diagnosed at each facility in a health system. If a health facility sees only a few malaria patients a year, it needs a small quantity of diagnostics and may not be able to use leftover diagnostics the following year. Data from three countries with different epidemiological settings showed that malaria cases tend to follow a "heavy tail" distribution: a small proportion of facilities see the majority of cases and the remaining large proportion of facilities each see a handful of cases per year, as shown in Figure 1 below.

Detailed data from these countries were used to create and validate a model that reflected real-world circumstances. Collecting data for all countries or situations would be costly in terms of time and resources, whereas modeling a situation allowed us to estimate with ease the wastage given different caseloads, number of health facilities, or other parameters.

The figure depicts real-world data from three countries and the modeled data points. The x-axis displays health facilities that diagnosed at least one malaria case, ranked by how many cases they diagnosed. The countries and model have different numbers of health facilities, so all data were placed on the same scale to ease comparison. The y-axis displays the number of malaria cases diagnosed per facility, and again these data are scaled for comparison, which lets us focus on the important aspect of the plot, that is, the shape of the distribution.

Figure 1. Distribution of malaria cases in health facilities.



As can be seen in the plot of each country and the model, a small proportion of health facilities saw a large number of cases, while the majority saw very few, just one to five cases per year. It is these low-caseload facilities that are most impacted by large pack sizes and short shelf lives.

To understand the cost implications of different box sizes and shelf lives, a three-year diagnostic procurement simulation was modeled with 20,000 cases per year and 500 health facilities. A limitation of this model is that, in reality, the number of cases diagnosed in each facility would vary year to year. As a result, the model underestimates potential wastage, as many facilities in the “heavy tail” would procure products but see no malaria cases in settings where malaria is declining. In addition, this analysis is less applicable to diagnostics used to detect malaria, which are often procured in large quantities to increase annual blood examination rates; however, it is relevant for a variety of other health products. And whereas the results are specific to this simulation and would change under different health system parameters, given the distribution shown above is the driving factor, the results are broadly representative of most country contexts.

PATH/Spike Nowak

Smaller box sizes could reduce wastage by 78%

Many diagnostics used in malaria case management are packaged in boxes of 25, but if the vast majority of health facilities diagnose only one to five cases of malaria per year, it is expected that many diagnostics will expire before being used, an assumption confirmed by the model. Assuming a 1-year useable shelf life, it is estimated that 31% of the diagnostics in the simulation scenario would be wasted. However, if the box size were reduced to hold 10 units rather than 25, only 14% would be wasted, resulting in large potential cost savings for health systems. Decreasing the number of units per box from 25 to 5 would result in an estimated 7% of the total procured product wasted, a reduction in wastage of 78%.

Waste could be reduced by 64% with a longer product shelf life

Increasing the shelf life of diagnostics also has a major impact on reducing wastage. Extended shelf life allows unused diagnostics procured in one year to be used in the next. Given a box quantity of 25, if the useable shelf life were increased from 1 year to 1.5 years, the percentage of wasted product would decrease from an estimated 31% of the total procured to 28% of the total procured—a much smaller decrease than seen from reducing the number of units per box from 25 to 10. However, if the shelf life were increased from 1 to 2 years, the estimated percentage of diagnostics wasted in the simulation scenario would decrease from 31% to 11%, or a 64% reduction in wasted product.

Drastically reducing waste is possible by both increasing shelf life and decreasing pack size

Waste can be reduced by increasing the shelf life of a product, decreasing the package size, or doing both. If box size were reduced from 25 to 5 units, and the useable shelf life were increased from 1 to 2 years, the percentage of total procured product wasted would decrease from 31% to 1%, or 95% in total (Table 1).

Table 1. Percentage of product wasted.

Box size (units)		25	10	5
Shelf life (years)	1	31%	14%	7%
	1.5	28%	12%	5%
	2	11%	4%	1%

Summary

Ideally, the downstream impacts on health systems of upstream product development decisions should be taken into account early in the product development process. Tackling issues like product shelf life and stability and package size can have a significant impact on whether a product is adopted by a health system and where the product is placed in the health system based on the cost implications outlined above. This is especially true in countries that use health technology assessment bodies to perform cost-effectiveness or budget impact analyses to help decide which products their health system will adopt.

This analysis indicates that the simulated health system could reduce wastage of malaria diagnostics by 95% if box size were decreased from 25 to 5 units and useable shelf life extended from 1 to 2 years. The large potential cost savings to end users and health systems are important to consider.

For more information: marketdynamics@path.org.

Mailing Address
PO Box 900922
Seattle, WA 98109 USA

Street Address
2201 Westlake Avenue
Suite 200
Seattle, WA 98121 USA

Date Published
June 2020