



## CASES IN GLOBAL HEALTH DELIVERY

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# Building Local Capacity for Health Commodity Manufacturing: A to Z Textile Mills Ltd.

*Africa needs direct foreign investment to build strong economies, and when 90 per cent of the malaria deaths are in Africa, why should we have to import bed nets?*

— Anuj Shah, Chief Executive Officer, A to Z Textile Mills Ltd., Arusha, Tanzania.

In the mid-1960s, when Anuj Shah was a young boy, he worked at his father's garment factory packing clothes on the factory floor on weekends and during school holidays. He gained an early appreciation for the family textile business and in 1978, two years after officially joining the company, he became its CEO. Thirty years later, in 2008, the family business, known as A to Z Textile Mills Ltd. (A to Z), manufactured one of the world's most effective malaria prevention tools: bed nets impregnated with long-lasting insecticide. Between 2004 and the end of 2008, the durability and effectiveness of A to Z's bed nets became clear, as did their potential impact in a part of the world where more than 300 million people were at risk for malaria. Anticipating major shifts in demand, A to Z had grown annual production capacity at its factory in Arusha, Tanzania by more than 6000%, from 300,000 nets to 19 million nets per year.

Shah believed, however, that the bed net industry faced significant uncertainty. The forecasted demand for long-lasting insecticidal bed nets (LLINs) looked unlikely to materialize despite the significant need for them in sub-Saharan Africa. Furthermore, Shah was concerned that A to Z's bed nets could not compete fairly with LLINs manufactured elsewhere. The combination of these challenges had worrying implications for A to Z, and Shah needed to decide how best to position his business.

## Malaria

In 2006 there were between 189 and 327 million cases of malaria and between 610,000 and 1.2 million deaths.<sup>1</sup> Pregnant women and children were at the greatest risk of developing severe malaria; a child under five died from malaria every 40 seconds. Approximately 90% of all malaria deaths occurred in sub-Saharan

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*Kileken ole-MoiYoi and William Rodriguez prepared this case for the purposes of classroom discussion rather than to illustrate either effective or ineffective health care delivery practice.*

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Africa, where malaria accounted for 18% of deaths in children under five (see **Exhibit 1** for more on mortality in children under five).

In 1897 Sir Ronald Ross, a British Army physician studying the disease in Calcutta, India, identified the *Anopheles* mosquito as the primary vector for malaria. Mosquitoes acquired the disease-causing microorganisms when biting an infected host and transmitted the microorganisms during subsequent blood meals (see **Exhibit 2** for the malaria parasite's life cycle).<sup>2</sup> Typically, when an infected mosquito bites a human, it transmits parasites that then multiply rapidly in the human host until there are tens of billions of parasites circulating in the blood. These parasites cause intense flu-like symptoms marked by fatigue, headache, and muscle aches with intermittent periods of high, wracking fevers; left untreated, the severe malaise can progress to profound anemia, kidney failure, and coma, and in some cases, death. In other cases, the infection can become chronic, leading to anemia, fatigue, and lassitude.

The mosquito's larval development requires relatively stagnant bodies of water such as swamps, ponds, and irrigation ditches, or potholes, discarded cans, and tires that fill with water after rains. As a result, heavy rains in malarious regions are usually followed by a surge in the mosquito population and increased malaria transmission.

Malaria has blighted humanity and altered the course of development for thousands of years. Humans migrated to avoid the deadly disease as it shaped the outcomes of wars, the stay of empires, and trapped millions of people in poverty. Physical evidence of malaria was identified in 40% of a group of Egyptian mummies from 3200 BCE.<sup>3</sup> References to the disease appear in Roman, Greek, Chinese, Indian, and Egyptian texts. The Roman Empire was an epicenter of malaria, and some historians believe that a malaria epidemic in 79 was partially responsible for the fall of Rome.<sup>4</sup> Numerous Roman scholars linked the symptoms of malaria to the proximity of foul-smelling swamps and stagnant water. By the fourteenth century, foreign popes were barred from residing in Rome for fear that they would succumb to "Roman Fever," which became more commonly known as *mal'aria*, or "bad air." Seven centuries later, malaria remained a global problem (see **Exhibit 3** for Malaria Global Distribution).

### ***The Evolution of Malaria Control***

Long before the relationship between malaria and mosquitoes became clear, swamp drainage was understood to be an effective strategy to reduce the impact of the disease. The ancient Romans understood the public health benefits of drainage clearly. As Columella wrote in *De Re Rustica* in around 35 CE:

There should be no marshes near buildings, for marshes give off poisonous vapours during the hot period of the summer. At this time, they give birth to animals with mischief-making stings which fly at us in thick swarms.

Some basic efforts to prevent standing water were successful in controlling the mosquito population and breaking the transmission cycle, and swamps and marshes were drained periodically in Europe and the Americas. Despite their short-term effectiveness in reducing the incidence of malaria, as drainage efforts lapsed, the *Anopheles* population started to rebound in many places where it was initially brought under control.

In addition to swamp drainage, people in many regions of the world began using nets of various designs to avoid mosquito bites as early as the twelfth century. In fifteenth century Japan, bed nets were a privilege of the wealthy elite, who could afford to protect themselves with nets of pure silk. However, by the seventeenth century the use of linen and cotton netting as bed nets, screens, and even to protect fishermen's cormorants was widespread.<sup>5</sup>

In 1939 Swiss chemist Paul Herman Müller ushered in a new era of mosquito control through the Nobel Prize-winning discovery of dichloro-diphenyl-trichloroethane (DDT), an insect neurotoxin that killed mosquitoes. The use of DDT spread quickly during World War II; in many war zones—from North Africa and Sicily to the Philippines and Burma—malaria was often more debilitating than enemy-inflicted wounds. The German, Soviet, and United States militaries all tried to protect their soldiers against malaria and other mosquito-borne illnesses by coating bed nets with DDT, which both repelled and killed mosquitoes.<sup>6</sup>

Chloroquine, the first widely available drug to treat malaria, entered the market not long after DDT. Armed with these new tools, the newly formed World Health Organization (WHO) launched the first coordinated effort to eradicate malaria in 1955. The WHO strategy relied on a combination of “vector control” and disease treatment—treating active cases of malaria removed the reservoir of infected humans and interrupted the cycle of mosquito-human-mosquito infection. Despite its stated goal of global eradication, WHO’s efforts were restricted largely to relatively developed regions plagued by malaria, including the Mediterranean basin.

After some success—including the elimination of malaria from Europe, North America, and Australia—mosquitoes began to develop resistance to DDT, and WHO removed it from the malaria eradication program. Subsequently, DDT was linked to bioaccumulation and toxic effects in animals, plants, and possibly humans.<sup>7</sup> By 1969 there was general agreement that the global eradication program had failed.

In the 1970s low- and middle-income countries, particularly in sub-Saharan Africa, were disproportionately affected by malaria. Funding for malaria programs decreased, and WHO dramatically scaled back its efforts. Malaria incidence began to rise, and drug resistance ominously spread (see **Exhibit 4** for the history of malaria control and mortality). In addition to high mortality, worker absenteeism and poor productivity among infected workers stifled economies in malarious countries. One study purported that by the late 1990s malaria cost sub-Saharan Africa as much as USD 12 billion each year, or roughly 1.3% of GDP.<sup>8</sup> In Malawi another study found that poor families spent up to 32% of their household income on malaria prevention and treatment.<sup>9</sup>

### ***The Return of Bed Nets***

After nearly eight centuries of use, in 1991 bed nets underwent their first formal evaluation. A study in children suggested that insecticide treated nets (ITNs) resulted in a 60% reduction in under-five mortality.<sup>10</sup> Subsequent studies confirmed the efficacy of ITNs for controlling malaria. In 1998 WHO, the United Nations Children’s Fund (UNICEF), the United Nations Development Program (UNDP), and the World Bank revived malaria control, dormant for nearly 30 years, with the Roll Back Malaria Partnership (RBM). RBM aimed to reduce the global burden of malaria by 50% by 2010.<sup>11</sup> The partnership worked to improve coordination among donors and governments and to facilitate the development of new vaccines, preventative tools, and more effective anti-malarials.

The first ITNs approved by WHO were made from polyester and came pre-packaged with an insecticide sachet with which the end-user treated the net. The nets themselves were effective physical barriers for the people sleeping under them; when treated with insecticide, other community members benefited indirectly due to the reduced number of mosquitoes. The first generation of bed nets required re-treatment every six months; the user had to wash and soak them in the insecticide. Failure to re-treat significantly reduced a bed net’s impact.<sup>12</sup> ITN re-treatment cost approximately USD 1.20 per treatment.<sup>13</sup>

In 2000 delegates at the African Summit on RBM in Abuja, Nigeria proposed expanding ITN use. Starting from close to zero, they set a target of 60% ‘coverage’ for all pregnant women and children by 2005. The proposed plan would have required 160 million ITNs at a total cost of approximately USD 1.12 billion.<sup>4</sup>

Between 2002 and 2005, there was a 10-fold increase in the coverage of ITNs in more than 14 sub-Saharan countries, largely attributed to the distribution of subsidized or free ITNs to pregnant women and children.<sup>1</sup>

Despite this increase, by 2005 fewer than 5% of eligible children slept under ITNs.<sup>14</sup> Many people at risk for malaria were unable to afford or access the ITNs, and acquiring and distributing ITNs to target populations was a major challenge for the governments of the 44 African countries committed to the Abuja Declaration. In addition, the first generation of ITNs often developed tears and holes after less than a year of use. Studies showed that fewer than 10% of ITNs were retreated as recommended, rendering the ITNs ineffective at repelling and killing mosquitoes. Few people were taught to understand the importance of protecting themselves with ITNs, and many ITNs were unpleasant to sleep under due to poor ventilation. Demand generation, distribution, and utilization were significant obstacles that needed to be addressed.

### ***Introducing Long-lasting Insecticidal Bed Nets***

The development of long-lasting insecticidal bed nets (LLINs) addressed many of the shortcomings of conventional ITNs. LLIN technology removed both the need for re-treatment and the distribution challenges of the re-treatment kits. LLINs were also more durable and remained potent for several years. However, they came with a higher upfront cost: between USD 4 and USD 6; they were at least twice as expensive as conventional ITNs. Over five years, however, LLINs were approximately 42% less expensive than the conventional ITNs and more effective (see **Exhibit 5** for cost comparison).<sup>1</sup>

Although some LLINs were made of insecticide-coated polyester, more durable nets were made of polyethylene, an oil-based resin commonly used to manufacture plastic bags. Insecticides were incorporated into the polyethylene resin during the manufacturing process and slowly released over time. Although more vulnerable to damage from direct sunlight, the thicker weaved polyethylene nets generally were more durable and maintained their insecticidal properties longer than ITNs and polyester LLINs.

Despite the advantages of LLINs, cost, utilization, and distribution were challenges of both ITN and LLIN programs. One study established that household retention of LLINs was 92.9% 18 months after the initial distribution; efficacy tests revealed that the mean mosquito “knock-down” after 60 minutes was 91.1%, and mosquito mortality after 24 hours was 99.4%. However, despite high household retention and efficacy, only 55% of children under five and 42.1% of pregnant women slept under the nets.<sup>15</sup> Distribution policies also varied widely. Some programs distributed one net per two children or pregnant woman, whereas others distributed one net per household regardless of the number of occupants.<sup>16</sup>

There was a persistent debate about whether end-users should pay for nets. Several studies concluded that many people could afford neither ITNs nor LLINs. As a result, the majority of LLINs were distributed for free or were highly subsidized. However, some groups opposed free distribution arguing that end-users were more likely to value their nets and use them effectively if they contributed to at least a portion of their cost. This view was based on a general belief in *user fees*, predicated on the notion that even the poorest consumers placed a value on products that was equal to or greater than the price. Therefore, if bed nets were purchased, one could assume that buyers understood their benefits and would use them appropriately; supporters of user fees claimed that if the nets were distributed without cost, the value was assumed by the donor rather than realized by the user.

In 2007 WHO and the Global Fund to Fight AIDS, Tuberculosis, and Malaria (the Global Fund) reported that the widespread implementation of LLINs, in conjunction with other interventions, had reduced the incidence of malaria in Rwanda, Ethiopia, and Zambia; under-five mortality declined by an average of 51% in Ethiopia, 66% in Rwanda, and 33% in Zambia.<sup>16</sup> Efforts to control malaria in these countries focused on three main interventions: the widespread distribution of both conventional ITNs and

LLINs; a mosquito control effort known as indoor residual spraying (IRS); and the wide use of a new drug for malaria, known as artemisinin-based combination therapy (ACT). Two additional strategies were implemented in specific areas: intermittent presumptive therapy for malaria and rapid diagnostic testing (RDT) for malaria to improve appropriate use of anti-malarials. WHO largely attributed the successes in Rwanda, Ethiopia, and Zambia to the significant increase in LLIN distribution. The increased use of RDTs was also believed to have contributed to the reduction in incidence due to improved differentiation between malarial and non-malarial fevers.

### ***Advocacy and Malaria Control Efforts***

After the Abuja Declaration in 2000, several studies re-emphasized the bed net's potential to reduce the burden of malaria in sub-Saharan Africa, estimating that 500,000 deaths could be averted if insecticidal bed nets were used widely.<sup>17</sup> Although Eritrea was the only country in sub-Saharan Africa to achieve the Abuja Declaration's 60% target for coverage, in 2006 RBM increased the target to 80% LLIN coverage of all vulnerable groups by 2010. In April 2008 UN Secretary General Ban Ki-moon pushed LLIN coverage targets even higher, calling for universal bed net coverage in Africa. The RBM Partnership launched the "Cover the Bed Net Gap" initiative to achieve the coverage goal for vulnerable populations in sub-Saharan Africa and sought 80% "effective utilization" of LLINs. In a 2008 report, however, RBM acknowledged several significant obstacles to achieving its targets:

On the current trajectory, achieving the goals of universal coverage and 80 percent long-lasting insecticide treated net (LLIN) utilization by end 2010, are unlikely to be met due to the timeliness and scale of available resources from the Global Fund and other partners, as well as substantial delivery challenges at country level. It is critical to note that "Covering the Net Gap" does not stop at financing and procurement but that success can only be defined as LLIN utilization by those at risk, which requires considerable resources for delivery, distribution and behavior change communications.<sup>18</sup>

RBM's LLIN procurement forecast for 2010 was 354 million nets, roughly triple the number of LLINs procured in 2007 (see **Exhibit 6** for the LLIN forecast). The majority of the procurement forecast was based on public sector financing and procurement; forecasts, however, were known to be inaccurate due to poor data, variability in the average life of LLINs, and other limitations on accurate forecasting. Of the 354 million LLINs forecast for 2010, RBM estimated that 80% of them, or roughly 280 million, might be implemented and utilized correctly.

Thus, by the end of its first decade of reinvigorated malaria control, RBM had significantly increased the level of funding available and demonstrated its ability to better coordinate control efforts worldwide (see **Exhibit 7** for the change in funding disbursements for malaria). Despite these efforts, significant challenges remained in sub-Saharan Africa. Morbidity and mortality from malaria remained high in most endemic areas, and ineffective anti-malarials were still in widespread use despite high levels of drug resistance.

### ***LLIN Quality Control: WHOPES Recommendation***

The WHO Pesticide Evaluation Scheme (WHOPES) was established in 1960 to promote and coordinate the testing and evaluation of pesticides used for public health. WHOPES acted as a regulatory body and became accepted as a guide for the qualification of pesticide-based health commodities intended for public health programs. Under RBM, the Global Fund provided most of the funding for governments to purchase bed nets and required that implementing agencies purchase only WHO-certified bed nets. WHOPES established three phases for demonstrating efficacy:

1. Phase I: Bio-efficacy of at least 80% mosquito mortality and/or 95% knock-down after at least 20 standard washes
2. Phase II: Efficacy testing in “experimental huts”
3. Phase III: Village-based efficacy testing over three years of recommended use in various settings

In an attempt to reduce the delay in LLIN implementation, WHO required the completion of only Phases I and II for nets to receive “Interim” status, that enabled net procurement and distribution throughout sub-Saharan Africa. Interim LLINs were meant to be reviewed periodically to ensure they continued to meet the established efficacy standards. Only LLINs that had successfully demonstrated their efficacy in multiple settings received a “Full” recommendation, which did not require subsequent WHOPES verification. However, from the perspective of procurement regulations, there was no difference between a WHO “Interim” and “Full” recommendation.

## **Producing LLINs: The Olyset® Consortium**

### ***Sumitomo Chemical Company and the Long-Lasting Olyset® Net***

From its inception, Sumitomo Chemical Company in Tokyo, Japan was committed to generating profits by selling products for the benefit of society. Sumitomo Chemical began operations in 1913 in the Shikoku region of Japan, where it manufactured fertilizer from recovered sulfur dioxide emissions from a copper mine. By 2007 Sumitomo Chemical had become a multinational company with 100 subsidiaries and more than 24,000 employees in six different chemical industries. According to its mission, the company leveraged expertise in chemical research and manufacturing with technological prowess in plastics and insecticides for the betterment of people, society, and the world.<sup>19</sup>

Sumitomo Chemical developed the Olyset® bed net technology in 1978. The Olyset® net was developed through a research program on insecticide-impregnated resins; Sumitomo Chemical developed a polyethylene resin that could be impregnated with the synthetic drug permethrin, an effective mosquito neurotoxin (see **Exhibit 8** for more on the Olyset® technology). By the 1990s Sumitomo Chemical was manufacturing bed nets from permethrin-impregnated polyethylene (see **Exhibit 9** for more about the manufacturing process). In 2001 WHOPES granted its first and, through December 2008, only “Full” status recommendation of an LLIN for the Olyset® net (see **Exhibit 10** for WHOPES recommended LLINs).

Sumitomo Chemical’s Olyset® technology represented a significant improvement in durability and efficacy over conventional ITNs. A study based in two Tanzanian villages reported that seven years after the introduction of Olyset® LLINs, 100 of the 103 initial nets were retraceable, and most were still effective as barriers and at repelling mosquitoes.<sup>20</sup> Because the polyethylene nets were made with thicker strands, their durability was higher than most polyester nets, which had a tendency to rip or develop holes. Despite higher upfront costs, high longevity and efficacy made the Olyset® net one of the most effective malaria prevention strategies—and at less than USD 1 per person per year, inclusive of distribution costs, one of the most cost effective (see **Exhibit 11** for cost effectiveness of malaria intervention strategies).<sup>21</sup>

### ***Forming the Consortium***

Dr. Pierre Guillet, a WHO specialist in vector control, envisioned the Olyset® Consortium in 2001 as a simple collaboration in which ExxonMobil donated plastic, Sumitomo provided the Olyset® technology, and an African manufacturer adapted the technology to manufacture locally. In April 2002 Guillet met with Dr.

Steven Phillips, Medical Director for Global Issues and Projects at ExxonMobil, at the Fourth Meeting of RBM.<sup>22</sup> Guillet explained his idea to Phillips, who responded with cautious enthusiasm, “WHO is really interesting. Pierre really meant well and was truly enthusiastic and he was a very knowledgeable entomologist.” Phillips believed a business plan was the natural next step. “I offered to finance the business plan on behalf of ExxonMobil,” but Guillet declined, citing WHO’s “ideological issue of not accepting private sector input. So, ultimately WHO decided to finance the business plan themselves....and that was the framing document that allowed players to come together.”

By late 2002 Guillet and Phillips had put together a public private partnership (PPP) of five for-profit and not-for-profit organizations: Sumitomo Chemical Company, WHO, UNICEF, ExxonMobil, and the Acumen Fund. While Sumitomo would contribute the LLIN manufacturing technology, WHO would bring the partners together, ensure quality standards were followed, and provide technical advice to the other members of the Olyset Consortium. UNICEF could help with net distribution and early purchasing; ExxonMobil—though unable to provide plastic for the nets given the complexity and price of importing from Saudi Arabia—offered assistance in project management and technical and financial support, including research on net strengthening. The Acumen Fund, a social venture capital fund, was interested in promoting the sustainable development of private, commercial markets providing goods and services in resource-limited settings; in addition, according to Phillips, Acumen Fund staff were “not only financiers, but more importantly they were the active project managers.”<sup>1</sup>

The group met in Geneva to establish the PPP’s objectives:

1. Prove the basic principles of technology transfer and local capacity-building as they apply to malaria prevention interventions
2. Enable a sustainable, local supply of LLINs
3. Significantly improve protection of vulnerable populations, particularly pregnant women and children<sup>23</sup>

After debating the issue, the Consortium agreed that the financial sustainability of the initiative, and particularly the financial sustainability of a for-profit bed net manufacturer, was crucial to the success of the Consortium’s objectives. WHO had put together a list of potential net manufacturers suitable for technology transfer from Sumitomo Chemical. Having integrated the Consortium into its corporate social responsibility portfolio, Sumitomo wanted to select a manufacturer in Africa for royalty-free Olyset® technology transfer. Sumitomo believed that the cycle of poverty in developing countries, particularly in sub-Saharan Africa, could be broken by preventing vector-borne diseases through local investment. ExxonMobil, like Sumitomo, also valued the corporate social responsibility aspect of the PPP and its potential to reduce the burden of malaria on the people of sub-Saharan Africa, including its own employees.

## A to Z Textile Mills Ltd.

*It is very clear: the problem of malaria in Africa needs a solution in Africa. Producing Olyset® nets locally saves lives, provides employment, increases the standard of living, and builds markets that support economic development across the continent.*

— Anuj Shah, CEO, A to Z Textile Mills Ltd.

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<sup>1</sup> For a teaching case on the Acumen Fund, see Professors Ebrahim and Rangan’s, “Acumen Fund: Measurement in Impact Investing,” HBS No. 9-310-011 (Boston: Harvard Business School Publishing, 2010).

Nathalal Hirji Shah, Anuj Shah's father, founded A to Z Textile Mills Ltd. in 1966. The business began as a children's clothes manufacturer with five sewing machines operated by family members. At first they purchased fabric to manufacture finished products, but they soon realized they had the capacity to manufacture the fabric themselves and that vertical integration would make the company more competitive. In 1970 the company diversified into bed net manufacturing, offering customers in the city of Arusha, and elsewhere in East Africa, protection against mosquitoes and malaria through the use of untreated polyester bed nets.

In 1981 Anuj Shah took charge of the company. Although he was the youngest in the family, his relatives recognized his passion and entrepreneurial spirit and rewarded him by supporting his leadership of the company. By the early 1980s the company had a fully integrated production line that included knitting, dyeing, and finishing, and it had begun manufacturing high-end products, including T-shirts, polo shirts, and high quality fabrics. A to Z relocated to a significantly larger site that enabled it to grow and further diversify its production portfolio. It began exporting garments and bed nets, as well as various household plastics, to regional African markets.

Although the company was still relatively small, it remained committed to pursuing bed net manufacturing and sales. As A to Z grew, it saw its production portfolio increasingly dominated by polyester mosquito nets. By the late 1990s the company had diversified its bed net production to include insecticide treatment, and by 2002 it was producing roughly 6 million polyester ITNs a year and was the largest vertically integrated ITN factory in all of Africa. It was selling ITNs to donors, to NGOs, and to private sector wholesalers who would sell nets in retail shops.

The members of the Olyset® Consortium were encouraged by A to Z's eagerness and unique experience in both plastics and net manufacture in East Africa. After assessing potential manufacturers and carrying out its own due diligence, Sumitomo Chemical chose A to Z as its LLIN partner. Sumitomo would transfer its LLIN manufacturing technology to A to Z as a royalty-free transfer and pay the USD 35,000 cost of the WHOPES evaluation.

The Acumen Fund facilitated part of the initial technology transfer from Sumitomo Chemical to A to Z, providing USD 325,000 of debt financing for A to Z's purchase of capital equipment and factory modifications. Sumitomo delivered the raw material to A to Z and provided technical and quality control support.<sup>23</sup>

### ***Growing the Consortium***

In addition to facilitating the technology transfer, the Consortium needed to develop dynamic distribution networks to ensure the Olyset® nets reached populations most in need, particularly pregnant women and children. Population Services International (PSI), a not-for-profit, social marketing organization that specialized in demand generation for health products and services, joined the Consortium in 2003 to aid in Olyset® net demand generation and distribution. Phillips explained:

PSI was brought in because 95% of the market was public and only 5% was private, and there were important issues around stimulating the private market....You can argue with this ideologically, but in terms of testing diverse market channels, there was a notion of 'why don't we test the 5% channel in terms of willingness to pay and price elasticity of demand?' So we set up a bunch of ancillary streams that would hopefully answer some important questions.

At this point, the Consortium included seven partners: the five original organizations, A to Z, and PSI (see **Exhibit 12** for more on consortium members). Phillips explained:

It took three years to get these seven players to act in concert to go from what was a wistful, highly creative, and highly ambitious idea to an actual, practical project that delivered initially... 250,000 bed nets...but if you had all these players in the room, they would have different views of who they were and why they were participating.

Since the Consortium members were primarily motivated by the opportunity to save a significant number of lives by developing a sustainable supply of locally made and highly effective LLINs, ensuring effective distribution was essential to their success. UNICEF purchased and distributed 90% of A to Z's first-year production, with financial support from the Rockefeller Foundation and ExxonMobil. UNICEF also provided assistance in scaling up production and supported distribution and voucher programs through hospitals, antenatal clinics, and immunization campaigns. ExxonMobil granted UNICEF USD 250,000 for Olyset® distribution in Cameroon and funded a voucher system there to facilitate uptake.

The Consortium decided to distribute 90% of finished LLINs through public sector channels and to distribute the other 10% through private sector channels, such as service stations. Phillips explained that the Consortium explored the private sector due to “an overt strategic decision by Acumen and ExxonMobil. One of the issues we were trying to address was sustainability and, as you know, sustainability is hard to even define. Standard sustainability practice in the commercial market is to let the market mechanisms play out, and it's pretty clear that there's not a standard market mechanism here.”

PSI invested USD 15,000 in marketing, an education campaign, and the development of local retail networks.<sup>23</sup> It also expanded distribution to six regions in Tanzania. PSI also invested in the creation of a brand name. Results from a 2004 market survey revealed that the net had become known in Swahili as *Nguvu za Ajabu*, or Magic Power, because of its purported ability to repel several different species of insects.<sup>24</sup>

In addition to a total investment of USD 11.3 million, ExxonMobil leveraged its oil distribution networks to enhance the delivery of nets through its chain of MobilMarts. The Acumen Fund provided a second loan of USD 400,000 and a grant of USD 275,000 to support private market development, long-term growth, and community responsiveness as well.<sup>23</sup>

Between 2003 and 2005 A to Z was the only company in Africa involved in the production of LLINs. Once it had established itself as an efficient and effective Olyset® manufacturer, A to Z signed a 50/50 joint business venture, known as Vector Health International (VHI), with Sumitomo Chemical to significantly increase production. Sumitomo Chemical's investment in VHI demonstrated its continued commitment to improving malaria prevention and economic development in Africa. Hiromasa Yonekura, President of Sumitomo Chemical, remarked, “This Tanzania operation is a stronghold for our Olyset® net business. From here, we will further expand our Olyset® net operations in Africa, and we will enhance our efforts in the fight against malaria and to contribute to Africa's economic development.”<sup>25</sup>

The VHI joint venture partially financed the production of a new Olyset® manufacturing site in Kisongo, an area located roughly 14 km (8.7 miles) northwest of Arusha. A to Z leveraged the infrastructure at new factory site in Kisongo to build another Olyset® production line independent of the VHI-Olyset® production line. It also used its increased revenue stream to expand its original Olyset® production line at the Arusha factory. By 2008 bed nets comprised 90% of A to Z's manufacturing portfolio, and annual production capacity had reached 19 million Olyset® nets.

### ***The Local Economics of Bed Net Production***

By May 2008 A to Z had created approximately 5,300 salaried positions, 90% of which were filled by women, and supported more than 24,000 people in the surrounding community. A to Z built housing for its

factory workers and was in the process of building a clinic and school at its new factory site for employees and their families. The Tanzanian government expanded the water and electricity networks to accommodate the new factory and built a road to enable the efficient transport of goods to and from the factory. In line with its commitment to the production of socially beneficial products, A to Z planned to expand its plastics recycling capabilities in 2008. Shah expected that by the end of 2008, A to Z would be recycling plastic in a new facility designated for washing, grinding, and processing plastics for packaging of non-consumable products. A to Z also had plans to expand stages of Olyset® production to smaller satellite industry producers.

The Executive Director of the RBM Partnership, Dr. Awa Marie Coll-Seck, believed that LLINs represented an essential tool in the effort to control malaria, and the increased manufacturing capacity in Tanzania signified progress toward not only malaria reduction, but also job creation, particularly for women. She also believed that the royalty-free transfer of the Olyset® technology from Sumitomo Chemical to A to Z “reaped tremendous results and [showed] how innovative partnerships can produce sustainable benefits for public health.”<sup>25</sup>

Reflecting on the initial objectives of the Olyset® Consortium, WHO’s Guillet remarked, “This experience can be a model for others...the strengths of the Consortium, as well as its limits, will only make the next partnership stronger. It is just a matter of recognizing the opportunity when you are at the crossroad.”<sup>23</sup> Phillips also commented, “We successfully completed this entire project without a single sheet of paper that defined the relationships or the terms or the expectations of this group in terms of what we were trying to accomplish.”

As a result of the successes, many of the distribution networks and purchasing agreements designed to facilitate A to Z’s establishment as a major global producer of LLINs were deemed no longer necessary. A to Z had capacity to meet a significant portion of the global demand for Olyset® nets. The Consortium had enabled A to Z to enter a complex and atypical market for a private company: selling commodities to public buyers who distributed them for free or at subsidized prices to a population that was otherwise largely unable to afford them.

## **Epilogue: Challenges Moving Forward**

Although the Olyset® Consortium achieved its original objectives, several challenges arose. Consortium members realized that demand generation and utilization were particularly challenging for the industry; a successful LLIN program would need to go beyond universal coverage since “coverage” did not equate to effective utilization. Additionally, the sustainability of A to Z’s Olyset® production was challenged by the complex linkages between donors, governments, companies, and end-users. A to Z found itself in a position where the Olyset® nets had to compete with less effective and less expensive LLINs manufactured in Asia that had only achieved “interim” WHOPEs certification. Additionally, donors’ long-established shipping and distribution networks for bed nets manufactured in Asia were preventing A to Z from capitalizing on its relative proximity to most of the world’s malarious regions. Frustratingly, donors and development organizations (bilateral and multilateral) required bed net manufacturers to quote prices exclusive of distribution and delivery costs, negating the advantage of A to Z’s local manufacture. There were also growing concerns about mosquitoes developing resistance to synthetic pyrethroids, which would render the permethrin-based LLINs little more than physical barriers.

## ***Demand Generation***

In 2008, 95% of LLINs produced by A to Z were purchased by donors and public buyers and provided to vulnerable populations for free or at highly subsidized prices. The donors, including African governments that used external donor funds, were bound by WHO protocols; the market was largely donor, and not end-user, driven. The majority of nets were sold to African governments, UNICEF, the Red Cross, DFID, USAID, NGOs, and other bilateral, public, or not-for-profit agencies. Although Shah was concerned about the sustainability of the business in this market, both Sumitomo Chemical and A to Z were confident that public distribution networks would maximize the number of nets delivered in the shortest time to vulnerable populations and therefore focused on the public, donor-driven sector.

Though A to Z sold only 5% of the Olyset® nets in the private sector to facilitate widespread uptake and grow private demand, A to Z established its own, private delivery network using a fleet of vehicles to deliver nets in East, Central, and Southern Africa. These efforts had to be coupled with education campaigns in which the delivery personnel made sure that recipients knew how to hang the nets, how to instruct clients about their use, and how to ensure that people appreciated the nets' value and would use them effectively.

## ***Competition***

Although Shah believed that competition was very healthy for the LLIN market, he was concerned about an artificial playing field. In an effort to increase the supply of LLINs for rapid scale-up, the Global Fund, WHO, and RBM decided that WHOPES "Interim" certification would be sufficient for LLIN procurement and distribution using donor funds. By 2007, four LLINs had achieved WHOPES Interim status. These less-expensive LLINs were guaranteed for only three to four years but competed equally against A to Z's Olyset® nets, which were guaranteed to last at least five years. Shah believed that this decision distorted the market, since price was no longer proportional to quality. He remarked:

What is unfair is a product which has "Full" [WHOPES] recognition and one which does not compete solely on the grounds of price. Under those circumstances, what is the advantage of having a Phase III WHO recommendation? Zero. What incentives are there to compete with a minimum standard when your product is superior? Zero....It's meaningless to have a product with "Full" WHOPES approval. It is a totally price-driven market....If the minimum standard is that the wheels move, then nobody will buy a Mercedes.

Although the Olyset® nets' longevity made them more cost-effective, many of the public buyers were more concerned with rapidly increasing coverage with less expensive WHOPES "Interim" LLINs rather than using Olyset® nets. Moreover, "Interim" LLINs that failed to report for the required follow-up WHOPES assessment continued to be eligible for public sector procurement. Although UNICEF's guaranteed purchase in the initial year of production provided some financial security for A to Z's risky expansion to LLIN manufacturing, such arrangements were often criticized as monopolistic.

Shah hoped that the donors would appreciate the risks undertaken by A to Z. Establishing A to Z's Olyset® line in East Africa incurred higher upfront costs than it would have in most places in Asia. It built a new factory, purchased new equipment, and required a large support infrastructure to invest in training thousands of employees, many of whom had never seen, let alone worked, in a factory like A to Z's Olyset® factory in Kisongo. A to Z was responsible for importing the impregnated resin to Arusha, extruding the polyethylene fiber, knitting, and sewing it into nets, and finally packaging and storing LLINs. As a result of these higher upfront costs and higher labor, electricity, and raw material shipping costs, A to Z's Olyset® net was inevitably more expensive than nets manufactured in Asia.

## A to Z Advantages

*The Olyset® model produces a vital public health product and simultaneously boosts economic development in Africa....This is truly an advance beyond aid, toward self-sustaining enterprise in the service of public health. It is a model that should be vigorously applied in other industries across the continent.*<sup>25</sup>

— Dr. Ali Mohammed Shein, the Vice President of Tanzania at the opening ceremony of the new A to Z factory in February, 2008.

Despite the challenges, Shah believed that A to Z maintained a competitive advantage over other LLIN manufacturers. A to Z was closer in proximity to the African end-users, resulting in reduced delivery and freight costs for finished LLINs. Other LLINs were imported, predominantly from Asia, where longer supply chains required complicated forecasting, procurement, and distribution networks to transport them to rural areas of sub-Saharan Africa. A to Z was able to bypass much of these complicated and time-consuming interactions and had invested in its capacity to distribute LLINs throughout Eastern, Southern, and Central Africa using its own distribution network. A to Z also had proven an unparalleled responsiveness to the demands of end-users, having altered the colors, the mesh size, and net sizes to better meet users' needs and wants.

Procurement policies, however, required that manufacturers quote standard free on board (FOB)<sup>2</sup> prices when competing for tenders—the cost of the nets when they left the factory gates or warehouses. This policy did not reflect A to Z's competitive advantage in proximity to the target market. Instead, A to Z's FOB price was roughly 3% to 4% higher than its competitors. If manufacturers were asked to quote cost, insurance, and freight (CIF) instead of FOB, A to Z would be priced competitively.

Significantly, Shah and the founders of the Olyset® Consortium believed that the value of producing LLINs in Africa went far beyond cost savings and offered the potential for sustainable economic development through long-term investment in the local workforce and economy. Shah believed:

If you spend a dollar on LLINs manufactured in Africa, there will be three benefits: you will provide a life-saving product to protect people against malaria; you will help in creating jobs and poverty alleviation; and you will promote sustainable economic development. We are not asking for loans; we just need the donor community to see products manufactured in Africa as having the added value of driving three outcomes with the same dollar.

Thus, although A to Z produced the most efficacious and cost-effective bed nets in sub-Saharan Africa, it struggled to compete with more remote manufacturers with cheaper upfront costs. Shah remarked, "as long as your products are cheaper, even if the product only lasts two years, you win the business." Despite forecasts of demand for 354 million LLINs for 2010, Shah was hesitant to invest any more capital in the expansion of A to Z's Olyset® manufacturing capacity. Speaking about a practice that he believed had become all too common in the distribution of bed nets, Shah described his impression of the effort to rapidly scale-up coverage: "Get the nets, get the coverage, get the press in, get the photographs, and get on the front page. After two days, you've forgotten about why you're on the front page. Instead, get to the front page and be remembered for providing a quality product." Shah believed that the health standards in developing countries would sustainably improve if donors focused on implementing global health programs that simultaneously reduced poverty. He remarked:

Africa does not need aid. It needs trade; it needs investments, and you can only do that if we look at the big picture. How do you strengthen the public sector in sub-Saharan Africa? You need to get people a job to earn

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<sup>2</sup> Free on Board (FOB) refers to the point at which the buyer assumes insurance, freight, and distribution costs. Standard FOB is generally at the manufacturer's warehouse or at the port of exit.

something; then they'll have clean water, they'll have good health care, they'll buy an Olyset® net, and they'll get two meals a day.

As Shah pondered these ideas, he was reminded of the Olyset® Consortium's initial objectives and wondered how much progress had really been made.

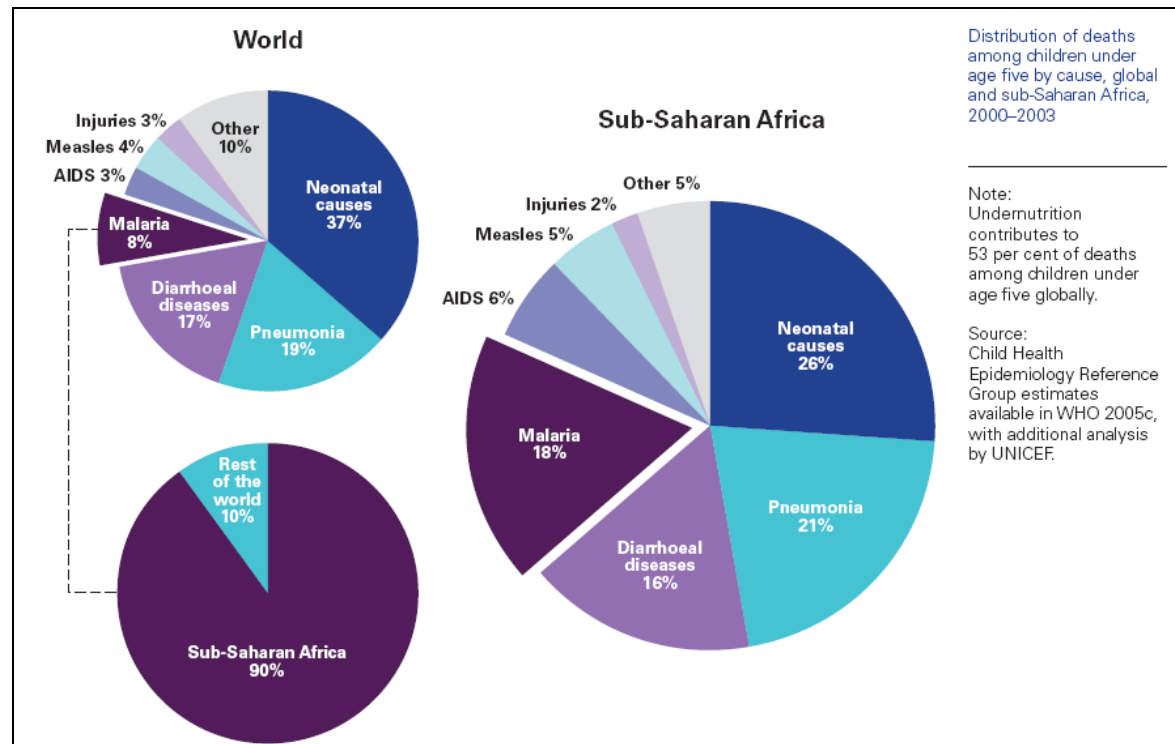
## A to Z's Future

In September 2000, 189 nations adopted the Millennium Declaration as a tool to guide development interventions around the world.<sup>26</sup> Its eight objectives, as defined in the Millennium Development Goals (MDGs), were to be achieved by 2015 (see **Exhibit 13** for MDGs).

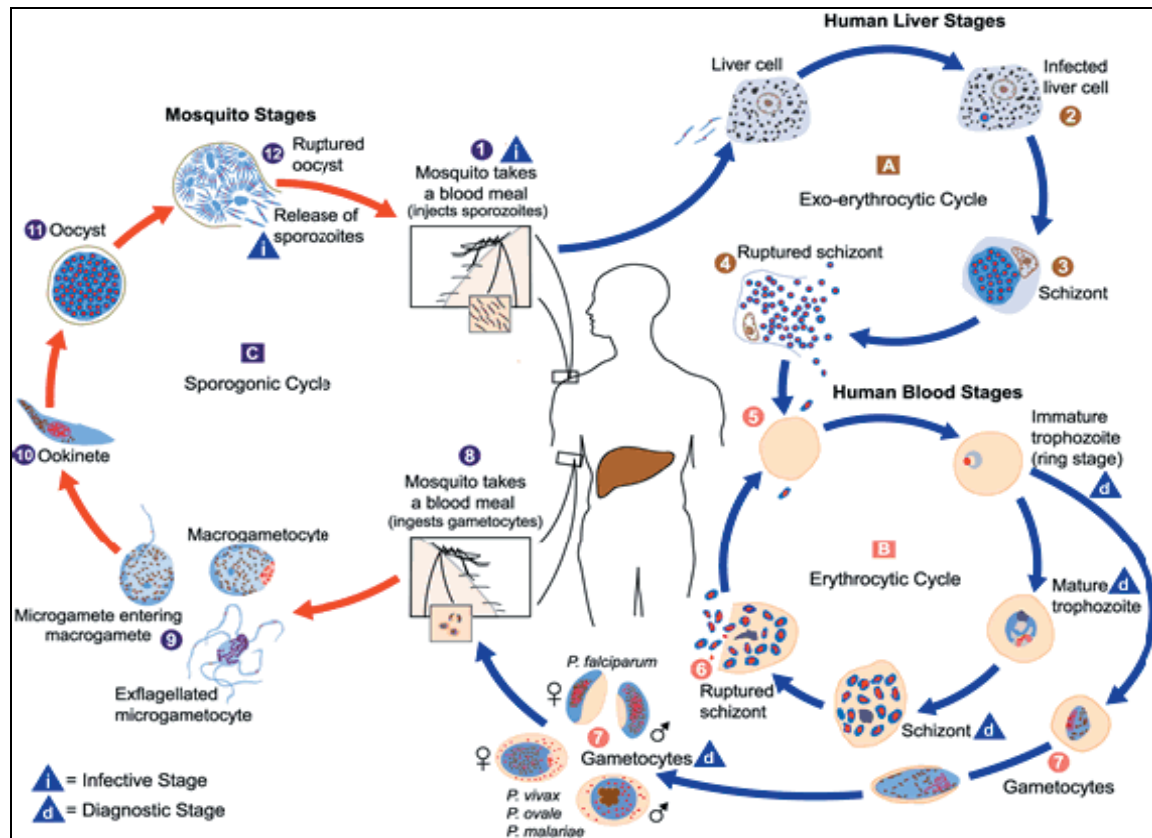
Shah believed that the local production of Olyset® nets in Africa represented a novel approach that directly addressed six of the eight MDGs and that it was a model that could be replicated in other sectors. After centuries of removing Africa's raw materials for processing and value addition abroad, he believed that the time had come for Africa to benefit from its own wealth. However, taking this step would require improved support and investment in talented people in resource-limited settings who were willing to take risks. Shah was full of praise for the donor community and its efforts to improve health care standards in sub-Saharan Africa. At the same time, he believed that the donors were missing an opportunity to effect lasting and comprehensive change through their failure to stimulate the production of quality health care commodities in sub-Saharan Africa.

The problem of malaria is not going to be finished today or tomorrow by saying, 'now everybody get under a net.' In three years you need new nets, and if another disease comes along the focus on malaria will be diverted.... If the donor community is sure that every three years it will have the resources to get people nets and that aid, rather than trade and investment, is the best thing for Africa, then they should not buy Olyset®, they should buy the cheapest nets available. But you must ask how long is the donor community going to be spoon-feeding people in Africa?

Shah was concerned about how much more he should invest in the growth of A to Z's Olyset® manufacturing capacity given the market uncertainty, regulatory ambiguity, and A to Z's dependence on the donor community. Although the target market was mainly children under five and pregnant women in sub-Saharan Africa, the buyers were primarily donors and development organizations whose incentives and actions he found to be ambiguous. Shah was particularly concerned about the potential repercussions of the LLIN industry's uncertainty on A to Z's employees who had built their livelihoods around their employment with the company. Shah felt a moral obligation to ensure that potential shifts in global policy, funding, or priorities did not lead to job losses at A to Z. With these concerns and challenges in mind, Shah needed to analyze both the LLIN industry and A to Z's position to decide whether he should continue expanding Olyset® production or diversify its portfolio to include other products and markets.

**Exhibit 1**     *Causes of Mortality in Children Under-five (2000-2003)*


Source: Malaria & Children: Progress in intervention coverage. UNICEF and RBM, 2007.

Exhibit 2 *Plasmodium Falciparum* Life Cycle

Source: *Killer Number One: The Fight Against Malaria* (United Nations Integrated Regional Information Networks (IRIN), February 2006).

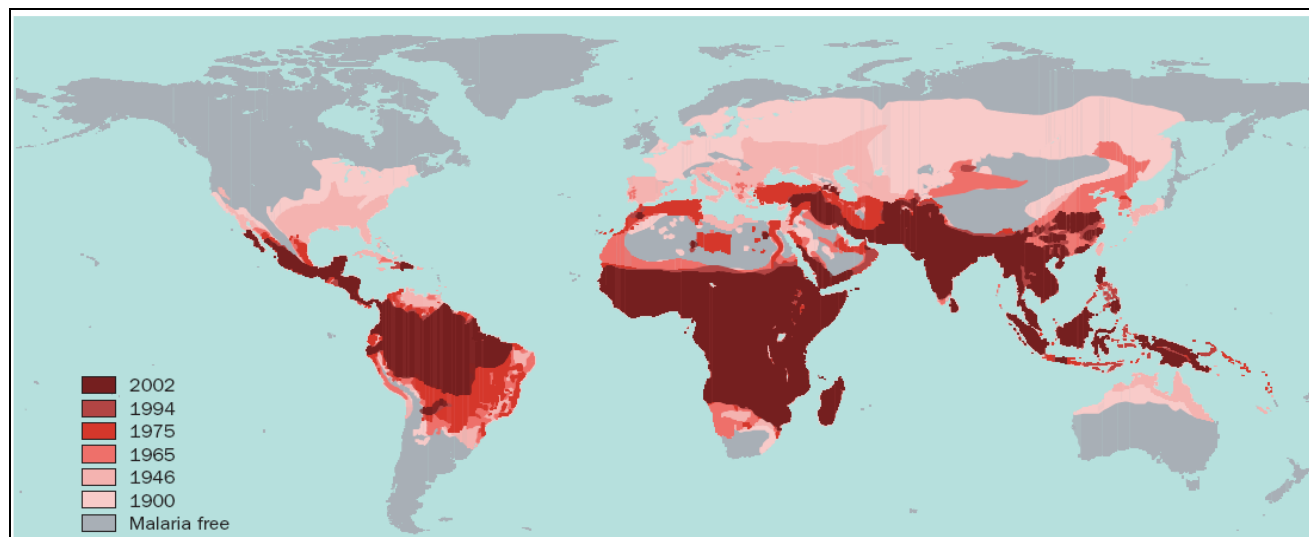
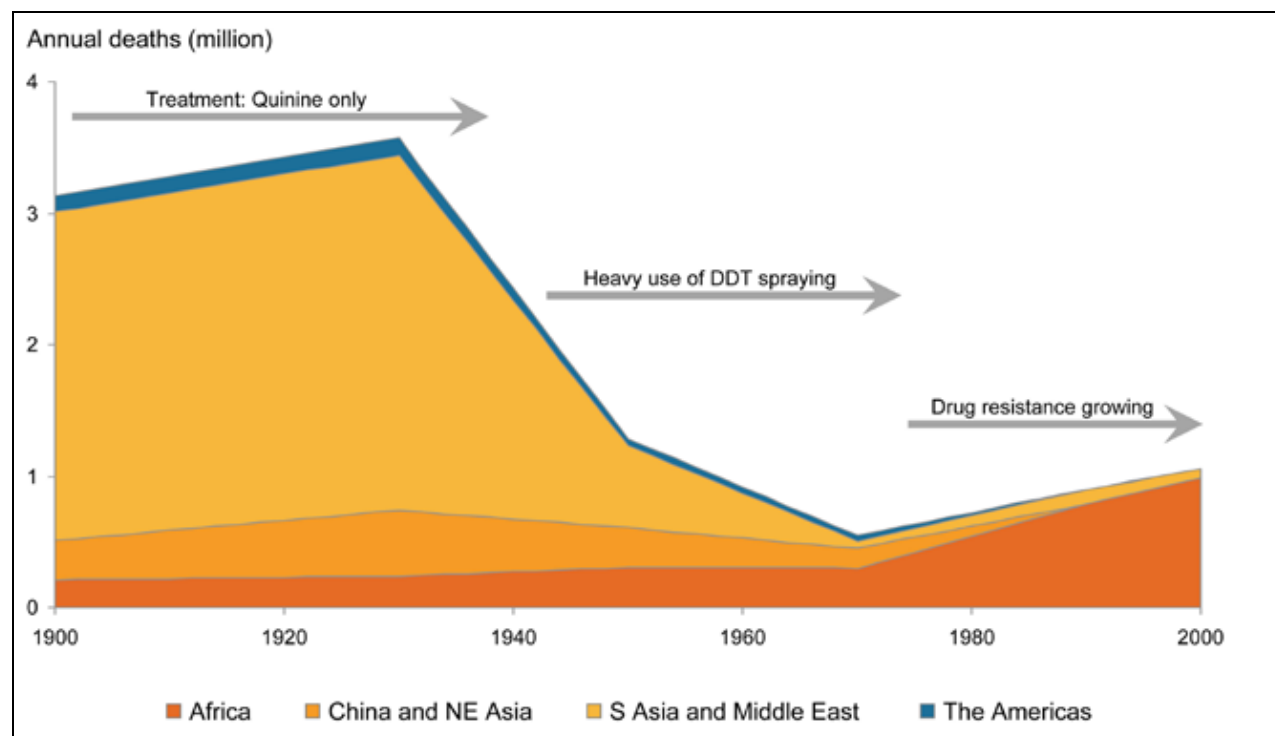
**Exhibit 3**      *Malaria Global Distribution, 1900-2002*

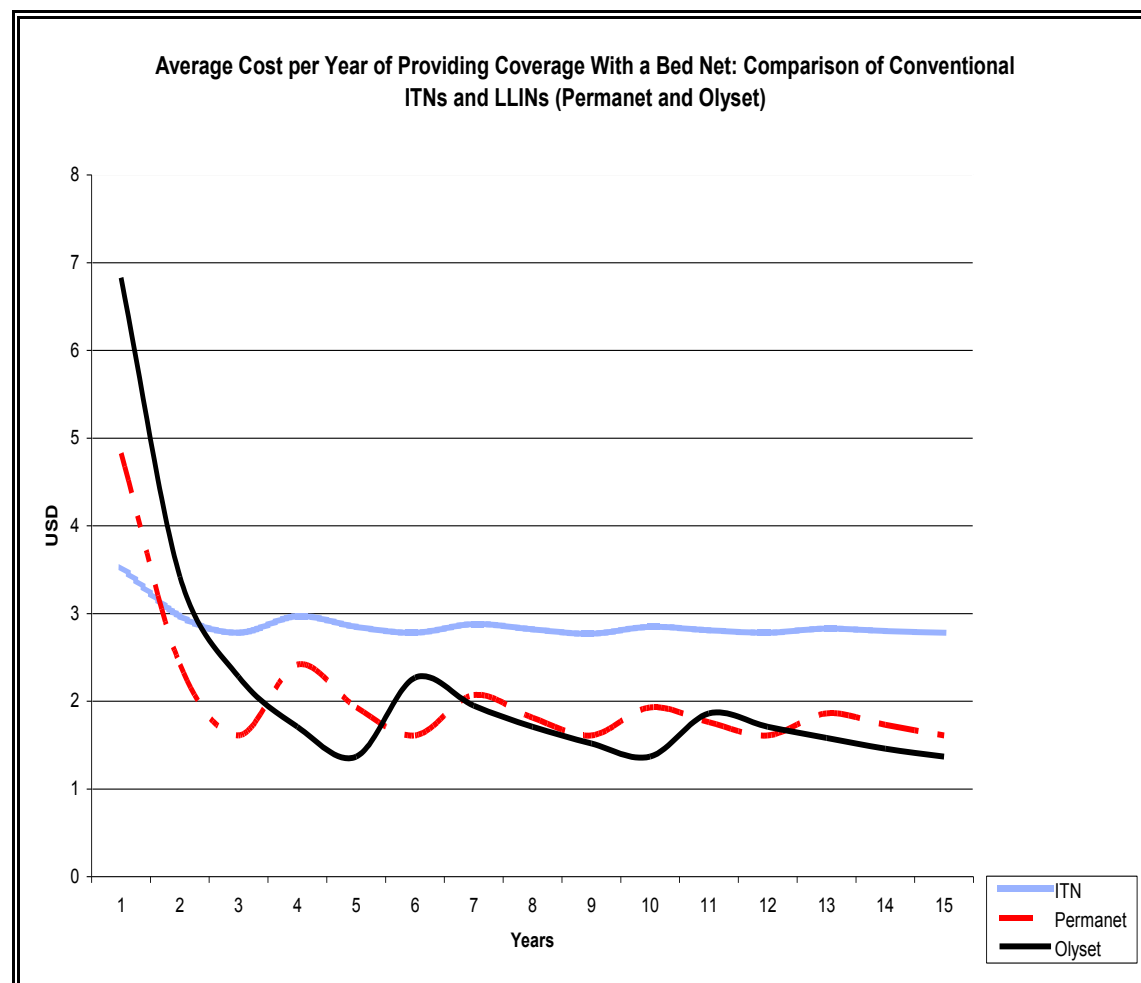
Figure 1. The global distribution of malaria since preintervention (~1900–2002). All-cause malaria distribution maps for the preintervention distribution (circa 1900)<sup>9</sup> and for the years 1946, 1965, 1975, 1992, 1994, and 2002<sup>12–17</sup> were georeferenced using ERDAS Imagine 8.5 (Leica Geosystems GIS & Mapping, Atlanta, GA, USA). Maps were then digitised on screen with MapInfo Professional 7.0 (MapInfo Corp, NY, USA). Areas of high and low risk were merged throughout to establish all-cause malaria transmission limits. The only modification of original maps was infilling areas labelled as unknown in China in the 1975 map<sup>14</sup> with the distribution recorded in 1965.<sup>13</sup> Each map was then overlaid to create a single global distribution map of malaria risk which illustrates range changes through time. Note that the 1992 distribution is excluded from the figure for clarity because it was so similar to that of 1994.

Source: Hay, S.I. & Snow, R.W. “The Malaria Atlas Project: developing global maps of malaria risk.” *PLoS Med.*, 3(12): e473. (2006).

**Exhibit 4**     *History of Malaria Mortality*

Source: Global Malaria Action Plan, RBM 2008.

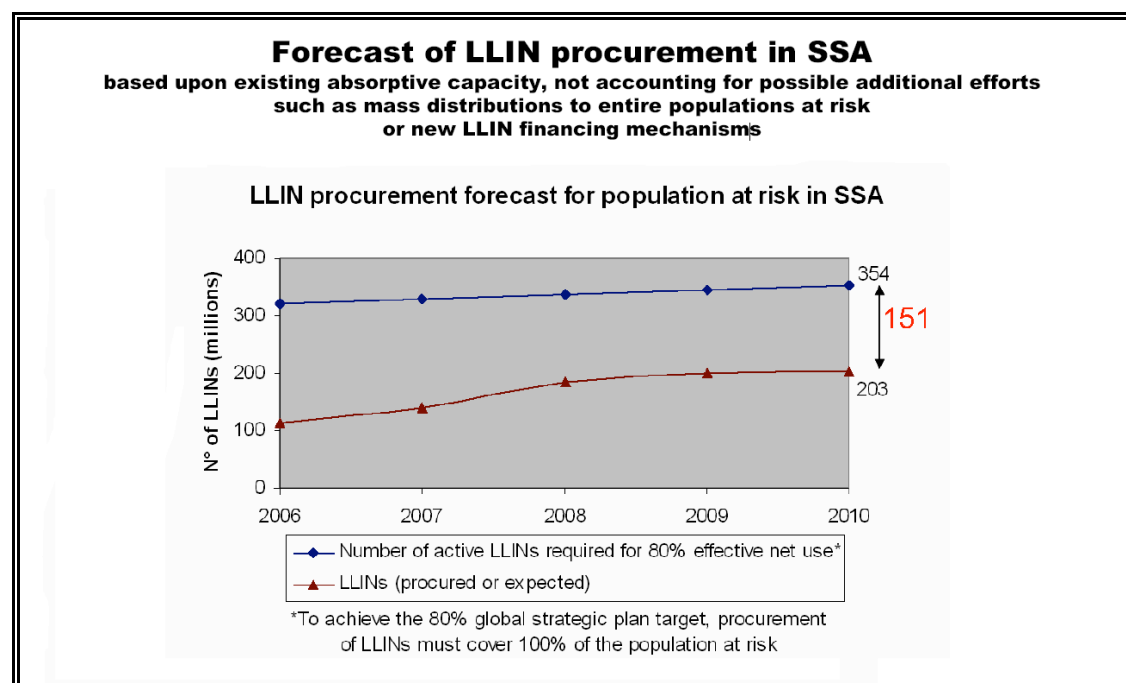
# Exhibit 5 Cost-effectiveness of Conventional ITNs vs. LLINs



Net	Cost	Delivery to Clinic	Total Cost	Re-treatment	Longevity (Years)
Conventional ITN	\$2.00	\$0.33	\$2.33	\$1.20	3
Permanet <sup>®</sup>	\$4.50	\$0.33	\$4.83	N/A	3
Olyset <sup>®</sup>	\$6.50	\$0.33	\$6.83	N/A	5

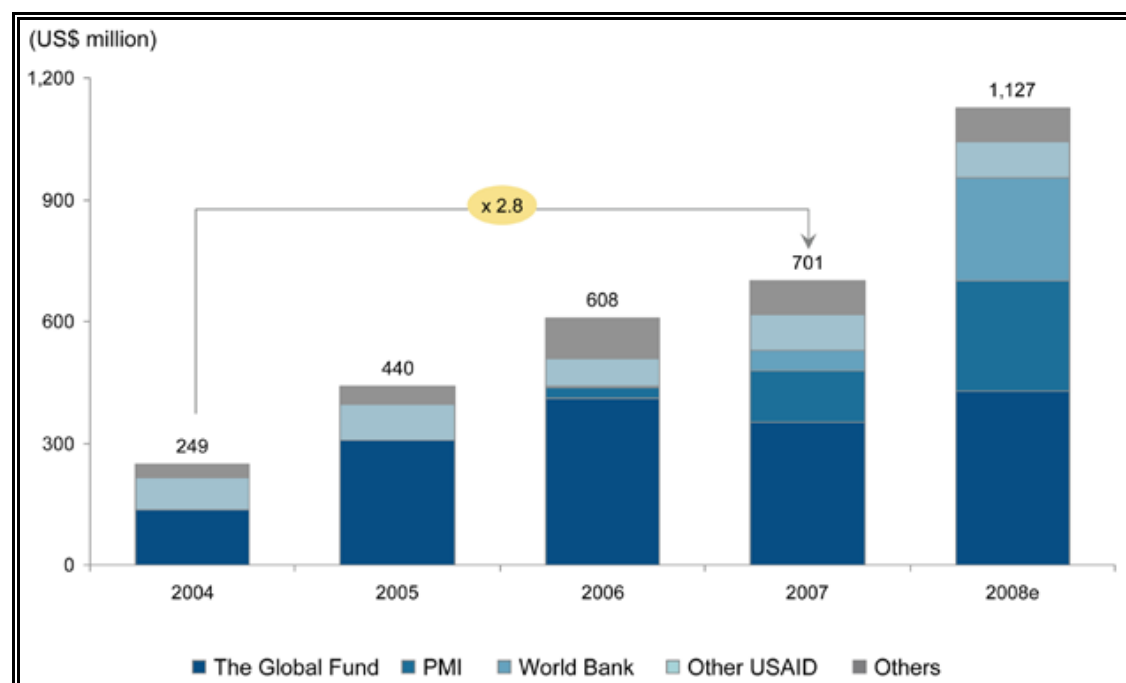
Source: Strategic Plan for Stimulating the Development, Manufacturing, and Widespread Distribution of LLINs, Management Sciences for Health (2004); and communication with A to Z Textile Mills, Arusha, Tanzania (May 2008).

### Exhibit 6 *Forecasting LLIN Demand*



Source: RBM: Procurement and Supply Management. Work Plan, Mid-Term Review May 2008.

### Exhibit 7 *Evolution of International Funding Disbursements for Malaria*

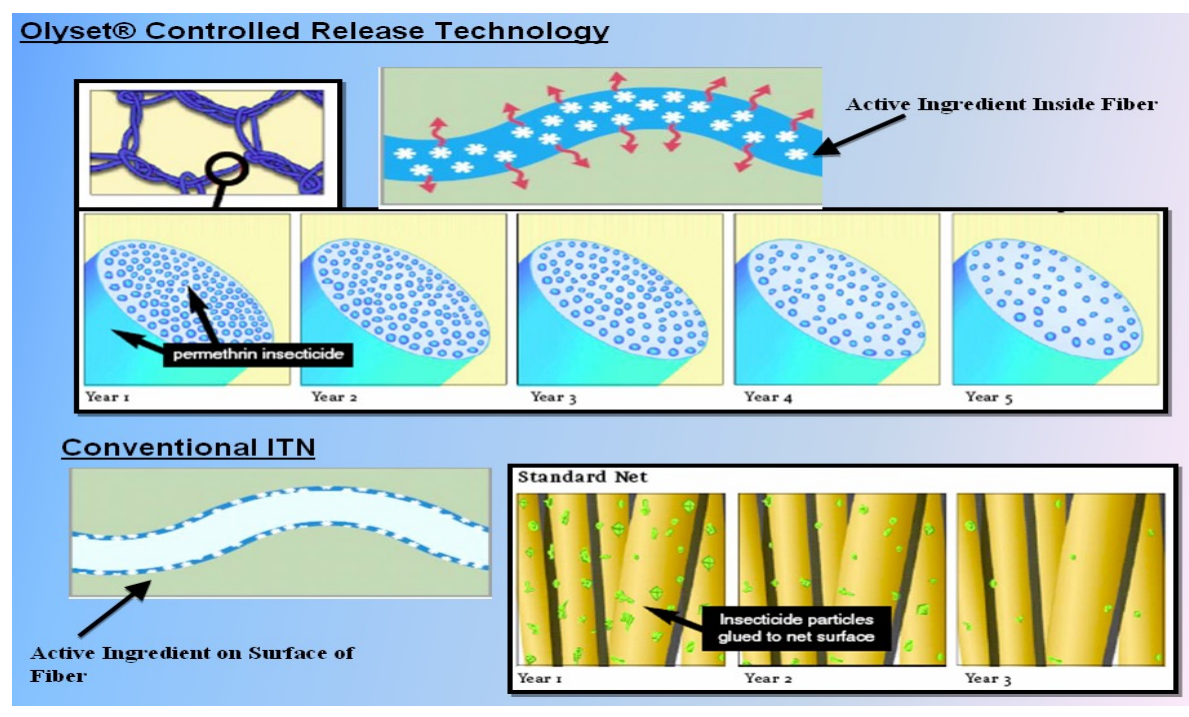


Source: Global Malaria Action Plan, RBM 2008.

## Exhibit 8 *Olyset® Technology*

Unlike conventional ITNs and most other LLINs, which were composed of coated netting, the Olyset® Net was made by incorporating 2% permethrin-impregnated polyethylene granules shipped from Sumitomo Chemical in Japan directly into the polyethylene resin during the manufacturing process. These granules, known as the “master batch,” were heated, extruded into fiber, and wound onto spools. The spools of fiber were then knitted into rolls of LLIN netting material, which were then cut and sewn by hand into the final product. Each net was then meticulously examined to ensure quality. The Olyset® nets were available in blue, white, and green.

The impregnation of the netting material allowed for the controlled release of insecticide onto the net’s surface. The Olyset® Nets continued repelling and/or killing mosquitoes for at least five years, while human exposure to the mildly toxic insecticide was minimized by maintaining concentrations below harmful levels.



Source: Developed from, Role of Olyset® Net in Malaria Control. A to Z Textile Mills.

Exhibit 9 *Long-Lasting Insecticide Nets and Olyset® Production Process*

Exhibit 10 ***WHOPES Recommended LLINs, December 2007***

<b><i>Product name</i></b>	<b><i>Product type</i></b>	<b><i>Status of WHO recommendation</i></b>
<b><i>Duranet®</i></b>	Alpha-cypermethrin incorporated into polyethylene	Interim
<b><i>Netprotect®</i></b>	Deltamethrin incorporated into polyethylene	Interim
<b><i>Olyset®</i></b>	Permethrin incorporated into polyethylene	Full
<b><i>PermaNet 2.0®</i></b>	Deltamethrin coated on polyester	Interim
<b><i>Interceptor®</i></b>	Alpha-cypermethrin coated on polyester	Interim

**Note:** WHO recommendations on the use of pesticides in public health are valid **ONLY** if linked to WHO specifications for their quality control. WHO specifications for public health pesticides are available on the WHO homepage on the Internet at <http://www.who.int/whopes/quality/en/>.

Exhibit 11 ***Cost-Effectiveness of Malaria Prevention Strategies***

<b>Intervention</b>	<b>Insecticide Program Cost (per person/year in USD)</b>
IRS/Carbamate	4.80
IRS/DDT	2.77
IRS/Pyrethroid	2.16
LN/Polyester	1.00
LN/Olyset	0.68

Source: WHO Global Malaria Program Strategic Technical Advisory Group, May 2006.

Exhibit 12 ***Olyset® Consortium Members***

CONSORTIUM MEMBER	DESCRIPTION
<b>ExxonMobil</b>	An oil and gas corporation with 38 oil refineries in 21 countries based in Irving, Texas, USA with a record net income of USD 40.61 billion in 2007, making it one of the world's largest publicly traded corporations.
<b>World Health Organization</b>	A United Nations agency based in Geneva, Switzerland that acts as a directing and coordinating authority on international public health issues, standards, research, monitoring, and consulting.
<b>Sumitomo Chemical Company</b>	One of Japan's top three chemical manufacturing companies based in Tokyo that makes chemicals for everything from plastics to agriculture to electronics invested in contributing to the sustainable development of society.
<b>United Nations International Children's Fund (UNICEF)</b>	A United Nations agency based in New York City, USA that provides long-term humanitarian and developmental assistance to children and mothers in over 190 developing countries.
<b>Acumen Fund</b>	A not-for-profit venture fund based in New York City that uses entrepreneurial approaches to address problems of global poverty to help build financially sustainable and scalable organizations that deliver affordable, critical goods and services to the poor.
<b>A to Z Textile Mills Ltd.</b>	A manufacturing company in Arusha, Tanzania that began as a garment factory in 1966 and became the only African company to manufacture LLIN starting in 2003.
<b>Population Services International (PSI)</b>	A not-for-profit, social marketing organization based in Washington, DC, USA and founded in 1970 that specializes in demand generation for health products and services in over 65 countries.

**Source: Created by case writers from publicly available sources.**

Exhibit 13 ***Millennium Development Goals***

<ul style="list-style-type: none"> <li>◆ Goal 1: Eradicate extreme poverty and hunger</li> <li>◆ Goal 2: Achieve universal primary education</li> <li>◆ Goal 3: Promote gender equality and empower women</li> <li>◆ Goal 4: Reduce child mortality</li> <li>◆ Goal 5: Improve maternal health</li> <li>◆ Goal 6: Combat HIV/AIDS, malaria and other diseases</li> <li>◆ Goal 7: Ensure environmental sustainability</li> <li>◆ Goal 8: Develop a Global Partnership for Development<sup>1</sup></li> </ul>
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Source: United Nations. Available at <http://www.un.org/millenniumgoals/>.

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