

NEWS

An Elegant But Imperfect Tool

Pesticide-treated mosquito nets save lives—in the short term. But reaching people who need them most is no simple task

BOBO-DIOULASSO, BURKINA FASO—The net is an elegantly effective trap. Drawn by the scent of a sleeping human, the female *Anopheles gambiae* mosquito closes in for her blood meal. But as she flies toward the human target, she runs into a web of cotton or polyester. As soon as she touches the net, a powerful insecticide numbs her legs. She might fall to the ground stunned, easy prey for lizards or ants. If she lingers, the chemical will kill her within a few seconds.

Insecticide-treated bed nets have emerged in the last decade as one of the great hopes in the fight against the mosquitoes that carry malaria. They are technologically simple, and more than 70 studies have shown that they work. In the first year after the introduction of bed-net programs into African villages, for instance, the mortality rate for children under age 5 typically drops by 15% to 25%. Even better, several studies have shown that the neighbors of those who sleep under bed nets are also protected, presumably because the nets not only block mosquitoes but also kill them in significant numbers. Based on those promising data, the World Health Organization in 1996 made distribution of treated nets a key part of its Roll Back Malaria program. The goal: to ensure that 60% of people in malaria-endemic areas sleep under nets by 2005.

Even so, bed nets are not the cure-all they are often touted to be, and their flaws are most evident in tropical Africa. In some parts of the continent, the malaria parasite and the mosquitoes that carry it are so thoroughly entrenched that even if bed nets killed nine out of 10 mosquitoes, residents could still receive dozens of infective bites

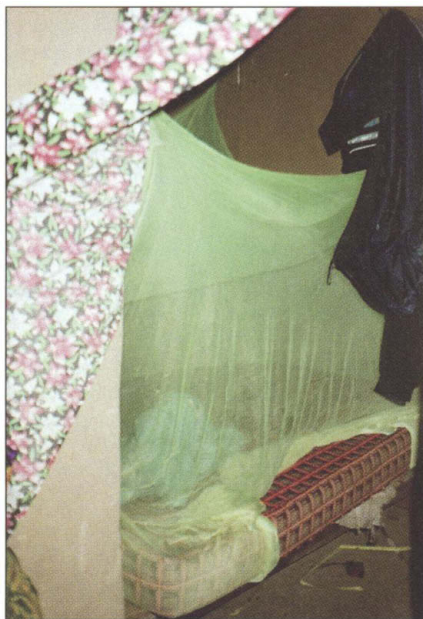
per year—so many that the overall disease rate would remain unchanged. Logistically, getting bed nets to the poor who need them most is a huge challenge, and ensuring that

the nets are retreated with pesticides every 6 months is harder still. Even if logistics were not a problem, concern is growing that mosquitoes will become resistant to bed-net chemicals, as they have to other insecticides.

On top of these difficulties, some data suggest that, although

\$8)—is enough to buy 30 kilos of rice or more than 200 good-sized mangoes. The village is on the edge of vast irrigated rice fields—a fertile spot for mosquito breeding—and villagers can receive hundreds of bites per night. Those with mosquito nets sleep much more comfortably, but some can't afford the luxury.

Sociologist Léa Paré-Toé, entomologist Thierry Baldet, and their colleagues at the Centre Muraz in Bobo-Dioulasso are conducting door-to-door surveys and small discussion groups to find out who in Bama lacks treated nets and why. The team asks who sleeps under nets, the last time the net was treated with insecticide, and how much the residents understand about the connection between nets and malaria. In one group of 12 farmers between the ages of 20 and 49, someone suggests that eating the wrong food causes malaria. Most in the group have nets at home, but few have them treated. Only a handful have heard that bed nets can prevent malaria. Such responses are not uncommon, Paré-Toé says, and they clearly demonstrate how far public health workers have to go before Roll Back Malaria is even close to meeting its

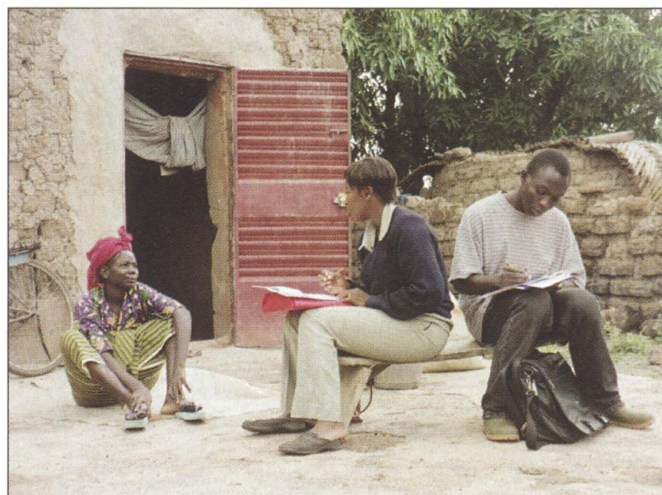


Real life. Researchers from Centre Muraz in Bobo-Dioulasso conduct door-to-door surveys to find who uses mosquito nets, who doesn't—and why.

bed nets clearly prevent malaria in the short term, they might leave children more vulnerable to the disease later in life by delaying the development of an immune response. In light of these caveats, some researchers are suggesting that money and efforts devoted to bed nets might be better spent on boosting treatment programs.

Bed nets for sale

The dirt roads of Bama, 45 minutes north of Bobo-Dioulasso, swarm with people on market day. Alongside neatly piled pyramids of tomatoes and mangoes, overflowing sacks of rice, and baskets of roasted black-and-yellow striped caterpillars, merchants display mosquito nets for sale. Nets are common here even though the going price—6000 West African CFA (about



60% target.

The team also asks how much a person is willing to pay for a net and pesticide treatment. But in reality, says Bob Snow of the Kenyan Medical Research Institute, Nairobi, "there's an enormous gulf between willing and able to pay" for many people in malaria-affected regions. He is pessimistic about so-called social marketing strategies—advertisements promoting bed nets and their use—that rely on existing market systems to sell nets. "If you believe bed nets work, why are you asking people to pay for them?" he asks.

Cost is an even more acute problem for retreatment programs. The group of insecticides that is most effective at killing

CREDITS: (LEFT AND RIGHT) G. VOGEL/SCIENCE

mosquitoes, pyrethroids, wears off after about 6 months, or sooner if a net is washed. Nets must be dipped regularly to retain their mosquito-killing ability. Although the process is not complicated, it is one of the

most difficult: preventing children from acquiring an immunity to the parasite that could be life-saving later on.

Modiano points to several studies that suggest that when malaria transmission is

bed nets decrease but do not stop parasite transmission, after a few years of consistent bed-net use, the number of malaria cases in a village could climb again to its original level. "I am not against bed nets," says Modiano, "but before going to a continental scale [as WHO is advocating], it should be shown that they work in the long term." Modiano believes that the best way to reduce malaria mortality is to broaden distribution of medicines and teach health workers and parents how to recognize and treat malaria, which, after all, "is a curable disease."

Snow, whose own studies have shown that people who sleep under nets often have fewer anti-*Plasmodium* antibodies in their blood than those who don't, agrees that in certain areas, nets are of limited value by themselves. "If all things remained equal, then in some areas of very intense transmission, the effects of insecticide-treated nets may be only marginal with time," he says. "But we would anticipate, hope, and wish that all things will not remain equal." Technological, social, and economic gains should all make ongoing net programs more effective, Snow says. For example, two types of permanently treated nets have recently gone on the market. Such a development "would be a godsend" to net-distribution programs, he adds. And even a partially effective vaccine might boost people's immunity enough to make up for that lost by sleeping under nets.

Some argue that bed nets are an adjunct, not a rival, to medical programs. Christian Lengeler of the Swiss Tropical Institute in Basel reasons that if health workers face fewer overall malaria cases—at least in the initial few years of a bed-net program—they can more effectively treat those that do appear. Treatment, in turn, also helps interrupt the cycle of parasite transmission. "Bed nets are a simple and elegant way of preventing part of the malaria burden, and they go hand in hand with treatment efforts," he says.

"The problem has been that people have seen bed nets as a panacea—the saving grace of malaria in Africa. That's not true," says Snow. He knows only one sure-fire solution: "Malaria is an absolutely huge problem, and it all boils down to money, money, money."

—GRETCHEN VOGEL

Acknowledgments A number of people generously contributed their time to this special news section: Frank Collins, Sonia Ehrlich, Anthony Kiszewski, Phil Lounibos, Pia Malaney, Andrew Mellinger, Jeffrey Sachs, Andrew Spielman, and Thomas Zavortink.



Mixed blessing. Irrigated rice fields are important sources of income—and ideal mosquito breeding spots.

weakest links in bed-net programs.

"It's hard for people to perceive an immediate benefit from treating their nets," notes entomologist William Hawley of the U.S. Centers for Disease Control and Prevention (CDC), who studies the effects of bed nets and their use in Kenya. People are even less willing to pay for redipping than for the original nets. When researchers have offered free retreatment, participation has been relatively high. But when they charge a fairly modest sum, 50 cents, according to a study in The Gambia, participation drops to about 20% of net owners. "It's as if you held national immunization days and then said to the parents, 'By the way, give us 50 cents to cover the cost of the shot,'" explains Richard Steketee, chief of CDC's Malaria and Epidemiology Branch, who works with Hawley in Kenya. "The immunization people would never dream of doing that."

A question of balance

In light of these problems, the massive efforts under way to encourage bed-net use are in danger of being misspent, warns malariologist David Modiano of the University of Rome, who has worked with several net projects in Burkina Faso. He fears that an overemphasis on nets will divert money from programs aimed at increasing access to malaria medicines and treatment. He also warns that successful bed-net programs could have an unintended side ef-

fect: reduced through successful bed-net programs, people's natural level of immunity—built up through exposure to the parasite—also falls. That leaves many, especially children, more vulnerable to getting sick after just a few infective bites. And because

Bird lover
Culex pipiens
 (Common house mosquito)

A real city dweller, *Culex pipiens* lives near people but feeds mainly on birds. Probably a major force in propagating West Nile outbreaks in bird populations.


Distribution: Urban areas in temperate zones across the globe.

Breeding habitat: Almost any water container; prefers polluted water.

Feeding: Occasionally settles for humans and other mammals.

Diseases: Besides perpetuating West Nile in birds, it may serve as a "bridge vector" that transmits the virus to people.

credit: USGS



Culex pipiens