

Assessment of a Targeted Approach to Preventing Malaria in the Oil and Gas Industry

Following the death from malaria of four of its expatriate employees while they were in nonmalarious countries, an oilfield service company developed a targeted, multicomponent malaria-prevention program. The program comprises two levels of malaria training, malaria arrival and departure quizzes, a malaria hot line, and a curative malaria kit (CMK). The cornerstone of the program is the CMK, which contains a diagnostic test that employees can use to diagnose malaria in minutes and standby (emergency) curative medication.

Introduction

Every year, malaria caused by the parasite *Plasmodium falciparum* infects 300 to 500 million people and kills between one and two million, particularly in sub-Saharan Africa, parts of South America, and in southeast Asia. Among the expatriate population working or living in these malarious areas of the world, malaria is a major occupational illness, responsible for numerous lost days and several deaths within the oil and gas industry every year. *Falciparum* malaria can kill non-immune individuals within a few days if not treated immediately.

This article, written by Technology Editor Dennis Denney, contains highlights of paper SPE 98457, "Assessment of a Targeted Approach to Preventing Malaria in the Oil and Gas Industry: Responses to a Web-Based Questionnaire," by A. Barbey, SPE, Schlumberger; A.H.E. Roukens, Leiden U. Medical Center; J. Berg, Shell Health Services; and S. Cannegieter and L. Visser, Leiden U. Medical Center, prepared for the 2006 SPE International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production, Abu Dhabi, UAE, 2-4 April.

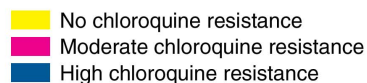
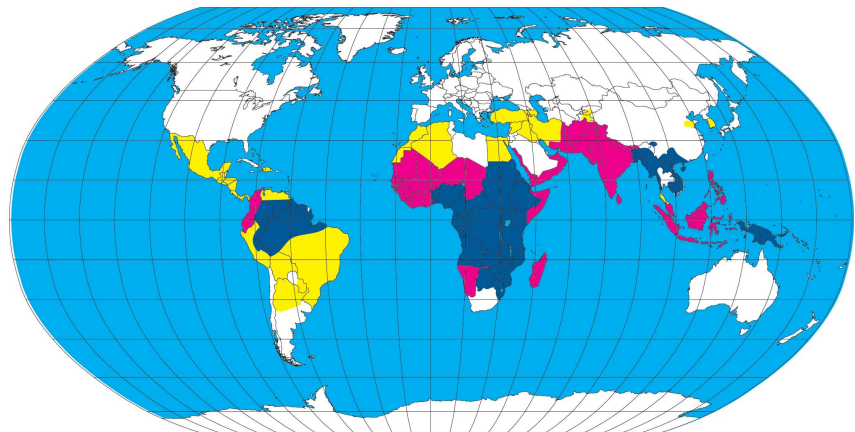


Fig. 1—WHO malaria country classification.

Because the symptoms of malaria are not unique—fever, shivering, joint pain, and headache—and they do not occur until 7 to 60 days after infection, malaria is easily misdiagnosed or improperly treated. Most of the expatriate deaths occur not in the malarious country where the disease was transmitted by the bite of an infected mosquito, but in nonmalarious countries where the infected expatriates have traveled for work or days off.

Four employees died of malaria between 2000 and 2002. All deaths took place outside of the malarious locations and in countries where the fatal form of malaria is not endemic. Following these deaths, a task force was created within the company with the aim of attaining and maintaining the goal of zero malaria deaths. The result was development of a malaria-prevention program based on the company's comprehensive quality, health, safety, and environment management system. The program pro-

vides processes and tools to fulfill the requirements of each of the system's eight elements. Components of the program are two levels of malaria training, malaria arrival and departure quizzes, a set of auditable malaria-prevention-program guidelines, and two innovative tools not previously used in oilfield malaria prevention: a malaria hot line and a CMK.

The malaria-prevention program was distributed by the oilfield service company to its international employees and their dependents and to its contractors working in high-malaria-risk areas. Since the prevention program began in early 2003, the service company has reported no malaria deaths within its employee/contractor population.

Several oilfield companies have adopted the malaria-prevention program, particularly the CMK. Although the program seems to be highly effective in reducing the rate of malaria deaths, the health adviser of a major oilfield company noted that it was not known if

For a limited time, the full-length paper is available free to SPE members at www.spe.org/jpt. The paper has not been peer reviewed.

the presence of the CMK could change people's attitude toward the malaria risk as well as their compliance with using preventive malaria medication.

To evaluate the malaria-prevention program, a Web-based survey was conducted over a 4-month period. The survey was a questionnaire open to all the oilfield service company's employees and their dependents. The survey was designed to assess the following factors.

- Employees' and dependents' satisfaction with the malaria-prevention program.
- Modifications of preventive behavior concerning malaria.
- Problems or failures in the malaria training, malaria hot line, or CMK.

High-Risk Countries and Populations

Malaria occurs in tropical and subtropical regions of the globe. Countries are classified as low, moderate, or high risk by the World Health Organization (WHO) on the basis of the parasite's resistance to the main antimalarial preventive medication, chloroquine. Countries where malaria is sensitive to chloroquine are in Group 1. As **Fig. 1** shows, high-risk malaria countries, where the deadly *falciparum* malaria is resistant to chloroquine, are in Groups 2 (moderate resistance) and 3 (high resistance).

The high-risk population for malaria consists of people without any immunity against the *Plasmodium* parasite. They are known as nonimmune and are usually all expatriates, even those who have spent a few years in high-malaria-risk locations. The number of nonimmunes working or living in high-malaria-risk locations is of considerable size in the oilfield industry.

Malaria-Prevention Program

Malaria-Awareness Training. Two malaria training modules were developed to raise malaria awareness and improve the ability of employees to assess and control malaria risk through prevention, early diagnosis, and treatment. Level 1, or basic, awareness is mandatory for all employees worldwide. Level 2, or more advanced, training is required for employees assigned or traveling to high-malaria-risk locations.

Company Health Standard. The malaria-prevention program was added



Fig. 2—Components of the CMK.

to the company's health standard to provide guidelines to line managers on how to implement an effective malaria-prevention program and to ensure the "zero malaria fatality" objective.

Arrival and Departure Packages.

Arrival and departure packages were developed to focus employees on risk awareness and on preventive and curative medications. A quiz must be completed by every employee upon arrival in a malarious country after receiving the Level 2 malaria training and again before departure from a malarious area to a nonmalarious area.

Preventive Measures. All locations emphasize and provide appropriate preventive measures, as follows.

- Chemically treated bed nets.
- Routine preventive malaria medication under a doctor's supervision and control.
- Insect repellents.
- Insecticide treatments or fogging to destroy mosquito larvae in company facilities and residences.

Dedicated Malaria Hot Line. The dedicated, toll-free malaria hot line, available from anywhere in the world, operates 24 hours/day, 7 days/week. The hot line is staffed by a team of multilingual doctors who are specialists in tropical diseases.

CMK. Most malaria fatalities in the nonimmune population occur outside of malarious areas, in countries where doctors and medical laboratories are

not trained to detect or treat the disease and where appropriate curative medications are not always readily available. The CMK was developed to address emergency cases in which an individual is more than 24 hours away from a tropical-disease medical center and malaria is suspected. The CMK shown in **Fig. 2** contains the following.

- Instructions.
- Forehead temperature-reading strips.
- Malaria-hotline telephone-number wallet card and three stickers for passports or posting in the office or home.
- Three blood-test kits for malaria.
- Curative medication.

If the blood test is positive, the infected person must start taking the curative medication (four tablets each morning and four tablets each evening for a total of 3 days) and seek medical assistance as soon as possible. In case of a negative test result, the blood test must be repeated 12 hours later. If three consecutive tests are negative and symptoms persist, the employee must call the malaria hot line for further instructions. The dedicated hot-line staff is fully trained to answer any questions or discuss problems concerning the use of the CMK.

Web-Based Questionnaire

A Web-based questionnaire was posted on an independent website. The questionnaire was designed to take 15 to 20 minutes to complete. More than 43,000 e-mail invitations to respond to the questionnaire were sent twice, at a 1-month interval, to oilfield ser-

vice company employees who, in the last 2 years, might have met the following conditions.

- Eligible for or participated in the company's malaria-prevention program.
- Traveled to, lived in, or worked in a malarious country.
- Had a suspected or confirmed case of malaria.
- Received a CMK from the company.
- Contacted the malaria hot line.

An estimated minimum of 25 to 30% had been exposed at least once during the previous 2 years to a malaria risk. Employees' spouses also were allowed to answer the questionnaire for themselves and their children.

Results

Employees of the oilfield service company logged on to the Web-based questionnaire 1,350 times. Four hundred people closed the website without answering any questions. After duplicate responses were removed, a total of 880 questionnaires were evaluated, although many were incomplete in that some respondents did not answer all questions that applied to them.

Discussion

In the preliminary findings of the Web-based survey, the oilfield service company's malaria-prevention program was rated very good to excellent by more than 60% of the respondents. One out of five respondents performed one or more malaria blood tests during their stay abroad. Nobody found the test too difficult to perform or reported an invalid test result.

The most frequent problems with the blood test were similar to those previously reported: inability to perform a finger prick, difficulty placing the drop of blood on the test strip, and difficulty interpreting the test result. These findings emphasize the importance of the instructions on how to use the blood test.

Malaria was reported as diagnosed by the CMK blood test in 15 employees; in 13 additional employees, a local doctor suspected malaria, but no blood test was performed.

Fifty people, 7% of the respondents, used the curative malaria medication. Most sought medical advice before or after taking the medication.

One-third of the respondents used the curative malaria medication without performing the malaria blood test. Some respondents (35) took the curative medication even with a negative blood test and in some cases (four) without seeing a doctor.

Of the respondents with a positive blood test, 73% considered that having the CMK made regular preventive malaria medication unnecessary. It should be stressed that preventive malaria measures (e.g., impregnated mosquito net, repellents) and regular administration of preventive malaria medication must continue to be emphasized in oilfield company malaria programs. However, if preventive measures or preventive malaria medication fails, the CMK allows any nonimmune person to self-diagnose in a few minutes and to self-treat malaria when no medical assistance is available.

Although it is tempting to assume that the preventive malaria program is responsible for the zero malaria deaths since 2003, the difference between four deaths in 3 years (2000, 2001, 2002) and zero deaths in 3 years (2003, 2004, 2005) is not significant considering that 4,000 to 6,000 employees and dependents are exposed to malarious locations.

Potential Limitations

The malaria risk of employees who did not respond to the survey is not known. The malaria hot line was called 127 times during 2003–05. However, only 53 respondents to the questionnaire claimed to have called the hot line.

The survey was not anonymous. Employees who are not compliant with the company's preventive malaria program were probably less likely to respond to the survey. On the other hand, respondents who are more concerned with their health are more likely to respond than others. This possible bias may overestimate the effect of the malaria-prevention program.

In the absence of a standard for diagnosing *falciparum* malaria, it was not possible to calculate the sensitivity and specificity of the malaria blood test.

In one-third of the cases, the diagnosis of malaria was suspected by a medical doctor despite (repeated) negative malaria blood tests or eventual laboratory investigation. Whether this represents a failure of the malaria blood test could not be analyzed. **JPT**