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Malaria Chemoprophylaxis Compliance Improvement: A New Approach

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Abstract

Awareness training, personal protection against mosquito bites, and vector control measures are all important in helping reduce *Anopheles* mosquito bites. However, these measures cannot completely eliminate the risk of contracting malaria. The prevention of malaria in non-immune individuals in sub-Saharan Africa relies heavily on the proper use of effective chemoprophylaxis. Compliance with effective chemoprophylactic regimens is problematic, especially in long-term expatriates who believe they have acquired natural immunity. In spite of implementing a comprehensive Malaria Control Program (MCP), with a goal of zero cases of malaria among non-immune individuals, the Chad Export Project experienced an increase in the number of malaria cases in the contractor non-immune workforce as construction activities in Chad and Cameroon accelerated. Several serious cases of *Falciparum* malaria were recorded, and four fatalities occurred. In response to this, a multidisciplinary team was formed to identify opportunities to enhance the effectiveness of the MCP. One of the team's key recommendations was to develop and implement a Malaria Chemoprophylaxis Compliance Program (MCCP) to address identified informational and behavioral shortcomings regarding malaria chemoprophylaxis use. The heart of the MCCP is awareness and education but compliance with chemoprophylaxis is further encouraged through collection of urine specimens from non-immune individuals for laboratory determination of effective anti-malaria medication usage. Data collected during the first 15 months that the MCCP was implemented in Chad and Cameroon show an overall low (i.e., <1%) rate of non-conforming specimens. After implementing the MCCP in Chad and Cameroon, the rate of malaria cases among non-

immune workers decreased fifty percent and the program has been extended to other operating locations in Africa.

Introduction

ExxonMobil conducts business in over 100 countries worldwide. In some of these countries (especially those in sub-Saharan Africa, parts of south east Asia, and Latin America), one or more forms of malaria are endemic.²

In order to safeguard its employees from the ill effects of malaria, ExxonMobil developed and implemented a comprehensive Malaria Control Program (MCP) based on the following "ABCD" strategy:³

- A: Awareness.
- B: (Mosquito) Bite prevention.
- C: Chemoprophylaxis use by non-immune individuals.⁴
- D: Diagnose and treat early.

This paper discusses the Chad Export Project's⁵ implementation of the MCP and in particular the development and implementation of a Malaria Chemoprophylaxis Compliance Program (MCCP), a MCP enhancement aimed at ensuring effective malaria chemoprophylaxis use by non-immune individuals in order to achieve the MCP's goal of zero non-immune malaria cases.

Chad Export Project - Background

Project Description and Background Information. The \$US 3.5 billion Chad Export Project (the Project) is currently the largest private sector investment in sub-Saharan Africa. Over the Project's anticipated 25-30 year life, approximately one billion barrels of crude oil will be produced from three oilfields in the Doba basin region of southern Chad for export to world markets, with peak production being 225,000 barrels per day.

A map providing some geographic context for the Project is provided in Figure 1.

² There are four *Anopheles* mosquito-transmitted parasites that cause malaria: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*. Malaria caused by the *Plasmodium falciparum* parasite is the most serious form of the disease and is the most prevalent type of malaria in Chad and Cameroon.

³ ExxonMobil's Malaria Control Program is based on a Malaria Control Program developed in 1998 for the ExxonMobil-led Chad Export Project. The ExxonMobil program was implemented worldwide beginning in 2001.

⁴ With regard to malaria, non-immune individuals are defined as those individuals who were not born and raised in the malarious country/region in question.

⁵ ExxonMobil has a 40% interest in the Chad Export Project and is the operator. Other Project Consortium members include Petronas (35% interest) and ChevronTexaco (25% interest).

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Figure 1. Geographic Context for the Chad Export Project

Key Project components in the oilfield development area in southern Chad are as follows:

- Oilfield Development Area
 - Komé, Miandoum, and Bolobo oilfields - approximately 250 wells will be drilled to develop and recover the hydrocarbon reserves in these oilfields.
 - Gathering system to collect and transport produced fluids.
 - Central Treating Facility to produce export quality crude oil.
 - Operations Center located in the Komé field, consisting of the CTF, an airstrip, housing for 200 individuals, and a 120 MW power plant to serve Project needs.
- Crude Oil Transportation System
 - 1070 kilometer long 760 mm diameter buried export pipeline from Komé, Chad to Kribi, Cameroon.
 - Three pump stations - Pump Station #1 adjacent to the Central Treating Facility in the Komé oilfield, Pump Station #2 near Dompta, Cameroon, and Pump Station #3 near Bèlabo, Cameroon.
 - Pressure reducing station near Kribi, Cameroon.
 - Floating Storage and Offloading vessel (the Komé Kribi 1), a 2 million barrel converted tanker fixed in place approximately 12 kilometers offshore via a single point mooring structure.

Planning for the Chad Export Project began in 1993, with construction beginning in October 2000. The first crude oil (from the Miandoum oilfield) was produced in July 2003, and the first sale of oil to international markets occurred in October 2003. Completion of the Project's Central Treating Facility (CTF) in the oilfield development area is anticipated by year-end 2003, with full production commencing in 2004.

Climatic Setting With Regard to Malaria. The climate in the portions of Chad and Cameroon traversed by the Chad Export Project's crude oil export pipeline can be characterized as being semi-dry sub-tropical to moist tropical.

Two seasons exist in the oilfield development area in southern Chad - a long dry season (October - May) and a short rainy season (June - September). During an average rainy season, approximately 1000-1100 mm of rainfall occurs.

Along the pipeline route from Komé, Chad to Kribi, Cameroon, the rainy season progressively lengthens. For example, average annual rainfall near Meiganga, Cameroon (~325 km southwest of Komé, Chad) is 1500-1600 mm, and at Lolodorf, Cameroon, the mean annual rainfall is approximately 1700 mm. In the coastal area near Kribi, Cameroon, two rainy seasons actually exist, resulting in a mean annual rainfall in excess of 2500 mm.

Climate and rainfall, coupled with the remoteness of many locales and the developing nation status of both Chad and Cameroon, result in a suitable environment for the malaria parasite's transmission vector, the *Anopheles* mosquito. The

map in Figure 2 reveals that conditions are favorable for the transmission of malaria throughout the Project area, from a minimum of 6 months each year in the oilfield development area in southern Chad to year-round in southern Cameroon.

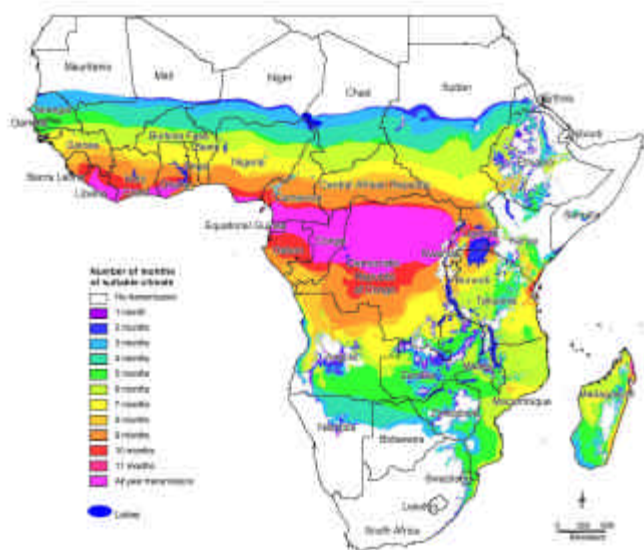


Figure 2. Map of Africa showing the number of months each year that are suitable for the transmission of malaria.

In the Project area, Chloroquine-resistant *Falciparum* malaria is the most prevalent form of the disease, although *Vivax* malaria also (rarely) occurs.

Personnel-Related Challenges Regarding Malaria and Its Prevention. The Chad Export Project's construction phase workforce peaked at over 13,000 individuals in November 2002. Chadians and Cameroonians, who have a degree of natural immunity to malaria and are familiar with the disease, constituted 65-90% of the workforce during the construction period. Based on epidemiological data from the countries of Chad and Cameroon and absent an effective control program, a high rate of malaria among the semi-immune workforce may have occurred, with significant lost time and several deaths.

Key characteristics of the Project's several thousand-strong non-immune construction phase workforce with regard to malaria are as follows:

- Diverse nature.
 - Composed of three groups, with some individuals having preconceived attitudes regarding malaria.
 - + Residents of non-malarious countries (e.g., Europe, United States, Canada) with little or no malaria-related knowledge/experience.
 - + Residents of malarious countries where less serious forms of malaria (*versus Falciparum* malaria) occur.
- Multi-lingual (most common languages = French, English, Spanish, Filipino).
- Geographically dispersed in locations where the risk of contracting malaria is significant.

These characteristics, taken together with the fact that the majority of the Project's construction phase workforce was provided by nine prime contractors and that the work front

was spread over a distance of >1000 kilometers, presented a number of malaria prevention challenges.

Implementation of the Malaria Control Program and Initial Performance

As part of their orientation training, all Project workers (both ExxonMobil and contractor employees) received a health briefing that included information about malaria and an overview of the Malaria Control Program's "ABCD" strategy for preventing malaria. Non-immune individuals were also reminded about the fitness-for-duty requirement for them to self-administer anti-malaria medication.

Overall, a relatively low number of malaria cases occurred among the Project's semi-immune workforce (*versus* the rate of occurrence in the general Chadian and Cameroonian population), and no deaths were recorded. This remarkable situation can be attributed to education, the promotion and use of mosquito bite prevention measures and ready access to high quality medical care for diagnosis and treatment.

A relatively low number of malaria cases were recorded in the Project's non-immune workforce in the early stages of construction. However, as construction activities accelerated in late 2001/early 2002 and the workforce grew accordingly, the number of malaria cases in non-immune workers began to climb. At approximately the same time (i.e., second quarter of 2002), two contractor employees who had been working on the Project in Cameroon died from *Falciparum* malaria upon their return to the United States.⁶ These two situations prompted the Project to undertake an immediate, detailed evaluation of the MCP and its implementation.

Although this analysis revealed opportunities for improvement in all facets of the MCP, it was determined that issues associated with malaria chemoprophylaxis use in the non-immune workforce (especially the contractor non-immune workforce) warranted particular and urgent attention.

Development and Implementation of the Malaria Chemoprophylaxis Compliance Program

A number of key learnings related to malaria chemoprophylaxis use in the non-immune contractor workforce arose from the 2Q2002 evaluation of the Project's implementation of the MCP, including the following:

- Some non-immune individuals were not taking any type of anti-malaria medication.
- Some non-immune individuals were taking anti-malaria medications that are not effective in preventing Chloroquine-resistant *Falciparum* malaria (e.g., Chloroquine, Chloroquine + Proguanil combination {Savarine}).
- Some non-immune individuals were taking anti-malaria medications that are known to be effective in preventing Chloroquine-resistant *Falciparum* malaria (i.e., Malarone, Lariam, doxycycline), but were not taking the medication as prescribed.

⁶ During the third quarter of 2002 (i.e., during the time that the MCCP was being developed and initially implemented), the Project experienced two additional contractor employee *Falciparum* malaria fatalities. As was the case for the two fatalities in 2Q2002, the 3Q2002 malaria deaths occurred outside of Africa after the individuals had returned to their home countries.

In view of these and other findings, a multidisciplinary team⁷ (the MCCP team) was assembled to develop a strategy to improve compliance with the Project's malaria chemoprophylaxis use requirement for non-immune individuals.

The team determined that the use of effective malaria chemoprophylaxis in the Project's non-immune workforce could be significantly improved if the following actions were undertaken:

- Develop a new training program aimed at non-immune individuals (both ExxonMobil and contractor employees) to reinforce the Malaria Control Program and its "ABCD" malaria prevention strategy, emphasizing bite prevention ("B"), effective malaria chemoprophylaxis use ("C"), and early diagnosis and treatment ("D").
 - Inform/remind non-immune individuals working in/traveling to Chad and/or Cameroon about the fitness-for-duty requirement to properly self-administer an anti-malaria medication known to be effective in preventing Chloroquine-resistant *Falciparum* malaria (i.e., Malarone, Lariam, doxycycline).
 - Inform/remind non-immune individuals about the importance of seeking prompt medical attention for any illness so that malaria could be ruled out or properly treated, despite the use of an effective anti-malaria medication.
- Develop and implement an anti-malaria medication use compliance assurance program aimed at non-immune individuals and require individuals to attest that they will participate in the program as a condition of their assignment to a malaria risk location (i.e., Chad and Cameroon).

With regard to the anti-malaria medication use compliance assurance program, the team determined that for such a program to be effective, it should possess the following attributes:

- Random, unannounced collection of biological specimens (i.e., urine) followed by laboratory analysis of the specimens to confirm the presence of a chemoprophylactic agent known to be effective in preventing Chloroquine-resistant *Falciparum* malaria.
- Well-documented specimen handling procedures designed to ensure specimen stability/integrity and the validity of analytical data.
- Confidential medical review process for individuals producing non-conforming specimens to determine their go-forward fitness-for-duty status.
- Conformance of all program components with appropriate clinical and medical information privacy protection standards.

With these attributes and requirements as the cornerstone, the team proceeded expeditiously to develop and implement a

Malaria Chemoprophylaxis Compliance Program (MCCP) for the Chad Export Project.⁸

Medical Review Process. Anticipating that some individuals would produce urine specimens that do not contain a detectable quantity of one of the three chemoprophylactic agents known to be effective in preventing *Falciparum* malaria (i.e., failed tests), a Medical Review Process was developed and incorporated into the MCCP.

The Medical Review Process is executed in a confidential manner by a designated Medical Review Officer (MRO) and was designed to comply with applicable medical information privacy protection standards.⁹

The MRO conducts an in-person or telephone interview with each individual producing a non-conforming specimen following a prescribed interview template. The consent of the individual to conduct the interview is sought.¹⁰ Depending on the information obtained *via* the (consensual) telephone interview, the following actions are possible:

- The individual is referred to a physician at the work location to be further interviewed and re-tested after a period of observed chemoprophylaxis use.
 - If the subsequent testing reveals a measurable quantity of the chemoprophylactic agent in the individual's urine, the individual is declared to be fit-for-duty and he/she is placed in a Frequent Testing Pool.
 - If the subsequent testing does not reveal a measurable quantity of the chemoprophylactic agent in the individual's urine, the individual is given the option of selecting one of the other two effective anti-malaria medications to self-administer, or to self-declare that he/she is unfit-for-duty in the malarious location. If the former option is selected, he/she is placed in a Frequent Testing Pool after being re-tested following a period of observed chemoprophylaxis use. If the individual self-declares that he/she is unfit-for-duty, a process is initiated to remove the individual from the malarious location as quickly as possible.
- If the individual is unable to take one of the three effective anti-malaria medications or he/she is unwilling to take one of these medications, he/she is declared to be unfit-for-duty in the malarious location and a process is initiated to remove the individual from the malarious location as quickly as possible.

Enrollment in the MCCP. All individuals eligible for anti-malaria medication use compliance testing are required to sign a MCCP Attestation Form to document their understanding of the program's requirements. By signing their Attestation Form, individuals acknowledge/agree to the following:

⁸ A medical ethics committee reviewed the procedural aspects of the MCCP during its development.

⁹ Separate MROs were appointed for ExxonMobil and contractor employees.

¹⁰ If an individual refuses to be interviewed or terminates an interview before it is completed, the MRO is instructed to conclude that the individual has self-declared that he/she is unfit-for-duty in the malarious location. A process is then initiated to remove the individual from the malarious location as quickly as possible.

⁷ The MCCP team included representatives from the business line, professionals from medicine and occupational health, law, and human resources groups, and experts in forensic drug and alcohol testing programs.

- It is a fitness-for-duty requirement for non-immune individuals to properly self-administer an anti-malaria medication known to be effective in preventing Chloroquine-resistant *Falciparum* malaria (i.e., Malarone, Lariam, doxycycline) when working in/traveling to a malarious location.
- On a random, unannounced basis, they will be instructed to produce a urine specimen at a designated time and place for the purposes of determining their compliance with the MCP's effective malaria chemoprophylaxis use requirement.
- Individuals producing non-conforming specimens will be asked to participate in a confidential medical review process to determine their go-forward fitness-for-duty status. Individuals determined to be unfit-for-duty will be removed from the malarious location (i.e., repatriated) as quickly as possible.

Results

Over the first 15 months (i.e., July 2002 - September 2003) of the MCCP's implementation in Chad and Cameroon, approximately 2500 urine specimens were collected for anti-malaria medication use compliance testing. The percentage of individuals producing non-conforming specimens was very low (<1%). The small number of individuals who have produced non-conforming specimens participated in the Medical Review with the following outcomes:

- 43% were entered into the Frequent Testing Pool (i.e., conditionally determined to be fit-for-duty).
- 57% demobilized from the Project or were declared unfit-for-duty and were instructed to leave Chad or Cameroon as quickly as possible.

The implementation of the enhanced Malaria Control Program, including its (new) Malaria Chemoprophylaxis Compliance Program component, has been effective in reducing malaria rates in the Project's non-immune population. This is evident in the data presented in the table below:

	No. <i>Falciparum</i> Malaria Cases per 200,000 Work Hours (Non-Immune Workers)	
	2002	2003
July	12.67	4.12
August	16.36	5.99
September	9.72	7.32

As can be seen, the rate of *Falciparum* malaria in the Project's non-immune workforce is markedly lower during the peak exposure (i.e., rainy season) months in 2003 *versus* 2002.

Discussion

The data presented above indicate that the implementation of an enhanced Malaria Control Program (MCP) featuring a Malaria Chemoprophylaxis Compliance Program (MCCP) can successfully reduce the rate of *Falciparum* malaria in non-immune individuals working in a malarious area.

The MCCP was introduced to Project workers as part of an effort aimed at improving the overall effectiveness of the MCP. This was accomplished by developing an aggressive malaria awareness and prevention training program that

reinforced the MCP's "ABCD" strategy. A multimedia presentation that was developed and produced in VCR and CD-ROM formats was particularly effective in this program. Presentations were given in French, English, Filipino, Spanish, and Malay so as to optimize their effectiveness with the Project's multi-lingual non-immune workers. Many sessions were also culturally adapted to increase their impact. In addition to discussing malaria chemoprophylaxis-related issues and the "mechanics" of the MCCP, the sessions focussed heavily on the bite prevention ("B") and diagnose and treat early ("D") components of the MCP.

Based on the success of the enhanced MCP in Chad and Cameroon (including the MCCP), the program has been extended to other locations based on malaria risk and operational considerations.

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