INTRODUCTION
Falciparum malaria has long been a significant cause of morbidity and mortality in the expatriates on mines in Africa\(^1\) and still remains a major threat in non-immune expatriates living in endemic areas, where up to 30% of expatriates develop malaria within two years.\(^2\) It is well recognised that the risk of international travellers (short term, long term and expatriates) contracting malaria depends on the region or country visited, the type and length of exposure and the precautions taken.\(^3\) In sub-Saharan Africa, malaria is estimated to cause over a million deaths per year and significant morbidity for local populations. The impact of malaria as an occupational disease for expatriates working in Africa is considerable in terms of death, lost time and productivity and evacuations (personal experience of authors). In a study of expatriate workers employed by a multinational mining company in 12 African countries, the malaria incidence in 1998 was greatest in Zambia where 82% of expatriates reported having had malaria.\(^4\) Over-diagnosis could not be excluded, but the need for expatriate understanding and best practice regarding chemoprophylaxis, diagnosis and management of malaria is clearly a priority.

Malaria prevention is based on health education and includes the use of barrier methods, and chemoprophylaxis. The type of chemoprophylaxis depends on factors such as the side effects perceived and experienced plus the endemicity of drug resistance.\(^5\) Principles of malaria prevention, i.e. awareness of the risk, reducing bites from anopheline mosquitoes, using appropriate chemoprophylactic drugs and awareness of the residual risk, prompt diagnosis and treatment of clinical malaria comprise an important component of health counselling given by the occupational health practitioner to all expatriates (employees

ABSTRACT
Malaria remains a threat to expatriates posted to endemic areas. The use of preventive measures by expatriates, including chemoprophylaxis, is variable. This survey was conducted by self-administered questionnaire to determine the knowledge, perceptions, beliefs and practices of 100 expatriate mineworkers in the Zambian Copperbelt towards malaria risk, prevention and chemoprophylaxis. A 66% response rate was obtained. Results indicated that 24% of the study group had suffered from malaria and those resident for over 2 years had been significantly more likely to have had malaria than those resident under two years. Although 92% of respondents had been advised to take chemoprophylaxis and 94% had been given information on prevention, 56% were not taking chemoprophylaxis. Of concern was the belief that anti-malarials should not be used during pregnancy. Occupational health practitioners advising expatriates need to implement a company policy based on updated information on malaria prevention.
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malaria prophylaxis was conducted in 1984 in Zambia in the Zambian Copperbelt. The low response rate (24%) perhaps reflected the casual attitude towards malaria in days before resistance to both chemoprophylaxis and treatment with chloroquine was prevalent. Of the respondents, who may well not have been representative of the population of expatriates, 67% believed the medication to be effective, but 23% had been taking anti-malarials incorrectly. Two decades later, malaria remains an occupational hazard in expatriates in the Zambian Copperbelt and there is increasing resistance to chemoprophylaxis. The aim of the research project described in this paper was to determine the knowledge, attitudes, beliefs and practices of expatriates in the Zambian Copperbelt towards malaria risk, prevention and chemoprophylaxis and specific objectives were:

- to determine the knowledge of expatriates regarding the risk of malaria;
- to determine the expatriate’s knowledge about and attitudes towards the prevention of malaria;
- to determine the use of prophylactic anti-malarials in expatriates; and
- to determine the beliefs and practices of expatriate miners towards malaria prophylaxis.

**METHODS**

A cross-sectional survey was conducted in 2001 using a self-administered, anonymous questionnaire circulated from the staff office to all the accessible working members (100 of 150) of an expatriate mining population living in the Zambian Copperbelt. Those off site or on leave were excluded. The piloted questionnaire was constructed along similar lines to that used in the survey done in 1984 in the same area. The demographic data comprised the nationality, age, sex, job, town and length of residence in Zambia. The questionnaire comprised general questions on:

- whether the subject had ever had malaria in Zambia;
- how to prevent getting malaria;
- advice given by the company or doctor on malaria prevention;
- how this advice was given; and
- whether malaria was a minor, serious or potentially fatal disease.

Specific questions related to the beliefs and practices of the respondent and family: type of prophylaxis; the time of year chemoprophylaxis was taken; whether children would be given prophylaxis and continue for four weeks after their return and pregnant women and malaria prophylaxis. The last part of the questionnaire consisted of a true or false answer regarding four common misconceptions.
affecting use of malaria prophylaxis (Table 1). Space was provided at the end for any comments regarding malaria prevention.

The completed questionnaires were returned to the first author. Data were analysed using the Epi-Info 6.04 software program, summary statistics were produced and comparisons made using Chi Squared at an acceptance level of \( p = 0.05 \).

**RESULTS**

The response rate was 66%. Of the 66 responders, 61 were male (92%) and 52 between the age of 40–60 (79%). Forty (61%) were in managerial positions, 20 (30%) senior staff and 3 (5%) from the general payroll. (See Figure 1) Forty (61%) were South African expatriates and 26 (39%) from elsewhere. Six (9%) had been in Zambia for less than 6 months, 33 (50%) for 6 months to 2 years and 27 (41%) for longer than 2 years.

Overall, 24% (16 people) reported having had malaria and 44 (67%) had not. The methods of prevention used were twofold: PEP [personal (insect repellents and bed nets) or environmental (residual insecticide spraying) protection] and CP [chemoprophylaxis comprising a variety of medications]. Three people contracted malaria while on reported chemoprophylaxis and 13 while not taking chemoprophylaxis. Of those taking chemoprophylaxis, 16 (48%) people were taking prophylaxis all year round, 12 (36%) only in the rainy season and 5 (15%) only when travelling outside town.

The duration of stay in Zambia and use of chemoprophylaxis is shown in Figure 2. The use of different types of prevention: CP only; insect repellent only; bed nets only; residual spraying of the home only; a combination of PEP with or without CP, or no measures at all (none) are shown in Figure 3.

The majority of respondents, 44 (67%), regarded malaria as a potentially fatal disease, while 21 (32%) regarded it as a serious disease and only 1 (2%) said malaria was a minor disease. Sixty-one responders (92%) had been advised by the company or the doctor to take chemoprophylaxis and 62 (94%) had been given information on malaria prevention. Information was either verbal or written, or a combination.

Regarding taking prophylaxis, 25 (38%) were taking chemoprophylaxis and 37 (56%) were not. Prophylaxis varied from mefloquine (44%), doxycycline (29%), chloroquine and proguanil(12%) to dapsone and pyrimethamine and paw-paw pips (15%)!

The question asking women if they would use anti-malarials during pregnancy was not really appropriate to the target group considering that all but 3 of the respondents were males. Despite this, all 8 respondents who answered stated that they would NOT take anti-malarials.

Twenty-three respondents (34%) used the comment section to ask for information or give their view on aspects. Some commented on the use of DDT-spraying in Chingola, some positive and others negative. Many participants expressed their concern about the side effects of long term use of malaria prophylaxis and many were confused on the conflicting advice regarding malaria prophylaxis they had received from different doctors and fellow-expatriates.

**DISCUSSION**

The prevention, diagnosis and treatment of malaria are major challenges for health services caring for expatriate mining communities. As increasing numbers of expatriates with their families become stationed in endemic malaria areas outside South Africa, company policies regarding prevention control programmes and individual counselling regarding prevention of malaria are a growing necessity. Risk and attack rates vary with numerous factors, such as place (rural more than urban) and season (wet more than dry), and updated information is needed to give personalised advice to each individual.¹¹

Not only are the knowledge, attitudes and beliefs about malaria crucial to prevention of malaria among the expatriates themselves but also their practices may have a wider influence on other travellers to the area. Lopez-Velez et al indicate in a study of returning Spanish nationals suffering from malaria that 15% of those who defaulted on chemoprophylaxis did so following the advice of local expatriates and or doctors in the country visited.³

This study was designed to discover the attitudes and beliefs of expatriates towards malaria prophylaxis. The limitations included the lack of access to the whole population and that the use of a questionnaire did not enable issues to be followed in depth. However, the response rate of 66% was good and it may reflect the interest in malaria in the

| Table 1. Response to specific questions on malaria chemoprophylaxis (Correct answers in bold). |
|-----------------------------------------------|---------------|---------------|
| Statement                                      | True          | False         |
| 1. Taking malaria prophylaxis masks (hides) the symptoms of malaria                      | 38 (61%)      | 24 (39%)      |
| 2. Malaria prophylaxis causes liver damage                                                   | 34 (61%)      | 22 (39%)      |
| 3. Malaria prophylaxis affects eyesight                                                    | 22 (43%)      | 29 (57%)      |
| 3. Prophylaxis protects against the rapid onset of cerebral malaria                           | 45 (82%)      | 10 (18%)      |
“Although 92% of expatriate mineworkers had been advised to take chemoprophylaxis, 56% were NOT using it.”

Figure 1. Demographics by age and position

Figure 2. Prophylaxis versus length of stay

Figure 3. Methods of malaria prevention
workplace since 34% of respondents provided comments at the end of the questionnaire. Rolfe’s study in 1984 had a disappointingly low response rate (24%) which perhaps reflected a casual attitude towards malaria at the time when resistance to anti-malarials was not problematic. However, Rolfe found that 70% of expatriates who had been resident for more than 20 years were taking prophylaxis, while only 26% of residents in our study living longer than 2 years in Zambia were still taking prophylaxis. Historically until the 1970s, the Zambian Copperbelt was considered relatively malaria free. However, due to urbanisation, resistance to insecticides, decaying infrastructure due to collapse of the mining industry and a variety of other factors, the occurrence of malaria has changed from peaks confined to the rainy seasons to malaria being diagnosed all year in Kitwe.

It is therefore an important and disturbing observation that, in spite of the study population acknowledging that they had received advice to take prophylaxis (92%), received adequate information on malaria (94%) and recognising malaria as a potentially fatal disease (67%), only 38% were taking chemoprophylaxis and 26% used barrier methods without chemoprophylaxis. Of most concern are the 27% of people taking no preventive measures. Reasons for these are often multiple with the most frequent being: fear of side effects, conflicting advice, breakdown of malaria and complacency. Randomised controlled trials have been used to determine toxicity of antimalarial agents for prophylaxis and treatment and there is now a consensus view of the general side-effects and contraindications for these agents which facilitates choosing suitable prophylaxis on an individual basis.

A limitation in this study was the target group in relation to the question on the prophylaxis in pregnancy. It is, however, of concern that 100% of those who responded thought that prophylaxis should be avoided as it may harm the foetus. Similar responses were found in Rolfe’s study. Pregnant women are a recognised and well-researched, high risk group for developing complicated malaria and, even in immune individuals, malaria prophylaxis is advised throughout the pregnancy. There is clearly a need to inform the educators about misinformation. For example in this study, more than 60% of responders wrongly believed that malaria prophylaxis hides the symptoms of malaria and that prophylaxis causes liver and eye damage and such misperceptions could detract from the use of chemoprophylaxis. There were limitations in asking these questions in a self-administered questionnaire as there such misperceptions could detract from the use of chemoprophylaxis. There were limitations in asking these questions in a self-administered questionnaire as there was no opportunity for clarification and the adverse effects of chemoprophylaxis in the past may still be feared or misinterpreted.

CONCLUSIONS AND RECOMMENDATIONS

Malaria as an occupational disease involves primarily employees and employers, but it is also of national, regional and global importance to promote occupational health. Many expatriates working in Zambian Copper mines originate from South Africa, and thus it is important for occupational health practitioners advising expatriates and business travellers to be aware of this major difference in potential exposure. Occupational health practitioners should conduct pre-placement malaria counseling and give updated, scientifically-based information to employees and dependants on prevention, symptom recognition and treatment, with specific emphasis on the danger of malaria in pregnancy. The influence of fellow expatriates should not be underestimated and regular education/re-education may be required.

It is advisable for expatriates to take anti-malarials at least in the seasons of high transmission and preferably throughout any season when transmission can occur. No preventive measure is 100% effective and people living in endemic malaria areas must understand that they can still contract malaria in spite of all precautions. At the very least, all expatriate workers and families should be using all the personal measures to reduce mosquito bites. Expatriates deployed to endemic malaria areas should receive regular counselling on malaria prevention and treatment, including the appropriate use of chemoprophylaxis.

CONFLICT OF INTEREST STATEMENT

No financial support was received for the study. The authors have no conflicts of interest to declare.

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