However, the companies which have already started work in field are Eassar Oil, ONGC, Reliance and CMPDIL.

Summary

Coalbed methane exploration may open up a new energy industry in India. Evaluation of coal properties, construction of adsorption isotherm, and study of geological setting of coal basins should be an integral part of initial research efforts. It is desirable to work out the techno-economic viability of a project after R&D efforts are completed and before exploration and exploitation are taken up.

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SCIENTIFIC CORRESPONDENCE

Usefulness of dipstick test (ParaSight^{TM}F) in high-risk groups for *Plasmodium falciparum* in Central India*

A simplified detection assay that uses a dipstick (ParaSight^{TM}F) developed by Becton Dickinson Advanced Diagnostics (Sparks, MD, USA) was evaluated in the field in forest villages of India[1]. Its simplicity of use suggested it could play an important role in field for the accurate diagnosis of *Plasmodium falciparum* infection. Therefore, we have introduced this technique to people who work in the field and report their experience of using this test in high-risk groups, i.e. infants, children and pregnant women in two districts of Madhya Pradesh (MP; Central India), where malaria is mesoendemic and epidemic prone.

The study was conducted during high transmission season of *P. falciparum* (August–November) in 20 villages of district Jabalpur and Chhindwara (MP) in 1998. The procedure was explained by a Laboratory Technician to one Field Lab Assistant (FLA) who then performed the test under supervision three times. The FLA (A) then explained the test procedure to his colleagues (B and C) who later performed the test in field without supervision. All three FLAs were assigned different study groups, viz. A, infants (1 m to < 12 m), B, children (1 yr to < 5 yrs) and C, pregnant women. Finger-prick samples of blood were collected by the FLAs from all available infants and pregnant women with or without fever. The FLAs then performed the rapid ParaSight^{TM}F test; however, in children only from fever cases. (Infants and pregnant women are highly vulnerable and together they represent the magnitude of malaria in an area. Further, infants are often without symptoms up to 6 months or more because of the mother's immunity and pregnant women generally do not come for blood examination as medicines are harmful to the foetus. Hence all available infants and pregnant women were included.) Verbal consent was obtained from the parents of infants/children and from the woman herself or her husband to carry out the test. Simultaneously, a trained microscopist made thick and thin smears which were re-examined by an independent expert unaware of the previous results for quality control. Parasite density was counted against 200 WBC in thick film and parasitaemia was calculated by taking 8000 as the average WBC count by a standard method (Parasites/µl = No. of parasites × WBC count/no. of WBC counted).

Of the 472 people of all age groups examined by both the methods, 139 were found by microscopy to be parasitaemic, 111 were infected with *P. falciparum*, 23 with *P. vivax* and 5 had mixed infection of *P. vivax* and *P. falciparum*. Mixed infections were analysed with *P. falciparum*. None of the 23 *P. vivax* cases detected by thick blood film examination gave a positive test. Overall, the dipstick was positive in 105 cases, including 5 mixed infections (Table 1) out of 116 cases (sensitivity, 90.5%), and negative in 331 out of 333 cases (specificity, 99.4%), giving a positive and negative predictive value of 98.1 and 96.8%, respectively (efficiency, 97%). Two (A and C) out of the

Table 1. Specificity and sensitivity of the dipstick ParaSight^{TM}F test in diagnosing *P. falciparum* in field as compared to thick smear by a trained microscopist in field laboratory

Dipstick ParaSight^{TM}F test	Microscopy		
	Positive[a]	Negative[b]	Total
Positive	105	2	107
Negative	11	331	342
Total	116	333	449

[a]Including 5 mixed infections of *P. vivax* and *P. falciparum*.
[b]*P. vivax* cases are not included.

*Paper presented in a meeting on 'Informal consultation on Malaria Diagnostics at the Turn of the Century' from 25 to 27 October 1999 in Geneva.

Table 2. Performance of the dipstick ParaSight^{TM}F test in diagnosing *P. falciparum* when used by field workers in remote villages of Jabalpur and Chhindwara in comparison with thick blood smear in field laboratory

	Field lab assistant								
District	A (Infants)		B (Children)		C (Pregnant women)		Technician (Adults)		Total
Village	Jabalpur	Chhindwara	Jabalpur	Chhindwara	Jabalpur	Chhindwara	Jabalpur	Chhindwara	
No. of cases screened	221	42	146	0	18	19	0	26	472
No. of blood smears positive for *P. falciparum*	23[a]	15	49[b]	0	2[c]	9	0	18	116
No. of blood smears positive for *P. vivax*	11	4	5	0	2	1	0	0	23
No. of dipstick positive cases	25	15	38	0	2	9	0	18	107
No. of blood smears negative	187	23	92	0	14	9	0	8	333
No. of dipstick negative cases	196	27	108	0	16	10	0	8	365

[a]Two mixed infections of *P. vivax* + *P. falciparum*; [b]One mixed infection of *P. vivax* + *P. falciparum*; [c]Two mixed infections of *P. vivax* + *P. falciparum*.

three FLAs performed the test on 263 infants and 37 pregnant women, respectively and were able to carry out the test without difficulty with excellent results. These FLAs discovered an epidemic of *P. falciparum* in Chhindwara as 15 out of 42 infants (36%) and 9 out of 19 pregnant women (47%) were positive for *P. falciparum* in mass blood survey. Subsequently, fever cases among adults were screened by a technician for malaria and 18 out of 26 adults (69%) were positive for *P. falciparum* (Table 2). However, one FLA (B) who had screened 146 children had some difficulty in interpreting weakly positive results. He was unable to assess properly the red line when it was faint ($< 100 \pm 2.0$ µl range 90–250 parasite/µl). This worker reported a high number (11) of false negative results (Table 2). Similar results were obtained by village health workers in another study carried out in Tanzania[2]. Further, two infants who were positive for *P. falciparum* by dipstick test were missed by the microscopist in the field, as the parasitaemia was very low (≤ 50 µl). Analysis of the results shows that where *P. falciparum* asexual parasitaemia is greater than 250 parasites/µl, the dipstick test is 100% sensitive.

Subsequently, based on dipstick results, a team consisting of a medical officer and a supporting staff carried out point prevalence surveys in 13 villages of Chhindwara and revealed that out of 1813 blood smears, 169 were *P. vivax* and 1141 were *P. falciparum*, giving a slide positivity rate of 72% and *P. falciparum* percentage of 87% (unpublished results).

The WHO global malaria control strategy[3] recommends rapid diagnosis of malaria at the village or primary health care levels, so that effective treatment can be administered quickly to reduce morbidity and mortality. In point of fact, the ParaSight^{TM}F test will support this strategy as it enables the field staff to make an immediate definitive diagnosis so that adequate therapy can be initiated without delay. Although the unit price ($1.20) of ParaSight^{TM}F test[4] does not permit its extensive field use in malaria endemic areas of India where many patients need a fever screen, however, limited use of this test has great potential for high-risk groups in primary health care centres in difficult and inaccessible areas as in Chhindwara to prevent the spread of disease.

Further, malaria control relies heavily on presumptive treatment of fever cases under Indian National Anti Malaria Programme. Because of lack of symptom specificity, a majority of the diagnosis is inaccurate with no resulting benefit to the people from the treatment. This results in wastage of drug supplies, which developing countries can ill afford[5]. This test not only helps to reduce the number of unnecessary treatments, but also provides a more rational diagnosis and the treatment. In addition, use of this test has great potential for high-risk groups in difficult and inaccessible areas to prevent morbidity and mortality.

Thus the study has revealed that a rapid test which requires little technical experience or equipment would therefore be invaluable in the diagnosis of malaria, especially in countries where laboratory facilities are poor or non-existent. Although cost is a factor, it must be weighed against the cost of high morbidity and mortality in high-risk groups and it is the test which can prevent the epidemic.

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