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Health care and illness in Lihir, New Ireland Province, in the context of the development of the Lihir gold mine

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SUMMARY

During 2000 a review of health care and illness in Lihir, New Ireland Province, was carried out while I was employed as a Community Health Research Officer with the Lihir Management Company, the manager of a gold mine on Lihir. The review aim was to document the health care providers for the local population and the illness burden suffered by Lihirians, and then to shape services to have a more preventive emphasis. It was discovered that the health care services available were well utilized by Lihirians. Health care was provided by the church, government and the mining company, and needed better coordination of services. Lihirians faced a relatively heavy burden of illness, with malaria the most common affliction. They also suffered significantly from lymphatic filariasis and tuberculosis, and children were poorly nourished. A considerable number of recommendations have been adopted since the health review to improve the health of, and delivery of health services to Lihirians.

Introduction

In 2000 while an employee of the Lihir Management Company (LMC), I conducted a review of the health status and existing health care services for the people of Lihir (1). The aims of this research were twofold: firstly, to discover exactly what services were provided to Lihirians in terms of health, who provided them, and what was their source of funding; and secondly, to find out what was the illness burden on Lihirians – what were the most common reasons for seeking treatment and what were the causes of morbidity and mortality among the population. With these pieces of information it was then possible to see if the services provided matched the illness burden – in other words, were services adequate for the illnesses being seen? How could the services be improved?

Lihir is a group of four islands situated east of mainland New Ireland. In 2000 it had a local population of approximately 10,000 spread over the four islands of Mahur, Masahet, Malie and the main island, Niolam. A gold mine was constructed in the mid-1990s and began production in 1997, managed by LMC, a subsidiary of Rio Tinto. There were approximately a further 1800 people on the island associated with mining; however, the health review discussed here was concerned with the local population only.

LMC was concerned at the number of public patients being seen each month at the Lihir Medical Centre (about 2500 occasions of service per month) and the continuing, unsustainable high cost of providing treatment. It was believed that Lihirians were bypassing aid posts in preference for the medical centre. An attempt had been made to limit the use of the medical centre by public patients by making it the referral centre for the northern half of Lihir only, yet this caused resentment in the community. Rather than trying to limit use of the medical centre, it was decided that a shift in emphasis from curative, reactive treatment to more

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preventive health care programs would reduce the illness burden suffered by Lihirians, and thus reduce the strain on the medical centre.

Methods

The research for this study reviewed existing data available on the health status of Lihirians. I am an anthropologist (2) and utilized my skills of research and interviewing, rather than conducting original medical research. The research was carried out with the knowledge and approval of the Subdistrict Health Manager, Albert Sahamie, and the Nimamar Local Level Government. All those people interviewed were informed as to the purpose of the research, and gave verbal informed consent to share their time and information on this basis.

The research on which this report is based was carried out over 6 months, from June to December 2000. Research consisted of interviews and meetings, a review of statistical and written reports on health in Lihir, a number of health surveys and a visit to Ok Tedi and Misima for comparison and information exchange on health care in the context of mining in Papua New Guinea (PNG). Interviews were conducted with all of the people actively involved in planning and funding health in Lihir, including Bruce Clark, Hospital Administrator Lihir Medical Centre, Albert Sahamie, Subdistrict Health Manager, and Lonnie Barok, Local Level Government Manager in 2000. Staff at the Lihir Medical Centre, Palie Health Centre, Masahet Health Subcentre and the 7 aid posts on Lihir were interviewed about their work, programs that are being done and any concerns they had.

All health reports about Lihir that could be found were reviewed, including the baseline health survey (3), maternal health survey (4), nutritional surveys (5,6) and a number of malaria and filariasis surveys. In addition statistical data were collected from aid posts, health centres and the medical centre on illness rates, causes of death, birth statistics, attendance at antenatal clinics, Well Baby Clinic results and usage of family planning services.

The major survey that was carried out was a maternal health survey, which was designed after discovering that women's health was particularly poor (notably a high maternal mortality rate), but precise reasons for this were not immediately apparent. This survey involved interviews with more than 150 women about their history and experiences of pregnancy and childbearing. Final results assisted in targeting services to best meet women's needs (7). There was also a survey done of the nutrition of workers to complement one carried out earlier on nutrition of subsistence farmers in some villages in Lihir.

In late November 2000 I visited Misima Mines and Ok Tedi Mining Limited to view alternative models of health care in PNG. All mining companies must negotiate the issue of provision of health care to the local population (even if they choose not to provide any) in the context of government and church-provided health services. In addition to these visits doctors who had worked at Chevron and at Freeport were interviewed about health services provided by these companies. These allowed a comparison of the benefits and problems entailed by other models of health care provided by resource companies in Papua New Guinea (and West Papua).

Results

Health care provision

Health care services are provided on Lihir by the provincial and local level governments, by the Catholic church, and in recent years by LMC. There are 7 aid posts on Lihir, providing a basic level of treatment; 2 of these are funded by the New Ireland Provincial Government and 5 by the Nimamar Local Level Government. There is one health subcentre funded by the Provincial Government. The health centre at Palie is funded by the Catholic church and, before the development of the mine, provided the highest level of health care available in Lihir. Finally, LMC built and funds the Lihir Medical Centre, which provides health care to public patients as well as employees of the mine.

In 1999 these combined health care providers provided at least 75,000 occasions of service to public patients on Lihir. At that time the local population was approximately 10,000. More than 45,000 occasions of service were provided by aid posts, the health subcentre and health centre. These figures disproved suggestions that Lihirians

were bypassing these providers in preference for the Lihir Medical Centre. Instead it suggested that Lihirians suffer a heavy illness burden, and well utilize the services available.

Before 2001, it had been decided that the medical centre would be the place of referral for the northern part of Lihir, while Palie Health Centre served as the referral point for the south of Lihir. Yet there was a great disparity in the levels of care provided by the medical centre in comparison with the health centre given its far superior resources, and thus the division of care caused considerable concern and anger among Lihirians. At that time Palie Health Centre only occasionally had running water and had power a couple of hours a day. The highest qualified staff was a health extension officer, compared to two doctors at Lihir Medical Centre. Palie had no fridge and a poor laboratory. Following recommendations arising from this research, this division in health care was eliminated and Palie upgraded. Seriously ill people were able to choose to go to either Lihir Medical Centre or Palie Health Centre from 2001.

Lihir is fortunate in that all aid posts are open, compared with 13% closed in 1998 in New Ireland (of a total of 60). Aid posts in Lihir also have few shortages of supplies of medicine as the Lihir Medical Centre orders supplies for aid posts through the government suppliers and then keeps them in store on the island. However, many aid post workers are unreliable and unpunctual, have poor hygienic habits and do little if any preventive health care work.

Mosquito-borne illness

There are two mosquito-borne illnesses in Lihir, filariasis and malaria. These are both transmitted by the *Anopheles* mosquito in Lihir (8,9). Lihir has no known cases of transmission of other mosquito-borne illnesses such as dengue fever and Japanese encephalitis even though appropriate vectors for these exist on Lihir (the *Aedes* mosquito).

Lymphatic filariasis exists on Lihir as evidenced by the swollen limbs particularly of people in the south-west of Niolam, and also by studies that have been done in the last 10 years. The most recent of these was done by Richard Kereu (Public Health Coordinator, Lihir Medical Centre) in December 1999. Richard carried out immunochromatographic ICT card tests for filariasis on about 3000 people, mostly from north Niolam and the outer islands but also from Komat village in south Niolam. From his results an average of 11% of people tested had a positive ICT card test, with two villages showing positive results for 50% and 44% of those tested. These villages had swampy areas nearby.

Malaria is a very significant health problem on Lihir. 21% of the presentations for outpatient service in 1999 and about 16% in 2000 were for malaria (the 2000 figures are missing data from aid posts for the final 4 months of the year). Malaria is the most common reason for taking sick leave from work. About 13% of admissions at Palie and 11% at the Lihir Medical Centre in 2000 were for malaria. There were 5 deaths in 1999 at Lihir Medical Centre and Palie Health Centre due to malaria, and there would have been many more deaths from malaria in villages around Lihir.

From blood slides also collected in Richard Kereu's study, between 20% and 40% of people tested in most villages were positive for malaria. For villages near the mine and townsite, LMC has conducted a program of malaria control involving residual spraying of buildings and larviciding of water pools. For these villages only 6-14% of people tested positive for malaria (though one swampy village recorded 38% positive).

I acknowledge here my debt to Richard Kereu, who died in 2001. He had extensive experience in public health, having worked with Ok Tedi before his work in Lihir, and was very committed to improving people's health.

Maternal and child health

Like most places in Papua New Guinea, the health of women and children in Lihir was relatively poor. There were 2 to 3 maternal deaths each year for a number of years before 2001. 20% of births occur in the village, mostly with no qualified supervision. 23% of pregnant women seen at the Lihir Medical Centre antenatal clinic had haemoglobin levels less than 9 g/dl, the standard for anaemia in Papua New Guinea, putting these women at high risk if they gave birth unsupervised and haemorrhaged

postnatally.

15% of births in hospitals were low birthweight (under 2500 g) in 2000. The infant mortality rate in 2000 was 30/1000, if one only included deaths in hospital, and thus the true rate would have been much higher. No comparison is available before the development of the mine, as none of the early reports ascertained the rate at the time. The immunization rate for children was very good, being 100% in the northern part of Lihir served by the Lihir Medical Centre, and about 80% for the southern area. Poor nutrition of children is a significant issue, with 39% of children being 60% to 80% of standard weight for age (moderately malnourished) and 1% less than 60% of standard weight for age (severely malnourished). One child died in hospital from malnutrition in 2000. In these last statistics, Lihir fares unfavourably with statistics available for New Ireland, where the percentage of children severely malnourished was 0.7% and the percentage moderately malnourished was 19% in 1999.

Communicable diseases

Rates of tuberculosis on Lihir are particularly high, and for 2000 there were 44 cases detected, compared with 29 cases for 1999, and 13 cases for 1998. It appears that there has been a sharp growth in the number of cases of tuberculosis on Lihir; however, it is possible that this is due to better ascertainment rather than an actual increase in cases.

These rates are high in comparison with the rest of Papua New Guinea. The rate for 2000 translates as about 340/100,000, a rate much worse than that for New Ireland at 112/100,000 or Papua New Guinea at 176/100,000 for 1999. If Lihir had a similar rate of tuberculosis detection as New Ireland we could expect 14.6 cases detected yearly. The number of 44 is therefore very high. Though the high rate of tuberculosis may be partly attributable to better detection and reporting in Lihir than elsewhere in New Ireland, this is nevertheless an area of considerable concern.

Compared with the records from New Ireland, Lihir has a fairly high rate of some types of STDs (sexually transmitted diseases) such as syphilis, donovanosis, gonorrhoea and hepatitis B. New Ireland had an average of 34 cases of gonorrhoea detected between 1995 and 1999. Lihir had 12 cases in 2000, yet had only about 10% of the population of New Ireland. It also had 12 cases of syphilis in 2000, while none was recorded for New Ireland Province for 1998-1999. There was one case of donovanosis in Lihir in 2000, while none was recorded for New Ireland for 1997-1999. Obviously there is a problem with the statistics from New Ireland on STDs, whether this is a problem in recording of cases or in actual detection. Rates of STDs on Lihir are likely to be higher than figures given, as there are no data from Palie Health Centre on sexually transmitted diseases. Palie Health Centre does maintain a register, but for 2000 there were only 3 entries, and it was not noted exactly what disease these people had or whether the presence of the STD was confirmed.

There were no known cases of AIDS (acquired immune deficiency syndrome) in Lihir during the study period, though there had been one confirmed case in the late 1990s, who had since died. However, on a trip to Lihir in 2004 I found that the situation had changed and there were approximately 10 confirmed cases of AIDS.

Lifestyle diseases and problems

Life on Lihir has changed dramatically with the development of the gold mine in the final decade of the twentieth century. There has been a change from a lifestyle based almost exclusively on subsistence production to one that also includes employment, small business and mine-derived revenues for many Lihirians. These new influences and lifestyle have started Lihirians on the path to a transition in the sorts of illness they will face during their lifetimes. During the life of the mine chronic illnesses that are common in developed societies are likely to become increasingly prevalent in Lihir.

Anecdotal evidence suggests that problems of obesity have already begun, particularly amongst workers who live in the camp. A nutrition survey by Dympna Leonard of village and camp food conducted in 1995 stated that too much of the energy from camp food came from fat (5). Workers eating in the company mess are noticed to load their plates. Male workers' body size and shape contrasts most with that of women in their 20s and 30s who live in the village,

do strenuous gardening work, bear children and generally eat only twice a day. There is a growing gap between the nutritional status of employed males and that of women and children living in the village.

Alcohol has become a significant problem in Lihir since the development of the mine: while alcohol was sold on Lihir before the mine construction, consumption was very low as people had very little income. Alcohol is now involved with a number of issues in the Lihirian community such as domestic violence, fights, motor vehicle accidents and the use of money for alcohol (rather than on other purposes such as food or school fees), and it will significantly contribute to the development of diabetes among Lihirians.

Women often attributed the incidence of severe or 'unjustified' violence to alcohol. Many fights in villages occur between males who are obviously drunk. Alcohol is obviously contributing to marital and village discord. There is no sign of the alcohol consumption decreasing. Police report that most of the incidents brought to them concern alcohol.

Most Lihirians smoke local tobacco when it is available. Some of those working at the mine have begun to smoke more (as they can afford to buy tobacco at the market) or to smoke commercially produced cigarettes. These changes will also have an impact on their health, increasing their chances of heart disease and cancer.

Thus changes in lifestyle occurring in the context of the production of gold in Lihir have the potential to shift the burden of illness from acute communicable diseases (such as malaria and respiratory diseases) and undernutrition to chronic conditions associated with lifestyle factors, such as obesity, diabetes and circulatory system disorders, particularly in those Lihirians with close association to the mine.

Discussion

Ok Tedi and Lihir – a comparison

A visit to Ok Tedi during the research period provided a valuable comparison for the Lihir situation. Copper and gold were discovered at Ok Tedi in 1968, and the mine has been in production since 1984. The North Fly area was isolated and had very few services before the development of the mine. In about 1988 Ok Tedi Mining Limited (OTML), through the Tabubil Hospital, took over control of 6 aid posts and 2 clinics in order to improve services. They now run these with the help of a yearly grant from the government (Dr James Steven, personal communication, 2000). In 2000 the administrator and one doctor were employees of International SOS (ISOS) (a contract medical company), while the remaining personnel were OTML employees. In comparison, the Lihir Medical Centre is wholly contracted to ISOS by LMC.

In Lihir ISOS and LMC have elected not to take over government and church health facilities, but to coordinate services and to improve the capacity of services where possible (for example, by distributing medicine to aid posts to improve supply). In the short term, coordinating services entails a lot of work and communication, but it is hoped that it will help to maintain the integrity and capacity of these services for the long term.

In health terms, Ok Tedi and Lihir share some characteristics. Before mining, malnutrition was common in the North Fly, with some stunting (10). Since mining has commenced diets have changed to include store-bought food, food from the company mess and alcohol. The energy intake of diets has increased, though the protein-energy ratio of diets is less. Diets remain deficient in niacin, riboflavin and calcium (11). There is some concern about the probability of increasing rates of circulatory system disorders given overall increases in weight and blood pressure (12). In Lihir malnutrition among children continues to be a problem, while there is concern for employed men given similar changes in diet to Ok Tedi.

In both Lihir and the North Fly malaria is endemic, and has been a major issue for OTML and LMC. OTML introduced a control program for malaria in 1982 involving larviciding of standing waters, fogging, residual spraying, provision of prophylaxis for non-immune employees and provision of repellent (13). This program has led to the control of malaria so that less than 30% of cases presenting at the hospital with fever symptoms are due to malaria. Lihir has also instituted a program of malaria control (see below).

In both the North Fly and Lihir there has been concern about population growth since mining began. Enough time has passed at Ok Tedi for it to be apparent that the crude birth rate has risen, birth intervals have shortened and the infant mortality rate has dropped (12,14). This is leading to concerns for women's health and food security in the long term. In Lihir it appears that the population is growing quickly, with land shortage becoming critical in some areas. Partially this is a result of immigration or return migration of Lihirians who left before mining commenced.

The situation on Lihir differs from Ok Tedi in that Lihirians have had a much longer exposure to contact with outsiders, and have had health facilities provided since the 1930s by the Catholic Mission. Their acceptance and usage of facilities is likely to be greater. It is easier to carry out health work in Lihir because Lihirians form one language and cultural group living in a defined and relatively accessible area. Environmental conditions and the many groups around Ok Tedi and along the Fly River must make health work difficult. Yet the health of Lihirians is not strikingly better than that reported for groups around Ok Tedi. Below is a discussion of some of the recommendations proposed and changes implemented to improve health in Lihir.

Recommendations from research

Research led to a considerable number of recommendations being made to better tailor services to meet the illness needs of the Lihir community. As with other mining communities it is necessary to negotiate the provision of health care by a number of service providers. Consideration also must be given to keeping services sustainable beyond the life of the mine. While in Lihir there is a fairly lengthy mine-life (some 35 years), there is little point constructing a system which is largely reactive and high cost. The preference of LMC was to adjust to a more preventive approach.

In Lihir it was found that better coordination was necessary between the programs and actions of the various providers. This has been achieved through the Lihir Health Committee which meets monthly and has representatives from all health providers, Subdistrict and Local Level Governments, Lihir Mining Area Landowners' Association (LMALA) (the landowners' representative group), women and LMC. This committee has a small budget and aims to achieve cooperation between all groups and better utilization of scarce resources.

One initiative of this committee has been to offer a quarterly award for the best aid post. This is judged by 2 or 3 committee members on patients seen, records kept, cleanliness, punctuality of the worker and upkeep of medical supplies. The award provides medical equipment and a small personal incentive for the worker. This incentive was aimed at improving the services provided by some aid posts, given that Lihirians complained that many workers were unreliable and care was substandard. It was hoped that with better service providers in villages people will seek help before health problems become critical.

A further recommendation of the review was that Palie Health Centre needed to be upgraded to meet basic health centre standards. To this end Palie has been fenced to exclude pigs, it has new composting toilets, basic maintenance work has been done, and ongoing efforts are being made to provide running water and power supply. A doctor visits at least once a fortnight from the Lihir Medical Centre to provide advice and help in the management of serious cases. With these changes Palie is now a viable alternative to the Lihir Medical Centre for those Lihirians living in the south of Niolam.

In terms of the health and illness of Lihirians, the review made a number of recommendations. It was recommended that effort be made to eliminate filariasis from Lihir by an annual dosage of medicine to everyone. Preventive treatment for filariasis had begun in the north of Niolam before this review. Following the review this program has been expanded to cover all of Lihir. Filariasis should take 5 years of medication to be eliminated, or by 2005-2006. This program took its inspiration from the filariasis elimination program initiated by Misima Mines.

Malaria is a major concern in Lihir. It would be impossible to eliminate the disease given the prevalence of malaria in New Ireland and the amount of travel between areas for employment, trade and visiting. So

the recommendation is to control malaria as much as possible. The Lihir Medical Centre is working with villages one by one to eliminate breeding sites for mosquitoes and larvicide those that remain, and to carry out residual spraying on houses, similar to OTML's control program. On Lihir the use of bed nets is also emphasized and supported through a subsidy on nets. Given the high percentage of outpatients and inpatients presenting with malaria, malaria control programs have the greatest likelihood of reducing levels of morbidity in Lihir and the number of visits to health care providers. Malaria control should also have a flow-on effect for other health problems such as malnutrition and anaemia.

To improve the health of women and children it was recommended that a nutritionist be employed to work with them to improve the level of moderate and severe malnourishment seen in children. It was also recommended that the Hib (*Haemophilus influenzae* type b) vaccine be given to all children on Lihir, and this has been implemented. It was also recommended that measures be taken to improve attendance at Well Baby Clinics (by better notification of visits) and to offer outreach antenatal clinics, especially for women on the outer islands.

It was recommended that a review of the programs for tuberculosis be carried out by an expert in the field to judge whether the rate of increase of cases is simply due to improved detection or to other factors.

The Local Level Government is gradually implementing a program to improve access to clean water and toilets in villages. In terms of clean water the program is progressing well, but most villagers continue to use the beach or bush for toilets: very few Lihirians have access to toilets. Given the continuing increase in population of both Lihirians and squatters migrating to villages near the mine, the lack of adequate sanitation will inevitably become a more serious issue over the years.

For sexually transmitted diseases, a program of health education has been put into place, including education on World AIDS Day, and education for employees. Sharps bins are also provided in health centres and some aid posts. More effort is needed, given the large population that travels into and out of Lihir for employment, who can bring diseases from other areas, and who do not have their families on site.

The illnesses suffered by Lihirians were similar to those in other parts of Papua New Guinea, with high levels of communicable diseases, including mosquito-borne illnesses, and some malnutrition among children. There were some areas of considerable concern, including high rates of tuberculosis and people testing positive for malaria by blood slide. The review made recommendations to improve these areas. It also highlighted the potential for an increase over the life of the mine of lifestyle diseases such as obesity, and circulatory system disorders. These need to be monitored closely, and at present all employees of LMC and major contractors have an annual medical check which provides this opportunity.

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REFERENCES

1 **Hemer SR.** Illness and health care in the Lihir Islands: a review. Community and Environment Department, Lihir Management Company, 2001:59p.
2 **Hemer SR.** A malamlien e makil: person, emotion and relations in Lihir. PhD Thesis, University of Melbourne, Melbourne, 2001:293p.
3 **Taufa T, Jones M, Day G, Mea V.** Baseline health survey of Lihir islanders. Kennecott, April 1991.
4 **Dickson R.** Lihir District maternal health survey report, August-September 1993. Unpublished report, 1994.
5 **Leonard D.** Nutrition and the Lihir workforce. Lihir Management Company, 1995.
6 **Leonard D.** Nutrition and the Lihir community. Lihir Management Company, 1995.
7 **Hemer SR.** Maternal health in the Lihir Islands: a review. Community and Environment Department, Lihir Management Company, 2002:36p.
8 **Bockarie M, Dagoro H, Hii J, Flew S, Waulas B.** Health impact of a gold mine in Lihir: entomological investigations. Lihir Management Company, 1993.

9 **Ebsworth P.** Technical support for the malaria control program, Lihir Island, NIP, PNG. Lihir Gold Ltd and International SOS, 2000.
10 **Maunsell & Partners.** Ok Tedi environmental study. Volume 5. Ok Tedi Mining Limited, Ok Tedi, 1982.
11 **Ulijazsek SJ, Hyndman DC, Lourie JA, Pumuye A.** Mining, modernisation and dietary change among the Wopkaimin of Papua New Guinea. *Ecol Food Nutr* 1987;20:143-156.
12 **Taufa T.** Longitudinal study of health and economic development in two Papua New Guinea communities, Wopkaimin, Ok Tedi (study) and Mt Obree (comparison) 1982-1993. MD Thesis, Flinders University, Adelaide, 1995.
13 **Schuurkamp GJ, Matango M, Napil J, Vergara RV.** Malaria control and the development of the Ok Tedi Mining project in the Star Mountains of Papua New Guinea: the initial construction phase. *PNG Med J* 1987;30:27-38.
14 **Taufa T, Lourie JA, Mea V, Sinha AK, Cattani J, Anderson W.** Some obstetrical aspects of the rapidly changing Wopkaimin society. *PNG Med J* 1986;29:301-307.