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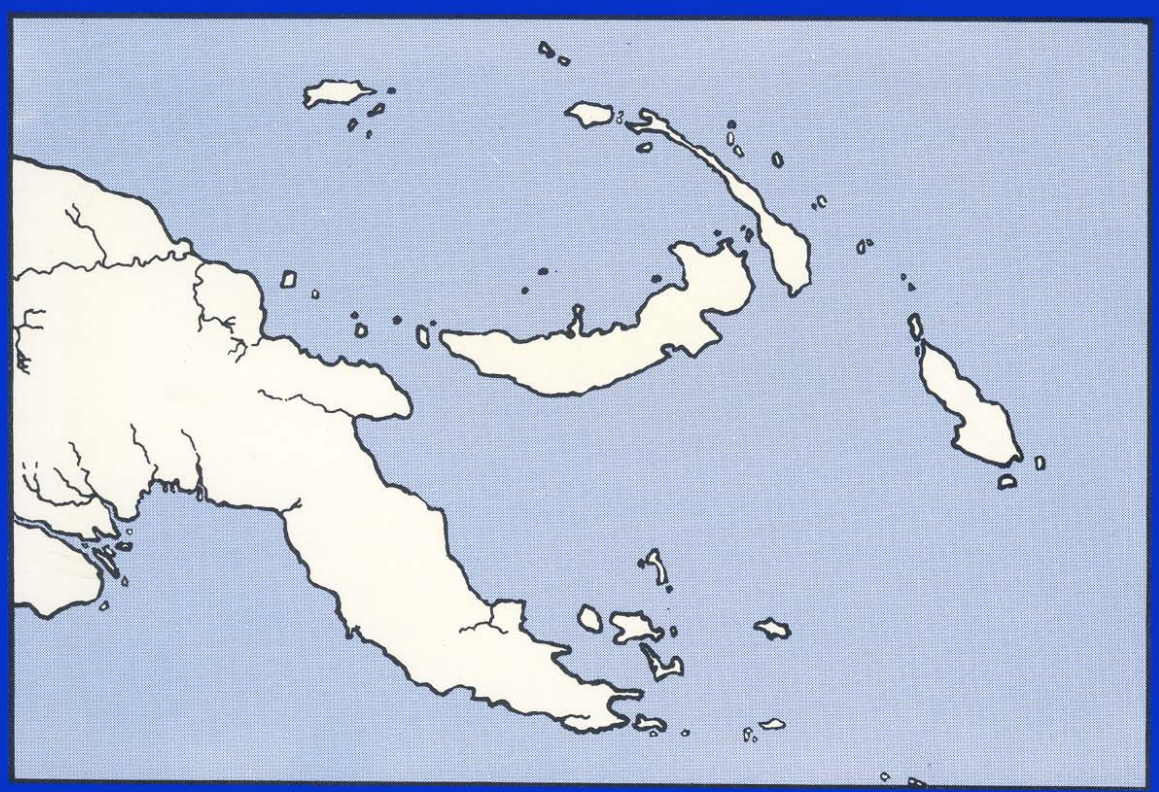

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CONTENTS FOCUS ISSUE ON HEALTH SYSTEM STRENGTHENING

PNG Med J 2009 Sep-Dec;52(3-4): 81-82

EDITORIAL

Strengthening Papua New Guinea's health system

I made a commitment when I accepted the position of Secretary for Health that my focus would be on providing improved health service access to the rural majority and the urban poor. In order to do this, we need to understand what is required, how much we can afford, who are our implementation partners and how we can know when we are making progress.

We face a unique set of development challenges in Papua New Guinea (PNG). It is not necessary to reiterate these. The National Department of Health (NDoH) has been actively involved with improving the performance standards of the health system. A key objective of the current National Health Plan is to improve the health of all Papua New Guineans by developing a health system that is responsive, effective, affordable, acceptable and accessible to the majority of the people. However, this is not a task we can undertake alone. Our challenge is to mobilize the support of our internal partners – central agencies, provincial governments, district administrations, communities, churches, non-government organizations (NGOs) and the private sector, as well as our external development partners, to work with us to improve service delivery. Our resources are not limitless, and we will need to make hard choices, about how to spend our development funds and how to ensure that the current resources are better managed. We must also learn the lessons of history.

I welcome this focus issue of the *Papua New Guinea Medical Journal* on health system strengthening, which helps us to document and share some of what has happened in the past two decades. The papers presented in this focus issue analyse our epidemiology, health behaviours, health system, health financing, health system governance and health workforce. The changing nature of our relationships with our development partners over the past two decades is reflected upon, as is our experience to date in working within a sector-wide approach. New ways of working with non-state partners are explored in the paper on public and private partnerships (1).

The papers discuss how changes in government legislation have influenced the development of a unified health service and changed the balance of power between the politician and the bureaucracy. This is a practical reality we have to learn to manage.

It is clear from the papers in this issue that, despite our limited progress, we have not been idle in attempting to confront some of the contextual issues which we are challenged by. The list of reforms and initiatives which we have implemented, which are outlined in the paper on PNG's health system, is extensive (2). I congratulate the many staff within the health system who have worked long and hard to bring these to fruition. I want to pay tribute to the health sector leaders who have preceded me during this period: Dr Quentin Reilly, Dr Ed Talwat, Dr Levi Sialis, Dr Isaac Ake, Dr Timothy Pyakalyia, Mr Paul Songo, Dr Puka Temu and Dr Nicholas Mann. They have initiated and led many of the reforms and initiatives documented in this volume.

I also want to acknowledge the tireless efforts of our churches in supporting us to continue to deliver services in the most difficult of circumstances. We are extremely grateful for the contribution that our churches continue to make to the health and well-being of our communities.

I also thank the Australian people for their support to enable so many of these initiatives and for their support in the compilation of this focus issue.

Much has changed over the past 20 years: we have seen the deterioration of the system in some areas, and the development of new models to strengthen the system in others. Let us learn from this experience, and as we prepare for the new National Health Plan, let us think about how, in partnership, we can mobilize all the good will and resources of all our health sector partners to build a better

health system for PNG. I hope that you will enjoy this special focus issue of the Journal, and that it will aid your own reflections on how to build a brighter future. This issue must provide us the evidence to build a new foundation for health. My commitment is to transform health systems, advocate for the human face of development and improve health service access to the rural majority and the urban poor. These papers can help us understand how to address our 'multiple organ failure' and get the whole system fit and healthy again.

Clement Malau

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Demography and the epidemiology of disease in Papua New Guinea

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SUMMARY

Papua New Guinea (PNG) remains a predominantly rural society. Declining mortality but only slow decline in fertility has led to an average annual growth rate of the order of 2.8%. If fertility continues to decline slowly, the population will reach 10 million soon after 2029; with an accelerated decline the population will be about 8.9 million persons in 2029. Wide differentials in mortality among provinces indicate considerable variation in mortality change. Infectious diseases which dominate the cause structure of mortality should be susceptible to health service intervention. Prerequisites are an appropriate mix of interventions, high levels of coverage, and high-quality monitoring and surveillance. It is critical that these unsolved disease problems be fully addressed as the combination of increasing urbanization, the AIDS (acquired immune deficiency syndrome) epidemic and an increasing prevalence of non-communicable diseases will place upward pressure on mortality rates. For the purposes of monitoring mortality change health services need access to methods for the calculation of mortality rates which have been validated in populations in PNG. Perhaps the most fundamental task of health services is to prevent unnecessary deaths. This article focuses on levels of mortality and the cause structure of mortality. It examines the relationship between health service interventions and mortality decline in PNG.

Population size and growth

Table 1 is based on data from the 1980 and 2000 national censuses (Papua New Guinea National Statistics Office, Key Statistical Indicators: Demographic Indicators, unpublished data). By 2000 the total population of Papua New Guinea (PNG) was 5.19 million people, including the small non-citizen population of about 20,000. The population had increased by a factor of 1.7 between 1980 and 2000 by means of an average annual growth rate of 2.8%. The urban sector had grown more slowly than might have been expected: in 1980, 12.3% of the population lived in urban areas; by 2000 this had increased to only 13.2%. In 2000 the towns were less strongly masculine than they had been in 1980: the urban sex ratio of males to females had fallen from 1.38 to 1.19. By 2000, the crude birth rate was 36.1/1000 population and the crude death rate 11.8/1000, indicating that fertility decline had lagged behind mortality decline. None of these results is indicative of substantial economic growth affecting ordinary people or of major social change.

Mortality change and differentials

There is no system for the registration of all births and deaths in PNG. Nearly all estimates of mortality are based on models and are obtained indirectly. Data are obtained from national censuses and from demographic and health surveys (DHSs). The building blocks of mortality estimates are histories of births and deaths in children under the age of five years over the five-year period before a survey. Direct estimates of infant and under-five mortality are based on a mother's information about the date of birth and, if relevant, the age at death of every live-born child she has had. Indirect

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Disclaimer: The views expressed in this paper are those of the author and not necessarily those of the Australian Agency for International Development (AusAID)

TABLE 1

PAPUA NEW GUINEA POPULATION IN 1980 AND 2000*

	1980			2000		
	Urban	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Total population, male	212 202	1 344 875	1 557 077	372 453	2 319 291	2 691 744
Total population, female	153 345	1 267 635	1 420 980	313 848	2 185 194	2 499 042
Total population	365 547	2 612 510	2 978 057	686 301	4 504 485	5 190 786†
Sex ratio (M:F)	1.38	1.06	1.10	1.19	1.06	1.08
Percentage of total	12.3%	87.7%		13.2%	86.8%	
Annual growth rate 2000/1980				3.20%	2.76%	2.82%
Crude birth rate/1000						36.1
Crude death rate/1000						11.8

*Unpublished data from the Papua New Guinea National Statistics Office – Key Statistical Indicators: Demographic Indicators
†Total includes a non-citizen population of 20 000

estimates are based on mothers' information about her age, the total number of children she has borne, and the number of those children that have died. These data are adjusted using models of fertility and mortality which assume underlying patterns of fertility and under-five mortality by age (1). Similar indirect methods of estimating adult survival are used to calculate adult mortality. Model life tables depend on assumptions that ratios between age groups for fertility and mortality are predictable in different regions of the world. Projections are used to calculate 'current' mortality (2).

Table 2 shows various point estimates of infant mortality, expectation of life and national population since 1946 (3-5, Papua New Guinea National Statistics Office, Life Tables 1990, 2000 and 2006, Key Statistical Indicators: Health, unpublished data). If mortality decline is measured in terms of infant mortality – the most accessible indicator in field surveys – then mortality declined rapidly from approximately 250 deaths per 1000 live births in the mid-1940s to approximately 57 deaths per 1000 in 2006. Over the same period life expectancy at birth increased from about 31 years for males and 32 years for females in 1946 to about 60 and 64 years respectively in 2006. The table also indicates an early period of rapid decline, slowing of the decline in the 1980s, an increase in infant mortality during the 1990s, and then a resumption of the decline. Two divergent estimates of mortality for 1971 in the table, based on analysis of the 1971 census, indicate how the use of different models can affect final conclusions.

Figure 1 is a graphical representation from the World Bank of retrospective infant mortality calculated from birth histories taken between 1971 and 2000 (1). The trend line was used for the World Development Index. A similar graph is available for under-five mortality. Estimates from the 1971, 1980 and 2000 national censuses and the 1991 DHS were based on indirect methods. Estimates based on both direct and indirect methods were calculated from the 1996 DHS. Although the graph does show two phases of decline in infant mortality, the difference is not nearly as dramatic as indicated by Table 2. Estimates from the 1980 census are shown to lie well below the trend line; data from the 1990 census have been omitted altogether. Estimates from the 2006 DHS of infant mortality of 57/1000 live births confirm the trend line (Papua New Guinea National Statistics Office, 2006 Demographic Health Survey, Maternal and Child Health Indicators, unpublished data).

Also characteristic of PNG mortality are the differentials in demographic and

TABLE 2

MORTALITY ESTIMATES 1946-2006*

	Infant mortality (per 1000 live births)		Crude mortality (per 1000 population)	Life expectancy at birth (years)		Population (million)
	Male	Female		Male	Female	
1946	232	251	30-35	31	32	-
1966	161	157	21	44	43	2.16
1971	130	120	20	49	50	2.44
1971	142	125	-	40	41	-
1980	78	66	14	49	51	2.98
1990	72	66	-	57	60	3.58
1996	82	72	-	-	-	-
2000	66	55	-	59	63	5.17
2006	58	51	12	60	64	-

*Refs 3-5 and Papua New Guinea National Statistics Office, unpublished data – Life Tables 1990, 2000 and 2006, Key Statistical Indicators: Health

epidemiological measures among provinces. This was demonstrated in a detailed analysis of the 1970 and 1980 censuses (5), which has been summarized in tabular form (3,6). In 1980, infant mortality was highest in the Highlands Region (85/1000), followed by Momase (76/1000), Papua (Southern) (58/1000) and the Islands (52/1000). Variation among provinces was even greater, with infant mortality ranging from 116/1000 in the Southern Highlands to 35/1000 in the National Capital District and 33/1000 in the North Solomons. No such detailed analysis has become available since. A recent review refers to continuing marked differentials between regions (7). Infant mortality failed to decline as it had in the past and showed no consistent pattern of change within the country. Infant mortality increased in Momase Region between 1980 and 2000, decreased markedly in the Highlands Region, was unchanged in the Southern Region, and decreased in the Islands; it was above 100/1000 live births in East Sepik and Gulf Provinces. Child mortality, in contrast, was said to have decreased nationally from 45/1000 live births in 1980 to 25/1000 in 2000.

Table 2 indicates that the expectation of life at birth doubled between 1946 and 2000 (3-5, Papua New Guinea National Statistics Office, Life Tables 1990, 2000 and 2006, Key Statistical Indicators: Health, unpublished data). However, life tables prepared by the National Statistics Office show only a small increase between 1990 and 2000 in the expectation of future years of life at the age of 35, which increased from 37.4 to 38.6 (Papua New Guinea National Statistics Office, Life Tables 1990 and 2000, unpublished data).

The DHS estimated maternal mortality to be 370/100000 live births in 1996, and 773/100000 live births in 2006. Maternal mortality is extremely susceptible to the availability and use of services. It has been suggested that maternal mortality would be 200/100000 in urban areas, 800/100000 in well-serviced

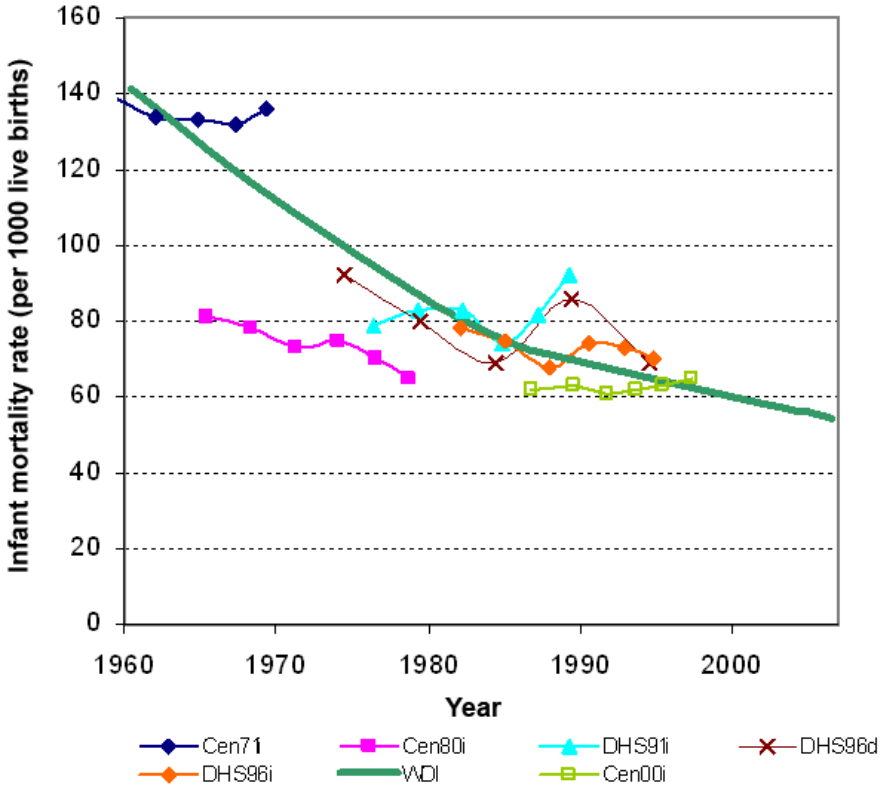

Figure 1. Estimates of Papua New Guinea's infant mortality 1960–2000. Source World Bank (1).
Cen71 = National Census 1971
Cen80i = National Census 1980 (indirect)
DHS91 = Demographic and Health Survey 1991
DHS96d = Demographic and Health Survey 1996 (direct)
DHS96i = Demographic and Health Survey 1996 (indirect)
WDI = World Development Index
Cen00i = National Census 2000 (indirect)

rural areas, and 2000/100000 in non-serviced rural areas (8). On this scale the current national estimates come in at about the level for serviced rural areas. Variation among provinces in the causes of maternal mortality indicates that large differentials within and among provinces can be predicted (9). As the percentage of mothers giving birth in health facilities (about 50%) did not change between the 1996 and 2006 DHSs, a doubling of the maternal mortality rate is implausible. Difficulties in sampling such a heterogeneous national population are a possible explanation of the results.

Population growth, fertility and fertility change

Given the comparative levels of mortality and fertility in 2000, it is obvious that slowing population growth depends on reducing fertility, and that further reductions in mortality will have only a small effect in increasing the growth of the population.

Analysis of the 1980 census indicated a total fertility rate (TFR) in 1978 of 5.4 and that, at then current levels of fertility and mortality, the population would double in a single generation (10,11). By 2000, the TFR had fallen to only 4.8 (Papua New Guinea National Statistics Office, Key Statistical Indicators: Health, unpublished data). For a detailed analysis, the reader is referred to a recent review (12). In brief, unless the decline in fertility accelerates, PNG population growth will remain above 2% – by 2029 the PNG population will grow to 9.8 million. If the decline in fertility did accelerate, the population would be about 8.9 million in 2029.

The cause structure of mortality

Table 3 shows the leading 15 causes of death in PNG hospitals and rural health facilities in 1998 and 2008 (13). Table 4 shows the leading causes of death in PNG health facilities in 1968 (14).

The overriding impression from these tables is of how little difference there was between urban and rural areas in the cause structure of mortality in 1998 and 2008, and

TABLE 3

LEADING 15 CAUSES OF DEATH IN HOSPITALS AND RURAL FACILITIES IN PAPUA NEW GUINEA IN 1998 AND 2008

Deaths in hospitals				Deaths in rural facilities			
1998		2008		1998		2008	
	% of deaths		% of deaths		% of deaths		% of deaths
Pneumonia	11.9	Tuberculosis	11.5	Pneumonia (<5 years)	14.0	Pneumonia (<5 years)	10.5
Heart disease	11.1	Perinatal conditions	11.3	Malaria (severe)	8.6	Malaria (severe)	9.4
Perinatal conditions	10.2	Pneumonia	8.1	Neonatal sepsis	7.4	Tuberculosis	7.8
Tuberculosis	9.0	Malaria	7.8	Pneumonia	7.4	Neonatal sepsis	7.8
Malaria	8.4	Meningitis	6.9	Meningitis	6.6	Meningitis	6.6
Cancer	5.6	Cancer	6.7	Tuberculosis	4.9	Other respiratory	4.6
Meningitis	5.4	Heart disease	5.3	Other respiratory	4.2	Pneumonia	3.7
Other respiratory	4.3	Other respiratory	5.1	Typhoid	3.8	Diarrhoea (<5 years)	3.5
Septicaemia	4.0	Anaemia	4.2	Anaemia	3.7	Anaemia	3.3
Accident and injury	3.2	Septicaemia	3.7	Accident and injury	2.0	Accident and injury	3.3
Typhoid	2.9	HIV and AIDS	3.5	Diarrhoea (<5 years)	2.0	Diarrhoea	2.0
Other obstetric	2.8	Accident and injury	2.9	Diarrhoea	1.6	Typhoid	1.6
Anaemia	2.3	Diarrhoea	2.6	Malaria (TFM)	1.1	Malnutrition	1.2
Diarrhoea	1.6	Typhoid	1.6	Malnutrition	1.0	Pertussis	0.9
Malnutrition	1.4	Cerebro-vascular	1.3	Measles	0.9	Snakebite	0.8
All others	16.1	All others	17.6	Snakebite	0.7	Diphtheria	0.4

HIV = human immunodeficiency virus
AIDS = acquired immune deficiency syndrome
TFM = treatment failure malaria

TABLE 4

LEADING CAUSES OF DEATH IN HOSPITALS FOR THE YEAR ENDING MARCH 1968

	% of deaths
Pneumonia	17.3
Gastroenteritis	11.6
Perinatal death	8.7
Malaria	4.5
Meningitis	4.3
Accident and injury	4.2
Tuberculosis	3.8
Cancer	3.6
Heart disease	3.4
Malnutrition	3.2
Chronic bronchitis	3.0
Upper respiratory infection	2.7
Anaemia	1.9
Maternal death	1.8
Whooping cough	0.9
Leprosy	0.7
All others	27.1

of how little had changed over the 40-year period. Of the leading causes of death in 1968, only maternal death and leprosy do not appear in the 1998 and 2008 listings. Harbingers of change are the inclusion of human immunodeficiency virus (HIV) and cerebrovascular disease (stroke) in the top 15 causes in urban areas in 2008. HIV and *Mycobacterium tuberculosis* are known to act synergistically in producing disease; the increased prominence of tuberculosis as a cause of death in hospitals in 2008 is likely to reflect the HIV epidemic.

Data showing the relative importance of different causes of death in health facilities are susceptible to selection bias. Table 5 shows leading causes of death in rural populations from six different field sites between 1961 and 1983; with the exception of pigbel (enteritis necroticans), these deaths correspond to deaths in health facilities (15-21). An extremely close match was demonstrated between population-based deaths in New Ireland and Bougainville between 1962 and 1967 and deaths in hospitals in the Islands Region in 1966-1967 (21). For these particular sets of diseases, health facility deaths can be treated as representative of all deaths in the country.

TABLE 5

LEADING CAUSES OF DEATH IN POPULATION-BASED SURVEYS OF MORTALITY 1961-1983 (15-21)

	Anguganak, Sandaun Province (500-750m) 1961-1968*	New Ireland and Bougainville (sea level) 1962-1967	Oro Bay, Oro Province (sea level) 1962-1967	Trobriand Islands, Milne Bay Province (sea level) 1962-1967	Baiyer River, Western Highlands (1000-2000m) 1963-1966	Tari, Southern Highlands (1500-1800m) 1971-1976	Tari, Southern Highlands (1500-1800m) 1977-1983
Pneumonia	1	1	1	1	1	1	1
Tuberculosis		3		2			
Cancer		2					
Chronic lung disease	3		2			2	2
Malaria	2						
Liver disease					2		
Dysentery			3				3†
Gastroenteritis				3			3†
Pigbel						3	
Accident and injury					3		

*Field site, province, altitude, years of survey
1 = leading cause of mortality
2 = second leading cause
3 = third leading cause
†Equal third

Mortality is predominantly infectious in origin. If deaths in rural areas in 2008 are taken as being the most representative of the country as a whole as it is now, then a handful of organisms contribute in a major way to more than half of all deaths:

Streptococcus pneumoniae –
Pneumonia (all ages), neonatal sepsis, meningitis

Haemophilus influenzae type b –
Pneumonia (<5 years), meningitis

Plasmodium falciparum –
Malaria, anaemia

Mycobacterium tuberculosis –
Tuberculosis

Streptococcus pyogenes –
Neonatal sepsis

Staphylococcus aureus –
Neonatal sepsis

Salmonella typhi –
Typhoid

Bordetella pertussis –
Pertussis

Corynebacterium diphtheriae –
Diphtheria

Human immunodeficiency virus –
Acquired immune deficiency syndrome (AIDS)

Introduction and spread of infectious diseases

One of the most dramatic changes in PNG over the last 150 years has been the increase in movement and migration of people. That PNG has one of the highest concentrations of languages on earth is evidence of the survival of small, discrete populations over thousands of years. The country, it is said, was protected from the outside by malaria, the difficult terrain and the ferocity of its inhabitants. Internally, the comparative isolation of small communities, fostered by these same factors, protected them from the spread of infection (22). In 1900 Robert Koch described a narrower range of distribution of malaria, fewer species per village and less frequent parasitaemia near Madang than is the case today (23). Between the 1950s and the 1980s malaria transmission increased in the highlands and the highland fringe areas (24). In 1926 Raphael Cilento remarked how men in the workforce were prone to pneumonia and dysentery on being moved from one locality to another even when the local inhabitants showed no such susceptibility (25). This paralleled a high incidence of lobar pneumonia in young men in urban areas in the 1960s and 1970s (26). As late as 1969, Asian influenza spread quite erratically through remote communities in Madang Province (personal observation). In addition were the epidemics of introduced infections: pertussis, tuberculosis, sexually transmitted diseases including HIV, typhoid and measles.

It should also be noted that a population protected by isolation did not need to develop protective behaviours against many infections, as discussed by Whittaker et al. in this issue (27).

Factors affecting mortality change

It is known that life expectancy, the inverse of mortality, correlates well with income. Increased income allows people to buy more food, better housing and better health care. Over successive thirty-year periods during the last century, national mortality levels around the world decreased at given levels of income. Improvements to medical technology meant that more effective interventions could be purchased at less cost. Better education meant that people made better public health choices and, in developed countries, major capital improvements to water and sanitation reduced the spread of infectious disease (28).

Evidence that health services were responsible for the decline in mortality after World War 2 in PNG depends on results from studies by medical officers of mortality in small populations. Such surveys were, of necessity, conducted in areas with good health services. In Tari, in the Southern Highlands, birth histories indicated a decline in infant mortality from 160/1000 live births between 1920 and 1951 to around 68/1000 from 1965 to 1971. Social and economic development was minimal. Although the government station had been established in 1952, Tari was not derestricted until 1965, when health services were first able to expand into the countryside. Infant mortality declined in four populations in the Islands

Region from 189/1000 during 1949-1952 to 49/1000 during 1962-1967. At Anguganak, in West Sepik, infant mortality was observed to decline from 109-134/1000 during 1962-1964 to 61-87/1000 during 1969-1971. In seven 'very cooperative' villages, infant mortality was 59/1000, but was 177/1000 in four 'uncooperative' villages. The health centre had been built in 1959, and before this the area had been visited only irregularly by medical patrols.

Two opposing factors affecting the force of mortality appear to have been in operation during these years. Favouring downward pressure on mortality was susceptibility of the common infections to antibiotics, antimalarials and vaccines. Favouring upward pressure on mortality was the increased transmission of indigenous and introduced diseases.

From the mid-1950s to the mid-1970s PNG had participated in the global program for the eradication of malaria. Comparatively low mortality from malaria in reports from the 1960s quite likely reflects the early successes of this program, which was largely based on indoor residual spraying (IRS) supplemented with mass drug administration. Its collapse in PNG coincided with that of the global program, failure being associated with behavioural change in the mosquitoes from indoor to outdoor biting, the emergence of drug resistance to chloroquine, and an inability to maintain logistically complex malaria operations. Routine spraying in coastal areas ceased in the late 1970s (29). Tuberculosis control has been adversely affected by operational problems, drug resistance and the spread of HIV.

Mortality differences among districts and provinces reflect quite different dynamics of mortality change. Mortality decline in the highlands between 1980 and 2000 may well reflect economic growth affecting child nutrition. Some provinces have benefited greatly from economic development, others not at all. On the other hand, economic development increases exposure to infectious diseases in urban areas and along transport routes. Underlying these changes are different food production systems and variation in the carrying capacity of the land. The factors affecting mortality change and the pattern of mortality itself are many times more complex than they were thirty or forty years ago.

Potential for health services to reduce mortality: interventions

PNG has reached a critical point in terms of mortality change. Although infant mortality has continued to decline, upward pressure on mortality rates will be experienced in at least three areas. The first is the effect of population growth, which will vary from province to province and from district to district. So far, PNG has been spared the effects of rapid urban growth. However, once a point is reached where subsistence agriculture can no longer support rural populations, increased migration to urban areas – with increased strain on already weak infrastructures – is inevitable. Areas of high population density, such as the Highlands Region, parts of the Sepik and the Gazelle Peninsula, may well be the first to evidence these effects. Second, the HIV epidemic will increase mortality in young adults through its direct effects and through increased transmission of tuberculosis. The third will be the transition to increased mortality from non-communicable disease. Effects of increased obesity (30) and of the shift from traditional tobaccos to cigarettes will become apparent in the cause structure of mortality. Once this occurs, PNG will be caught in the trap – which has afflicted many developing countries – between the unsolved problems of infectious disease on the one hand and the diseases of the epidemiological transition on the other. These diseases are more difficult to treat than acute infections, and demands on health services will continue to increase.

Health services, therefore, need to renew their efforts to manage the 'unsolved problems' of infectious disease, and of maternal and neonatal mortality. Priority interventions are listed in Table 6. Principal areas for intervention are behavioural change, immunization, and efficient and effective treatment of individual cases of disease. Some brief comments follow.

Vaccines, as well as chemotherapy for malaria and tuberculosis, have 'indirect' effects on transmission, either by reducing the population of non-immune people below the level at which the disease can propagate or, in the case of chemotherapy, by reducing the total reservoir of infection and/or the prevalence of infective cases. There are well-defined thresholds below which these indirect effects do not occur. Incomplete coverage

TABLE 6

CLASSIFICATION OF INTERVENTIONS AGAINST LEADING CAUSES OF MORTALITY

Health problem	Primary prevention of underlying causes or of transmission	Secondary prevention of disease	Tertiary prevention of death and complications
Malaria	LLIN, IRS, source reduction, larval control, nutrition	Intermittent preventive treatment	Chemotherapy
Pneumonia	Housing, nutrition	Pneumococcus and Hib vaccines	Chemotherapy, oxygen
Maternal, perinatal mortality	Reduce TFR, improve women's nutrition	Antenatal care	Supervised deliveries
Tuberculosis	Housing, chemotherapy	[BCG vaccine]	Chemotherapy
Gastrointestinal infections	Behavioural change: water, sanitation, food hygiene	[Typhoid vaccine]	Rehydration, selective antibiotics
Diphtheria, pertussis, tetanus, measles, pigbel, polio, hepatitis B	Indirect effect of vaccines	Direct effect of vaccines	Patient care
Nutrition	Behavioural change: infant feeding practices	Micronutrient supplements	Patient care
STDs/AIDS	Behavioural change: safe sex	TB control	Chemotherapy
Fertility	Behavioural change: family planning		

LLIN = long-lasting insecticidal nets
IRS = indoor residual spraying
Hib = *Haemophilus influenzae* type b
TFR = total fertility rate
BCG = bacillus Calmette-Guérin
STDs = sexually transmitted diseases
AIDS = acquired immune deficiency syndrome
TB = tuberculosis

of a population with a vaccine may not have the desired effect, simply because the threshold for indirect effects has not been reached: eg, at least 92-95% immunization coverage is necessary to prevent measles outbreaks (31); and 95% coverage is required for measles vaccination compared with 80-86% of individuals in a population for polio (32). Inadequate treatment for tuberculosis, in particular, can be downright harmful, leading to the emergence of drug resistance, amongst other problems.

Potential for health services to reduce mortality: coverage

The most fundamental determinant of impact of an intervention is its coverage. If an intervention does not reach the intended population, it can have no effect. Table 7

summarizes measures of coverage under the headings of access, availability and utilization of services, and lists indicators that could be combined to analyse these under operational conditions (eg, to place utilization data in context, to show where services are not providing appropriate coverage, and to show why they are not doing so). If it can be assumed that vaccines are biologically active, it is a relatively simple matter to calculate coverage on the basis of a known numerator (the number of persons vaccinated) and an estimated denominator (population size). It is much more difficult to estimate coverage when an intervention is based on case management. Table 7 indicates that estimates need to be made of the population living within two hours of functioning facilities, and that maximum possible coverage for mobile clinic-based services be estimated similarly. Such statistics need to be maintained on an ongoing basis at district and provincial level. The capacity to maintain and use these statistics for planning, implementation, monitoring and evaluation needs to be supported and sustained.

Potential for health services to reduce mortality: monitoring and surveillance

The estimates of mortality described in this article have principally been used for the planning of health services by the National Department of Health and by international agencies, including the Australian Agency for International Development (AusAID), the World Health Organization and the World Bank. Differences between them reflect the application of different models and assumptions to, essentially, the same data sets. Indirect methods are essential for the estimation of mortality in populations lacking systematic vital registration, but depend on the accurate collection of data – and have their own methodological problems (2).

Few studies have related directly observed mortality in PNG populations to the indirect estimates. Data from Tari indicated considerable deviation from the commonly used West Model Table, with comparatively high mortality in adults over the age of 40 and comparatively low mortality in children

TABLE 7

SERVICE-BASED MEASURES OF COVERAGE

Level	Mode	Measure
Access	Monthly MCH clinics	Population within 2 hours' travel of a clinic point
	Fixed facilities: aid posts, health centres, hospitals	Population within 2 hours' travel of a fixed facility
Availability	Facility open and staffed	Number of days/week, hours/day
	Essential medical supplies	By health problem
	Essential equipment	By health problem
Utilization	Clinic attendance	By function: children immunized, antenatal examinations etc
	Number of cases: Outpatient attendances Admissions/discharges Deaths	Proportion of cases due to a particular cause Cases per 1000 or 100 000 population

MCH = maternal and child health

(22). PNG needs methods to determine changes in adult mortality that are validated in its own populations. It should be noted that the Papua New Guinea Institute of Medical Research has maintained longitudinal population studies in Tari through to the mid-1990s, together with similar studies of mortality in the Asaro Valley, Eastern Highlands Province and in the Wosera District, East Sepik Province. New methods of estimating morbidity and mortality through household surveys are now available. Given the differentials in mortality, there is a need for provincial-level population data for provincial planning and the capacity in PNG to maintain and utilize these methodologies.

Even more importantly, disease control programs require accurate data for monitoring and surveillance. Even with high levels of coverage, the application of interventions without careful monitoring is not likely to be sufficient for purposes of disease control. The most demanding program is against malaria. Geographic information systems and global positioning devices form the basis for the computer-based mapping of cases of malaria and of the distribution of interventions (33-35). For example, successful programs of control in Brazil, Eritrea, India and Vietnam have depended in large part on the ability to deploy a package of interventions and on 'data-driven' decision-making (36). In the face of scepticism about the effect of child immunization on mortality it has been important to be able to measure the benefits directly (37). Behavioural change needs to be monitored as carefully as any epidemiological indicator.

Conclusions

Health services in PNG are entering a critical phase of their history. Upward pressure on mortality will stem from three major sources: population growth with associated migration to urban areas, the epidemic of HIV and AIDS, and non-communicable diseases. The unsolved problems of infectious disease need to be addressed as expeditiously as possible, as otherwise health services risk being overwhelmed. Health managers and planners need to be aware of the strengths and weaknesses of current estimates of mortality which, because of wide differentials in mortality and fertility, are inadequate for planning at provincial and district levels. They need to have the capacity to develop, support and utilize their own data sets. Strategic responses to maternal mortality and mortality from infectious diseases require high levels of coverage of an appropriate mix of interventions, and the capacity for decision-making based on high-quality health information.

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Beyond the numbers: Papua New Guinean perspectives on the major health conditions and programs of the country

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SUMMARY

How members of the community perceive and respond to diseases and health problems are important variables to take into account when planning interventions and priorities in a health system. This paper summarizes some qualitative research undertaken in 2001 and 2002 in Papua New Guinea as part of the formative research for health promotion activity development for immunization, maternal health, tuberculosis and malaria services. It provides some highlights of the health beliefs and health-seeking behaviours amongst a range of urban and rural populations in a range of provinces in Papua New Guinea (PNG), and across a range of age groups including young adults. The findings reinforce that these health-related issues are seen by most of the population as important, although maternal health lags behind, especially in male respondents' perspectives. However, how they respond varies often with the planned health system interventions, and these differences need to be understood and addressed in order to increase the acceptability and efficiency of health services in PNG.

Introduction

If the modern health service is truly interested in bringing health care to all of the people of even the remote areas, professional medical and health care workers need to understand a lot more about the beliefs of people that attend ... (and) must apply their skills without increasing the shame (helplessness) people feel (1).

This paper will briefly take the reader through a journey of health beliefs and health-seeking behaviour in a selection of Papua New Guinean locations.

The identification of the major disease burdens in a country needs to go beyond that of numbers and needs to enter the world of the people of the country. What are their concerns, and what do they rank as the major health problems and risks? How do they prevent disease, and what health-seeking behaviours do they resort to when they perceive that they are not well?

Medical anthropology in Papua New Guinea (PNG) has developed over several decades, but has been limited in numbers when one considers the rich cultural diversity of PNG. The qualitative studies that constitute PNG's medical anthropology may have resulted from direct enquiry, may have been opportunistic in nature, for example, when observant participants in the health system have noted cultural differences (2,3), may be general ethnographies (4-11) or highly focused studies on a particular disease or behaviours (12-15), or, most recently, may have been part of the increasing wealth of studies on human immunodeficiency virus (HIV) and sexual health (16,17).

This paper analyses some of the data collected from a series of formative research

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activities undertaken by the Health Promotion Branch of the National Department of Health of PNG (18-20). The wide range of people involved in the design, conduct and analysis of the research are acknowledged at the end of this paper. It focuses on the data collected on malaria, tuberculosis (TB), childhood diseases preventable by vaccination and safe motherhood (in which 3 topics were studied). This research series was to form the basis of a succession of health promotion activities from 2002 to 2005. The purpose of this paper's analysis is to provide some insight into the broad range of Papua New Guinean perspectives on health and illness, prevention and cure, health-seeking behaviour, and the responsiveness and acceptability of the health services provided in PNG.

Methodology

A rapid ethnographic assessment methodology was used for the research. Rapid ethnographic assessment methodologies have developed primarily in response to the requirements of applied primary health care programs, to provide information vital to the design of successful intervention programs (21-25). As Vlassoff and Tanner (26) commented, "Rapid assessment methods are an essential basis for the translation of research results into disease control activities."

The research was primarily conducted via interviews, focus group discussions and observations (27-31). Using these techniques, qualitative research endeavours to see the social and cultural world from the point of view of the participants, and seeks to explain why people adopt particular behaviours or attitudes (32-35). This technique is particularly useful for uncovering cultural aspects which may cast illness in a completely different light.

Each of the six studies was devised with clear aims, which in turn informed the objectives for each study. The National Department of Health (NDoH) staff and the World Health Organization (WHO) technical advisers to the NDoH provided technical guidance and review to identify key areas of inquiry, technical questions of importance, analysis of the technical aspects of the studies, and prioritization of recommendations. The research questions were finally compiled into an *Interview and Focus Group Discussion Question Guide*. The research tools, along with a draft question guide, were pre-tested by fifth-year medical students from the University of Papua New Guinea's Department of Community Medicine in Oro Province.

Field research was undertaken in various localities within a total of 9 provinces (Table 1). The provinces selected to take part in the study were chosen to represent the four regions of Papua New Guinea: Highlands, Islands, Momase and Southern. The research aimed to provide a representative insight into similarities and differences between coastal and highland areas, between rural and urban communities, and the services delivered in these areas. In each province, an attempt was made to survey urban and rural areas equally, as well as to include some periurban localities.

Study sites were selected and finalized via consultation with provincial, district and local-level government officials. The field sites and respondents were selected purposely by provincial health staff and were not randomly selected. This being the case, the results of the research cannot be statistically analysed or generalized to the wider population. The choice of settlements in urban areas also means that environmental conditions are not necessarily typical of urban areas.

Entry to the field site was negotiated by the Provincial Health Office contact – either through village leaders, councillors or health workers.

The field research was undertaken in two rounds; the second round was essentially a reiteration of the processes adopted in the first but with different topics, personnel and locations involved. Round one, which comprised the field research on tuberculosis, malaria and immunization, was conducted from September to October 2000, while round two topics – related to safe motherhood – were investigated from February to March 2002.

Before embarking on fieldwork, the research teams were trained in rapid qualitative methods, ethics and data collection. Data analysis was taught over the course of the research process. In each province, time in the field – which would generally last a week – was interspersed with periods of training, coding and analysis in

TABLE 1

PROVINCIAL DISTRIBUTION OF FORMATIVE RESEARCH STUDIES

	Round One*			Round Two†
Province	**Malaria**	**Tuberculosis**	**Immunization**	**Safe motherhood**
Madang	✓	✓	✓	
Milne Bay	✓	✓	✓	
Morobe	✓	✓	✓	
National Capital District	✓	✓	✓	
Western	✓	✓	✓	✓
Western Highlands	✓	✓	✓	✓
Sandaun				✓
Central				✓
New Ireland				✓

*Conducted from Sep to Oct 2000
†Conducted from Feb to Mar 2002 with 3 study components but treated here as a single study

Port Moresby. The return to Port Moresby also facilitated development of further questions or additional lines of enquiry. Approximately the last half of the four-month time-frame for each of the studies was generally devoted to final analysis and compilation of the results.

In each location, information was collected from male and female adults and teenagers. This entailed engaging people in conversation for informal interviews or inviting them to join a focus group, where the interviews were structured according to a prepared question list. To gain an appreciation of the health issues being confronted, information was also collected from staff at the health service centres utilized by the target community. To obtain some basic economic and demographic information about the communities within which fieldwork was carried out, community profile interviews were undertaken with village leaders and other significant figures. In each location, data were collected from health service staff, adult women and men, and male and female teenagers (which included unattached individuals in their twenties). Selection of respondents to take part in focus group discussions and formal interviews was by invitation from the research teams or village leaders. Researchers also engaged in conversations and informal interviews.

The analysis of the information followed the 'thematic analysis' or 'grounded theory' approach. This presupposes that theory can be built up through careful observation of the social and cultural world (36-38). A grounded theory is inductively derived; that is, it reaches general conclusions by reasoning from particular cases. The theory is created, developed and provisionally verified through systematic collection and analysis of information pertaining to a phenomenon (39). Rather than using deduction (imposing a set of external analytic categories on the primary material), the grounded approach sees theory as emerging from that material (40). Grounded theory attempts to overcome 'etic' (outsider's) problems of interpretation by

staying close to the 'emic' (insider's) view of the world. The information must be sorted into meaningful units and this organizing system is derived primarily from the information itself (38).

Ethical clearance for the research was given by the PNG Medical Research Advisory Committee. Informed verbal consent from study participants was obtained before discussions and formal interviews took place; and responses were noted down. Confidentiality was assured at all times and research data were stored securely at the Health Promotion Branch (HPB). Additional demographic data – including age, years of schooling and number of children – were also obtained.

Data analysis

Data analysis was undertaken according to the following series of six general steps:

1. Data arranging – handwritten notes were taken during interviews, then coded (labelling text) later.

2. Data processing – ordering and coding the field notes according to a coding scheme that was developed after initial interviews and refined during the analysis process. The coded interviews were reviewed by another researcher and recoded if necessary. The coded interviews were then cut and sorted ('posted') into envelopes. The material was coded to facilitate the identification of persistent words, phrases, themes or concepts so that underlying patterns could be identified and analysed (38).

3. Data reduction – summarizing the data within each code. Two research team members and two research facilitators analysed the data sets. Codes were sorted into specific ideas, issues and themes which were then summarized on A3 analysis sheets, with selected quotes attached. The frequency of different ideas or themes within codes was also analysed for differences between age groups, gender and urban/rural respondents.

4. Data display – summary matrix display sheets were displayed on a wall and reviewed by the research team and authors. Memorandums and diagrams were used to record discussions and developing issues.

5. Confirming findings – results between codes were compared. Confirmations and contradictions were resolved or explained by re-examining initial summary sheets and coded texts.

6. Drawing conclusions – conclusions, key concepts and ideas for health promotion were discussed and recorded in memorandums and whiteboard diagrams. Analysis also included compilation of demographic characteristics of respondents, and a breakdown of types of interview method by type of respondent, urban/rural source and province.

Findings

Malaria was reported by respondents to be the most common and most important illness in the community, followed by, in order, TB, diarrhoea and cough.

Terminologies and taxonomies

Local names reflect a common phenomenon of naming illnesses by their symptoms. In Tok Pisin, malaria is commonly referred to as 'sik hat' or 'sik kol'. When people use the term malaria or the local name, they may simply mean the symptoms of malaria – fever or feeling cold.

"People know malaria as *deanam*, which refers to 'skin hat' or fever. Another term used is *nangi*, which refers to mosquito sickness." (Male adult, urban, Western)

Both rural and urban respondents showed widespread knowledge and understanding of the common signs and symptoms of malaria. There did not appear to be any significant differences between males and females and between adults and teenagers in the type or range of signs and symptoms given (Table *2*).

The key Tok Pisin terms used for TB are 'TB', 'strongpela kus', 'kus wantaim blut', 'kus na sotwin', 'kus longtaim'. Strong cough, cough with blood, shortness of breath and prolonged cough are the types of cough most frequently associated with TB. 'Strongpela kus' (strong cough) can mean any cough

producing sputum or phlegm. However, there was no consistent period defined for a prolonged cough, which ranged from more than one week to one or two years, or was a cough that does not finish.

Cough and weight loss were the dominant symptoms identified. Cough with blood was the most frequently mentioned, followed by strong cough, cough with shortness of breath and prolonged cough. Adult women provided more responses for children's symptoms than males or teenagers, which suggests that they have more experience in observing different coughs and weight loss, plus perhaps more exposure to health information.

There are a number of different names used for immunization in PNG, almost all of which focus on 'sut' (injection) (Table 3).

Causation

There are multiple beliefs (frequently many held by the same individual) pertaining to the transmission of malaria. Very few responses indicated knowledge of a parasite life cycle phase in mosquitoes. Many people appear

TABLE 2

SIGNS AND SYMPTOMS OF MALARIA REPORTED BY PAPUA NEW GUINEAN RESPONDENTS

In adults		
Cold/shivering	Fever	Headache
Sleeps a lot by fire or sun	Loss of appetite	Joint pain
Pale	Dizziness	Loss of weight
Unconscious	Yawning	Watery eyes
Vomiting	Cough	Weak
In children		
Fever	Loss of appetite	Convulsions/fits
Cold	Sunken eyes	
Irritable	Not breastfeeding	Pale
Crying	Diarrhoea	Cough
Weight loss	Weak	Skin dusty
Sleepy	Yawning	Big spleen
Watery eyes	Headache	Stomach ache
To take children to clinic		
Not eating/drinking/breastfeeding	Weak	Crying a lot
Not playing	Shivering	Fitting ('ai tanim')
Shortness of breath/fast breathing	Skin goes yellow	
Loss of weight	Fever	

TABLE 3

NAMES USED BY PAPUA NEW GUINEAN RESPONDENTS FOR IMMUNIZATION

Names in Tok Pisin		
immunization	'bebi sut'/'pikinini sut'	'tambu sut'
'banis sut'	'pasim sut'	'lukaut sut'
'was sut'		
Names in 'tok ples' (local languages)		
Milne Bay Province		
bebi anawoman	*aniwogaga*	*nitona*
Morobe Province		
kogo bungi	*yaunga*	*nemba okak deke*
moiok meieng	*konok yantan fumati*	
National Capital District		
deka sut (Kote language)	*baliko so* (Kote language)	
Western Province		
nira sut	*enga agori*	*pita aulema deme*
pita aome	*pita ibanime* ('stapim sik')	*temeteme komopi*
suntik		
Western Highlands Province		
krupipsip kale	*kale*	

to believe that malaria is instantly transmitted by the bite of a mosquito. Although most respondents knew of the link between malaria and mosquitoes, the exact nature of transmission was not clear to many, was not clearly specified or was simply not known (Table 4). Except in the Western Highlands (due to the higher elevation and cold), mosquitoes were perceived as being a big problem, particularly by urban respondents.

Principal breeding sites mentioned were tins, coconut shells, swamps, water pools, wet places, toilets and rubbish sites. Trees were also recognized as resting places for mosquitoes. Dark places and the bush were associated with places where mosquitoes rest and bite. Mosquitoes were thought to bite mainly at night after sunset. Daytime, early evening and early morning were only occasionally mentioned as biting times.

The wide variety of causes of TB mentioned reflects different levels of causation – microscopic, personal and environmental. TB is known to be a contagious sickness, spread by direct or indirect contact with an infected person and their environment. Coughing ('kus') and spitting ('spet'), and sharing food and utensils with infected persons were most frequently mentioned. Generally, any contact with

TABLE 4

KNOWLEDGE OF CAUSES AND SPREAD OF MALARIA

Mosquitoes		
Mosquitoes cause malaria (non-specific); mosquito germs and parasites	Mosquito bites spread malaria	Mosquito bites sick person and spreads to another person
Mosquito eggs on food and water	Mosquito bites animals and spreads to humans	Other insects spread malaria – flies, cockroaches
Environment		
Dirty places and houses where mosquitoes breed (toilets, drains, swamps, tins, shells, rubbish, grass)	Bad smell/air	Bad water
Seasons and winds		
Hygiene		
Dirty clothes, bedding	Dirty food/handling	Dirty/bad water
Dirty body	Stepping on sputum	Sharing food, smokes
Body contact and sex	Too many people inside net	Dogs and pigs with 'scabies'
Other		
Travel to towns, city, coast	Intermarriage between highlands and coast	

sputum is thought to be directly infectious, although a few respondents specifically mentioned droplet spread. There are thought to be many ways of contracting TB through contact with people with TB and materials contaminated by them. Contaminated materials that can spread TB include eating and cooking utensils, food and leftovers, betelnut and lime, cigarettes, bedding and clothes. Environmental airborne spread was also thought to occur through dust, dirt, wind, air and pollen. A few respondents thought vector-borne spread through flies and mosquitoes possible.

Many people also believe that there are many other (plural) causes of TB, including food, alcohol and drugs, inheritance, moral failure and sin, spirits and the supernatural, blood transfusion and poor housing. Bad food is also thought to be a cause of TB, such as eating too much salty food, drinking sweet teas, eating sweets, eating unripe fruits and eating a great deal of meat. Smoking is commonly associated with chronic coughing and therefore TB. TB and other serious illnesses are commonly thought to result from personal or parental sin, and spiritual or socio-moral errors (such as failing to honour ancestors or rituals). These causes are commonly believed to be associated with any illness which is chronic, difficult to cure, not cured by either western or traditional medicines, or which results in death. It is probable that there are many traditional beliefs regarding the cause of TB, including

sorcery and punishment for wrongdoing. However, respondents rarely mentioned these causes, perhaps due to the fact that non-Christian beliefs or secret types of knowledge are generally not admitted in public discussion. Such beliefs do not necessarily contradict germ theory, because people may believe that wrongdoing or sorcery may influence one's susceptibility to germs.

One half of all female respondents were not aware of the causes of maternal deaths, although this was partly because no such deaths had occurred in their communities. The reasoning pertaining to maternal deaths is equivocal, since such deaths may be understood from a cultural or from a western medical perspective. Many women are uncertain what to believe and, as can be seen from the following list of causes, their responses are mixed:

- Retained placenta, excessive loss of blood
- Frequent deliveries – 'klostu klostu' (too close) – and short of blood
- Sorcery by secret admirers, or a man the woman has refused to marry
- Heavy workload during pregnancy
- Abortion attempts (unmarried young girls) – heavy bleeding
- Heavy workload after tubal ligation
- Infection after home delivery (mother not thoroughly cleaned)
- Postpartum haemorrhage and retained placenta, delay in seeking hospital help
- Husband's infidelity
- Non-payment of bride price by husband
- Twins – first twin normal delivery, second twin transverse lie
- Non-attendance at antenatal clinic (ANC) and non-compliance in treatment.

As maternal deaths are often seen as unavoidable due to being caused by sorcery or immorality, serious consideration is not given to preventing them through western medical means.

Prevention

Prevention of these common illnesses was clearly discussed by all respondents. However, many of the ways to prevent illnesses were different from the 'western' public health recommendations – and more linked to intrinsic beliefs regarding causes of these illnesses.

Bednets are the most well-known method of prevention for malaria, followed by coils and repellent. In terms of environmental modifications to support prevention, cutting grass is the most well-known method, followed equally by cleaning the house and surroundings, burning rubbish and burying tins and shells. Many respondents could name a range of prevention methods.

> "Go the clinic and get medicine, clean in and out of the house, bury tin, coconut shells, use mosquito nets, coils, oil, make fire using coconut husk or waste scrapings of coconut." (Male teenager, urban, Madang)

However, knowledge of preventive practices does not mean that they will be practised. There were many reasons why people said they did or did not use bednets. The common reasons given for using bednets were:

- Stops, prevents or chases away mosquitoes from biting
- Stops malaria sickness
- Keeps away/kills mosquitoes and flies
- Less disturbed sleep.

The common reasons given for not using bednets were:

- Too hot – with both treated and untreated nets, people feel hot and uncomfortable inside a net, complaining of a lack of circulating air
- Too crowded – people complained of feeling overcrowded or trapped
- Smell – the smell of treated nets,

particularly when the net is first treated, is unpleasant

- Side-effects – treated nets cause coughing, sneezing and feeling itchy
- Poisonous – people fear that the treated nets are poisonous to children
- Not effective – nets are not effective if the net is not treated, has holes or is not hung properly
- Cost – people cannot afford nets.

Virtually all respondents had knowledge and ideas about the prevention of TB, which mirrored ideas about the contagious nature of TB, plus prevention by immunization and treatment of existing cases. The main categories of prevention included:

- Immunization
- Early and complete treatment of TB
- Avoiding contact with the TB germ through coughing, spitting (including standing on spit)
- Avoiding sharing of utensils, food and other materials
- Avoiding contact with and sleeping with persons with TB
- Personal and household cleanliness/ hygiene
- Avoiding wrong kinds of food.

These categories can be used to define correct and incorrect ways to prevent the spread of TB. Again many respondents have several simultaneous ideas about ways of preventing TB:

> "To prevent *nokopelmo* [TB] people must have clean environment, practise washing hands, cover mouth when coughing, use own eating utensils, do not share smokes, do not spit around, wash food like 'kukamba' and other fruits before eating them." (Male teenager, rural, Western Highlands)

> "It can be prevented if people get treatment early from the health services and plenty of fruit juices." (Female teenager, urban, National Capital District)

> "[Person with TB] must use own toilet, own eating utensils." (Male teenager, rural, Western Highlands)

Knowledge of prevention and protection of babies and children was often situated within a health/illness model of hygiene. Cleanliness of body, food and environment, in addition to good diet, are well known for promoting health and avoiding sickness. Traditional leaf medicines are also used to prevent sickness, but their use depends on their availability, knowledge of how to use them, and belief in their effectiveness. Situated in this system of prevention is the role of immunization. The popularity and acceptance of immunization is enhanced by the power associated with injections in curing illness. While this is a strong advantage for marketing of immunization, it may also lead to confusion between injections for immunization and injections for treatment.

> 'The *bebi nira* works fast inside the body so the baby will not get any diseases and it also fights against any germ inside the body. Some of the mothers have no difficulties looking after sick babies because all their children are fully [immunized]." (Female teenager, urban, Western Highlands).

> "It makes the whole body strong and protects children from getting sick, strengthens all their bones." (Male teenager, rural, Madang)

Early and quick treatment of sickness was mentioned as frequently as immunization as a means of protection. Pluralistic use is made of modern and traditional treatment systems where they are known and available. Thus immunization is but one of several pathways to prevention and protection.

Certain cultural beliefs exist and rituals are practised by pregnant women – some of which may facilitate and some of which hinder the normal progress of pregnancy, labour and delivery. Problems are thus either prevented by partaking or not partaking in these activities. Pregnant women and their husbands are required to comply with certain prohibitions, particularly in relation to food; and it is believed that defying these will result in adverse consequences for the health of

the mother and child (Tables 5 and 6).

Additionally, while there was some recognition that pregnant women should be careful to minimize heavy work during the first and second trimesters, there is a belief in some places that heavy work, such as gardening, in the last trimester enhances the baby's descent and facilitates delivery. To facilitate labour and delivery, pregnant women use a variety of traditional rituals. For instance, in the highlands, women eat special herbs to reduce labour pains, drink water held in a taro leaf to speed up delivery, breathe flower pollen as an analgesic for labour pain, and tie a magic rope around the abdomen. The men there report that women in late pregnancy are told to wash and bathe frequently in flowing water to ease the birth.

Focus groups revealed that many of the female teenage respondents are not well informed about pregnancy and childbirth. The teenage respondents often say they learn by observing other teens and through circulated peer information, but the adequacy of this knowledge is unclear.

The general study population strongly associates maternal death with external factors (Table 7), such as sorcery or the breach of behavioural norms and taboos on the part of the pregnant woman or her husband.

Health-seeking behaviour

The pattern of resort for treatment of malaria is diverse and complex. The types of treatment and the order in which they are taken depend on the symptoms experienced, the severity of symptoms, what type of home treatment is working and whether it is effective, and access to the nearest clinic (Figure 1). Three times as many respondents said that they would use home treatment first before seeking treatment at a clinic. Treatments with water and steam/sweating therapies provide symptomatic relief. Home treatments may involve simple cold water therapy or more complex therapies, including taking leftover clinic medicines and store-bought medicine, particularly in urban areas. Faith healing is also part of the repertoire of remedies, which may be conducted at home or by a recognized healer. A crucial reason for seeking clinic treatment is that home treatment is ineffective or the symptoms

TABLE 5

FOOD PROHIBITIONS IN PREGNANCY AND CONSEQUENCES OF BREACHES

Types of food prohibited	Health consequences of breaches
Fish, crab, turtle, pork, cuscus, flying fox, octopus, shells, cassowary meat, snake meat	Overdue pregnancy, prolonged and difficult labour, baby born malnourished, stillbirth
Postpartum prohibition of pork, certain fish, galip nuts, wild fowl	Spoil baby and growth stunted
Coconut cream in food	Baby gets cough when born, baby not strong and active, bad blood on baby, sores on umbilical cord
Certain types of bird	Maternal death
Eggs, tomatoes, ripe bananas, pawpaw, pineapple, breadfruit leaf	Baby has lumps and swellings, deformities, protruding eye balls
Spice ('lombo', chilli, ginger)	Not allowed during first and second trimester, will cause miscarriage or preterm baby
Avoid drinking water after delivery	Causes postpartum haemorrhage

TABLE 6

TYPES OF FOOD ENCOURAGED DURING PREGNANCY

Types of food allowed	Reasons for consumption
Greens/vegetables, fruits	Supports the growth of a healthy baby
All garden food, fish, sago	Helps body build adequate blood and enables baby's growth
Coconut milk, taro, yam, banana	Helps with lactation and strengthens woman, baby grows strong and healthy

TABLE 7

CULTURAL EXPLANATIONS FOR COMPLICATIONS IN PREGNANCY AND CHILDBIRTH

Cause	Consequence
Worry caused by husband's acts of infidelity	Causes severe labour pain, prolonged labour, even maternal death
Non-payment of bride price	Causes maternal and prenatal deaths
Defying cultural prohibitions	Results in prolonged labour, severe labour pains, APH or PPH and maternal death
Relatives' grudges against pregnant woman	Results in labour complications – difficult labour
Many sexual partners during pregnancy	Causes difficult labour

APH = antepartum haemorrhage
PPH = postpartum haemorrhage

return. While home medicines and treatments are recognized as effective in providing relief, clinic medicine was acknowledged by many respondents as working better and faster, and curing malaria. Clinics and hospitals are also preferred because trained nurses and doctors can diagnose and confirm whether the illness is malaria or not.

Roughly equal numbers of urban and rural respondents reported that they would go (or send a child) to a clinic as soon as possible or when they see the signs of illness. Depending on the severity of the signs, others wait to see whether the condition worsens before attending a clinic. Children are more likely to be taken for clinic treatment, particularly if the signs of illness are serious – such as convulsions, excessive crying or failure to feed well. Distance and transport are important considerations in decision-making relating to treatment, and the availability and cost of transport are crucial

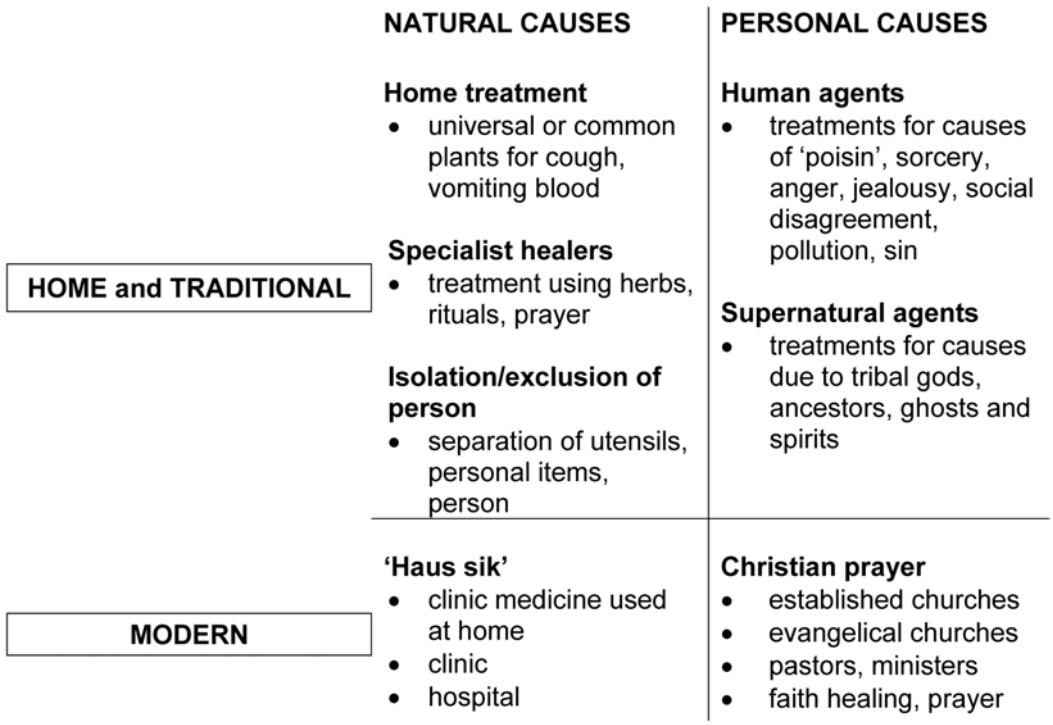

Figure 1. Model of treatment seeking for malaria.

factors. Other barriers to access that delay or prevent patients from reaching health clinics are adverse weather conditions, clan fighting and road blocks, particularly in the highlands.

Further barriers to using clinic and hospital services are the cost of admission and treatment fees, quality of health services and waiting times. Several urban respondents said they disliked having to wait a long time for treatment and would not bother going to the clinic unless it was really necessary.

The need to protect mothers and babies from sickness in pregnancy was understood by many rural and urban respondents. Malaria prophylaxis is widely known to be given to pregnant women, but is not always linked to prevention of malaria. There was almost no mention of malaria causing miscarriage or leading to undersized babies, which suggests that the increased risk of malaria in pregnancy and the sequelae of malaria in pregnancy are not well known.

Taking iron to prevent anaemia was also well known and linked to making blood stronger. Making the baby and mother grow healthy and strong appears to be a central concept in pregnancy. Not all respondents agreed that antimalarials should be given during pregnancy. Some respondents believe that chloroquine and other medicines such as aspirin are too 'strong' and will cause damage to the unborn baby. Chloroquine may also be linked with its use in abortion and suicide, although this was rarely mentioned.

A range of home remedies are used with the onset of different types of cough, for example, hot water, sea water and leaf medicines (Figure 2). Traditional healers and prayers are also used if home treatments are not successful and when the illness appears to be more serious. Home and traditional treatments are used pragmatically, by trial and error, until a treatment is found which is strong enough to combat the sickness. The use of home treatments is affected by access to and cost of attending a clinic or hospital.

Clinic or hospital treatment was most often said to be used as a first resort. Urban respondents were more likely to use clinic

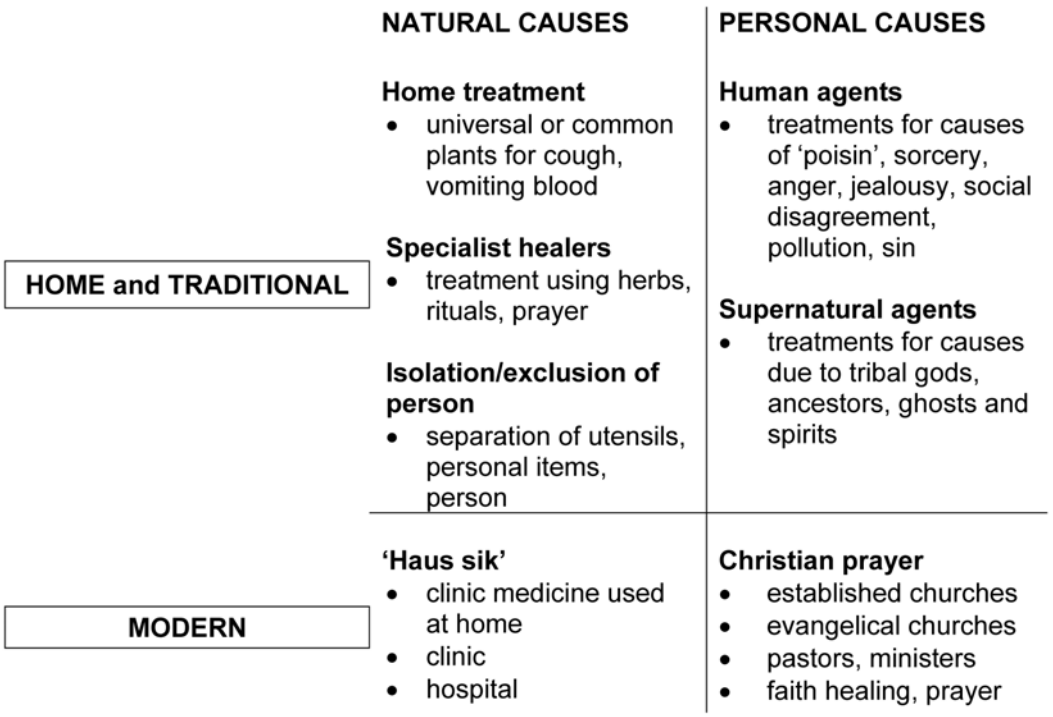

Figure 2. Model of treatment seeking for tuberculosis.

medicine as a first resort, which probably reflects easier access to clinics and less access to traditional medicines or healers. Hospital treatment was frequently described as better, more or most powerful, and as curing the sickness. People's confidence in hospital treatment was not simply related to the medicines used, but to the trained staff and the opportunity for the patient to remain in hospital to finish treatment – which means that people with TB are not a threat to the community. Approximately half the responses suggested that clinic/hospital treatment would be sought at the onset of the disease because the 'haus sik' is seen as the only place to get effective treatment. A similar number of responses suggest that people with signs of TB would go to a clinic or hospital in the later stages of illness – when the condition gets worse or after observing serious signs of illness. Weight loss, weakness and respiratory symptoms (coughing blood, shortness of breath) are signs of serious illness that persuade respondents to seek modern medical treatment. With respect to treatment decision-making, individual adult patients and their immediate family make the decision to seek treatment. Extended family members are more likely to be involved when decisions on treatment are made about children and the elderly.

Treatment in hospital was the preferred option for many respondents as they believe that otherwise the disease will be spread to the community, and patients will not be properly supervised and will not complete their treatment. Fewer responses – nevertheless, approximately half – indicated that people would complete treatment in the community.

Support and supervision of TB patients are not considered to be easy for family members. One respondent in Western Province described difficulties faced in looking after a relative with TB at home, including the costs of check-ups (and other treatments) and the refusal of friends and community members to come to the house.

Even if people were allowed to complete treatment at home, almost all respondents

indicated that they would also impose isolation/separation measures to prevent the spread of TB. People on TB treatment are likely to face stigma and exclusion in the community as this is part of the cultural response to TB, which will continue until a person is considered cured.

> "Supplying treatment to take home is not good as patient will spread germs. Let him stay in hospital. If patient comes back home we won't be pleased to meet him as we are frightened of germs. We …will separate plate, cup, spoon, bedding." (Male adult, rural, Madang)

TB is feared as a deadly disease, with some people believing that there is nothing to be done but to "wait and die". TB patients are also said to be afraid of dying in hospital, and may be ashamed of people knowing that they have TB.

An additional factor is the fear created by the close association between AIDS (acquired immune deficiency syndrome) and TB. Some respondents also thought that TB causes AIDS. Such beliefs cause people with TB to fear seeking treatment, while families and communities will be afraid to care for them. This leads to further stigma, shame and harm to people with TB.

A major reason for non-completion is 'les long dringim marasin'. 'Les' has several meanings, including dislike, 'cannot be bothered', reluctance or being lazy. TB medication is both complex and may have unpleasant side-effects (see below). People taking TB treatment also experience the fear that taking too many tablets could kill them. Additionally, if the symptoms of illness do not abate quickly, it is presumed that the medicine is not working. Feeling better and thinking the medicine is ineffective are also important reasons why patients stop taking tablets.

Attitudes and preferences regarding place of delivery

Most women said that, ideally, they would prefer to deliver at health facilities where skilled help is available, and they often also recognize that antenatal clinics offer worthwhile assistance. They discussed the fact that not all women attend ANC and that some of these women encounter problems or die later. Other women said that they attend ANC to confirm an estimated date of delivery, make sure that the baby is healthy, and get medication to protect themselves and the baby from illness. Primigravidae and other women who anticipate likely problems during labour and delivery therefore state that they attend an antenatal clinic and have a hospital delivery. However, if women do not anticipate that they will have problems, they opt to deliver at home.

Many women said that they miss attending clinics due to a lack of transport or money. They said that missing an appointment entails that, on a following visit, they are scolded by nurses for missing the previous appointment, and they felt that nurses should see women whenever they are able to attend, without finding fault. Thus they identify an important problem, beyond the barriers of accessibility and cost, which is the alienating behaviour on the part of the nurses.

> "The nurses talk angrily to us like this: When your husband asks you to open your legs wide, you listen and open them wide. When your husband is on top of you, you do not call out; now you call out loudly – shut your mouth and stay put." (Woman, periurban, Western Highlands Province).

Respondents often mentioned that considerable support from family members and others is available at home, whereas this family support is not readily available at a distant health facility. Other reported factors affecting women's decisions regarding where to seek care and give birth include:

- Irregularity of mobile baby clinics in most provinces
- Women do not like to take medicines provided at an antenatal clinic, or are not used to taking medicines
- Uneducated women are too embarrassed to attend ANC, as they cannot read treatment orders and instructions
- Remote areas have no health services, not even an aid post, and women cannot attend an ANC
- Unmarried girls do not attend an ANC, are embarrassed and at times intimidated by nurses when they have

no husband

- The health facilities are in a bad condition, very unhygienic – mothers and babies are likely to be infected
- Shortages of medicines
- Too few hospital beds, many mothers left waiting outside, often deliver outside
- Food is not provided by health facilities
- Nurses don't wash babies
- Service fees are far too high.

Some women, however, recognize the importance of getting preventive treatment for both mother and baby. Health services' assistance is usually sought during obstetric emergencies or for complications and when women fall sick from other medical illnesses. However, traditional practices for management of complications are also described and often formal health care is not sought until these have been tried. Which traditional management is tried is often linked to what the traditional belief is about the underlying contribution to that complication (Table 8).

Decision-making surrounding a home versus hospital birth is, however, not decided upon by the expectant mother alone. As one teenage female respondent in a rural village in Western Province pointed out, often the husband and wife decide together where the baby is to be born, and sometimes uncles and aunts are also involved in deciding. Additionally, respondents indicated that, while they make basic material preparations for the mother and baby, they make no specific plans regarding delivery sites and they do not concern themselves with health implications. A concern expressed by many respondents related to health workers not explaining labour and delivery procedures, or general medical interventions, to mothers. This allows misunderstandings to arise, resulting in the hospital procedures and treatments being blamed for complications that occur. It also means that opportunities to improve the general knowledge of the population about the medical facts of pregnancy and parturition are lost.

Factors affecting demand and supply for immunization services

The demand for immunization critically depends not just on knowledge and awareness of immunization, but also on the priority attached to immunization and supply issues, in particular access to and quality of immunization services. Access involves the availability of, and barriers to, immunization services by both parents and health workers. The proximity, cost of reaching, and irregularity of maternal and child health (MCH) immunization services were key variables identified. More than twice as many responses indicated that MCH clinics were irregular or not available (compared to other clinics). Several respondents said that MCH patrols had stopped, forcing mothers to bring

TABLE 8

TRADITIONAL PRACTICES TO PREVENT OR TREAT CHILDBIRTH COMPLICATIONS

Practices employed	Objectives of techniques
Mixtures of herbs, tree bark, ginger and lime used to wash body or for drinking	Traditional labour induction remedy for prolonged or difficult labour
Magic	Prevents obstetric complications, maternal death, stillbirth
Spells on betelnut and applied to abdomen	Reduces severe labour pain and birth complications and facilitates quick delivery
Consumption of herbs	Reduces labour pain
Constant water contact (washing and sit in water) (Western Highlands Province)	Enhances easy labour

their children to the nearest clinic. Lack of transport and vaccines, absence of a site for the clinic in the village and adverse weather conditions were reasons cited for nurses not conducting MCH clinics. Losing the Child Health Record was also said to deter mothers from attending for several reasons – the cost of replacing the card, parents not being sure when to go, and nurses becoming cross with parents.

Other events taking place in the community, such as funerals, meetings, 'mothers' work', looking after other small children, card games and bingo were also said to deter attendance at immunization sessions. The priority or importance attached to immunization was decreased if the child was thought to be healthy or too young for immunization. Personal factors, such as mothers being tired or parents quarrelling, also lower priorities. Parents may forget about the date of next immunization or its importance.

The main side-effects of immunization reported were fever, crying, and soreness or swelling at the injection site. Side-effects are treated with cool water, paracetamol and kapok leaves applied to the injection site (which is believed to be highly effective). Various reasons are thought to cause side-effects, including negative perceptions that immunization is not good, or too strong, for the child's body. Some respondents blame the injection technique of the nurses. Such ideas could deter mothers from bringing a child back for further immunizations, but only one response indicated that mothers were afraid of the side-effects.

Discussion

The studies clearly demonstrate that treatment-seeking behaviour is complex and diverse, and it depends on multiple factors and contexts. Cost, convenience, access, availability and effectiveness of treatment options are important factors considered in making decisions. Additionally, the severity of symptoms and whether a person's condition is improving or deteriorating are also critical considerations in treatment decision-making. Plural or multiple combinations of treatments are often taken in the search to prevent or treat symptoms and cure the illness. Home treatments often provide effective relief of symptoms and can be encouraged. Only harmful treatments, such as blood letting, need to be discouraged.

Sorcery and traditional beliefs are a major influencing factor on treatment-seeking behaviour and acceptance of conventional and mainstream treatment techniques. These need to be taken into account in terms of health promotion, particularly within rural areas.

The data and analysis have limitations which need to be considered for future studies and in drawing conclusions for health promotion from the study. In particular, the design feature of conducting research for three research topics in each round limited the time available for data collection on each topic. In addition, owing to the limited skills of some of the researchers, there was perhaps an overly rigid use of the question guide. Most of the researchers had limited probing skills, which sometimes led to superficial, limited, unclear or ambiguous responses being recorded. Asking additional questions, or using conversational techniques to get respondents to clarify and expand on their answers, are important skills for interviewing. The researchers tended to find that interviews were often difficult to obtain in urban settlements owing to other commitments and activities of respondents. The summary analysis methods used for this initial analysis are not equivalent to a full (thick) textual analysis. However, the limitations of the research are acceptable and do not impact fundamentally upon the usefulness of the results in terms of drawing conclusions and reaching the objectives and aims of each of the studies.

Conclusion

There is a rich but limited literature on medical anthropology in PNG (41). Few recent ethnographic studies have been undertaken but, likewise, there are limited rapid formative qualitative studies recorded in the published literature (42,43). These types of study also have their role in informing health service and system design, and monitoring and evaluating health services (26).

One way of doing things differently from the past, and perhaps being more effective and achieving better outcomes, starts with having better baseline understandings of the various communities' views on illnesses and

their causes, of health-seeking behaviours and of the facilitators and barriers to seeking prescribed care. As Romanucci-Ross and fellow authors (44) noted: "For health services and providers to achieve the goal of optimal human health ... they must be aware of and pay attention to the duality of biology and culture and the interconnectedness of this at patient, family, community, provider and health system levels, in many and complex ways."

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Working together to get back to basics – finding health system solutions

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SUMMARY

This paper highlights the key changes to the health system over the past 20 years, including the impact of the Organic Law on Provincial Governments and Local-level Governments, the politicization of the system, the changing balance between government and development partners in financing the health system, and the development of a sector-wide approach in the Papua New Guinea health sector. It discusses reform efforts at bureaucratic and regulatory level to address these problems. Key health sector policy issues and lessons learned over the past two decades are highlighted. The paper concludes with an examination of what is needed to 'get back to basics' through mobilizing all health sector partners with the aim of getting the health system delivering improved health outcomes.

Introduction

There is an overwhelming sense of public dismay about the shape of the Papua New Guinea (PNG) health care system, and it is seen as a government responsibility to fix. Recent media articles about maternal mortality (with graphic photographs) and the outbreak of cholera – a disease not seen since the 1960s – emphasize the acute nature of the health system problems. It is the expectation of the public, the government and donors alike that somehow the Secretary for Health should fix the health system. It is also a common public expectation that the government will provide all basic services to the population. To some extent this is a hangover of the colonial era, modelled on a British public welfare model, combined with the 'cargo cult' mentality that all services will be provided by someone else, rather than by one's own efforts – 'samting bilong gavmen' – and in part by the lack of alternative choice to consumers of health care.

While many commentators are fond of assigning blame, the PNG health system is actually a casualty of 'multiple organ failure' caused by a range of internal and external contextual factors, with wide-reaching impacts on the system. These include impacts of disintegration of the system as a result of the Organic Law on Provincial Governments and Local-level Governments (OLPGLLG), consequential fragmentation of resources, and systems failure within the sector, including drugs and medical supplies, financial systems, workforce planning and human resources development. Despite the

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many and oft-cited failings of the PNG health system, there remain many hard-working and committed people within the system who sincerely want improvement.

This paper provides a potted history of some of the key health system developments over the past two decades, and discusses critical implementation and policy challenges, whilst reflecting on the lessons learned.

A potted history

Nothing happens in isolation, and there have been a number of external and contextual factors that have affected the health sector. Table 1 summarizes these.

Policy and governance framework: bureaucracy and politics – changing the mix

As outlined in the paper by Day in this issue (2), the 1995 OLPGLLG has had profound effects on the operation of the health system, at provincial and district levels. It politicized the system, giving national Members of Parliament (MPs) far greater roles in provincial and district decision-making than ever before. It also established quasi-political structures at district and provincial level (the Joint District Planning and Budget Priorities Committees and Joint Provincial Planning and Budget Priorities Committees) that control a significant percentage of the funding to the sub-national levels. At the district level, the committee is chaired by the local MP. At the provincial level, the committee is chaired by the Provincial Governor, an elected position.

Administrative services in each province have also become more subject to political control. National public servants in the provinces report to a Provincial Administrator, who reports to the Governor. This has changed key dynamics in relationships – where previously the Provincial Health Advisers saw themselves operating at the national level, Provincial Administrators have not. This has created serious fractures in traditional links between the National Department of Health (NDoH) and provincial officials, and has weakened the ability of the NDoH to influence provincial health service delivery – a serious consequence, given that the majority of health care to the population is provided by provincial governments.

Successive health administrations have developed a range of responses to deal with this dysfunctional circumstance. These have included the development of plans, standards and legislation to create some governance arrangements that allow the system to be functional. Table 2 summarizes the key responses intended to improve the operation of the health system.

Can the health system deliver health outcomes?

There is clear and abundant evidence that, if a basic package of health interventions is delivered, health will improve. However, PNG suffers from implementation failure. Future health improvement will not be achieved by doing what has always been done. By focusing on the 'what is needed' first, it will be possible to define implementation strategies, some of which may involve different approaches from those traditionally utilized in PNG.

At the simplest level, what needs to be provided by the health system (and what was previously provided by the health system before Independence) is:

1. The availability of effective interventions for the main causes of morbidity and mortality

2. The provision of skilled health workers at the point of service who are able to provide those interventions

3. The provision of essential logistical elements to enable the health worker to provide effective interventions – basic facilities; treatment manuals; drugs and medical supplies; radio communications; transportation for referral; and an equipped referral centre, able to manage emergency and trauma

4. Information, education and communication, and other health promotion activities directed at communities to obtain their cooperation and acceptance of the interventions, and to support and empower community engagement in healthy behaviours

5. Population coverage.

TABLE 1

KEY CONTEXTUAL FACTORS WHICH HAVE SHAPED THE HEALTH SYSTEM

Pre-Independence (before 1975)

- Significant gains made in the health status of the population, with improvements directly attributed to the provision of health services (1).
- Centralized organization and administration of health services, with highly defined vertical public health programs designed and implemented with emphasis at the district level.
- Highly centralized control ensured effective management of resources by a functioning bureaucracy and closely supported delivery and management of health services.
- Provincial hospitals provided technical and logistical support whenever required.
- Significant numbers of international contract officers in line management and service roles at national, provincial and district levels.

Early 1980s

- Australia provided direct budget support after Independence.
- No bilateral donors in the health sector (only ADB and WHO; and ADB funds flowed through the government budget).
- Coordinated process in place for planning the development budget, and clear separation of the recurrent and development budgets.
- OLPG – rural health services were transferred to provinces; hospital services were delegated to provinces (2).
- NDoH left with no effective mechanism to maintain standards and ensure health policy implementation in hospitals and rural health services.
- Provincial governments saw the decentralization as a chance to ignore the NDoH.
- Appointment of provincial health officers became politicized.
- Mobility of the health workforce declined as staff became part of provincial establishments.
- Functional roles and responsibilities were poorly defined, leading to poor resource allocation, lack of coordination and inefficient management of health services, and the deterioration in quantity, quality and coverage of basic health services.
- Wingti Government redirected resources to economic sectors, resulting in a progressive decline in the available resources for the operation of health services.

Late 1980s

- 1986 – Australia began discussions about moving from budget support to programmed aid.
- PNG reacted by turning to other donors. In a very short period, the following donors became active in the health sector: USAID, JICA, the People's Republic of China and the EU. The net effect of multiple bilateral donors created a huge management burden on the NDoH. Much of the funding was extrabudgetary and not reflected in official budgets.
- 1983-1988 – real per capita expenditure for health fell by 9%.
- Capital expenditure on hospitals fell from about 14% in 1978 to 4.5% in 1987.
- Projected a shortfall of K24.7 million in 1995 to grow to K40 million by the year 2000 (3).
- Aid post orderlies became public servants.
- Rural patrol allowances were more than doubled in a single decision, but were not budgeted for, with the effect that patrols were significantly reduced.

1990s

- Major revenue shocks.

- Bougainville crisis – Bougainville contributed approximately 16% of national revenue.
- 1990 – 10% devaluation of kina.
- 1994 – further devaluation of 12% and floating of kina resulting in further devaluation.
- Progressive reduction in Australian budget support from 24% of total revenue in 1984.
- Staffing shortfall estimated to be 1440 nurses and 1655 community health workers (4).
- Public Hospitals Act (1994) makes hospitals quasi-statutory authorities, responsible to an independent board of management reporting to the national Minister for Health – largely causing hospitals to stop supporting the rural health care system.
- Economic crisis point in 1994-1995, with several branches of government unable to meet debts or salary commitments.
- Structural adjustment program and a program of microeconomic reforms including one to reduce public servants – aid post orderlies, now public servants, were shed in large numbers by provinces as part of the reforms.
- By 1999, AusAID had 16 separate projects and programs operating in the health sector.
- In 1999 the Secretary for Health reported he spent 70% of his time servicing donors.
- In 1999 the NDoH requested that AusAID support a move towards a SWAp in the health sector.

ADB = Asian Development Bank
WHO = World Health Organization
OLPG = Organic Law on Provincial Government
NDoH = National Department of Health
USAID = United States Agency for International Development
JICA = Japan International Cooperation Agency
EU = European Union
AusAID = Australian Agency for International Development
SWAp = Sector Wide Approach

This simple framework for achievement of health outcomes provides a useful way to highlight key health system issues.

The availability of effective interventions

PNG has been well supported by international technical agencies such as the World Health Organization (WHO) and its own medical and clinical community, and has up-to-date, clear intervention strategies and clinical protocols for the key causes of morbidity and mortality. The focus in terms of priority diseases is well defined in the 2006 to 2008 Strategic Plan for the PNG health sector (5). There is good evidence that the provision of these interventions works in PNG (1). The key question is **how** to get these interventions to the majority of Papua New Guineans – see also Riley in this issue (6).

The provision of skilled health workers at the point of service

The health workforce is a major constraint to delivering health outcomes. As outlined in the paper by Aitken and Kolehmainen-Aitken in this issue (7), there are major workforce issues that need to be addressed; these range from numbers to skills mix, to distribution, to training and to performance management. This is an essential part of any future strategy to solve PNG's health challenges. They also point out a number of cost and training lead time issues that need to be part of the new National Health Plan implementation and resourcing strategy.

TABLE 2

SUMMARY OF KEY RESPONSES TO IMPROVE THE OPERATION OF THE HEALTH SYSTEM

Standards and Regulations		**Of note**
The 1997 Hospital Standards	Designed to assist boards of management to maintain and improve the quality of hospital services as required by their by-laws.	The process is voluntary.
Minimum Standards for the District Health Services (2001)	Form the basis for service planning, implementation and evaluation at Provincial and District Health levels.	Neither affordable nor enforceable.
Legislation		**Of note**
Public Hospitals Act (1994)	Established hospitals as quasi-statutory authorities, responsible to an independent board of management, and through them to the national Minister for Health.	Has reduced hospitals' support services to the rural health care system.
National Health Administration Act (1997)	The NHAA provides a framework for health planning and coordination between the NDoH and Provincial and District authorities.	Signnificant blurring of roles and accountability in its implementation.
Provincial Health Authorities Act (2007)	Enables provinces to create a provincial health authority to deliver both public health services and curative services.	The initial rollout will take place in three provinces in 2009. Further work is underway to develop the new financial arrangements and to establish management and staffing structures for the provincial health authorities.
Reform of Intergovernmental Financing Arrangements – Amendment to OLPGLLG (2009)	Amendment to the OLPGLLG to ensure that funding is provided to provinces on the basis of the cost of delivering services.	Provinces must now expend function grants according to 'Minimum Priority Activities'. If allocations are not made in provincial budgets for these activities, the Treasury Department will not approve them.
Planning Frameworks		**Of Note**
The National Health Plan 2001-2010	Policy basis for the sector, and the Health Sector Improvement Programme. A new National Health Plan is currently under preparation.	Too broad and wide-ranging to form the agreed work program for the SWAp.
PNG Health Sector Strategic Plan 2006-2008	Establishment of priority health programs for the PNG health sector.	Provides basis for the MTEF.

The Corporate Plan 2009-2013	The Corporate Plan provides the NDoH itself with guiding objectives for execution of its role in the national health system.	Articulates clearly the governance, planning and performance frameworks for the sector.
Provincial Plans and Annual Activity Plans	Provinces follow a multisectoral district-based planning system at both local and provincial levels, which is not always consistent with the Annual Activity Plan requirement of the NHAA.	Lack of integration between the Annual Activity Plans mandated by the NDoH and Provincial Plans.
Mechanisms for allocating resources, monitoring and measuring performance against priorities		**Of note**
Medium Term Expenditure Framework (2003)	A framework to allocate resources according to key health needs in PNG.	Internal capacity to update and use the MTEF is limited and has not continued to be applied systematically to the budget process.
Common funding mechanism – Health Sector Improvement Program (HSIP) Trust Account (2001)	A consolidated mechanism for donors to channel funds to provinces.	Accountability problems and slow expenditure. Effectiveness hampered in some provinces by mismanagement. Remains a parallel system.
Partnership Agreements and Code of Conduct (2004)	Set out respective commitments of the Provincial Government and the NDoH (and Development Partners). The Agreements also define the target performance levels for each province.	Require significant advocacy and negotiation skills. Five partners signed. New partners have not been asked to sign.
Performance Monitoring Framework (2001)	A set of 19 Core Indicators initially developed and now prescribed by the NDoH as compulsory reporting requirements for the health system.	Measured annually through an Annual Sector Review process.

NHAA = National Health Administration Act
NDoH = National Department of Health
OLPGLLG = Organic Law on Provincial Governments and Local-level Governments
SWAp = Sector Wide Approach
PNG = Papua New Guinea
MTEF = Medium Term Expenditure Framework
HSIP = Health Sector Improvement Program

Training outputs for some categories of key health worker are already lagging behind requirements, as the population is steadily growing. Innovative solutions to this health workforce crisis will be needed.

The provision of essential logistical elements: basic facilities and logistics

Basic health facilities and staff housing are in poor shape in most parts of the country, and there is no systematic asset maintenance and replacement program. Significant refurbishment and renovation of rural facilities was supported by AusAID (Australian Agency for International Development) in six provinces under the Health Services Support Program (HSSP) (2000-2006). However, this has not been continued under the Sector Wide Approach (SWAp) arrangements.

United Nations Children's Fund (UNICEF), Japan International Cooperation Agency (JICA), AusAID (through the Women's and Children's Health Project) and WHO have maintained ongoing technical and logistic support to the NDoH and provinces for cold chain equipment, vaccine supplies, program implementation and capacity building; and the Capacity Building Service Centre (CBSC), funded by AusAID, has been used to engage PNG specialists to manage the national Expanded Programme on Immunisation (EPI). However, at present, without significant political and financial commitment from the Government of PNG, the sustainability of these logistical arrangements is dependent on development partners (DPs) continuing this support. Planned transition of many of these operational costs to the government has been in limbo since 2004.

Drugs and medical supplies

No health system can deliver health outcomes without a functioning medical supply system which ensures that, when a patient attends a health facility, they get the right treatment, in the right quantity and of the right quality. In the 1980s and during the period of pre-decentralization, the medical supplies system in PNG worked well. The system was highly centralized, well managed, well funded and supported by highly motivated and experienced staff with adequate financial resources to procure and distribute medical supplies. Over the past 20 years, the medical supply system has deteriorated and is now functioning poorly in all areas. The current procurement and distribution arrangements are completely inadequate to ensure that medical supplies are available in the right place and at the right quantity and quality to support strategic health initiatives. A range of factors have contributed to this.

Inadequate appropriations

The appropriation for drugs and medical supplies has been chronically inadequate. The Health Services Support Program estimated a deficit of K70 million in 1998 for drugs and medical supplies.

1990 and 1994 devaluations of the kina and floating of the kina

In 1990 there was a 10% devaluation of the kina; in 1994 there was a further devaluation of 12% and floating of the kina, resulting in further declines in its value on the international market. This made a significant dent in the purchasing power of the PNG kina appropriations. All drugs come from outside PNG.

Population growth

The annual population increase is at the rate of 2.8% per year. This means that there has been an increased demand on the services of all health facilities and an increase in the use of medicines, and thus an increased requirement for medicines and medical supplies to serve a larger population.

Increasing complexity and cost of treatments

There have been a number of new or increased costs added to PNG's medical supply requirements that were not factored into the earlier projections. These include such items as more expensive malaria treatments, Hib (*Haemophilus influenzae* type b) vaccine, new combined tuberculosis (TB) treatments, long-life impregnated bednets, condoms and anti-retrovirals for HIV (human immunodeficiency virus) treatment.

Deterioration in provincial transport systems

The responsibility for distribution of medical supplies from the provincial capital

rests with the provincial health office. A combination of inadequate recurrent financing at provincial levels, poor functioning of the Health Sector Improvement Program (HSIP) Trust Account in many provinces and the closure of shipping and air services has meant that many provinces are unable to get drugs and medical supplies to health centres and aid posts.

Complete breakdown in the requisition system

While there was a sound requisition system that worked in PNG in the past, it no longer exists. There is an absence of a culture of monitoring and management, and a general apathy towards managing processes.

Lack of distributed budgets for drugs and medical supplies

The drugs and medical supplies budget rests with the NDoH, and not with the service provider level which actually consumes the resources. The service providers, through the decisions made on a day-to-day basis in direct clinical care, effectively undertake many of the rationing decisions; however, given the lack of distributed budgets, they do so in the absence of any framework of priorities.

Health facilities do not maintain basic store-keeping practices

There is little stock control and, as a result, facilities are short of some items and carry excesses of others. Expiry of drugs prior to use occurs on a large scale, and the Kit Review findings found K30 million in expired stock (4).

Alternative procurement and distribution systems have proliferated

Because of the inability of the medical supply system to deliver, a range of alternative procurement and distribution systems have proliferated.

- For a number of years, under the Health Service Development Program (HSDP), the Asian Development Bank (ADB) supported and funded a kit system for distribution to aid posts. A suitable continuation of this system was not put in place and aid posts now do not get regular supplies of drugs.
- Between 2000 and 2006, at the request of the NDoH, HSSP managed the procurement and distribution of a kit system for all health centres in the country, representing approximately 40% of the medical supply requirement nationally (in fact, it often represented the sum total of medical supplies received in some areas). It was designed as an emergency measure until the planned medical supply reforms were in place.
- No satisfactory replacement for this system has been put in place.
- TB drugs are supplied by the Global Drug Facility, via WHO, direct to Provincial Disease Control Coordinators.
- Bednets, condoms and rapid diagnostic kits are procured and distributed by a range of different donor mechanisms.
- Anti-retrovirals (ARVs) are currently funded by the Global Fund, procured through WHO and managed by the Disease Control Branch.

Ensuring adequate and timely quality and quantity of supplies into the country is a critical issue and will require coordination between various partners in the health sector engaged in supporting vaccine delivery, family planning, reproductive health commodities and DP-funded projects, including the Global Fund and government agencies. Without critical and urgent action, no other interventions will have significant impact

Communications

Radio communication has been a success story of the past decade. With AusAID funding, the HF radio network now covers over 80% of health facilities. This has impacted upon the lives of many remote communities (8).

Information, education and communication and health promotion

Huge communication challenges

The fact that Papua New Guinea has an

impressive cultural diversity sets a challenge to strategies of communication and community participation in support of health promotion. Because of the high rates of illiteracy and the geographical dispersion, print media has little impact over the majority of the population and electronic mass media (radio and television) is limited to the cities. The main vehicle for health information is and has been interpersonal communication, mainly through health workers.

Policy set but limited implementation capacity or resources

In PNG, health promotion is embodied in the concept of 'Healthy Islands' as outlined in WHO's New Horizons in Health Approach (9) and endorsed by the Minister for Health in 1995. The 1998 National Executive Council decision No 10/98 directed the NDoH to develop a plan of action to implement the Healthy Islands Concept. Several problems constrain progress. Many of these problems stem from a lack of resources and skills in the area of health promotion. The Health Promotion Branch (HPB) consists of print and audio-visual design and production (including traditional and popular media) with research and evaluation, training and community action units. However, several factors have hampered HPB productivity and effectiveness; these include: HPB was in desperate need of a vision, and of management and planning support; there was no global view or direction for where health promotion in PNG should be heading; staff motivation was low; other branches held a negative perception of HPB because it was demand driven rather than proactive, and requests for support were often ignored; there were low staffing levels, particularly in the Healthy Islands Section, and there was no career path; many staff were not trained in health promotion and there was no budget to support further training; the skill set across the existing staff made it difficult for HPB to adopt a comprehensive approach to health promotion; and there was a perception that HPB was more a print and media resource centre rather than a health promotion planning and advisory agency.

Limited set of approaches

Approaches taken to health promotion were predominantly focused on printed information, education and communication (IEC) materials. The low literacy rate limited the coverage and there was no reliable mechanism for distribution, which with IEC resources often failed to reach or go beyond provincial centres. Monitoring and evaluation of health promotion activities was non-existent. Many community-based interventions had been implemented without regard for measurable impact or focus on health outcomes. So there was limited evidence on what was effective that could guide best-practice health promotion in PNG.

Evidence base of health promotion development

PNG had a history of health education materials production, but most of the materials produced were not based on formative research and there was no monitoring system to ensure proper utilization of materials. The vertical top-down and centralized modus operandi of the national HPB, plus the pressures received from donors and government officials, had resulted in materials that have little relation to the health priorities of the NDoH. A clear example of donor-driven activity is the large amount of material produced on AIDS/STDs (acquired immune deficiency syndrome/ sexually transmitted diseases) prevention, in spite of the fact that STDs rank 20th as causes of morbidity and mortality in PNG. The fact that much of the production is in print (posters, booklets and comics) is also contradictory in oral-based cultures and with such high illiteracy rates. "It is clear that models of materials production have been imported regardless of a previous analysis of local culture and indigenous channels and modes of communication" (10).

As discussed by Whittaker et al. (11), a series of formative research activities were undertaken in 2001-2002 to fill the evidence gap and focus the health promotion activities on the priority health problems of PNG. In addition a series of activities in broadening approaches, developing the capacity in-country for monitoring and evaluation of health promotion, a broader and more sustained engagement with communities and some policy development were initiated. Unfortunately, many of these activities, although they had good initial gains, have been eroded by the continued deterioration in financial resourcing, staffing and competencies, and the lack of engagement of the provincial health authorities in health promotion; as DP funding declined, so did

the quality, quantity and coverage of these health promotion activities. The global health initiatives and resourcing for HIV have infused at least financial resources. The limited capacity in PNG for a broad range of health promotion approaches continues to limit the potential of prevention and community engagement.

Population coverage highlight

All estimates suggest that population coverage has declined. Key indicators of this include facility coverage, immunization and maternal health care.

Facility coverage has declined

In 1998 there were estimated to be 189 health centres, 319 subcentres and 1506 aid posts. This compares with an estimated 2304 aid posts in 1990 – a loss of almost 800 aid posts in eight years. Further closures were reported as a result of the Government Reform Program in the late 1990s, which required provinces to make substantial staffing cuts.

Immunization coverage has not improved

The 2006 Demographic and Health Survey (DHS) suggests that only 54.6% of children aged 12-23 months were fully vaccinated, ie, had received BCG (bacillus Calmette-Guérin for tuberculosis), measles vaccine, and three doses each of DTP (diphtheria and tetanus toxoids and pertussis) vaccine and oral polio vaccines. Measles and DTP vaccine coverage has not improved since 2003. Coverage of 90-95% is needed to maintain herd immunity or prevent the re-emergence of epidemic transmission. Limited accessibility to and from remote communities is a major impediment to achieving higher vaccination coverage in PNG.

Maternal health care and outcomes have worsened

The preliminary analysis of the 2006 DHS indicates a maternal mortality rate of 733 per 100000, which appears to have increased from 370 per 100000 in the 1996 DHS – although the number needs careful interpretation. The challenges of distance, isolation, declining numbers of formal and informal health workers with obstetric training, the reported decline in supervised delivery to less than 40%, and infrequent transportation to health facilities in an emergency account for this.

Can the system deliver?

It is quite clear that health services in PNG are in crisis. Population pressure, resource constraints, human resources and drugs shortages, and weak management systems have resulted in declines in the coverage and quality of health services. The aid post system, which was the backbone of the PNG health service, has collapsed in many areas of the country. The evolving administrative and political structures under the OLPGLLG have made it difficult to clearly target where responsibility lies for various aspects of health care delivery. The needs in the provinces for support in many areas are immense. Replacement or rehabilitation of health infrastructure alone would absorb all funds available and more.

A balanced and targeted implementation program to ensure the basic requirements are in place is needed, in cooperation with service providers at national, provincial, district and community levels, as well as key partners – non-government organizations (NGOs), churches, the private sector and DPs – in a prioritized approach to the restoration and rehabilitation of basic health services. This will require unprecedented levels of cooperation, negotiation, capacity building and patience, over an extended period of time.

Financing the health system – show us the money?

It is clear what needs to be done – but is it affordable? Probably not in the medium term. Despite the enthusiasm about the forthcoming liquefied natural gas (LNG) project, PNG government agencies are expected to face a tight fiscal environment that will lead to reduced budget allocations in the near term (12).

Health expenditure in context: medium-term expenditure framework

A key initiative to address fragmentation of the financing among national, provincial and district administrations, politicians and DPs has been the Medium Term Expenditure Framework (MTEF), which developed a framework to allocate resources according

to key health needs in PNG (13,14). The MTEF has provided prospective estimates based on current and future budget allocations and aims to reduce the imbalance between the necessary monetary outlay required to achieve set interventions and the actual funding available for these interventions.

PNG's most important health sector priorities guide the MTEF and the allocation of resources within the annual budget to appropriately deal with the health sector management, resources, employment and capacity; to develop budget ceilings and priorities that support realistic and focused annual activity plans; and to provide explicit monitoring and evaluation processes to ensure health priorities are appropriately being funded and achieved (13,14). The MTEF also provided estimates of the total resources available to the health sector, the health care cost for selected health care interventions, the cost of delivering priority interventions, the allocation of budgets according to the MTEF priorities and the proposed resource reallocations, and set budgeting ceilings for different health branches (9).

A major achievement of the MTEF was to translate resource allocation decisions into 2004 official budget programs and provide budget ceilings for branches, when for the first time NDoH branches were given budget ceilings to produce an affordable annual activity plan (AAP) and plan ahead the activities that would be cut down due to funding shortage. This led to resources being shifted towards top health priorities and saw funding increase from K29 million to K73 million from 2002 to 2006 (14).

A key policy question raised by the MTEF is whether the range of services is sustainable. The direct service provision costs in all key priority areas are expected to rise rapidly due to changes in population, changes in price in accordance with the expected, relatively modest inflation rates, changes in the coverage rates for the interventions, and changes in the intervention profile during the period – eg, the introduction of the Hib vaccine. This also raises the question of whether any new services are affordable.

Merely keeping up with the pressure of population growth and some relatively modest coverage increases will subject PNG to substantial resource pressure, and consequently careful thought needs to be given to the extent that new services can be resourced. Containing population increase would produce savings; for example, maintaining the number of infants requiring infant immunization at the 2006 level would itself fund increasing the level of contraceptive coverage by approximately 25% by 2008 (12).

Despite the considerable early potential of the MTEF, it seems to have evolved into a sophisticated costing model (13) and NDoH personnel still lack the necessary budgeting costing and financial skills required to properly support the MTEF. Not only does this affect the quality of the MTEF processes, but it also undermines the NDoH's negotiation power with DPs and central agencies, as NDoH personnel are unable to suitably analyse the implications that proposals will have for government expenditure and health budgets (9). The MTEF does not now appear to be linked to the National Budget timetable or processes, nor does it appear to have an impact on resource allocation decisions. This is a matter to be addressed, if the limited pool of resources is to be used effectively.

A significant change over the past two decades has been the growing dependence on DPs and a corresponding decrease in the proportion of government health expenditure as a proportion of public sector expenditure on health (12-14). Between 1997 and 2004, while overall funding increased, DP expenditure increased to account for one-third of total health expenditure (12). DPs contribute approximately 53% of the non-labour budget for the NDoH. With increased reliance on DPs, aid predictability poses a major sector risk. For example, the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) has rated the HIV and malaria programs in PNG as "inadequate but with potential demonstrated". GFATM represents a major part of the funding for national programs for TB, HIV and malaria. Withdrawal of GFATM support would be a disaster. DP support tends to be channelled in three-to-five-year time horizons, and future support is uncertain. This ambiguity threatens to destabilize the momentum achieved in programs thus far. A much longer time horizon is needed.

Partnerships for service delivery

The PNG National Health Plan 2001-2010 has an entire chapter devoted to Partnerships in Health and recognizes that "sustainable health outcomes … cannot be achieved by the health sector alone using traditional approaches" (15).

The picture painted above suggests that, in many places in PNG, the basic requirements to deliver health outcomes are simply not there. Health improvement will only be achieved through partnerships. The NDoH has only limited direct responsibility for service provision, and in addition to ensuring the timely and reliable delivery of drugs, equipment and medical supplies, and workforce planning and production, the NDoH needs to have a strong role in advocacy and partner coordination.

The key partners for implementation are central agencies, provincial governments, district administrators, local level governments, hospital boards, churches and faith-based organizations, NGOs and the private sector. An absolutely vital group of partners for financing, and policy and technical support are the DPs. The mere term 'development partners' indicates a strong recognition that there is a partnership in place. The framework established for the SWAp (discussed in the section below) provides a model for partnerships with other bodies. In reality, whether the partner is a donor, a provincial government, a church organization, a hospital or the private sector, the same partnership framework and principles will be required. These include:

1. *Shared goals* as outlined in the National Health Plan
2. *Capacity to contribute* – whether a funding partner, a technical partner or an implementation partner, all partners need to bring something to the partnership table
3. *Develop agreements* such as memoranda of understanding that define the formality of the relationship
4. *Documented expectations and commitments* of all partners to the tasks agreed upon
5. *Clarity about resource requirements* to develop, negotiate, implement, evaluate and sustain the planned action
6. *Development of an agreed way of working*, dealing with conflict and disagreement, and supplying feedback about program results and outcomes
7. *Defined communication channels and meetings*
8. *Ensure measurable outcomes* are meaningful to all partners involved
9. *Develop an evaluation framework* to measure progress towards outcomes.

Partnerships with central agencies

Central agency (CA) partnership and cooperation is vital to the implementation of health services, especially through the HSIP. The CAs which have had the greatest negative impact on the implementation of the HSIP to date include: Central Supply and Tenders Board, Internal Revenue Commission, Department of Personnel Management (DPM) (Health is one of those agencies to which DPM has devolved human resources management (HRM) responsibilities, so this will be less of an issue in future) and the Department of Finance. The Provincial and Local Level Services Monitoring Authority (PLLSMA) has grown in strength following its reinvigoration a number of years ago. The PLLSMA and its network of province-level committees and the Provincial Coordinating and Monitoring Committees are opening much needed channels between national and sub-national levels of government, helping to synchronize reform efforts. A close partnership between the NDoH and PLLSMA will be essential. The Prime Minister's National Planning Departments have a key role to play in addressing health sector problems.

Partnerships with provinces

Provincial governments are responsible for the implementation and management of all non-hospital staff, services and facilities in each province. They also are responsible for funding training and maintaining facilities and equipment. Provinces vary widely in population, geography, culture, infrastructure and access. A differentiated approach will be needed for each province: mapping existing resources, partners (churches,

NGOs, private sector etc), services and service gaps, and developing province-specific strategies for improving services and coverage. A mechanism for coordinating all sources of support at a provincial level will also be needed to monitor progress and ensure complementarity of effort.

Partnerships with churches and faith-based organizations

Churches are an indispensible partner in rural health care delivery. There are approximately 20 different denominations providing health services in the country. Churches are primarily involved in the provision of service to the rural areas and the training of health workers. Government is the main source of finance for both, meeting over 80% of the costs of church health services. Churches Medical Council (CMC) operating grants were re-centralized in 2002 and cash funds are now released directly to the Church Health Secretary for each denomination in the provinces. Churches provide the reach for health services into some of the most difficult-to-reach areas of the country. Some churches have the willingness to extend their services, if funding were made available. However, churches have not always had access to DP funding and programs. As part of the provincial mapping process proposed above, the potential to extend the reach of churches should be examined.

Partnerships with public hospitals

While the vast majority of Papua New Guineans will never attend a provincial or regional hospital, they provide essential secondary and tertiary care, training for health workers, clinical research and clinical leadership, and have the potential to support the rest of the health system. Hospitals have, however, been largely neglected by DPs since the conclusion of the Hospital Management Operations Improvement Project, funded by AusAID in 2001. They struggle to provide adequate infrastructure, staffing and equipment. The implementation of the Provincial Health Authorities Act (PHAA) will address some of the coordination issues with rural health services, but will not address the problems with infrastructure, staffing and equipment, and the overcrowding currently faced by many hospitals.

Partnerships with the private sector

In PNG, which is characterized by uneven government health services, there has long been a tendency to utilize alternative health arrangements, especially by large employers. A 1994 survey of private companies in PNG found that 66% of companies surveyed provided some sort of onsite health care, and that 21% of those provided care for families of employees, and 16% for surrounding communities (16). The development of privately provided health services in PNG has been largely unregulated and unsupported by the government, with the exception of health services provided by churches (17).

While there has been limited formal study into health provision by the resources sector in PNG, larger companies – including Lihir Gold, Porgera Joint Venture, Oil Search, Kainantu Gold and Ok Tedi Mining Limited – all provide significant health services for their employees, with some companies extending their services to their mine's impact area and local communities.

Non-mining partnerships currently operating in PNG include the Global Fund to Fight AIDS, Tuberculosis and Malaria, the Clinton Foundation and the Asian Development Bank's HIV/AIDS Prevention and Control in Rural Development Enclaves Project. Ramu Sugar, a major sugar production company, and other plantations are also involved in providing various health services to their employees and families. The recently established PNG Business Coalition Against HIV/AIDS (BAHA) has also been engaging the business community in addressing HIV and AIDS issues through advocacy and the provision of support for the development of HIV and AIDS workplace policies (http://www.baha.com.pg).

The paper in this issue on public-private partnerships highlights some options for mobilizing the private sector further, in a constructive way, in the delivery of health care (18).

Partnerships with development partners

DPs have grown in importance and prominence in the PNG health sector over the past 20 years. Australia is the largest donor, the ADB has a longstanding presence in the sector, while WHO and other UN agencies, UNICEF, UNDP (United Nations

Development Programme) and UNFPA (United Nations Population Fund), have provided technical and limited financial assistance; JICA has been active in the hospital sector and logistics, and New Zealand's International Aid & Development Agency (NZAID) has a modest program of assistance. More recently, the Global Fund and Clinton Foundation have provided significant funding – PNG received GFATM grants for malaria and HIV in 2004 and 2005 respectively of US$40 million, with a GFATM grant for tuberculosis of US$29 million approved in 2007; a further grant proposal has been submitted and is currently approved. A Country Coordinating Mechanism (CCM) was formed to coordinate funding proposals to the GFATM, negotiate the grant, and monitor and report its progress and implementation. The CCM membership is drawn from both the private and public sectors, and operates outside of the SWAp.

PNG's interest in pursuing a SWAp had been on the agenda since 1995 and in 1999 the NDoH formally approached AusAID to move towards a SWAp in the health sector. In a SWAp, "All significant funding for the sector supports a single sector policy and expenditure program, under government leadership, adopting common approaches across the sector, and progressing towards relying on government procedures to disburse and account for all funds." (19).

A key feature of a SWAp is that the government takes leadership, responsibility and accountability for the performance of the sector as a whole, with all projects and programs being consistent with and contributing to agreed sectoral goals. The role of DPs is to support planning and financing of the sector program and the capacity building of government institutions and individuals to deliver their obligations. The program of activities derives from a common policy framework and agreed program of work, which is fully costed and integrated into a medium-term budget framework.

Much attention in the SWAp literature is focused on the capacity of the recipient government to participate effectively in the SWAp process. A review of sector programs in Africa found that the effective use of aid requires greater capacity building within government than has been achieved in Africa (20). The capacity building effort needs to be sustained, long-term and clearly focused on capacity building of recipient government individuals and institutions. This seems to be the case also in PNG. To some extent, the void in strategic planning and decision-making has been exploited (probably unintentionally) by DPs and rather than facilitating an agreed work program, the SWAp has tended to drive the agenda within the health sector.

On the DP side, participation in a SWAp requires new sets of skills and approaches for DPs. The role of DPs under a SWAp incorporates a much greater technical role. To participate effectively, DPs require staff with sufficient sector policy background to be credible partners at the policy table. The successful progression of the HSIP will require a level of continuity of relationships which cannot be achieved where DP staff are highly mobile.

In reality, there have been significant challenges for all partners. The SWAp has reduced the autonomy of all partners – and fundamentally changed the nature of relationships. DPs have needed to relinquish control; and the government has had to open its policy formulation to outside scrutiny and potential intrusion.

The complex interrelationships between donors, governments, bureaucrats, communities, contractors and consultants, and the vagaries of individual and agency behaviour are critical in determining the effectiveness of the SWAp mechanism. A key challenge in PNG has been maintaining coherence with SWAp arrangements. Some DPs do not manage all their programs through SWAp mechanisms, and others participate in the SWAp but still engage in direct dialogue with the NDoH outside of SWAp arrangements.

A key policy paradox is the parallel policy paradigms of SWAp and decentralization. Generally, it is increasingly being recognized that there is a fundamental conflict between a SWAp and decentralization (Enrico Pavignani. Swamped in SWAp? Experience-inspired remarks about sector-wide approaches. Unpublished draft manuscript, 12 Oct 2000). SWAps are intrinsically centrally focused. The integration of a decentralized system of governance with the centralized paradigm of the SWAp is one of the main challenges of the HSIP. In Uganda,

the implementation of a SWAp in the health sector significantly influenced the redefinition of central-local power relationships (A. Jeppsson. SWAp in a decentralised context: some experiences from Uganda. Unpublished consultancy report, Jun 2000). Implicit in this commentary is a view that this is a negative force. Paradoxically in PNG, because decentralization has been seen so strongly as a problem for health service operation, this is seen – at least behind closed NDoH doors – as a benefit. The capacity for the NDoH to use DP resources as additional leverage with provinces to get them to improve their alignment to the National Health Plan is seen as a significant benefit. Notwithstanding this, there remain inherent tensions between decentralization and a centrally managed SWAp. A planned SWAp review in 2009 will consider some of these issues and look to how the SWAp can be reshaped.

Key challenges for the future

A long-term systematic approach to getting the basics in place does work

In an evaluation of a major program of assistance, the PNG HSSP, it was found that the impact of the capital works, the National Health Radio network and increased drug availability was significant on service outcomes and patient satisfaction. The evaluation concluded that this first phase of the long-term development of the health system in PNG had achieved visible improvements that indicated the presence of a stronger foundation for rural service delivery. It noted that increased supervision and support to outreach activities of rural facilities needed to continue to be the main strategies for consolidating the benefits (8).

Don't be confused between means and ends

A SWAp is a means to an end; it is not an end in itself. It is a way of delivering DP assistance to tackle the priority development issues of a given country. If the proceeds of the SWAp are not directed towards priority interventions – which will deliver the greatest health gain – it will not have the desired effect. If the underlying poor capacity of the health system is not addressed, it cannot deliver the desired impact of the SWAp. A SWAp is another way of mobilizing already available resources to target health sector problems in a consolidated way. It does not in any way mitigate the requirement to address any underlying sector problems such as limited capacity, poor accountability and a weak human resource base.

Use capacity that exists

The health system may need more capacity, but it also already has significant levels of capacity. Health sector stakeholders have different strengths and weakness. The Capacity Building Service Centre has successfully used various methods (inter-provincial twinning, meetings, workshops with hospitals and rural services, etc) to share strengths across provinces. Partners have more capacity than is often assumed, but they are operating in an environment where it is not utilized.

Find willing partners

The key partners for implementation are central agencies, provincial governments, district administrators, local level governments, hospital boards, churches and faith-based organizations, NGOs and the private sector. An absolutely vital group of partners for financing, and policy and technical support are the DPs.

Slow and steady wins the race

There is no quick fix. PNG health outcomes will improve with systematic focus on getting the basics in place. There is a distinct tendency for funding (or the prospect of future funding) to drive strategy. For example, commitments to fund anti-retroviral therapy will place severe pressure on NDoH capacity and future recurrent expenditure, and potentially limit resources from being extended as planned in other priority areas. In this way, while a short-term funding prospect may be appealing and desirable, the long-term effects can be debilitating.

Focus on the basics

We emphasize the five basic elements to achieving improved health outcomes from the system, as previously described:

1. Effective interventions for the main causes of morbidity and mortality, where and when required

2. Skilled health workers at the point of

service who are able to provide those interventions (7)

3. Essential logistical elements to enable the health worker to provide the effective interventions

4. Information, education and communication, and other health promotion initiatives and efforts directed at communities – to obtain their cooperation and acceptance of the interventions, and to support and empower their engagement in healthy behaviours

5. Population coverage.

PNG faces a unique set of challenges. Provincial governments are responsible for delivering health services, but there are extreme differences in the cost of doing so, related to the transport constraints in reaching remote populations, while there are also extreme differences in the financial resources available to them. High transport costs of reaching services impede the poor from accessing services. Some of the solutions to these problems lie outside the health sector. Health financing will be constrained, and there are difficult choices to be made in deciding what services can be provided in the medium to long term – and how best to deliver them in diverse environments. The time for talking, policy formulation and analysis is past – PNG needs a sensible, affordable, feasible plan to get basic services to the population. This will require the mobilization of many partners, innovative approaches, and a slow, steady and uncompromising focus on getting the interventions to the people.

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The primacy of politics: charting the governance of the Papua New Guinea health system since Independence

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SUMMARY

To chart the course of health governance in Papua New Guinea (PNG) since Independence, this article identifies two arks of public sector administration in PNG. Each was instigated by the passing of an Organic Law. The reform periods presaged by the Organic Law on Provincial Government 1976 (OLPG) and the Organic Law on Provincial Governments and Local-level Governments 1995 (OLPGLLG) have fundamentally transformed the political and administrative structures governing the country, and in particularly those relating to health. Comparing the organization of the government-operated health system during each of these reform periods not only reveals why PNG's health services have struggled to improve since Independence, but also casts light on the key drivers of fundamental reforms in PNG. Ultimately, the exercise illustrates the 'primacy of politics', and why political concerns invariably trump service delivery concerns.

Towards Independence

During the colonial period, Australia administered Papua New Guinea (PNG) through conveniently delineated administrative districts whose regularly changing borders had little social or traditional relevance (1). The number of districts grew from 13 just after World War 2 to 19 before Independence in 1975 (1). Like other colonial administrations, and inevitably magnified by the remote and expansive terrain, the Australian system of administration in Papua and New Guinea was highly centralized. District Commissioners existed to "ensure directives from the central administration were properly implemented" (2). Staff from each of the government departments were present in the district, but reported directly to their parent departments (2). Provincial health officers were nominally in charge of health services in the district, but any significant financial, staffing, planning or management matters were decided centrally.

As the prospect of self-rule began to materialize in the late 1960s and early 1970s, so too did regional and local tensions. The difficult prospect of uniting PNG's hundreds of disparate communities as one nation, in the face of the likely tendency towards regional separatism, had earlier concerned colonial administrators such as Sir John Kerr (1). These same concerns would weigh heavily on the minds of the framers of PNG's Constitution. The preparations for nationhood – in practical, political and intellectual respects – were dominated by efforts to balance the tensions between the centre and the periphery. These tensions, in their evolving guises, have formed a permanent backdrop to PNG's political and administrative history. The arguments, concerns and controversies present when the form of the nascent independent PNG was conceived, history has since shown, constituted the first instalment of a debate which recurs at each of the pivotal moments in the history of PNG.

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The 1977 Organic Law compromise

The early 1970s featured much public debate within PNG on the respective merits of various forms of governance available to the prospective nation. The deliberations of the Constitutional Planning Committee (CPC) – established in 1972 as a committee of the House of Assembly – were the most prominent and important. Australia had prepared its colony for only two levels of government; local and national (1). The concept of introducing provincial government was a 'home-grown' response to the disparate nature of the country, and a reaction to the highly centralized nature of Australian rule (1,3,4).

The second interim report of the CPC, released in 1973, considered implementation of district-level (that is, provincial) government as "an important step towards accommodating strong political pressures for the granting of significant autonomy to particular areas of the country which have been building up over the last five years" (5). A final report was delivered to the House of Assembly by the Committee in 1974, and strongly recommended establishment of provincial government in order to bring government closer to the people. "Decentralization of government services", contended the CPC, "will make them more accessible to the people they should serve. Decentralization of decision-making will make government more responsive to local wishes and needs."(6).

During the course of the CPC's deliberations, self-government had been granted on 1 December 1973, with Michael Somare taking up the post of Chief Minister. As momentum towards Independence grew, fuelled by the eager Whitlam government in Australia, who proposed 1974 as the year for Independence, Somare came under increasing pressure from secessionist movements (1). The Papua Besena movement, led by Josephine Abaijah, sought self-government for Papua, primarily because of concerns of domination by the populous highlands region following Independence (1,3). The long-simmering breakaway movement in Bougainville, driven by resentment towards the exploitation of its huge copper resources, had already been placated with the establishment of an interim provincial government in late 1973 (1,3). The Mataungan Association of East New Britain's Tolai people, and the Kabisawali Association in the Trobriand Islands also agitated for autonomy (3).

Questions about the timing of Independence also preoccupied the House of Assembly during this period. There was still no consensus on Provincial Government. In late May, the interim government of Bougainville announced its intention to secede (1). This provided Somare an opening. Dorney (1) quotes Somare as admitting that "the threat of Bougainville secession gave me the ideal opportunity to make a quick move". On 18 June 1975, Somare successfully "rescinded the earlier motion stipulating that the Constitution had to be in place before any date was set for Independence", and nominated the eventual date – 16 September (1). Soon after, when further talks with the Bougainville secessionists broke down again in July, "Somare successfully moved that provincial government be cut from the Constitution" (1,7).

Therefore, as originally adopted upon Independence in 1975, there was no provision for provincial government in PNG's Constitution (4). However, negotiations in the aftermath of the Declaration of Independence by the Republic of North Solomons (Bougainville) saw the national government agree to amend the constitution to guarantee a system of decentralized government in return for Bougainville ending its pursuit of statehood. This was to be achieved by passing an organic law to establish provincial government (4). The Organic Law on Provincial Government 1976 (OLPG) outlined how legislative responsibilities would be shared between provinces, the boundaries of which had been freshly delineated in the Organic Law on Provincial Boundaries 1976. Thus provincial government was born out of political compromise. Implementing a governance structure best able to efficiently deliver services was of secondary concern to the political imperative of national unity.

The OLPG in theory

A corollary of the politically driven decision to institute provincial government was the need to engineer a legislative framework that took into account the vastly different levels of development between provinces. The national government was faced with treading the fine line between providing enough

autonomy to satisfy the more developed provinces, in particular Bougainville, while not crushing the less developed provinces with a burden their more limited administrative and institutional capacity could not withstand.

A solution was derived from recommendations of the CPC (6). The OLPG delineated responsibilities of each level of government into three categories: national functions, where the national departments retained control; transferred functions, which became the responsibility of the new provincial governments; and a third category of 'national delegated functions', which were to be performed by the province but ultimately remained the responsibility of the national department (8,9). The third category of functions was designed to be handed over to the provinces once they demonstrated adequate capacity to take them on. Law-making powers were granted according to a similar three-fold division: "fields determined to be primarily provincial, fields where the legislative power is exercised concurrently with the national Parliament, and any other areas without national legislation, with certain limitations" (4). Health, along with all of the other major areas of activity, was deemed a concurrent subject (4). There was no further delineation in the law regarding which aspects of health should be controlled by each respective level of government (10).

Funding flows from the national government to the province reflected the three-fold delineation of responsibilities. Funding for transferred functions was provided by the Minimum Unconditional Grant (MUG) according to a formula contained in the OLPG (10). Effectively, the MUG was to reflect the cost of providing the respective transferred functions. The MUG was the major source of provincial government revenue, and its unconditional nature meant it could be allocated "according to the wishes of the provincial government receiving it" (10). Salaries for public servants, however, continued to be paid directly to the public service from the national level. In addition to the MUG, the OLPG made provision for three other types of grant to be distributed from the national government to the provinces. Additional unconditional grants were determined by the National Fiscal Commission, and intended to allow new activities to be undertaken – such as expansion of services – and reduce inequalities between provinces (4). A derivation grant recompensed the provinces for 1.25% of the exports originating in a province, less any royalties, while conditional grants were tied grants also used by the national government for equalization among provinces (4).

The public service was intended to be a national public service, to be shared between levels of government – a 'single unified public service' – to use the catch-cry of the time (4,10). To facilitate this, an administrative shell was established in each province – a 'Department of the Province', headed by a Secretary of the Province. In effect, these departments were much like the national departments, but instead were active in numerous functional areas, and were politically and legally responsible to the provincial government, not a national minister (4). Each provincial department had staff assigned to numerous functions, each arranged as a division, including one for health. Those staff carrying out provincial functions would be under the control of the provincial government, and all staff carrying out "any health activity [that] became a 'transferred activity' …" would come under provincial control (10).

The OLPG and health

The transfer of power to the provinces for health, along with the transfer of public servants from their national departments to the new provincial divisions, formally occurred on 1 July 1978 – but was a drawn-out and poorly defined process, both legally and administratively (4). The National Health Plan 1986-1990 (11) reflected that "the move from strong, centralized control to full decentralization to the provinces was a major and sometimes difficult process which took six years (from 1977 to 1982) to achieve". The National Department of Health (NDoH) was particularly resistant to forfeiting its control of health service delivery and, due to the disorganization and lack of capacity at provincial level, was able to retain significant control for a considerable time (2).

However, despite the NDoH's reticence, by the mid-1980s, provincial Divisions of Health had taken on a relatively standardized organizational and management structure. The Division of Health was headed by an Assistant Secretary for Health, who in turn was responsible to the Secretary of the Province for the operation of health services

in the Province (12). The Secretary of the Province was responsible to the Provincial Minister for Health, who reported to the Provincial Executive Council.

The Division of Health was organized into sections, each headed by a section head, "responsible for the management of the various health programme areas, including the hospital, maternal and child health services, disease control, nutrition, malaria control, environmental health and dental health" (13). The Provincial Hospital, a delegated function under the Organic Law, was run by a Medical Superintendent, while those sections dealing with rural health were under the control of the Provincial Health Extension Officer (PHEO). Assistant Secretary for Health positions were filled more by nationals – rather than expatriates – as time progressed, and they became more likely to be health extension officers, rather than medical officers (2).

The Organic Law on Provincial Government in practice

Regan (10) helpfully explains that, "rather than providing a definitive division of responsibilities", the Organic Law on Provincial Government 1976 is "better understood as establishing flexible processes for continuing movement of powers and resources between the levels of government". However, this intentional lack of definition, an inbuilt flexibility necessitated by politics, ultimately proved detrimental to service delivery. As Regan (10) comments, the "flexibility aimed at in the legal arrangements ... created a high degree of administrative and legal complexity". Financial flows, staffing arrangements and functional responsibility were confused.

These issues in themselves would be restricting enough, without the additional presence of two other key inhibitors. Firstly, provincial bureaucrats and politicians did not move into an existing bureaucratic system. Dorney (1) simply concludes that "the country's public service was not ready for the upheaval". Secondly, another political imperative – the need for speedy implementation – ratcheted up the pressure and foreclosed the option of a more gradual or staged approach to implementing the reforms (10). These challenges were inevitably reflected in poorer health system performance.

While some provincial departments of health performed relatively well, on the whole "few of the essential organizational elements were present" (2). Quite simply, "the provincial divisions of health were poorly prepared to assume the increased levels of responsibility which the decentralization process pressed upon them" (2). By 1987, "only 37% of health centres and 21% of subcentres had performed even a single supervisory visit to each of the facilities under their supervision" (2). And rather than correcting themselves over time, the blurring of responsibilities and fundamental conflicts underpinning health administration gradually worsened. Writing in the early 1990s, Lausie and Thomason (2) observed that most provincial health divisions were "operating at a level of dealing with daily crisis situations and of struggling to keep programs functioning at all".

A new Organic Law

By the early 1990s, a coalescence of factors created the environment for substantial reform to be embarked upon. At the national level, the bureaucracy was showing a noticeable dip in performance, as the carry-over from the professional culture instilled prior to Independence began to dissipate (14). Lausie and Thomason (2) also point out that the first round of decentralization resulted in the "dispersion of already scarce management skills". The curtailing of the Public Service Commission upon the introduction of the Public Service (Management) Act 1986 facilitated politicization of the public service. Accompanying the decay at the national level was a similar atrophy in the provinces, underlined by what Dorney (1) describes as the horrible state of provincial finances. He recalls that "by early 1990s, no fewer than ten provincial governments were under suspension". The ill-definition of roles and responsibilities between levels of government had not been overcome. Together, these factors contributed to a discernable deterioration in the level of service delivery, particularly in health.

In 1993, Prime Minister Paias Wingti appointed a bipartisan committee, under the chairmanship of New Ireland politician Ben Micah, to consider the issue of provincial governments (1). According to Kavanamur and colleagues (14), the reforms were "home-grown and wholly driven by the

government of the day". However, as in the early years of nationhood, competing pressures from the periphery – and the desires and needs of national politicians to control these pressures – compromised good policy-making. Although ostensibly undertaken to address the deterioration in service delivery, many sensed that national level politicians were conveniently using the crisis in service delivery to enable them to push through far-reaching, self-serving reforms (15). Sean Dorney (1) is amongst the more forthright of numerous commentators who view the reforms as simply a ploy by national politicians to redress power balances between themselves and their provincial counterparts. "Early in his second stint as Prime Minister," contends Dorney (1), "Paias Wingti decided to get rid of the troublesome provincial politicians."

As in the first round of decentralization, the radical changes in government were predicated on the principle that decision-makers should be as close to their constituents as possible. This was ostensibly the justification for the first major political reform occasioned by the Organic Law on Provincial Governments and Local-level Governments 1995 (the New Organic Law or OLPGLLG), which created a whole new elected level of government – local-level governments. But the other key political reform – the issue that provoked secession threats and did most to intensify suspicions of national politicians' real motives – was the decision to remove elected provincial government, which was ultimately achieved by the passing of a constitutional amendment. During negotiations towards the new organic law, "leaders in four of the island provinces – Manus, New Ireland and East and West New Britain – threatened to secede", recalls Dorney (1). Under the old organic law, Standish (16) explains, "The provincial assemblies and their executives undercut the status and local roles of MPs."

The OLPGLLG legislated that provincial governments would now comprise the national parliamentarians from the respective province, along with the elected heads of the local-level governments, and a number of additional appointed members. This was despite the strong warning of the CPC (6), who had years earlier determined that "it would be wrong to allow a person to be a full member of a Provincial Assembly and of the National Parliament at the same time". Further strengthening the hand of the national politicians was the creation of another level of administration that corresponded to the district, analogous to the electorates of open members. These 89 District Administrations, however, were bureaucracies that were not aligned to any level of elected government. The OLPGLLG also designated the open member as the chair of the newly formed Joint District Planning and Budget Priorities Committee (JDPBPC), a quasi-political structure granted significant control over the allocation of resources. Similar structures were instigated at the provincial level – ie, Joint Provincial Planning and Budget Priorities Committees (JPPBPCs).

The OLPGLLG and health

Sensing the potential for confusion created by the OLPGLLG, the health sector was proactive in its response. Section 42 of the OLPGLLG had declared 'rural health' a provincial responsibility, but exactly what this encompassed was not clear. Conscious of the problems caused by lack of definition in the first round of decentralization, the NDoH (17) pursued the development of "enabling legislation to define 'rural health' and the different powers, functions and responsibilities of the three levels of government and their respective administrations". The National Health Administration Act 1997 was the NDoH's ambitious effort to respond to the OLPGLLG. It sought to balance the new reality of provincial control for health service delivery, while framing the policy setting and technical supervisory role of the national line department (18). To mitigate against the disruption to horizontal coordination as a result of the OLPGLLG, boards and committees were set up at the national, provincial and district level – the National Health Board, Provincial Health Boards and District Health Management Committees respectively.

The OLPGLLG "resulted in a disruption of the vertical integration of the health system, with each level in the hierarchy answerable to the corresponding administrative level, outside of the public health systems" (19). The OLPGLLG provided that the Provincial Administrator was Chief Executive Officer (CEO) of the provincial government, and the administrative head of all staff in the province (OLPGLLG, Section 75). The key health official in each province, the Provincial Health

Adviser, was mandated to assist the Provincial Administrator in the implementation of health policy and in the provision of technical support. Yet although the Provincial Health Adviser was de facto held responsible for the delivery of health services in each province, they did so without direct control over resources. Instead, the direct power to manage staff and finances rested largely with the Provincial Administrator. Thus, in almost all cases, health staff in the province reported to non-health officials. The same pattern of management was repeated at the district level.

The Public Hospitals Act 1994 had earlier established Hospital Boards, which appointed CEOs to run each of the provincial hospitals and reported directly to the Minister. This effectively ended provincial responsibility for curative health services. The creation of this new management structure had the effect of greatly diminishing the cooperation between hospitals and the provincial health administration. Previously, this cooperation had been a feature of the PNG health system. Whereas Provincial Health Officers enjoyed direct control over both rural health services and provincial hospitals under the OLPG, passage of the Public Hospitals Act 1994 and the OLPGLLG left the Provincial Health Adviser responsible only for rural health services, and even then, as has been made clear, with far reduced power.

Further diluting the Provincial Health Advisers' capacity for effectiveness was the absence of the Provincial Health Minister. The executive arm of provincial government under the OLPGLLG was the Provincial Executive Committee, and comprised members of standing committees along with the Governor and Deputy Governor (OLPGLLG, Section 23). No longer were Provincial Health Advisers able to lobby the Provincial Health Minister. Gone was a previously invaluable means of promoting the importance of health, and the related opportunities for elevating key issues to the political level. Similarly, funding decisions were now made by the JDPBPCs and the JPPBPC, chaired by the District Administrators and Provincial Administrator respectively. The routine result was the total absence of a voice advocating health needs when financial priorities were planned and articulated.

The OLPGLLG in practice

It took surprisingly little time for a consensus to be reached that the OLPGLLG had been a disaster for service delivery. A mere three years after the changes occasioned by the reforms were introduced, the Public Service Reform Management Unit (PSRMU) – a unit of the Prime Minister's Department – released a sobering report. The Functional and Expenditure Review Report on Rural Health Services, produced as a requirement of the World Bank's Structural Adjustment Program by the PSRMU, was damning of the OLPGLLG's effect on service delivery, concluding that "the Organic Law has indeed been a major factor in the deterioration in service delivery" (20). The review went on to argue, "The [new] Organic Law has destroyed the vertical integration that is essential for the successful operation of any health system. For a health service to operate effectively in an area, there needs to be a single point of budget and management accountability. The Organic Law fragments responsibility for both budgets and management." (20).

In the most troubling echo of the OLPG, the OLPGLLG was "drafted fairly hastily and in relative isolation from the public servants who would have to implement it" (18). This hastiness was reflected in the need for numerous amending Acts in the next three years. The changes wrought by the OLPGLLG were far-reaching and necessitated a flurry of supporting legislation. The Public Services (Management) Act 1995 and Public Finances (Management) Act 1995 were key pillars of the sweeping raft of changes to public sector administration. In a repeat of the experience of the first round of decentralization, within a short time governments at all levels – on the whole without the requisite preparations and capacity – were thrust into operating within an entirely new governance structure. The public service couldn't cope.

The understanding that the OLPGLLG has drastically impeded improvements in service delivery is now essentially accepted as fact. It is explicitly stated in numerous government documents, including the national government's Medium Term Development Strategy 2005-2010, which – after noting that service delivery has deteriorated since the passage of the OLPGLLG – laments that "on the whole, service delivery systems are

dysfunctional and there remains widespread confusion over functional (who does what) and financial (who pays for what) responsibilities across the three levels of government" (21). The health sector did, however, make its own attempts to redress the broken vertical integration caused by the OLPGLLG.

In fact, citing the urgency of re-establishing vertical control in the health sector for service delivery, the PSRMU suggested three options for streamlining the operation of the health sector. While the second of these options was pursued, these reforms did not lead to lasting and fundamental improvement. A consultancy report from La Trobe University commissioned by the NDoH in 2004 to revisit the streamlining issue in fact argued that the best course of action would be to "address the systemic problems caused by the Organic Law and allow a new, considered and coherent solution" (22). However, citing the difficulty of this course of action, it ultimately recommended pursuing this option in the long run, while acting to develop streamlined administrative arrangements in the provinces in the medium term. This report sparked a series of efforts which ultimately culminated in the Provincial Health Authorities Act 2007 (PHAA). Expressed in the simplest terms, the PHAA is an attempt to return health sector organizations to a state similar to that which existed under the OLPG, where the Provincial Health Adviser controlled curative health and rural health services, and could direct staff and finances. The PHAA facilitates this by allowing for the creation of a Provincial Health Authority in the province – upon agreement of the Minister and the Governor – whose head is responsible for delivery of all health services in the province.

The primacy of politics

Tracing the implementation of the two key organic laws in PNG since Independence reveals that, in its simplest terms, the history of health sector governance is the story of the health sector responding as best it can to the prevailing legislative and administrative environments. The difficulties in health service delivery are inextricably linked to the broader political and governance context. Efforts to improve service delivery, while ostensibly the driving force of reform efforts, have ultimately taken a back seat to the primacy of politics. PNG's experience supports Dillinger's (23) contention that decentralization is not the result of some "carefully designed sequence of reforms aimed at improving the efficiency of public service delivery". Instead, he argues, such reforms are generally "a reluctant and disorderly series of concessions by central governments trying to maintain political stability".

This is not to say that serious attempts to grapple with the bottlenecks to service delivery have not been made. It simply reflects the political reality at the national level, where the need to preserve national unity – when it comes to the crunch – inevitably trumps implementing the best service delivery model. The problem is that these two objectives are often in conflict with each other. The challenge for PNG's current and future politicians is to continue to walk the fine line between providing enough autonomy to local decision-makers, while also ensuring the political and administrative structure required to facilitate improved service delivery. The challenge for the PNG health sector is to understand this delicate balance, find and promote solutions to achieve both, and learn from the mistakes of the past.

For a number of reasons, these debates cannot simply be wished away. While it may not seem so on the surface, the fundamental contentions arising from PNG's unique political make-up are as relevant today as they ever were. Balancing the centre and the periphery remains vital, yet complicated. It was clear the simmering regional political undercurrents present at the nation's birth had not been entirely calmed by the first round of decentralization. It remains clear that they continue to exist today, most notably reflected in the overwhelming July 2009 decision by the National Parliament in favour of the proposal to split Southern Highlands Province and Western Highlands Province and create the new provinces of Hela and Jiwaka. In addition, Bougainville, under the terms of the peace treaty it signed with the national government, must vote on its future status in a referendum. Both Bougainville and the National Capital District operate outside of the OLPGLLG, and are apportioned funds from the national government in a different manner to other provinces. New Ireland is another province that has been pushing for greater autonomy.

In some ways, the fact that PNG is a unitary state, and not a federation, complicates implementing fundamental reforms. In a unitary state, the sub-national components are a creation of the state. In a federation, the state is a creation of the sub-national components. While the difference is subtle, it is important. Whereas in a federation the entrenched existence of the constituent states helps mitigate against consideration and implementation of radical reform measures by the centre, in a unitary state this constraint does not exist. In a unitary state, and particularly in one where service delivery problems are so marked, the urge to institute a 'big-bang' reform effort from the centre is stronger, and can be politically fruitful, at least in the short term. This urge is also more powerful now that it is no longer checked by elected provincial politicians.

Therefore, in PNG at the national level, there is an intrinsic bias for radical reform, rather than incremental reforms. The pursuit of a second round of decentralization via the OLPGLLG is the most ready example. In retrospect, the process of instigating and implementing the new organic law was remarkably reminiscent of the earlier introduction of the OLPG. The debate was similar, the political pressures similar, the haphazard implementation was similar, and the results broadly similar. Some of the critical mistakes were repeated. Although there was agreement that not enough skilled bureaucrats were available to staff provincial administrations during the first round of decentralization, this did not prevent creation of a further 89 local-level governments in the second round of decentralization triggered by the OLPGLLG.

Ultimately, pursuing a path of repeated efforts at radical reform means that the health sector – and the other service delivery sectors, for that matter – is forced into reactive cycles. While the National Health Administration Act 1997 was a proactive effort to prepare the health sector for the changes occasioned by the OLPGLLG, health system governance was reorganized in a reactive manner. Health system governance changed because of the higher-level political reforms; the political reforms were not initiated or driven by an identified need to change health system governance.

The tendency to implement 'big-bang' reforms can also tend to obscure the importance of painstaking stepwise reform efforts, and also potentially destroy these improvements in an instant. A relevant recent example of the potential of productive stepwise effort is the work of the National Economic and Fiscal Commission (NEFC) to reform PNG's intergovernmental financing arrangements. Close to a decade of work has recently culminated in the Intergovernmental Relations (Functions and Funding) Act 2009. Amongst other things, the legislation allows for a fairer allocation of national government revenue distribution to provinces, on the basis of the cost of services and the maxim of 'funding follows function' (24). This is an example of working within the current system to improve it. The streamlining reforms in health are another example of a long-considered reform process which stands to yield significant improvements to health service delivery should the process be rolled out carefully and effectively. However, should another far-reaching reform effort (analogous to those instigated by the OLPG and the OLPGLLG) be pursued from the centre, improvements such as these two examples – and others like them – may be for naught.

Conclusion

Facilitating and improving service delivery should rightly be the priority of all levels of government in PNG for a long time to come. But policy-makers, and particularly those in health, have to be mindful that the political and administrative structures best able to improve service delivery may not simultaneously serve the political imperative of maintaining national unity. When these objectives clash, history – along with the unique construction of the PNG polity – shows us that the primacy of politics ensures service delivery concerns are secondary. Rather than railing against this reality, those working to improve health outcomes in PNG must appreciate it and ensure they make progress despite it.

ACKNOWLEDGEMENT

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Human resource development: new assessments and new directions*

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SUMMARY

The National Health Plan (NHP) 2001-2010 required a health workforce situation analysis and strategy to match the NHP's priorities and strategies. This paper is based on the work that was done in 2001 to support the preparation of a Health Human Resource Development Strategy for Papua New Guinea (PNG). The analysis showed that changes in health sector financing, population growth and changing health needs had created many human resource problems and challenges. This paper focuses on the main categories of health worker in PNG: doctors, health extension officers, nurses and community health workers. It presents analyses of workforce numbers and costs, and discusses future health system and human resource strategies based on the 2001 study and subsequent developments.

Introduction

Human resource strategies must be grounded in the reality of a country's health problems and service delivery systems and structures if they are to be appropriate and effective. In Papua New Guinea (PNG), the major health problems have remained largely unchanged in the past 20-25 years. Infectious diseases, malnutrition, trauma and violence, and the complications of pregnancy and childbirth still persist as the main health problems for the majority of the population, which remains mostly rural (85%). The main epidemiological change has been the growing incidence of infectious diseases as a result of the increased size and mobility of populations and the growth of larger, denser populations in periurban communities.

Human resources in health have been a critical problem in PNG for many years. The key health workforce issues include shortages of some cadres but an underemployment of others, a skill mix imbalance, a maldistribution of health workers, and an ageing health workforce. In 2000, PNG had a staff to population ratio of 0.58 health care workers per 1000 people, considerably lower than international standards. There is a growing gap between the resources available for health personnel and the resources required to adequately staff health institutions and activities, despite a significant level of government health budget devoted to human resources. More importantly, declines in health budgets first affected the 'goods and services' component of health budgets. The lack of resources for outreach services in particular has had profound effects on the roles and activities of different health workers.

This paper has been prepared from a 2001 health workforce situation analysis, conducted to support the preparation of a Health Human Resource Development Strategy for PNG. The analysis showed that changes in health sector financing, population growth and changing health

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needs had created many human resource problems and challenges. The existing health workforce in PNG consists of an extensive list of 32 health cadres. Of this workforce, 85% are community health workers (CHWs), nurses, health extension officers (HEOs) or medical officers (MOs) (Department of Health, Human Resources Branch, Port Moresby, 2008). This paper focuses on these main categories of health worker in PNG. It presents analyses of workforce numbers and costs, and discusses future health system and human resource strategies, based on the 2001 study and subsequent developments.

Workforce analysis

Projected workforce costs

The gap between the resources available for health personnel and the resources required to adequately staff health institutions and activities is demonstrated in Figure 1. It shows the cost projections of the health workforce estimated for the period 2001-2010. Three different scenarios were examined, in addition to the baseline:

- Baseline: Maintain the current number of health workers, with no increase in their numbers
- Scenario 1: Maintain a constant population per staff ratio
- Scenario 2: Improve the population per staff ratio by 1% per year
- Scenario 3: Achieve the minimum standards for staffing rural health services and hospital facilities.

The cost of each category of staff, relative to other cadres, is influenced by the relative size of the average salary and the total number of health workers in each cadre. The wide salary ranges in 2001 between key categories of health worker are shown in Table 1. The table shows how staff allowances can be a substantial economic burden on government expenditure. Particularly for medical officers, overtime/on-call and domestic market allowance (DMA)

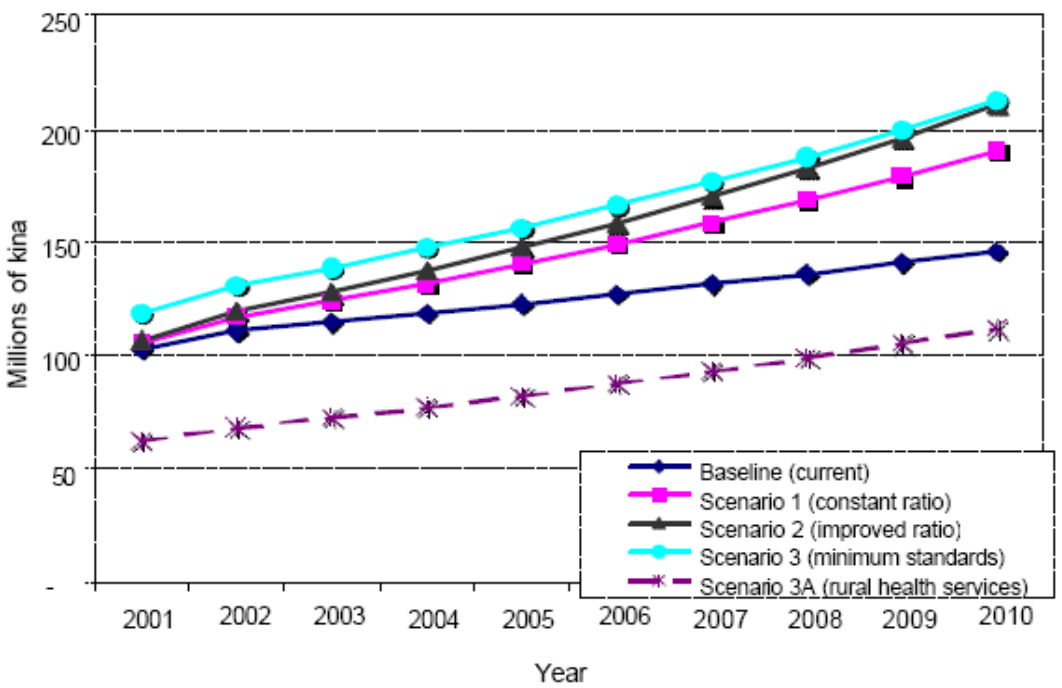

Figure 1. Total salaries and allowances 2001-2010, by scenario (in millions of kina).

TABLE 1

COMPARISON OF AVERAGE BASE SALARY VERSUS AVERAGE SALARY PLUS ALLOWANCES (2001)

	Average base salary	Average allowances	Average salary + allowances	Allowances as proportion of salary	Average PS grade and point
Medical officers	21,583	17,125	38,708	79%	12/4
Nursing officers	11,795	1,369	13,164	12%	7/4
HEOs	18,483	5,979	24,462	32%	11/1
EHOs	14,201	5,700	19,901	40%	9/1
CHWs	6,067	1,500	7,567	25%	2/6

PS = public service
HEOs = health extension officers
EHOs = environmental health officers
CHWs = community health workers

have a substantial impact on the total costs of their salary and allowances.

Distribution and composition of the workforce

Workload Indicators of Staffing Need (WISN), developed in the late 1980s (1), were used to assess staffing needs, based on current activities. A comparison of the actual nurse and CHW staffing levels in rural health centres with the numbers that were predicted by workload indicators of staffing need suggested that both nurses and CHWs were underemployed or underutilized in most provinces (Figures 2 and 3). Overall in 2000, nurses were approximately 20% in excess of the number indicated by health centre workloads, while community health workers in health centres were 47% more than those required by their workloads.

Loss of transportation (vehicles and/or fuel and maintenance) was a key factor leading to health centre underutilization relative to staffing levels. This had been the result of declining budgets for 'goods and services' since the mid-1980s. Reduced or absent transport meant reduced or absent mobile maternal and child health (MCH) clinics. Nursing staff who previously spent the majority of their working days implementing the monthly program of mobile MCH patrols were spending their time with other nurses or CHWs, sharing an unchanged or reduced number of patients at the MCH clinics and general patient care at the health centre.

Previously, the HEOs had been doing much of the clinical care, especially the inpatient care at the health centre. Allegedly, in 2001, they spent most of their time at the health centre 'doing administration'. In addition, approximately 90 HEOs were full time in district health manager or disease control positions as a result of the decentralization of health management to the district level. Many health centres were, therefore, overstaffed with nurses and had underemployed HEOs because of the changes in the health centre's overall workload.

Minimum staffing standards are included in the policy document, *Minimum Standards for District Health Services in PNG, 2001* (2). Table 2 compares workload-based staffing needs with minimum standards. According to this, 27% of all centres had workloads appropriate to the minimum standards. It is important to note, however, that 37% of government health centres and 66% of district health centres required less staffing than the minimum standards. In 2002, more than one half of the centres in the Southern Region required fewer nurses than the standard. In Momase, it was only a third. Momase had almost twice the number of

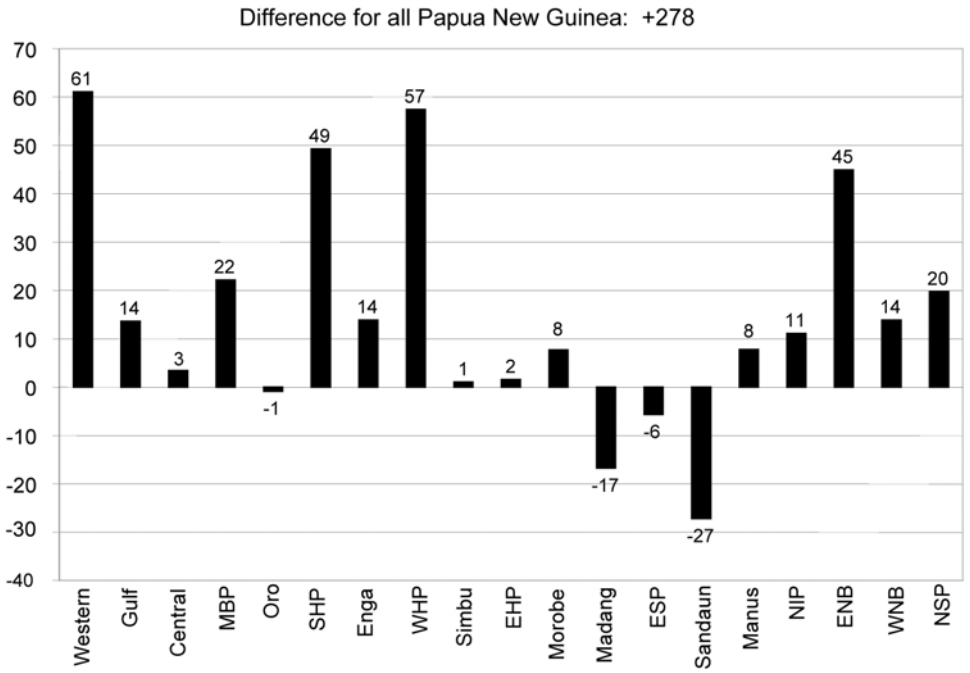

Figure 2. Difference between the actual number of rural health nurses and the required number using the Indicators of Staffing Need, by province, Papua New Guinea, 2000.
MBP = Milne Bay Province
SHP = Southern Highlands Province
WHP = Western Highlands Province
EHP = Eastern Highlands Province
ESP = East Sepik Province
NIP = New Ireland Province
ENB = East New Britain
WNB = West New Britain
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centres, thus needing more nurses than the Southern Region.

The above data suggest that minimum standards for rural health centre staffing were not helpful because staffing needs differed due to the great variation in workloads among all of these centres. This in no way diminishes the importance of the other standards. In the present economic circumstances, where cost efficiency is of great value, the use of workload-based indicators of staffing need is much preferred. These also provide a much more rational basis for allocation of other resources.

In 2002, approximately 60% of all rural health facilities had sufficient MCH attendances and deliveries to justify a nurse for those services alone (this assumes that an MCH and delivery workload requiring half or more of a nurse's time justifies devoting a nurse to the role). Posting nurses to the other 40% of centres or to upgraded aid posts, therefore, accepts some strategic sacrifice of cost efficiency in order to improve use of services in communities with low utilization. This becomes an important strategic issue, given the loss of outreach MCH and immunization services from lack of transport.

Community health workers at aid posts

The number of aid posts had reduced over time and the actual status of many aid posts in 2001 was uncertain. It was not clear where to draw the distinctions between an aid post being open and temporarily closed and between temporarily closed and permanently closed. Equally confusing were the data on CHWs. No information was available about their ages or length of service, or when they

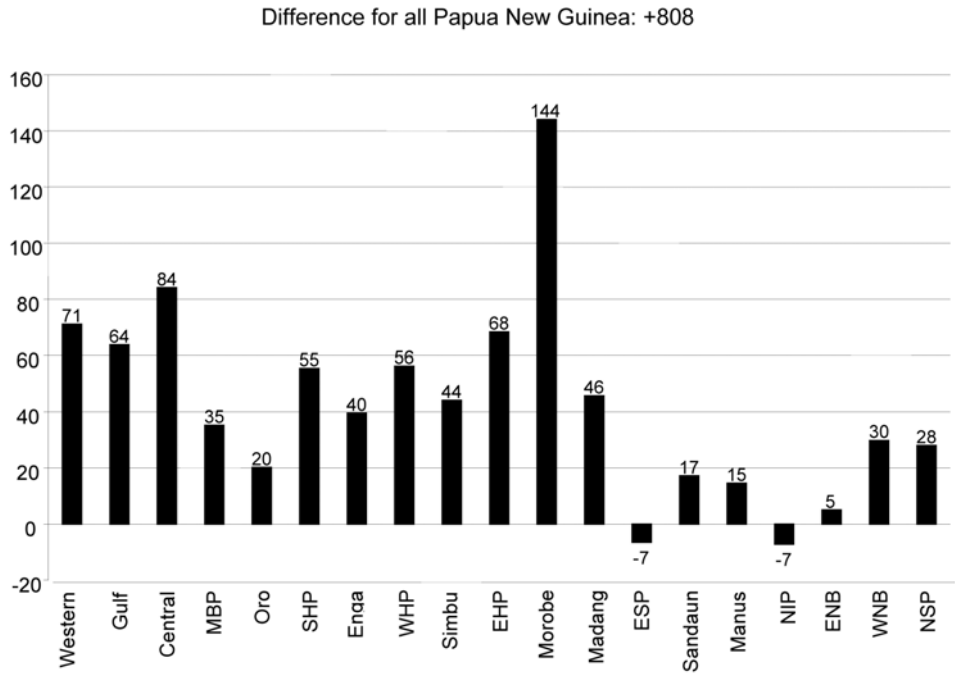

Figure 3. Difference between the actual number of rural health centre CHWs (community health workers) and the required number using the Indicators of Staffing Need, by province, Papua New Guinea, 2000.
MBP = Milne Bay Province
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were expected to retire. On the basis of Workload Indicators of Staffing Need, rural health centres appeared to have almost 50% more CHWs than they needed in 2001. On the other hand, up to half of the aid post CHWs were reportedly cut in some provinces under the 1999 structural adjustment.

Improving the skill composition to meet special needs

Midwifery

The National Health Plan (2000-2010) has a policy goal to place a midwife in each health centre in the country. An improvement of the current 40% rate of skilled birth attendance will certainly require wider access to and use of midwives. Skilled birth attendance must include the competences to provide basic emergency obstetric care. The basic pattern of causes of maternal mortality remains unchanged. There are regional excesses of haemorrhage in coastal areas due to the high prevalence of anaemia. In the highlands, an excess of puerperal sepsis probably reflects the increased prevalence of sexually transmitted infections (STIs). The higher mortality ratios associated with grand multiparity continue everywhere as a consequence of persistent high fertility rates. Anaemia, malaria and STIs also contribute significantly to high perinatal mortality rates through low birthweight and congenital infections. Midwives should, therefore, bring a public health preventive approach, as well as a clinical contribution, to the solution of these problems. Antenatal care should aggressively address the problems of STIs and anaemia, and ensure that women have the possibility to use family planning to space and/or limit their number of pregnancies.

TABLE 2

DISTRIBUTION OF FACILITIES BY NUMBER OF NURSES REQUIRED BY WORKLOAD ISN COMPARED WITH MINIMUM STANDARDS FOR STAFFING

Number of nurses predicted by workload ISN compared to minimum standard staffing	Number of facilities													
	District HC[2]		Government HC[1]		Church HC[1]		Government SC[1]		Church SC[1]		Urban clinics[3]		Total facilities	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Number of nurses equal to minimum standard	5	7	26	31	10	22	20	19	79	38	13	23	153	27
Need fewer nurses than minimum standard	46	66	31	37	5	11	65	61	79	38	29	52	255	45
Need more nurses than minimum standard	19	27	27	32	31	67	22	21	51	24	14	25	164	29
Total	70	100	84	100	46	100	107	100*	209	100	56	100	572	100*

ISN = indicators of staffing need
HC = health centres
SC = subcentres
[1]Minimum standard – 2 nurses and 5 community health workers
[2]Minimum standard – 6 nurses and 7 community health workers
[3]Minimum standard – 4 nurses and 7 community health workers
*Because of rounding the totals do not add up to 100

Figure 4 shows the distribution of rural health facilities according to the number of deliveries in the year 2000. The cut-off points at 75 and 150 deliveries were used in the graph because 150 annual deliveries was the standard workload originally calculated for a midwife (1). The original standard workload was calculated for nurses with basic midwifery skills and so the standard workload for midwives with broader midwifery responsibilities now needs to be calculated separately. 75 or more deliveries still justified posting a full-time midwife. This means that 91 health centres and 54 subcentres qualified for at least one midwife. If the criterion for posting a midwife had been lowered from 75 to 50 or more annual deliveries (one per week), the number of facilities qualifying for a midwife would have increased to 100 health centres (50%) and 93 subcentres (30%).

Disease control

An intermediate level training program in disease control, which combines training in the clinical and public health skills required for such a role, is urgently needed. In 2002, HEOs were posted to Disease Control Officer positions in some provinces and districts. There was no qualification or coherent program of training for a Disease Control Officer, nor does one exist up till now. Such a program should be open to HEOs and nurses; both cadres have an appropriate level of entry competencies in clinical and public health skills. Targetted training would serve the disease control programs well. It would also provide another clearly defined career option for health workers. The School of Medicine and Health Sciences has the most appropriate set of resources to organize such a program.

Integration of health promotion into work programs

In 2001, there had been a renewed interest in health promotion. This included the Healthy Islands approach with its component programs for Healthy Schools, Healthy Markets, Healthy Villages and so on, as well as a renewed interest in improving nutrition. In order to promote these programs, there had been proposals for the training and appointment of health promotion officers and district nutrition officers in each district in the country. These did not represent the most effective approaches for the following

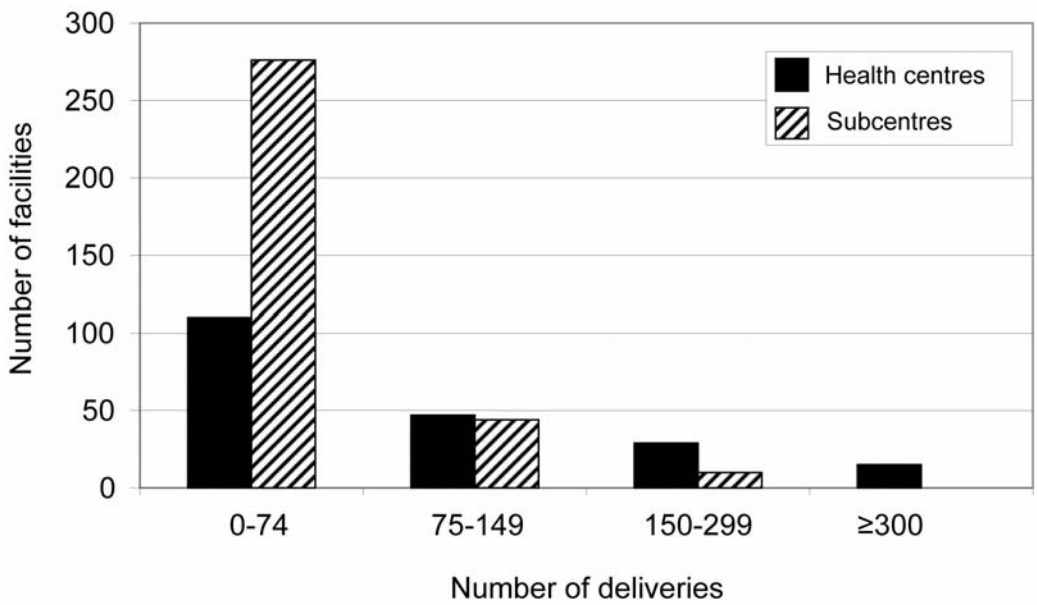

Figure 4. Distribution of rural health facilities by number of deliveries in 2000.

reasons:

1. The budget could not support the training and employment costs of these health workers without sacrificing other important positions.

2. The transport upon which these workers would rely for access to rural communities to deliver their programs was no more accessible to them than to the MCH and other programs that had broken down for lack of transport.

3. The approach appeared to take insufficient account of the roles of other health workers. MCH nurses and CHWs already had frequent contact with these communities and had some of the behaviour change skills. Environmental health officers (EHOs) had many of the special skills required for the large environmental component of the Healthy Islands approach.

Meeting hospital staffing needs

Hospitals that provide secondary or tertiary health services are complex institutions. Most of the services that they provide require the interaction of different cadres of health workers in teams or work units. The effectiveness of each type of worker depends upon the contribution of another, or is justified by the needs of another. Thus, doctors and specialist medical officers, in particular, need the support of diagnostic, surgical and other therapeutic facilities and staff to make full use of the skills that they have developed in their training. Without this kind of support, it is difficult for a doctor to accomplish much more than other less qualified primary care workers.

A health care team effectively led by a doctor creates expectations of the team being able to provide a full range of high-level health services. This is, however, physically very difficult for a single doctor to accomplish and it has been argued for the past 30 years, therefore, that a hospital must have at least two doctors for the services to be sustainable over time.

The 1997 Hospital Standards (3) were developed with the principle of the work unit in mind. The general and specialist nurses and the different allied health personnel are all specified. In 2001, however, only incomplete data were available at the national level to demonstrate how close the actual staffing of hospitals was to those standards (4). The general picture was clearly one of understaffing in all categories. The deficits, however, seemed to be greatest among the more highly trained categories of staff. This made it difficult to assess how efficiently existing hospitals were using their expensive human and other resources.

Specialist nursing and career structures

Preliminary data from the National Inventory of Health Facilities (4) suggested that the staff strength of both general nurses and nurse administrators was approximately 50% in excess of standard, while the staff strength of specialist nurses was 60% below standard. This suggests, first of all, that the numbers of specialist nurses being trained were much too low. Secondly, the motivation to stay in this work may have been insufficient, due to the majority of opportunities for promotion within the nursing profession being in the ranks of nursing administration. In 2002, it was estimated that only 50%-70% of nurses who had trained in a clinical specialty were continuing to practise that specialty. It appeared that specialty nursing diplomas were not adequate for promotion, but were necessary for admission into nursing administration training.

Specialty nursing was an area that required much greater, more careful examination and future planning than had been the case. The skills are critical to hospital care, the numbers are relatively small, and the training in some cases involves expensive overseas training. Given the concentration of these critical resources in Port Moresby at that time, future recruitment needed to be much more deliberate in attempting to find individuals who were likely to return to the provincial hospitals from which they came.

Because of the variety of different nursing roles and positions, it is important to establish a career structure in which salary levels, positions, qualifications and experience are more clearly tied together. A position with greater responsibility should certainly be rewarded. Responsibilities should not, however, be defined only on the basis of the numbers of subordinates or the size of the budget that is managed. Specialist medical

officers are recognized for the additional professional responsibilities that their roles necessitate. Specialist nurses should be similarly recognized in order to encourage extended tenure within their specialty. This is particularly crucial for such specialist nurses as midwives who are needed for work in Level 4 and 5 hospitals and rural health centres.

Community health workers for hospitals

Earlier findings from a series of reviews of the status and work of CHWs in six hospitals revealed that:

- Up to 70% of hospital CHWs had been trained as enrolled nurses or nurse aides many years before; they had had little continuing education since then
- Many hospital CHWs were regularly performing nursing procedures for which they had not been trained
- The old CHW curriculum did not include a number of nursing skills considered very important for hospital practice (5).

A strategy to address this training gap in nursing skills for CHWs who are already in service still needs to be developed. The revised CHW curriculum does include a module on basic nursing skills, entitled *Basic Nursing Care* that now corrects this omission for future graduates.

Training

Two significant factors impose opposite pressures on a human resource planning process: the need for fiscal constraint and the desire to prepare for increased demands from a growing population. Fiscal constraint creates three challenges for the health sector:

- Unavoidable deliberate choices between the different cadres, according to the priorities of the sector
- Likelihood of not being able to employ all the graduates of training programs
- Pressure to close training programs, if there are not enough students to make the training cost-effective.

The values of quality and efficiency become more important when budgets become tight. These values can best be met by:

- Reviewing and revising rural health care strategies to maximize equity of access to priority interventions within the constraints of resources available
- Reviewing and revising the roles and responsibilities of the rural health team to match the new health services strategies, and planning numbers to be trained appropriate to needs
- Avoiding the creation of whole new cadres of health workers, when most of the desired functions can be carried out (sometimes more efficiently) by other health workers
- Balancing the output of different post-basic training programs to match needs and priorities.

Population growth is the second major pressure that constantly affects training programs. With a national population growth rate of almost 3% per annum, PNG can expect that the population will double in about 25 years. During the life of the 2001-2010 National Health Plan (NHP), therefore, population growth will have added about 45% to the year 2000 population. The health services workload can be expected to increase at least to the same extent. It is usually assumed that the numbers of direct care personnel such as doctors and nurses need to increase in step with population. In 2002, the training capacity for nurses and CHWs was not able to maintain the then current levels of staff. It certainly was not able to match the population growth rate during this NHP period either. This is one of a number of reasons why increased efforts are needed to make family planning services more available to people.

Medical officers

For many years, PNG strived hard to attain its required number of doctors and specialists. By 2002 this quota was almost filled and the challenge then became to slow down and adjust production in such a way that expensive excesses were avoided but future staff needs were met. Doctors and specialists are valuable health service resources; they are also several times more expensive to train and employ than other

health workers. For these reasons, it was particularly important to be as accurate as possible in estimating requirements for, and the consequent supply of, the different categories of medical officer in the health care system, and to make the most efficient use of the training capacity.

In 2001, the overall availability of doctors and some of the main specialist categories was soon to be sufficient to meet the projected needs, as set out in the hospital standards documents. Increased medical student intakes could not therefore be sustained if the graduates were expected to find places in the resident medical officer (RMO) and registrar training programs, or in subsequent employment. Intakes of 60 into the second year meant 50 to 55 graduates, leading to 100 or more doctors requiring residency posts over two years. With only 84 government-funded RMO positions and even fewer positions in hospitals with adequate Senior Medical Officer (SMO) supervision, this problem had already become apparent in the 2001 round of RMO post allocations. If the students already admitted and active in the program at that time were all employed in the public sector on graduation, they would have increased the number of doctors employed by the government by almost 50%, and added 4.88 million kina to the salary budget of 2005. The data in Table 3 are projections of the resulting number of doctors if medical school student intakes continued at the same rate as in 2000. The number of doctors employed by the public sector at the beginning of 2001 – 275 – will have doubled to 552 by the end of 2010. That number is 36% in excess of the number required to keep up with the current population to doctor ratio. It is 48% more than the number required to meet the minimum standards for doctors in both urban and rural hospitals. This would create a medical officer salary bill in 2010 equivalent to the whole 'goods and services' budget of 2001.

The budget constraints expected during this period were such that employing all of the medical graduates produced during that time would not be possible without severe sacrifices from the rest of the health system. The only way of avoiding this would be for the government to employ only the doctors it could afford. The 2002 Australian Agency for International Development (AusAID) Human Resources Report emphasized that allowing graduates to complete the two-year rotating residency was important because it would enable them to have full registration with the Medical Board. From there on, however, government would not be in a position to guarantee employment to all PNG medical graduates.

Paradoxically, shortages of some categories of doctors were possible in hospitals in the future. Several larger hospitals had come to rely on registrars in the specialty training programs to meet their service needs. As the need for more paediatric and surgical specialists – and consequently registrars-in-training – declined, these training hospitals and their specialist staff would have had to work out how they were going to meet those service needs. Possible medium-term responses included the development of a specialist training program in family medicine/rural health. Such a program would prepare multi-skilled doctors for work in Level 4 and 5 hospitals, the outpatient clinics of Level 1 to 3 hospitals, larger urban clinics, or private general practice.

The longer-term response to meeting hospital needs will involve a much more careful attempt to balance the supply and demand for doctors and specialists. The first step should be a re-evaluation of hospital staffing standards and the categories of medical officer that best suit different positions in specialty inpatient and outpatient units, general outpatient clinics and emergency care units. Secondly, it will require an adjustment of the intakes into the medical school and specialty training programs so that outputs more closely match the slower ongoing needs for replacement and population-based expansion.

Nursing officers

In 2000, the capacity to train nurses had dropped below the level where it could replace those lost through the estimated 6.7% annual attrition rate of nurses. This came about through the closure of six training schools. A further temporary decline was experienced due to Lae School of Nursing taking no intakes in 2000 and 2001, and the Sopas School of Nursing not taking an intake in 2000 because of its move from Enga to Pacific Adventist University outside of Port Moresby.

The report of the Taskforce on Preservice Nurse and Community Health Worker Education (6) analysed the situation for both nurses and CHWs. In order to regain the 1998 staff strength by 2004, nursing schools would have to produce 383 graduates to fill the deficit, plus an adequate number to replace the ongoing normal attrition (Table 4*)*. The capacity of the training schools would have to almost double if this were to be achieved. In 2001, preliminary estimates of the capital costs required for increasing the capacity of the nursing schools were made. This amounted to over 9 million kina.

It was not yet clear in 2001 what numerical targets were best for nursing staff. As discussed above, the actual numbers of nurses in the rural health system in 2000 were about 260 (20%) more than what would be indicated by the workloads of those facilities. WISN were not available for hospitals, but in 2000 the actual number of nurses in hospitals was only 108 (7%) short of the number required by the 1997 Hospitals Standards. Many of the 260 excess rural nurses would have found productive work if resources could have been redistributed to upgrade aid posts to improve the declining MCH utilization rates.

Population growth until 2004 implied the need for an increase of another 1400 nurses at the 1998 population to nurse ratio. This was not feasible. A growing gap of this type made it important to search for other sources of staff. It also appeared that nurses had had a higher annual attrition rate (6.7%) from the service than other health staff (probably closer to 5%). The reasons for this were not documented, but it would be very worthwhile to do so. It may be that there are ways in which nurses could be persuaded to stay in service longer or to seek part-time employment, if full-time work is not viable for family or other reasons.

A final issue that needs to be better understood is why a much smaller proportion of younger nurses were in rural health work. Figure 5 shows the age distribution of a set of nurses for whom data were available in 2000. If this decline in the proportion of nurses in rural clinics represents a loss of interest in rural health work among young graduates, the change to university-based training programs for nurses is of concern, since it is likely to worsen the trend.

Specialist nurses

As already noted, there was a severe shortage of specialist nurses, especially in hospitals outside Port Moresby General Hospital. This reflected both inadequate numbers being trained and excessive losses to administrative positions that provided better status and remuneration.

The specialist training programs that build upon the diploma/certificate in general nursing can be organized into a vertically and horizontally integrated system (Figure 6). Following a diploma or certificate in general nursing and a minimum period of experience, a nurse could be accepted into one of the specialty clinical nursing programs. These programs are designed to meet the various needs of both the rural and hospital health sectors. On satisfactory completion of any one of these programs, the student would receive a Bachelor of Clinical Nursing degree. The midwifery and paediatric nursing curricula each need to be coordinated by up to four different universities towards a common set of entry qualifications and final expected competencies. The other four specialty clinical nursing programs would be offered at the University of Papua New Guinea (UPNG).

In 2001, there were three postgraduate diploma programs: community health, nursing education and nursing administration. The community health and nursing administration diplomas were preparing individuals for provincial and senior hospital administration positions. At some stage, an equivalent certificate course should be developed for ward sisters or other junior hospital nursing administration positions. These certificate programs could be offered at either UPNG or Divine Word University (DWU). If a hospital nursing administration certificate is desired, it may be necessary to run courses at both institutions to meet the potential need.

The postgraduate diploma programs should be located so as to make best use of the unique strengths of the different universities. The divisions of Public Health and Nursing at UPNG have the combined public health and specialty nursing skills capacity to be the most appropriate to offer the diplomas in community health and community health nursing (if two tracks are needed); DWU, with its developing strengths

TABLE 3

NUMBERS OF MEDICAL OFFICERS RESULTING FROM CONSTANT MEDICAL SCHOOL INTAKE

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PNG population	5,130,365	5,268,885	5,411,145	5,557,246	5,707,291	5,861,388	6,019,646	6,182,176	6,349,095	6,520,520	6,695,574
Population per MO ratio, 2001	18,656	18,656	18,656	18,656	18,656	18,656	18,656	18,656	18,656	18,656	18,656
Required number of MOs[1]	275	282	290	298	306	314	323	331	340	350	359
MOs for hospitals at MS[2]	357	357	357	357	357	374	374	374	374	374	374
Number of MOs employed at start of the year[3]		275	304	338	369	401	430	457	483	507	530
Intake of PNG medical students[4]	54	56	54	54	54	54	54	54	54	54	54
PNG graduates (90%)[5]		43	49	49	50	49	49	49	49	49	49
Attrition from workforce[6]		14	15	17	18	20	21	23	24	25	27
MOs at end of the year[7]		304	338	369	401	430	457	483	507	530	552
Excess MOs over 2001 level[8]		29	63	94	126	155	182	208	232	255	277
% excess over 2001 level		11	23	34	46	56	66	76	84	93	101
Excess MOs over population ratio[9]		22	48	71	95	116	134	151	167	181	194

% excess over population ratio	8	16	21	26	29	31	33	35	36	36
Excess MOs over MS[10]	-53	-19	12	44	56	83	109	133	156	178
% excess over MS	-15	-5	3	12	15	22	29	36	42	48

PNG = Papua New Guinea
MO = medical officer
MS = minimum standards
[1]The number of medical officers required to maintain the population to MO ratio at the 2001 level
[2]The number of medical officers required by Minimum Standards for Hospitals (1997); in 2005 MOs for Level 5 hospitals increased to 2
[3]Transferred from the number at the end of the previous year
[4]This number does not include any students from other nations; the number was 51 in 1998 and 54 in 1999
[5]Assumes a 10% failure rate from the intake four years earlier
[6]Attrition is assumed to be 5% from the number at the beginning of the year
[7]The number at the beginning of the year + PNG graduates – attrition from workforce
[8]The number in excess of the 275 at the beginning of 2001
[9]The number in excess of the number required to maintain the population to doctor ratio for that year
[10]The number in excess of minimum standard requirements

TABLE 4

NURSING SCHOOL OUTPUTS: PROJECTED DEFICITS IN THE NURSING WORKFORCE UNTIL 2004*

	1998	1999	2000	2001	2002	2003	2004
Nurses at beginning of year	3017	2972	2922	2871	2835	2775	2710
Workforce attrition (6.7% pa)	202	199	196	192	190	186	182
Nursing schools' output (actual)	157	149	145				
Nursing schools' intake minus attrition**				156	130	121	106
Nurses at end of year	2972	2922	2871	2835	2775	2710	2634
Annual workforce deficit	45	50	51	36	60	65	76
Cumulative workforce deficit	45	95	146	182	242	307	383
Year-end nurses as % of number at start of 1998	99	97	95	94	92	90	87
Workforce to maintain population : nurse ratio	3111	3207	3306	3409	3515	3623	3736
Year-end nurses as % of number to maintain population ratio	96	91	87	83	79	75	71

*Adapted from Preservice Nurse and Community Health Worker Education, Final Report of the Task Force, Aug 2001 (6)

**Estimated student attrition is calculated on the basis of the average attrition from schools in the previous five years – attrition rates vary greatly between schools and across years

in hospital administration and nursing, would be the best place to offer the nursing administration diploma. The University of Goroka would be the best location for the nursing education diploma.

Midwives

The issue of how to determine the numbers of midwives needed for rural health and hospital services has already been addressed. An estimated 423 were required to meet the workloads of both health centres and hospitals in the year 2000. The actual number of active midwives in that year was about 275. The only established midwifery training program was in Port Moresby and a new one was due to start in Goroka in 2001. The Pacific Adventist University outside Port Moresby was planning, and succeeded in, the introduction of a midwifery program as an additional fourth year to their Diploma in General Nursing. A fourth program had been proposed at St Mary's (Vunapope) in association with Nonga Base Hospital, but in fact was started in Madang in 2003.

A feasible program of targets for increasing the capacity and outputs of midwifery training by the year 2009 is shown in Table 5. The proposed timetable for commencing the different programs meant that there would be little impact on the midwife deficit until the second half of the decade. One of the

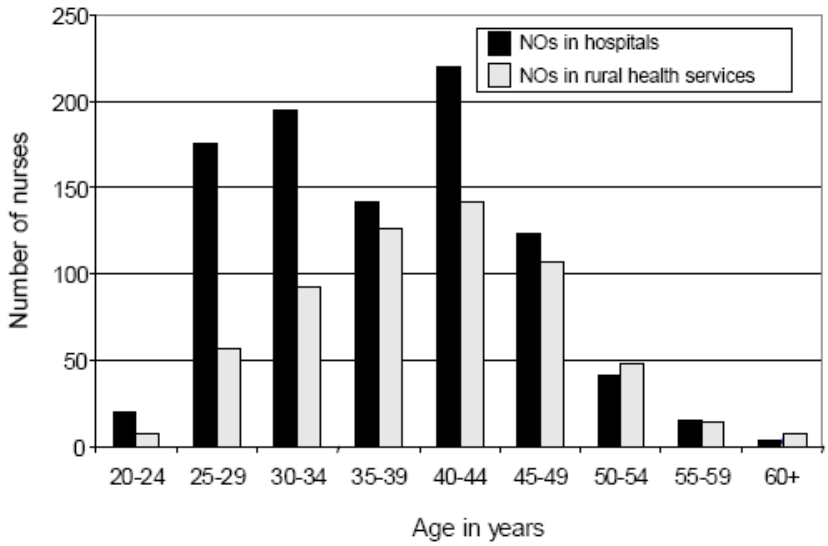

Figure 5. Age distribution of nurses (7). NO = nursing officer.

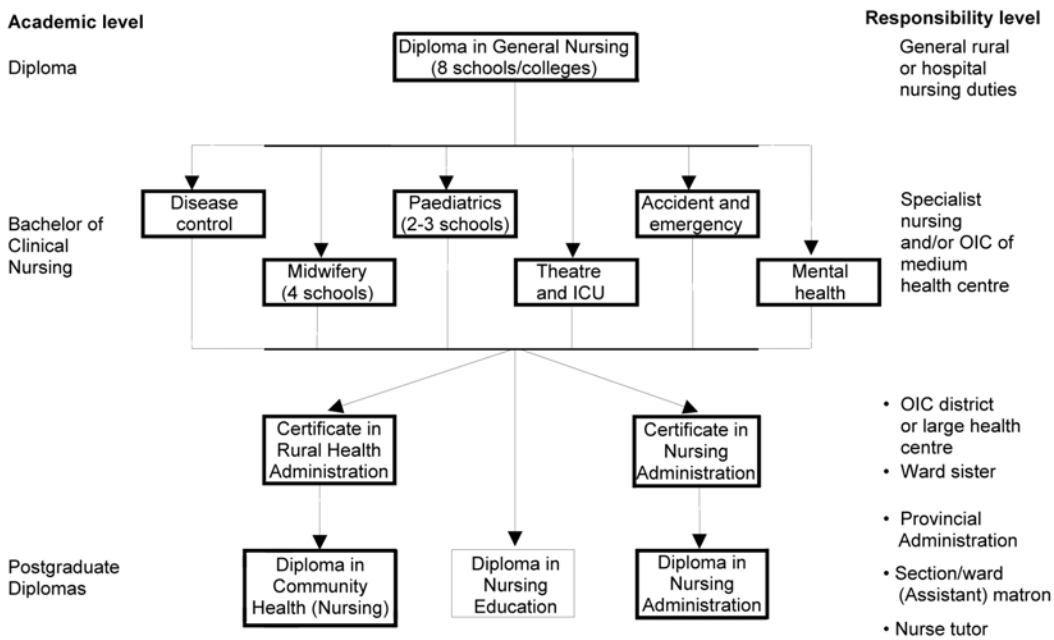

Figure 6. Possible scheme for academic progress and levels of responsibility in rural and hospital nursing. ICU = Intensive Care Unit. OIC = Officer in Charge.

anticipated costs of midwifery training was the removal of the nurses-in-training from their previous posts. In view of the low capacity of nurse training schools at the beginning of the decade, it was considered advisable that this cost to health services be deferred until later in the decade, when general nurse outputs were expected to increase.

Midwifery training programs need to prepare their students adequately and appropriately for the job they will be required to do as graduates. Firstly, the role of the midwife needs to expand from only midwifery to encompass the full scope of reproductive health. Midwives in PNG should be as confident and competent managing STIs and family planning as they are when conducting a delivery or providing basic emergency obstetric care. Secondly, their training should emphasize practical training to achieve competence. Thirdly, they need to be trained in public health to manage preventive obstetric care through antenatal clinics and by mobilizing and training village birth attendants.

Concern has been expressed about the quality of the midwifery training programs (8). Three of the four schools have combined programs with paediatrics. This raises concerns about the adequacy of time to develop competencies in either area of practice. This weakness is made worse by both the lack of time given to clinical practice in some programs and problems with the quality of training in clinical practice. This applies particularly to the management of complications of pregnancy and childbirth, which is the main reason for having trained midwives in health centres.

Paediatric nurses

The extent of the need for paediatric nurses was not clear in 2001. Most of the health centres with sufficient paediatric admissions to justify a paediatric nurse already had an HEO, who was trained to the same level of competence. There was probably a need for extra paediatric nursing skills in some of the biggest health centres in the Highland and Momase Regions, and in government and church rural hospitals. These skills were certainly required in urban referral hospitals. As with the midwifery training program, the public health dimensions of child health problems, as well as clinical skills, needed to be emphasized. It was recommended that the training curriculum should include a strong applied clinical and public health nutrition component, in view of the constraints on training a separate cadre of district nutritionists in the foreseeable future.

Mental health nurses

Estimates were hard to come by, but only 40% or less of mental health nursing graduates appeared to be continuing in mental health practice. In many cases, this reflected the poor commitment of hospital authorities to mental health compared to other areas. As a result, there may not have been a mental health program in many hospitals, or mental health-trained nurses may have been assigned to other areas of a hospital. This represented a waste of resources. The 2002 Human Resources Report recommended discouraging further training in mental health nursing until mental health programs had been developed at provincial hospitals and in provincial rural health services. It also recommended using the very capable mental health training staff in the Division of Nursing to undertake applied health services research to develop and evaluate innovative programs in mental health.

Acute care nurses

The training capacity in theatre and intensive care nursing was in the process of being developed in 2001. No data were available on the deployment of graduates of the earlier programs in theatre and intensive care nursing. Estimates of the needs were also not yet available. Numbers in both groups were likely to be small, making forward planning of the training programs all the more essential.

The staffing of accident and emergency care clinics required a careful needs assessment. Approximately 50 HEOs were deployed in hospital outpatient clinics and urban clinics in 2001. Their training was appropriate for this role. However, improving the range and quality of their skills in a special program in accident and emergency was considered a good investment. It could also provide a clear career step for those HEOs who preferred to remain in clinical care, rather than move to administration.

TABLE 5

RECOMMENDED OUTPUT OF MIDWIFE TRAINING SCHOOLS, 2000-2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Target for hospitals[1]	218	227	236	245	255	265	276	287	298	310
Target for rural HC[2]	205	211	216	222	228	234	241	247	254	261
Total targets	423	438	452	467	483	499	517	534	552	571
New graduates										
Port Moresby[3]	23	24	24	24	24	24	24	24	24	24
Goroka[3]		12	24	24	24	24	24	24	24	24
St Mary's/Nonga[3]					24	24	24	24	24	24
Pacific Adventist University[4]							20	20	20	20
Attrition										
Leave service (6.7%)[5]	18	18	18	18	18	18	18	18	18	18
Loss to other jobs (25%) of training output)[6]	6	9	12	12	18	18	23	23	23	23
Total MW in service	274	283	301	319	355	391	442	473	504	535
Deficit	149	155	151	148	128	108	75	61	48	36

HC = health centres
MW = midwives
ISN = indicators of staffing need
[1]The number of midwives is the number determined by the workload ISN for all provincial hospitals in 2000 plus the additional midwives needed assuming an annual increase of 4% in urban populations
[2]The number of midwives is the number determined by the workload ISN for all rural health facilities in 2000 plus the additional midwives needed assuming an annual increase of 2.7% in rural populations
[3] Existing or proposed post-basic midwifery programs
[4]The final year of the proposed Bachelor of Nursing program at Pacific Adventist University is expected to produce equivalent competencies to the other midwifery programs
[5]6.7% has been taken as the overall annual loss to service of nursing staff
[6]Currently, an estimated 30% of nurses with midwifery training are in other nursing jobs, mostly nursing administration; a lower rate of 25% has been adopted for these estimates, since the opportunities in administration will not grow as fast as the production of midwives

Estimating both the numbers of nurses needed in accident and emergency care and the competencies required would take careful planning on the part of a variety of medical and nursing specialists. The growing importance of urban lifestyle health problems would need to be addressed. This would be well worthwhile, and should lead to improvements in the quality of care in outpatient and casualty departments.

Community health workers

The situation with respect to CHWs in 2001 was confusing. It was also one of the best arguments for the creation of a comprehensive database of health workers. In 2000, workers falling under the official name of 'CHW' included those (mostly women) who were originally trained as state enrolled nurses and nurse aides, and others (mostly men) who were trained as aid post orderlies and hospital orderlies.

Preliminary data from the 2000 National Inventory of Health Facilities (4) gave a total of 5571 CHWs. In urban areas, the total number (1226) was divided between hospitals and urban clinics. In rural areas, more than half were in health centres, and the remainder were at aid posts. The number of CHWs employed in hospitals (973) was only 65% of the minimum standards recommendation (1487). Most were nurse aides or state enrolled nurses. Only small numbers of graduates of the previous ten years, who trained under the CHW curriculum, had taken positions in hospitals.

The actual number of CHWs working in health centres (2525) was 47% greater than the workload-derived number (1722). This is in keeping with the already noted pattern of overstaffing in relation to workloads in rural health centres. It was not known how many of these CHWs were at health centres because aid posts had been closed temporarily or permanently, or because they were old orderlies, now semi-retired but still drawing a salary (possibly because they had no retirement benefits to claim). Whatever the explanations, the situation was more difficult to understand in light of the reports that up to half of the CHWs in some provinces were terminated under the structural adjustment in the 1999 budget.

The actual attrition rate of CHWs from the service was not known. In 2000, the numbers of CHWs in the different age groups remained high until the age of 45. The numbers declined fairly quickly in the age groups older than 45 years. This suggests an annual attrition rate closer to 5% than the official 6.7%. For the CHW workforce of 2000, these rates imply either 279 or 373 lost or retiring each year. The pattern of attrition was probably different from the large cuts in CHWs during the structural adjustment exercise of 1999. There were, however, no documented data at the NDoH on exactly who was retrenched at that time.

CHW training schools continued to close in the years before the 2001 Human Resource Study. There were no government CHW training schools left; all were run by church agencies. These tended to draw their recruits from the province in which they were located or from neighbouring provinces. Those planning the production of CHWs should bear this fact in mind so that regional needs can be met in the future.

The average annual output of the CHW schools was 215 between the years 1998 and 2000. That translated to an annual shortfall of either 64 or 168 between the numbers trained and estimated losses (for 5% and 6.7% attrition rates, respectively). As with the nurses, therefore, the capacity of the training schools needs to be increased to match this shortfall. Alternatively, the existing CHWs need to be redistributed from those facilities with too many staff.

Health extension officers

During the 1990s, there was increasing talk of 'the HEO problem'. This appears to have been an ill-defined 'problem'. There was and clearly remains a concern about the role of the HEO in the health centre, and speculation as to whether the time had come to replace HEOs in health centres with either doctors or nurses. There is probably more than one solution, and consideration needs to be given to the timing of any changes. First, however, it is essential to define the problem and its causes.

The key issue in 2001 was that the role and position of the HEO was no longer clearly defined. One consequence of this was the decline in enrolments for the HEO training course. The competency goals originally selected for the HEO training and residency programs were those required by the officer

in charge (OIC) of a health centre. This involved clinical, public health and administrative roles. By 2001, however, almost 50% of HEOs had moved into full-time administrative positions. 116 HEOs (25%) were in provincial health administration positions and another 100 (22%) in district health administration. About 150 HEOs (33%) were clinical HEOs or OICs in health centres, and another 47 (10%) were in clinical practice in hospitals or urban clinics. The remainder were in hospital administration, training or the National Department of Health (HEO Association, Tables of HEO postings, Jun 2001).

The 'HEO problem' had two main causes. The first cause was the 'nurse problem'. The overstaffing of nurses (relative to workloads) in health centres meant that the clinical role of the HEO had been largely taken over by nurses. The second was the proliferation of administrative positions as a result of the organizational changes from decentralization to districts. Almost 80% of government health centres had at least one HEO. District health centres with only a district health manager/ coordinator constituted 17% of all health centres although it was not known how much involvement these HEOs had with the day-to-day running of the health centre. 60% of health centres had an HEO assigned as OIC or as an additional clinical HEO (many of the larger or district health centres). 22% of health centres had no HEO; most had catchment populations less than 10,000 people. A lack of any consistent criteria for posting HEOs to health centres was, therefore, a secondary cause of the 'HEO problem'.

Most church health centres did not have HEOs, and appeared to manage quite well without them. This was one of the main reasons for suggesting that nurses should replace HEOs. The fact that several church health centres, subcentres and 'hospitals' did have HEOs suggested, however, that the absence of HEOs from most church centres may rather have been the result of a historical preference of the churches for appointing the nursing staff that they had trained in their own training schools.

There is no reason to believe that the job description of the HEO should change significantly from the original health centre OIC. Arguably, given the increase in infectious disease transmission resulting from population changes, there is an even greater need for their clinical and public health management skills. That being the case, the staffing needs and criteria of health centres need to be reconsidered. This includes the requirement that all health centres of a certain size and workload should have an HEO, whether run by government or church.

The implied complaint that HEOs were being wasted in 'administration' needs closer examination. Their role as health centre OIC includes both public health management as well as facility administration. Their public health management training and experience provides much of the explanation as to why HEOs have filled many of the leadership roles in both provincial and national health departments over the past 25 years. The Community Health Diploma at UPNG continues to provide the additional skills required for those positions.

Conclusion

The 'problems' of the different health cadres in Papua New Guinea cannot be understood or addressed as separate issues. They are bound up together with each other and with the still unresolved health system breakdown that developed during the 1990s with the declining operating budgets of the health system. The 'HEO problem' was significantly a result of the 'nurse problem'. The 'nurse problem' started off with the loss of transport for outreach services and the consequent underemployment of nurses confined to health facilities. This was exacerbated by the similar 'CHW problem' of underemployment in health centres as a result of aid post closures and an ageing workforce.

Continuing low utilization rates of immunization, antenatal care, skilled birth attendant and family planning services suggest that the basic health system problems of equity of access remain unresolved, especially for women and children. Resumption of mobile outreach services may be necessary for some remote areas, but do not make up for the loss of regular access to curative services and to skilled birth attendants. Careful consideration needs to be given to expanding the network of fixed facilities with competent MCH staffing. That would require redistribution of appropriately trained and supervised nurses

and CHWs but would result in greater utilization of services. Improved coverage of the population supports more effective health and nutrition promotion, and is much more effective and efficient than creating additional cadres of health staff.

Staffing levels for facilities would be best guided by the use of workload indicators of staffing need, rather than fixed Minimum Staffing Standards. The WISN approach should be used to develop staffing criteria for all health centre cadres, including HEOs and midwives. The workload standards should then be applied to church, as well as government, facilities.

The transfer of health professional training programs to universities has been a challenging but, so far, successful process. A long-term challenge is to match the training programs for specialty training of nurses and HEOs with career structures that reward those who remain in clinical practice and not just those who are able to move into administrative positions. The more pressing and immediate concerns are to a) avoid an inappropriate number of graduates from the medical school, and b) assure an adequate capacity to train nurses, midwives and CHWs for all parts of the country.

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Persistence as the path from motivation to performance in the Papua New Guinea health sector

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SUMMARY

This paper considers how the individual capacity states of motivation, confidence, skill and ability relate to performance, and identifies a crucial role for the discretionary behaviour of individuals: specifically, employee persistence and innovation. The study *Understanding the people and performance link: unlocking the black box* undertaken by Purcell and colleagues is relied upon in constructing a theoretical framework for the conceptual interrelationships between performance and the human-resource-mediating variables, which is then applied within the Papua New Guinea (PNG) health sector context. The study by Purcell and colleagues, which was informed by organizations with well-developed and functioning human resource policies and practices, is distinguished from the PNG health sector, where human resource frameworks are largely ineffective – yet it is determined that the importance of 'discretionary behaviour' relative to performance, whilst varied, is undiminished.

Introduction

Nothing in the world can take the place of persistence. Talent will not; nothing is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan 'Press On' has solved and always will solve the problems of the human race.

The above quotation is attributed to John Calvin Coolidge, the 30th President of the United States of America, and has since given comfort to many who have struggled and continue to struggle against challenges for which they may be ill-equipped and which, at times, seem insurmountable – challenges of the like confronted by the Papua New Guinea (PNG) health sector. It is in persistence that Coolidge placed his hope and underpinned his success in restoring confidence to a scandalized American administration – and it is persistence that this paper suggests the PNG health sector depends upon in delivering services. The recent review of the Capacity Building Service Centre (CBSC) reveals the crucial role that persistence plays in stimulating innovation and driving performance.

Background

The CBSC is an initiative funded by the Australian Agency for International Development (AusAID) that supports the health sector of PNG. It is responsible for the implementation of varied capacity-building programs identified and prioritized by its governing partnership, of which the constituent members are the PNG Government (represented by the National Department of Health, the Department of Provincial and Local Level Government and the Department of National Planning and Monitoring), the Australian Government (represented by AusAID) and a private

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company, JTA International, which is contracted by AusAID to manage the CBSC. The CBSC recently completed a review of its capacity-building programs for 2008. One aspect of the review relied on stories told by individuals within the health sector who had received direct support from the CBSC. These individual stories were intended to capture changes in the intermediate capacity states that lead to performance – 'motivation', 'confidence', 'skill' and 'ability'. However, the stories collected often went beyond mere description of changes in intermediate capacity states to provide evidence for changes in individual and organizational performance and intimate causal inter-relationships. Specifically, the stories suggested a catalytic role for the concepts of persistence and innovation in driving performance within the varied and complex contexts of the PNG health sector.

Theoretical framework

The issue of which mediating variables encourage employees to perform and how they interrelate has been well considered in the field of human resource (HR) management, as practitioners and academics alike have attempted to identify how HR policies and practices affect organizational performance. Whilst it is mostly accepted that they do affect performance (1,2), there is significant debate and uncertainty regarding the means by which this occurs and the extent to which context bears relevance – a debate that inevitably relegates any proposition to only a partial truth. Indeed it has been suggested that the idea that there is an 'answer' out there at all may well be an illusion (1). Yet it is in this uncertain side of the causal chain that CBSC support, when directly applied to an individual, resides – targeting the mediating variables themselves and influencing performance accordingly. There are relationships at work; their characterization in a meaningful and relevant manner, however, is an elusive endeavour.

Perhaps the most significant study on the relationship between HR practices and

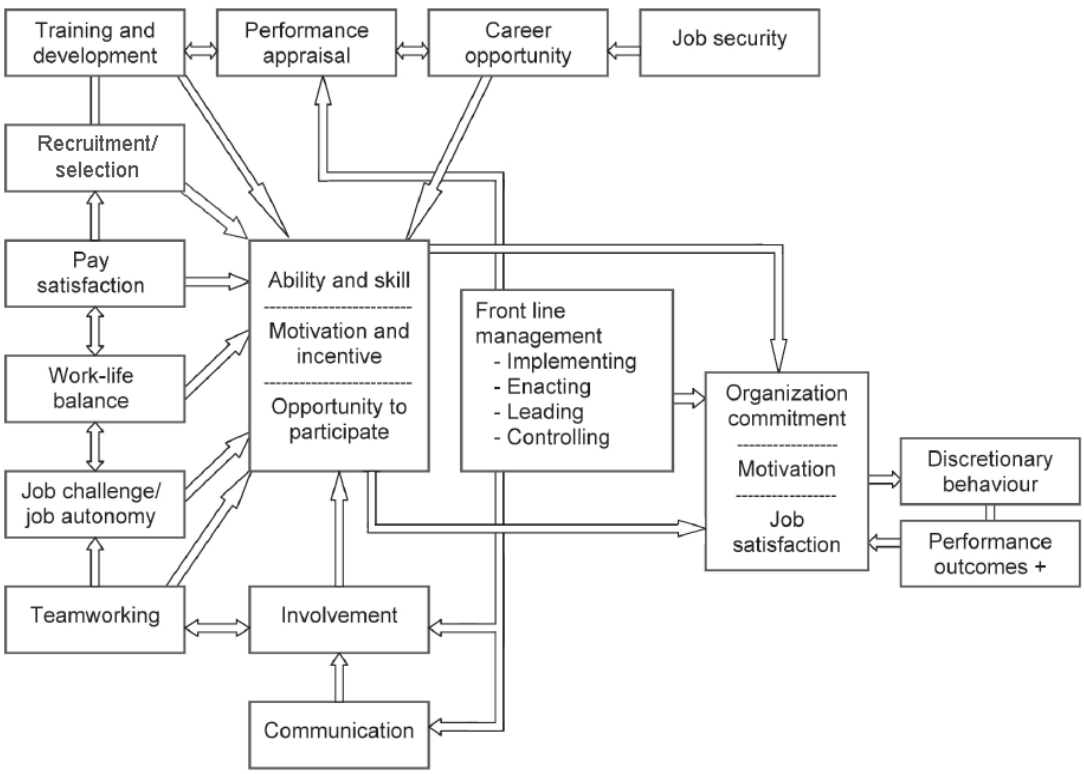

Figure 1. People and Performance Model. Redrawn from ref. 3.

policies and organizational performance is *Understanding the people and performance link: unlocking the black box* undertaken by Purcell and colleagues (3), which resulted in the development of the People and Performance Model displayed in Figure 1.

The model recognizes 'ability and skill', 'motivation and incentive' and 'opportunity to participate' as the core building blocks of human resources. It suggests that it is these concepts that contribute to job satisfaction, commitment and motivation in employees, which in turn encourage discretionary behaviour. It is 'discretionary behaviour' that maintains a close causal relationship with performance. The Chartered Institute of Personnel and Development (CIPD) – the funding body for the original study – states that 'discretionary behaviour' refers to employees "making the sorts of choices that often define a job, such as the way the job is done – the speed, care, innovation and style of delivery" (2). It is a concept associated with those employees 'at the coal face' delivering the goods and services. It is the discretionary behaviours exercised by these individuals – behaviours that are not easily measured or monitored – that were identified in this study as the difference between an average and a high-performing organization (2). It may involve "emotional labour (smiling down the phone), using knowledge to solve a problem or suggest an alternative to the customer, or it may be internal to the work of the organization, such as cooperating with team members, helping probationers learn shortcuts or sharing new ideas on work processes" (2) – it is about employees, at their own discretion, going the extra mile.

Applying the framework to CBSC and the PNG health sector

The study by Purcell and colleagues (3) was informed by 18 organizations with well-developed and functioning HR policies and practices, and sought to distinguish between those that were 'just OK' and those that were 'great'. The question that follows, then, is how relevant the model is to the developing context of the PNG health sector, where the HR landscape is stripped back to its mere outlines and the HR policies and practices identified by Purcell et al. (3) (the external boxes in the People and Performance Model in Figure 1) are weak and uncoordinated, and largely incapable of producing planned effects. It is a situation where 'the psychological contract' – the employees' emotional investment in the job, their expectations and aspirations (2) – is continually threatened and breached by the resultant forces of ineffective systems across the sector.

The recent review of CBSC suggested that this notion of 'discretionary behaviour' remains a powerful driver of performance within the PNG health sector. It suggests that not only are the systemic constraints *not* disabling of the relationship between 'discretionary behaviour' and performance but, indeed, it may be the means by which such constraints can be overcome by those responsible for actually delivering the services. Three story extracts relied upon in the review are informative in this regard.

Story 1: Provincial nutritionist

"Well, before I started work, I had a personality in which I used to feel ashamed and had no confidence. I found it hard to ask questions or discuss things with others. I did things in isolation and worked alone. Until 2006 … that's when I was selected a partner with CBSC – that's the time where I saw that somebody was interested in me, wants to really help me and build my capacity. And then … this assistance was given to me all the way up where it made me see and realize that I can do it. Yes… I can just go, I can just go and knock on doors for support. Now I can handle things/situations. Now I can talk with confidence in a lot of ways. Now I can see that my boss has recognized my capacity and has given me added responsibilities so when I go and ask for funding support with my plans and proposals they approve it – so I see that this has become my capacity. That was the big difference – I now have this strength."

Story 2: Hospital unit clinical supervisor

"Medical waste incineration has not been practised for many years now due to breakdown of the old unit. Medical waste was disposed off at the public dump. Mothers took their placentas home after birth. I was motivated and encouraged by [CBSC] of my responsibility and that of the management to ensure safe medical waste disposal and that throwing away waste at the public dump was poor and illegal practice. This standard

gave me a challenge to come up with an alternative arrangement. My involvement in the design of the home-made incinerator using a local oven bakery concept guided by WHO [World Health Organization] infection control policy is a new local innovation. I look forward to its installation soon for improvement of medical waste practices."

Story 3: Deputy Director of Nursing

"I think persistence is the biggest change, because it is so easy to give up and that's often what we do. At first I thought planning was the most important thing, but plans can still go wrong and so if you don't persist nothing will change. At first I would plan and make activity plans. Then nothing would happen; either transport wouldn't come because the District Office was using it instead, or there was no money or other people let you down – you could get the transport and go to the village but the people wouldn't be there because they weren't told. So I would think, 'What's the point?' I truly used to feel that this was all a waste of time. I felt very frustrated. I wanted to just give up and go away sometimes. I used to feel very frustrated. CBSC suggested looking at alternatives. They suggested planning ahead. They suggested helping people take responsibility for their own actions. They also suggested that we had to persist and overcome obstacles. Recently I wanted to go to an island to do some community mobilization there. I had it all planned. I would spend a couple of days working, and then I could spend my days off there. But it seemed as if it wouldn't work out because the patrol boat had no money for zoom, so the trip was cancelled. Before, I would have given up."

Retrospective program logic

A retrospective program logic was developed as part of the review, which synthesized causal relationships across a number of informant stories. This is displayed in Figure 2.

Whilst not specifically seeking evidence of this linkage, the review of CBSC has captured some causal relationships that, in hindsight, support the role of 'discretionary behaviour'. The connection that has been identified is more specific and emphasizes the catalytic influence that employee persistence and innovation bear on performance. Employee confidence, understanding of their role, and their skills and abilities are seen to contribute to their feeling able to perform in their role. With other factors, this feeling able to perform contributes toward motivation. A motivated individual with the necessary skills and abilities can, on their own, contribute to performance. However, the review of CBSC suggests that performance will more readily, and to a greater extent, occur where employees are being persistent and innovative. In the study by Purcell and colleagues (3), where positive elements regarding individual discretionary behaviour were present the level of performance was increased. From the review of CBSC, we can observe that the discretionary elements of persistence and innovation are key drivers of performance in contexts where obstacles to performance require employees to 'go the extra mile'. This is likely to be a common occurrence within the PNG health sector as a complex environment where the path to performance is rarely straightforward. The systems that support any role will often be weak, ineffective and unreliable – thus it may be that, to make a difference, the health sector relies on individuals exercising discretionary behaviour: being persistent and being innovative.

The implications for PNG health sector and interested stakeholders

CBSC support, when directed to the individual, is targeting the mediating variables – in the story extracts contained in this paper, these include 'confidence', 'motivation', 'skills and abilities' and a 'sense of responsibility for service outcomes'. However, the lack of systems integration and use of HR systems and practices within the CBSC in targeting support draws into question the utility and sustainability of this practice of targeting the mediating variables. In considering this question of relevance, a further finding of Purcell et al. (also supported by other studies) suggests that it is not the HR policies and practices themselves that are crucial for sustaining the link between HR and performance, but rather the way management in general – but especially immediate line managers and team leaders – apply these policies and practices (3).

Whilst the CBSC support is ostensibly separate from the respective organizations in which the individuals supported are

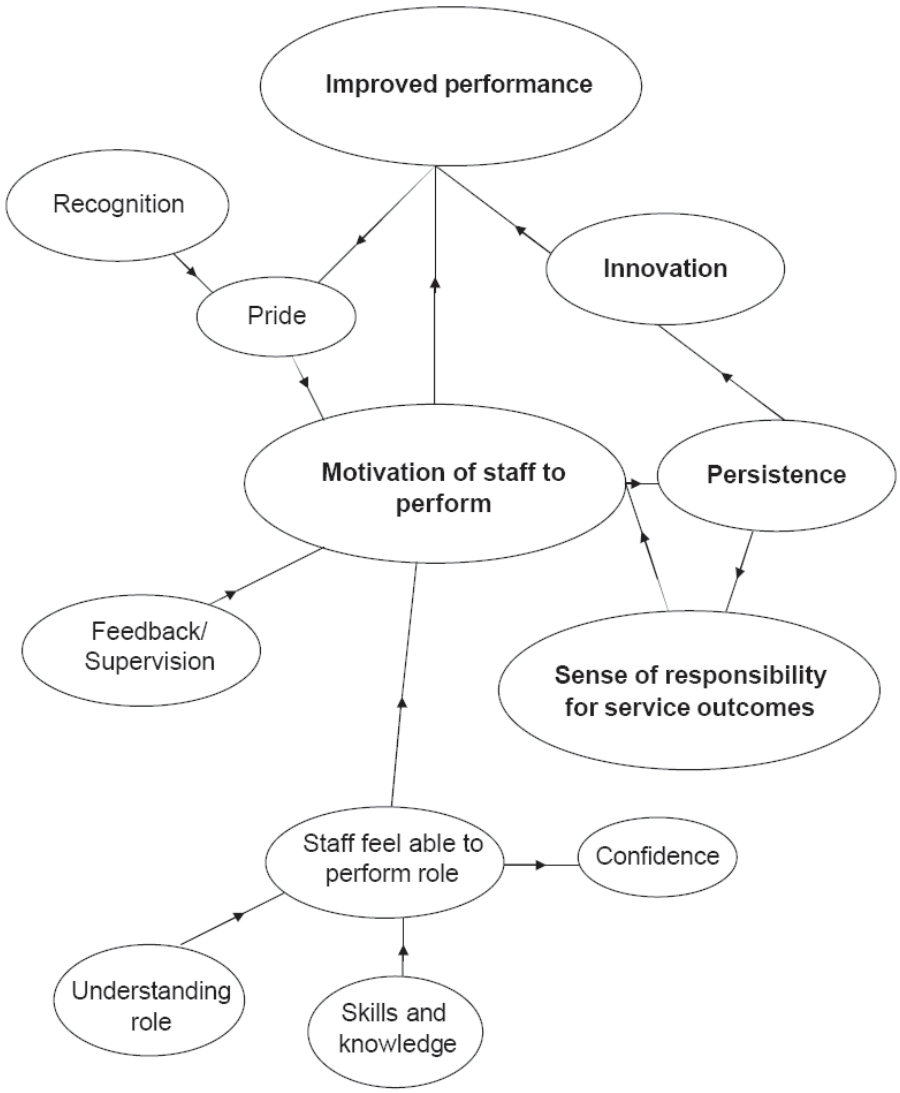

Figure 2. Retrospective Capacity Building Service Centre program logic. Redrawn from ref. 4.

employed, its function is not foreign to the organizational setting. The nature of CBSC support is akin to the function of a leader, which can be defined as "the process in which an individual influences other group members toward the attainment of group or organizational goals" (5), and its positioning akin to that of a facilitatory-style line manager. It follows, then, that whilst CBSC outcomes may or may not be sustainable (the question falls outside the scope of this paper), the insight regarding the conceptual relationships is of sustainable influence and of significant relevance for continued practice. The importance of recognizing the catalytic power of discretionary behaviour, of engendering commitment and motivation – and in turn persistence and innovation – in an environment where systemic support is weak, is of equal if not greater importance to all health sector leaders and managers as it is to CBSC and comparable initiatives.

It could be argued that such efforts are futile at the service delivery end of the sector – and developing innovation and persistence at an individual level within ineffective systems may actually harm levels of motivation, as systemic failure overcomes the positive momentum achieved within individuals. For example, within the PNG health sector, despite all effort and innovation at service delivery points, it may occur that essential medical supplies cannot be accessed and service delivery disabled accordingly; or perhaps on a more strictly HR front, the payroll system is not working effectively and staff members, as a result, are not getting paid. These systemic disablers of performance are apt to disrupt and present a strong argument against focusing on the mediating variables that link HR to performance. Whilst this paper does not seek to make such a recommendation (but merely identifies the linkage and catalytic role that persistence and innovation play with regard to performance) there are a number of counter-arguments for consideration by health sector leaders and managers in contemplating these relationships.

A context of ineffective management systems and poor performance across the sector distinguishes the PNG health sector from the participant organizations in the Purcell et al. study (3), and whilst the recent CBSC review suggests that the scope for discretionary behaviour to drive performance is undiminished (if not heightened) in this circumstance, the question of whether this only holds true in the short term has not been addressed. The intervention of a systemic failure (or other confounding factor) that threatens employee motivation and commitment is analogous to (if not congruent to) a breach of the 'psychological contract'. As the study of Purcell et al. acknowledges, when this occurs, performance drops. Moreover, the regularity and severity of such events are likely to be increased and heightened within a developing context. Against this, however, the expectations of employees (in terms of HR policies and practices, as well as related stakeholder performance issues) are likely to be vastly different to any of the organizations in the Purcell et al. study (3). Further, an American study (6) has suggested that it is not the breach of the 'psychological contract' that is the major threat to performance, but rather the climate of employee relations at the place and time when such a breach occurs and how it is understood. According to Robinson and Rousseau (6) the negative consequences that accompany a breach of the 'psychological contract' are much less likely to occur when there is a pre-existing high level of trust between employees, their managers and the organization and there is effective communication on why the problem occurred that triggered the action. Remembering that any exposition of the relationship between the mediating variables that link HR to performance is inevitably only a partial truth, 'commitment', 'innovation' and 'persistence' present as possibilities open to the entire sector (where other improvement initiatives may not, for want of mandate, resources or many other reasons) – and the risks associated with their development can be managed and mitigated.

Conclusion

The causal relationships between the intermediate variables, or capacity states, of the human resources of an organization and performance are uncertain. Employee job satisfaction (where the 'psychological contract' is intact), commitment and motivation are considered to be the core drivers of performance; however, the study by Purcell and colleague (3) suggests that it is the 'discretionary behaviour' of individuals that is the crucial variable in achieving high levels of performance – a variable that is considered to be partially dependent (and influenced by) employee commitment, job satisfaction and motivation. The recent review of CBSC capacity-building programs in the PNG health sector identified the importance of individuals' discretionary behaviour; specifically, it attributed improvements in performance to the catalysts of individual persistence and innovation. This presents an insight for management and leadership approaches within the health sector – in particular in its periphery with those more directly responsible for delivering services – and has potential to overcome broader systemic constraints that any single organization, agency or initiative is positioned or mandated to address. The critical role of individuals' discretionary behaviour in driving performance in the PNG health sector emphasizes the importance of being interested in and motivating employees; fostering organizational commitment and a sense of responsibility for delivering services; maintaining informal as well as formal

networks; encouraging and supporting individual discretion and innovation; and developing an attitude of 'press on'. For resultant improvements in performance levels to be institutionally robust and sustained, employee expectations on what is possible need to be managed, a relationship of trust has to be maintained, and open communication on issues that threaten that trust needs to occur.

ACKNOWLEDGEMENT

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Public-private partnerships for health – what does the evidence say?

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SUMMARY

This paper provides an overview of the literature regarding public-private partnerships (PPPs) by examining several case studies from around the world and documenting the lessons learned across different PPP models. In addition, it focuses on experience in the facilitation of two PPPs between the public and private sectors in Papua New Guinea (PNG) and discusses the potential benefits that may be delivered to PNG communities through pursuing further such PPPs for health.

Introduction

Public-private partnerships (PPPs) refer to a wide variety of ventures involving diverse arrangements, from small, single-product collaborations with industry to large entities hosted in United Nations agencies or private not-for-profit organizations (1).

Definitions of PPPs tend to vary based on the objectives, ideology, scope, composition, funding mechanism and structure of the partnership. The Global Health Initiative (GHI) defines a PPP as a voluntary collaboration that builds upon the strengths of each partner, optimizing equitable resource contribution and allocation to achieve a shared agenda which produces sustainable results for the benefit of all involved (2).

The Initiative on Public-Private Partnerships for Health (IPPPH) was created to study PPPs for health. It identifies two main types of PPP: those with a product development focus, and those which focus on improving access to health services. The IPPPH concluded that PPPs for health "provide significant benefits with very few side effects, particularly in the case of tropical diseases" (3). PPPs may be classified into four major categories:

1. **Global health initiatives:** generally originate in developed countries with the aim of improving health conditions around the world, often with a focus on poor and developing nations (4,5).

2. **Privately financed public sector projects:** most commonly in developed nations including Australia, New Zealand, the United Kingdom (UK) and many European countries (6,7).

3. **Local, national or regional partnerships led by public or civil society:** operate around the world, with the Community Care Network (CCN) in the United States (US) being an example of such a partnership (8,9).

4. **Industry partnerships:** most common in developing countries, especially in the African region, with many multinational corporations, national industrial enterprises and small to medium-sized enterprises entering into health-related PPPs in the last few years in a wide range of sectors – including mining, oil and gas, agriculture, food and beverage (10,11).

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The World Health Organization (WHO) (1) describes the following objectives of PPPs:

- To develop a product, eg, the Medicines for Malaria Venture
- To distribute a donated or subsidized product to control a specific disease, eg, initiatives to distribute leprosy medicines
- To strengthen health services, eg, the Gates Foundation/Merck Botswana Comprehensive HIV (human immunodeficiency virus) and AIDS (acquired immune deficiency syndrome) partnership
- To educate the public
- To improve product quality or regulation
- To contribute towards health improvements for the poor by combining the skills and resources of organizations in innovative ways.

During the mid- to late-1990s, enthusiasm for PPPs grew in response to several factors, including: (i) the growing scepticism about a private sector approach; (ii) a growing pattern of collaboration in the US between the federal government, private universities and private pharmaceutical companies in the development and marketing of new pharmaceutical products – such as the collaboration initiated by the Bayh-Doyle Act that was passed by Congress in 1980; and (iii) the decision by the Rockefeller Foundation, the Gates Foundation and other organizations to utilize PPP models to address the growing world-wide crises of HIV and AIDS, malaria, tuberculosis (TB) and other major diseases (12).

A large proportion of the literature is concerned with global health initiatives which generally include a wide variety of partners, including national governments, international agencies, donor agencies, non-government organizations (NGOs), private health care organizations, pharmaceutical companies, philanthropic organizations and industrial organizations. These initiatives are formed to accomplish a wide variety of aims and have resulted in extensive experience in the drawing together of diverse partners in order to achieve health improvements for the public good. Other literature is focused on partnerships which involve partners from industries whose core business focus is not related to health care.

A major source of case study information concerning industry-based partnerships for health is the GHI, which was an initiative of the World Economic Forum (WEF). The GHI has produced over 50 case studies of industry-based health programs for HIV and AIDS, malaria and TB. They have also produced broad evaluations of opinion and capacity regarding these diseases within industries in Africa. Guidelines for industry programs and some partnership-related material have been published through the GHI.

This paper will review the general findings of the literature and summarize models of relevance to Papua New Guinea (PNG).

Models of PPPs

While large amounts of money are flowing into countries to implement and manage interventions for diseases such as AIDS, TB and malaria, health system failures limit how quickly these interventions reach patients and communities. Significant attention has been focused on strengthening public sector management and provision of health systems, but not on how the private sector can assist. Private delivery of health care in developing countries is becoming common, and it is frequently in these countries where the poorest of the poor receive care. This private delivery of health care is, however, often unregulated. The private share of health care expenditure, particularly out-of-pocket spending by the poor, in developing countries is large and growing (13). Figure 1 provides an overview of the key types of PPPs for health.

Table 1 outlines the possible roles and benefits for different partners in PPPs for health, education and poverty alleviation.

A Gates Foundation review of PPPs (16) states that PPPs should have a well-defined and compelling overall goal. The scope should be unambiguous in terms of geography, patient populations, functional activities, timelines and intended benefits for each partner. Partners should also be cognisant of their roles and responsibilities in order to realize the benefits.

The Gates Foundation identified five basic

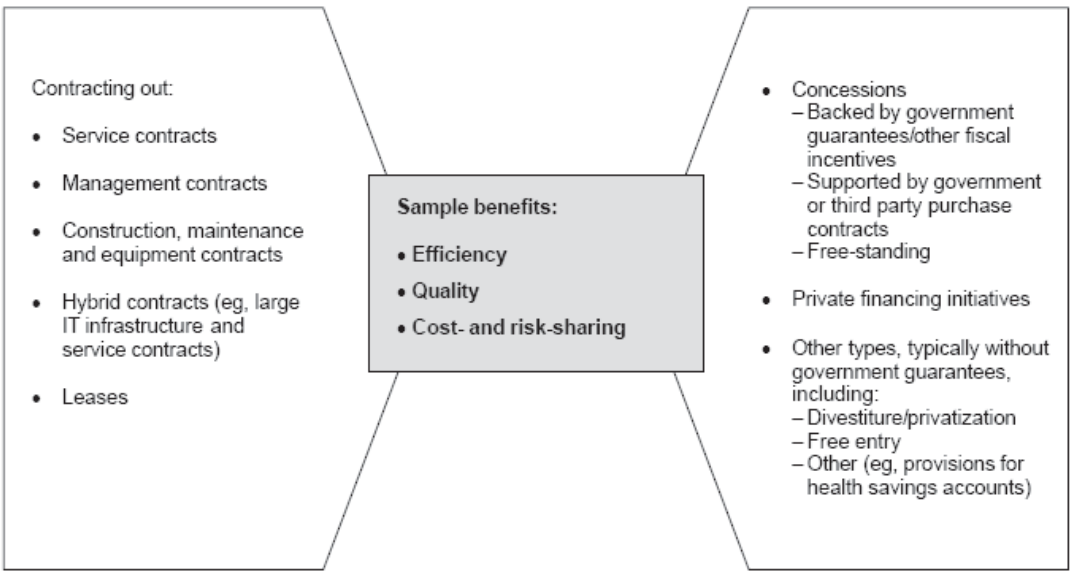

Figure 1. Key types of public-private partnerships and collaboration in the health sector.
Source: Public-private partnerships and collaboration in the health sector: an overview with case studies from recent European experience. The International Bank for Reconstruction and Development and The World Bank, Washington, DC, 2006 (14). IT = information technology.

PPP structures:

1. **Simple affiliation:** Lacks a formal structure or staff, and is coordinated by a board, steering committee, technical working groups and informal communications to make decisions. In most cases, partners operate as equals. This structure has benefits in that the costs are minimized; it promotes fast, personalized and flexible decision-making; and is suitable where informal collaboration is the primary mode of interaction. However, it generally lacks dedicated staff and typically will lack a single accountable leader.

2. **Lead Partner:** One partner assumes a strong leadership role, defines the strategic and technical agenda, and works with other partners to make operational decisions. This model is appropriate where the alliance seeks deeper coordination or combination gains between partners, and where one partner is a natural leader (eg, the lead partner has recognized expertise in the field, and has the alliance as part of its core mission).

3. **General Contractor:** One partner is the clear leader, decision-maker and controller of funds; this partner's staff operates the alliance, which places substantial power in their hands. This model can be highly effective in environments requiring speed and risk-taking, where it is important to have any one partner play the project manager role, and where that partner has specific and crucial skills. To function effectively, the general contractor must be a leader that others are willing to follow or work with as subcontractors.

4. **Secretariat:** Quasi-formal partnership organization and staff, with small partnership office and skilled managers supporting key partnership functions. There are a group of partners operating more or less as equals and generally characterized by centralized funding. Secretariats can be expensive to create and maintain in terms of both cost and time, and this model is therefore appropriate when partners seek deeper

TABLE 1

ROLES IN MULTI-STAKEHOLDER PUBLIC-PRIVATE PARTNERSHIPS*

Partner	Contribution
Global private sector	• Core business competency • Strategic philanthropy • Policy advocacy • Program leadership
International donors	• Resources • Development expertise
International NGOs	• Global networks • Implementation experience • Development expertise
Academic institutions	• Education expertise • Technical expertise • Monitoring and evaluation capability
Local private sector	• Resources • Local leadership • Entrepreneurship • Execution on the ground
Local government	• Stewardship • Openness to innovation
Local technical agencies (private and NGOs)	• Development expertise • Implementation expertise • Technical expertise • Partnership brokering

NGOs = non-government organizations

*Source: Amended from: Harnessing private sector capabilities to meet public needs: the potential of partnerships to advance progress on hunger, malaria and basic education. World Economic Forum, Geneva, 2006 (15)

combination gains, a large number of diverse partners are involved and separation from parent institutions is desirable.

5. **Joint Venture Company (JVC):** Partners create a separate legal entity with its own staff and resources, and the entity is allowed to operate more or less independently. This model requires more effort to create and roll out, and add focus and separation from parent institutions. It is best used to seek deeper gains while valuing risk-taking and operating speed. It is used frequently when a private company is directly involved as a donor, to provide some formal separation of the not-for-profit activities of the partnership from the for-profit activities of the company. The success of a JVC requires establishment of the separate entity and providing the entity with sufficient independence and resources (16).

PPP case studies

Spain

The Alzira Public Private Investment Partnership (PPIP) is an established partnership between a consortium of private companies led by Adeslas, a private health insurance company, and the Valencia

Government. Starting in the late 1990s, the government of Valencia embarked on the PPIP model in an attempt to control costs while upgrading access and quality of health services. In 1999, the private consortium, which also includes a construction company, built the €61 million Hospital de La Ribera to serve as the cornerstone of this PPIP and to provide a full range of primary through to tertiary care services to a catchment area of 250,000 people at an agreed capitation rate. The contract between the government and Adeslas is for a period of 15 years, with a clause that allows for renewal. A specific stipulation in the contract limits Adeslas's return on investment to 7.5%. A unique feature of this PPIP is that the 'money follows the patient', in that residents within the catchment district are given freedom to choose where they receive care. Visits are tracked via electronic medical record cards, and if patients seek care outside of the Alzira health network, Adeslas must pay an agreed-upon fee to the provider that treats the patient. This model ensures that Adeslas provides quality care and service, or patients will go elsewhere. A study completed in 2007 showed that Alzira's operational costs were 25% less than the Valencia regional average for the same basket of services. Benchmarks show that Adeslas has an average length of stay in hospital of 4.8 days compared to between 6 and 7 days for the area's government-run facilities. Additionally, patient satisfaction is very high, with a rating of 87%. This model clearly demonstrates that the private sector has delivered a higher quality of service at a lower cost to the population of Valencia than the publicly run facilities. The success of the Alzira model has prompted the government of Valencia to initiate several more PPIPs (13).

Turks and Caicos Islands

The Turks and Caicos Islands (TCI) are an overseas territory of the UK, located southeast of the Bahamas in the North Atlantic Ocean, with a population of approximately 35,000 spread across several islands. Health services have traditionally been publicly financed through general revenue and managed by the Ministry of Health. The poor and limited infrastructure of the current facilities and growing health needs of the population made it increasingly difficult for the government to provide accessible and high-quality services. The Turks and Caicos Islands Government (TCIG) thus formed a PPIP with Interhealth Canada Limited (ICL) to build and operate two integrated primary, secondary and tertiary care facilities on different islands over a period of 25 years. The new facilities will be operational in April 2010. To support the operation of these facilities, the government is also implementing a mandatory national health insurance plan to cover its entire population, which will be funded through employer and employee contributions and subsidized through general revenue. The health insurance plan will be operational in 2009 to allow it to accumulate sufficient funds to ensure financial sustainability for the health care system. The hospital buildings and facility management services will be paid by the government through a set unitary payment over the life of the contract.

Clinical services will be paid based on a capitation formula which will be determined by accumulating two years of data from actual experience on utilization and costs once the facilities are operational. At the outset, a critical consideration for TCIG was to ensure that the majority of staff, including physicians, at the existing hospitals would transfer to ICL once the new hospitals were built. ICL has already begun a process to assess staff and provide extensive training to upgrade staff skills and build long-term capacity on TCI. Quality assurance is an important component of this PPIP. The arrangement provides for a detailed set of key performance indicators based on international standards within which ICL must abide. The agreement requires that the Canadian Council on Health Services Accreditation accredit ICL facilities; maintaining accreditation is a prerequisite for payment. The government will also provide ongoing monitoring of quality and access through the creation of a Health Regulatory Agency to monitor all health care on the islands (13).

Lesotho

Lesotho is a land-locked country, surrounded by South Africa, with a population of 1,804,000 and an ageing health system infrastructure. As part of a national health care strategy, the Minister of Finance and Development Planning spearheaded a $500 million PPIP to provide all clinical services and replace the country's 100-year-old main referral hospital in the capital city of Maseru. A key reason for pursuing a PPIP model was to improve the management of health

services delivery. Analysis of current facilities showed that by making an incremental increase in the resources devoted to these facilities, several thousand more patients could be seen through a public-private investment model. Demonstrating a clear plan for improvements in access and quality (ie, clear value for money) reduced opposition to the model by physicians, staff and others. In addition, government scepticism about the involvement of the private sector was overcome through examination of successful PPPs in other sectors. The contract, which was signed in 2007, is an 18-year partnership between Netcare, a South African health care company, and the government of Lesotho to replace the existing hospital and operate two feeder clinics, providing the full range of primary, secondary and tertiary care. The World Bank assisted the government with technical assistance through their International Finance Corporation arm, and by providing a political guarantee to allay private sector fears of investing in a low-income country from their Multilateral Investment Guarantee Agency (MIGA). All funding for the PPIP will come through government resources; expenditures are not expected to exceed health sector budget projections. This PPIP approach is being led by the Finance Ministry in partnership with the Ministry of Health in order to introduce the private sector as a long-term partner in health services delivery in a low-income setting (13).

Egypt

Egypt's population of 76.5 million is served by a comprehensive, but insufficient, publicly funded health system. Recent policy changes, including the implementation of universal health coverage and the initiation of the Takamol Project to incorporate a range of social components within existing clinics, have led naturally to a large-scale move to expand and update the health service infrastructure. The Egyptian Government is undertaking this expansion through a range of PPP modalities. Procter & Gamble and PricewaterhouseCoopers, for example, are supporting the system through their corporate social responsibility initiatives. The Al Bank Al Ahly Hospital, financed by the National Bank of Egypt, is a Private Financing Initiative (PFI) being used to expand tertiary care infrastructure. Although political and social opposition to engagement with the private sector remains a challenge, the initiatives have moved forward due to ministerial support, facilitated by the increasing autonomy being granted to all public hospitals, which has allowed local initiatives and collaborations to be entrepreneurial and adaptive to local opportunities (13).

Mexico

Over the past 60 years, Mexico's population of 102 million has undergone a significant epidemiological transition. In 1940 infectious diseases were the main cause of illness; today, cardiovascular disease and accidents are the most important drivers of morbidity and mortality. To address this change, the national health system is undergoing broad restructuring, building new health networks centred on regional specialty hospitals. Much of the infrastructure for the new networks is being built through PFIs, with both Mexican and international private partners. Engagement of the private sector for facility construction and management has allowed the public sector to concentrate on clinical service provision. Outcomes have been generally positive, although organizational and financial barriers remain. Decentralization of national health budgets to the state level was one of the primary facilitating factors in the growth of PFIs (13).

South Africa

Primary health care in South Africa is nominally free, but often inaccessible for poor communities. The private sector is an important participant in all areas of health in South Africa, and at least two private care models supplement the care available from the government, with a particular focus on filling the gap in low-income primary care. The first is the Primary Care Network Model, using contracting arrangements similar to those of health maintenance organizations, with both health insurance plans (for payment) and general practitioners (for provision of care) to provide defined access to primary care services. Primary Care Network Models serve 500,000 people, or 7%–8% of the insured population. The second model is the Primary Care Clinic Model, which provides health services through chains of purpose-built primary clinic facilities. Although smaller in coverage than the Primary Care Networks, Primary Care Clinics are supported by at least two companies and are profitable. As with the first model, most patients of the Clinic

Networks are covered by private insurance. Both private care models offer a cost-effective opportunity for the government to engage in partnerships to extend existing primary care services (13).

India

Indian health facilities are mostly located in urban centres, with poor availability in rural areas. India is going through a health transition, with non-communicable diseases becoming a major threat that the public health system is not geared to handle. Private health care providers make up a large proportion of India's health system, with utilization studies showing that a third of all inpatients and three-quarters of outpatients utilized private health care facilities.

The focus of various private-public collaborations has been on:

- Developing strategies to utilize untapped resources and strengthen the private sector with a public goal in mind
- Enhancing the capacity to meet growing health needs
- Reducing the financial burden of government expenditure on speciality and superspeciality care
- Reducing the regional and geographic disparity in health care provision and ensuring access
- Reaching remote areas or targeting specific population groups
- Improving efficiency through evolving new management structures (17).

The state government initiative in Tamil Nadu involved industry in improving the performance of Primary Health Centres (PHCs). Under the collaborative agreement, businesses adopt and take responsibility for the building, maintenance and equipment of a local PHC, health subcentre or district hospital. The state government has the continued responsibility to provide drugs and staff. Under a flexible memorandum of understanding (MoU) corporations are able to increase or reduce their involvement depending on the scheme's performance. Most of the industrial parties chose the PHCs around their plants, and to date industry has committed to spend up to INR13 million. The collaboration also provides an opportunity for the state government to get feedback from industry on various management issues of the PHCs (13).

Industry partnerships: Anglo American and HIV and AIDS – South Africa

"The Anglo American experience has shown that private sector action on HIV and AIDS can have positive impacts on health and profits. In high-prevalence settings, it is inaction that poses the greatest threat to business." (18). The HIV and AIDS program was initiated and developed within the company over the last 20 years. In 2003 it was extended out to the community and PPPs were initiated. The following key lessons have been learned:

- The first lesson for successfully managing an HIV and AIDS program is to focus on a limited number of goals and tasks. Anglo's goals are zero new infections, zero employees falling sick or dying of AIDS, and zero HIV-positive babies born to employees' families. Accomplishing these objectives can often depend on just one or two key activities.
- The second lesson is to define key performance indicators and set targets against them. Progress against the indicators should be measured regularly, so that changes can be made if results are inadequate.
- The third key lesson is to bring management expertise to community initiatives. Good management is essential if community HIV and AIDS projects are to work, and companies such as Anglo American have plentiful experience to bring to the table. A management structure needs to be in place for several years to make a difference and, as in all business fields, planners should endeavour to find managers with a strong commitment to the program (18).

Anglo's community efforts are based on applying past business successes to the community on a larger scale. An example of this is a project to build a community health centre in Lillydale, a poor rural area in Mpumalanga Province. Lillydale has a high

HIV prevalence, and the government health system has been unable to cope with the epidemic. A number of Anglo's employees come from the area, and the company is working to improve the quality of health care in the community through a PPP. Anglo Coal South Africa has partnered with Sir Richard Branson's Virgin Unite and the President's Emergency Plan for HIV and AIDS Relief in the initial project rollout. It also plans to partner with the local public health service and with non-government organizations.

The private sector and malaria

A recent report by the WEF (19) lists possible roles in malaria control for the private sector:

1. Health sector firms can develop new, cheaper or more efficient drugs, diagnostic tests and vaccines, and can work to strengthen medical infrastructure and training.

2. Construction and engineering firms can build mosquito-proof structures and promote vector control by eliminating breeding sites.

3. Energy companies can make dam reservoirs safe against malaria.

4. Food, beverage and retail sector businesses can use their strong distribution networks to deliver malaria prevention and treatment tools.

5. Information technology companies can work with governments to develop disease surveillance systems and to strengthen health management systems.

6. Media and entertainment firms can promote malaria awareness and education about prevention and treatment.

7. Financial services firms can help the poor cope better with malaria by developing microcredit programs that include information and access to health insurance.

8. Logistics and transport firms can deploy their services in delivering malaria commodities.

9. Business associations may contribute by distributing good practice guidelines and acting as an information resource to assist firms that lack the resources to create their own malaria programs. They can also encourage manufacturers of drugs and mosquito nets to provide consumers with comprehensive information and to combat the problem of counterfeit drug sales, which is prevalent in many developing countries (19).

Business coalitions for HIV and AIDS

In January 2008, the WEF produced a report on Business Coalitions for AIDS (20). There are four regional and 47 national business coalitions with a further 10 national business coalitions scheduled for launch in 2008-2009. Collectively, these coalitions have reached over one million organizations with HIV and AIDS policies and programs. Business coalitions are still a relatively new concept world-wide; more than 40% were launched in the last two years and more than 60% in the last five years. The four regional coalitions spanning Africa, the Arab region, Asia Pacific and the Caribbean were launched in the last two years.

To ensure success, coalitions have formed partnerships at the national, regional and international levels with key stakeholders. In addition to the private sector, these include international donors and stakeholders, other regional and national business coalitions, governments and civil society groups. These relationships are not only critical for the coalitions, but also for the wider stakeholder group to deliver a coordinated and complementary response to the epidemic. Some business coalitions are supporting the private sector to tackle not only AIDS, but also TB and malaria. For example, The Cameroon Coalition of Community Affairs for AIDS, TB and Malaria was established to support private sector efforts to address all three disease areas, and the Kenya HIV and AIDS Business Council recently introduced TB programs. In the private sector, an increasing number of companies are introducing wellness programs into the workplace, which can include HIV and AIDS. This destigmatizes HIV and AIDS by integrating the disease into an overall wellness package (20).

Industry partnerships: the Joint United Nations Programme on HIV and AIDS (UNAIDS) and Coca-Cola

The UNAIDS and Coca-Cola partnership utilizes the firm's vast distribution channels and marketing capacity for HIV and AIDS campaigns. These assets have also been deployed by the Global Polio Elimination Initiative. The identification and mobilization of firms and industries beyond the pharmaceutical industry represents a major challenge, but is also a potentially rewarding area of future development in PPPs. Even more encouraging is the fact that there remains tremendous potential to push the PPP envelope even further by attracting non-conventional firms and industries into international health initiatives and mobilizing untapped assets in the commercial and civil society sectors (21).

Lessons learned

The WEF (15) found that companies that have been successful in public-private initiatives often begin by assessing their own interests, goals and assets and then thinking creatively about how these could be applied to best meet development needs. In consultations with the WEF, PPP practitioners recommend the following key guidelines:

- Find motivated partners and agree on common goals, acknowledging different competencies and approaches
- Choose the partnership model best suited for the goal
- Identify a well-connected 'champion' to ensure the continuity and success of the partnership
- Create a win-win partnership with measurable benefits and results
- Define partners' roles and responsibilities clearly from the onset and build capacities to fulfil them
- Develop strategies for sustainable PPP financing and management in the early stages of partnership planning
- Focus on meeting the needs of customers and stakeholders, rather than external contributors such as donors
- Represent and include all stakeholders in the planning and life cycle of the partnership
- Agree on clear targets, monitor progress and agree on an exit strategy where appropriate
- Manage PPPs as a business unit within the company
- Provide strong coordinating mechanisms and effective governance for collaborative PPPs
- Convene public and private stakeholders to catalyse and broker partnerships, share best practices and guidelines, and identify funding sources
- Conduct consistent and long-term monitoring and evaluation studies to evaluate PPP outcomes.

The Gates Foundation (16) identified a number of elements related to operational planning and performance of PPPs:

- Success of PPPs requires a degree of operational planning, partner commitments, and performance targets and monitoring
- Detailed operating plans are important to effectiveness and efficiency
- Mechanisms to ensure effective and timely decision-making and access to resources are important
- Partners must define their roles and make specific resource commitments (eg, staff, technology, money, facilities etc)
- A shared vision of success is important
- Concrete performance targets and deliverables should be set at various stages of the partnership
- There is a need for a simple but powerful performance measurement tool/scorecard
- Tracking performance across these three dimensions was found to be

useful.

PPPs and relationships

"The relationship between public and private sectors has traditionally been, at best, icy. The private sector has seen governments and NGOs as inefficient, holier-than-thou bureaucracies, simultaneously squandering public money and complaining about not having enough of it. The public sector, on the other hand, has tended to view all business as inherently selfish and all business incursions into the public sphere as hypocritical." (22).

Relationship issues are critical to the success of PPPs. The importance of maintaining consistent high-level commitment to the partnership or initiative, and of dealing consistently and effectively with changes in the membership of the partnership, cannot be understated. It is these latter issues which require management of the differences in private and public sector motivations, expectations, ways of 'doing business', and other 'people issues' that are the focus of the following discussion.

Public and private sectors don't speak the same language

There is a longstanding and deeply rooted mutual suspicion in the relationship between the public and private sectors, and a significant challenge in forming PPPs is dealing with such attitudes and building understanding and trust. The public and private sectors have different incentives and objectives – at the basest level, social good versus commercial gain. Governments (and often donors) tend to think that any activity taken by the private sector is likely to be solely motivated by a drive for profit, or that the private sector generally takes advantage of situations to promote their own interests. Some may have ideological objections to the work of mines, or to making profits in general. On the other hand, the private sector can be disdainful of government capability and see cooperation with the public sector as a waste of time, is impatient to see quick action, and lacks an understanding of communicable diseases and their potential to impact on productivity. A desire in private industrial ventures to operate 'inside the fence' can be both longstanding and entrenched.

Miners are good at mining

Many mining companies feel that managing health is important, but don't know exactly what to do about it. Large-scale mining operations require a wide variety of professional expertise to plan and operate their mining ventures, which often involve the development of innovative solutions to highly complex technical problems. In terms of financial, business, project management and technical skills, mining companies are well equipped. There is often a focus on problems which are critical to the success of the mining process, which frequently involve controlling highly hazardous energy sources and chemicals.

Mining professionals, however, have not traditionally been seen to give public health care a high priority. The construction of a hospital or medical centre and the provision of basic health services has for many years been a common approach to health management in the mining industry. Longer-term community-based public health strategies are not often seen in the industry, and, if they do occur, most are the result of high levels of disease in the workforce threatening the production process.

While the threat of financial failure due to public health issues is generally averted by current practices, the potential benefits of proactive public health programs in terms of improved productivity and contributions to sustainable social and economic development have not yet been publicly recognized. In this respect, mines 'don't know what they don't know', and a strategy to create a demand for public health technical expertise is needed.

Public and private sectors have different incentives

While the public sector mandate is to provide health services to the population and improve public health conditions, the private sector mandate is to create enhanced shareholder value. Thus, it is not always immediately obvious to private sector management why they should invest shareholder capital into health programs, especially beyond their own workforce. Private sector chief executive officers (CEOs) need to be convinced by a sound business case that disease can impact upon economic

growth and business, and that by improving health they can save money, reduce staff turnover and improve their risk profile. At a broader level, they need to be convinced that being actively involved in community health programs will improve their reputation and relationship with stakeholder communities, and ultimately their 'social licence to operate'.

The private sector gets things done

Once the private sector has been convinced to engage, things happen. The private sector is accustomed to getting things done and moves fast. In JTA's experience, the active support of the private sector in the rollout of public health initiatives enables the initiatives to be delivered faster, and often better. Regardless of the effectiveness with which the private sector implements initiatives, unless the capacity of government to sustain these initiatives is also built, they will collapse after mine closure.

Third parties can help

Significant and encouraging progress was made in several Papua New Guinean mining/ health PPPs; however, it is unlikely that this would have been the case without the assistance of a third party in the creation of an environment characterized by open dialogue and a shared vision of the benefits of the partnership. Even with open dialogue between partners, it was found that there is a constant need to manage and maintain the partnership relationship. Importantly, there have been times when the politics of the general relationship between the mine and the government have slowed the progress of the PPP. The dedicated efforts of a third party to maintain focus during the course of implementation has been highly beneficial.

If each partner has agreed to common objectives from the inception of the partnership and has a clear understanding of the benefits of partnership, a third party can assist them to overcome their differences and come back to the table. A specialized third party is often also in a better position to identify and leverage the resources of other agencies (such as donors) to support the extension of specific elements of the public health programs.

In relation to public sector advocacy for PPPs, tools are needed to assist companies in assessing the risks to their business in relation to health issues, which will assist companies in realizing the benefits which PPPs for health can provide to their core business objectives, and in recognizing the value of PPPs for health.

The Wilton Park Conference on PPIPs (13) identified a number of critical success factors for PPPs, including:

1. Trust between sectors
2. Political will and feasibility
3. Third party assistance
4. Coordination between ministries
5. Integration into larger systemic goals
6. Obtaining buy-in from the community
7. Data collection and evaluation systems
8. Flexible, long-term contracts.

And to the future …

PNG has a long history of health services funded and provided by government. Even the churches, which are in reality 'subcontracted providers to government', have long been seen as an extension of the government health system. In many parts of the country, the government has been unable to provide services to its own standards.

Benefits

There are potential benefits in looking at future mining developments as having social sector potential, as well as economic potential. While many will question the sustainability of engaging third parties in the provision of services, this should be seen in the context of the long life cycles of most mining operations, which can exceed 20 years.

The benefits to government are:

1. Expansion of the reach of public health services
2. Strengthened financial, logistical and in-kind support
3. Improved infrastructure capability to support operation and maintenance

4. Strengthened public health programs for priority issues such as HIV and AIDS

5. Capacity development of the health system

6. The presence of a viable partner who can guarantee delivery of strategic health priorities in districts over a long period.

The benefits to industry are:

1. Improved social development in mining-affected areas

2. Improved quality of health care for workforce

3. Strengthened risk mitigation in relation to epidemics and communicable disease

4. Communities from which it will draw much of its workforce will be healthier

5. Enhanced social licence to operate.

Funding

There are a range of potential funding sources for PPPs, including: government; private sector; landowners; the Sustainable Development Program Company; related Foundations (eg, the Ok Tedi Development Foundation); donors; members of parliament; the tax credit scheme; and equity and debt.

Depending on the specific context, a long-term funding plan would need to be developed and might comprise a mix of government, private sector, donor contributions, royalties and tax credits. The National Tax Credit Scheme provides significant potential to fund infrastructure once a mine is operating. The establishment of a long-term funding mechanism for maintenance and operating costs which can sustain the delivery of health services after the closure of the mine is the most important aspect of funding arrangements in terms of sustainability.

Governance

There are a range of models operating in PNG currently. The 'HIV in Enclaves Project' of the Asian Development Bank (ADB) has the National Department of Health (NDoH) as the 'executing agency'. The North Fly Integrated Health Programme has an Implementation Coordinating Committee consisting of all key stakeholders. In Morobe, it is proposed that the governance framework of the PPP will be integrated into the current Morobe Provincial Management Unit (MPMU), which already provides governance support to PPPs in the agricultural and education sectors. The MPMU is chaired by the Provincial Administrator and consists of representatives from the government, landowner groups and industry. The PPP will require that the mining company, Harmony Gold, becomes a statutory member of the MPMU. On Lihir, the landowners have formed an alliance with the technical service provider and are jointly implementing the program.

Building government capacity to monitor and regulate

Currently, the PNG Government does not have the capacity to monitor and regulate a widely subcontracted health service model. Specific elements that would require development include: an appropriate policy and regulatory environment; contracting and monitoring expertise; access to expert advisers for due diligence and transaction implementation; development of payment and performance models; and the expertise to develop, manage and negotiate.

There are currently opportunities to address these issues. In April 2008, the government signed a MoU for Proposed Technical Assistance for the Development of a National Public Private Partnership Policy for PNG with the ADB. The PPP framework should be composed of four core components: (a) policy statement, (b) institutional arrangements, (c) legal and regulatory parameters, and (d) implementing guidelines. Complementing this is the opportunity, within an ADB health sector technical assistance grant, to develop a governance framework for PPPs for the health sector.

Conclusion

The experience with PPPs involving the mining sector in PNG has been extremely encouraging. The inability of the PNG Government to deliver adequate health services to much of the population provides an opportunity to reflect on the role of

government in health service provision. In PNG a significant proportion of health services are already, in effect, 'contracted out' to the churches. There seems to be little reason why other providers with appropriate skills and capacities could not also be engaged by the government to provide services to significant geographical areas. For this to be successful, it will be necessary for the government to develop additional regulatory, contracting and monitoring capabilities. Changes of this nature in PNG's approach to health service provision will require some manoeuvring of mindsets on both sides, but they are not out of the question.

There continues to be bullish estimates of untapped mineral resources in PNG, with the resources sector expected to remain a significant element of PNG's economy for many years to come. Because of its rich mineral potential, PNG has often become referred to as 'a pot of gold'. With a little ingenuity, turning that gold into health care in PNG is well within reach.

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Working together for a better future

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SUMMARY

In this review we reflect upon the papers within this focus issue of the *Papua New Guinea Medical Journal* on the theme of health system strengthening, and provide a summary of lessons learnt and ways forward from the lessons and experiences of the past. Priority areas have been identified for consideration by the health sector and its various players and stakeholders moving forward, particularly in the context of the next National Health Plan. The imperative need to focus on the basics is emphasized: to make sure that key health interventions are implemented; that health workers have requisite skills and are placed where services are needed; that there is an uncompromising focus on ensuring, by whatever means, that the essential logistical elements are there to enable the health worker to provide the interventions; that key messages are communicated to, and provide support for, communities to attend care and practise health-promoting behaviours; and that population coverage is increased. The need for a long-term, systematic approach to getting the basics in place is essential. In developing and implementing this approach, caution needs to be taken with regard to confusion between means and ends. It is important to maintain focus on the desired outcome – improved health of Papua New Guineans; and to use, but not be distracted by, the means for getting there – including the various health sector reforms being implemented. It is essential to identify and focus on ways in which the existing capacity within the system can be harnessed, and to ensure that the environment supports the effective and efficient use of existing capacities. The capacity of the health sector – and the careful, measured use of partnerships – to extend service delivery to underserved populations is discussed in broad terms.

Introduction

Take time to gather up the past so that you will be able to draw from your experience and invest them in the future.

Jim Rohn, Business Philosopher

This focus issue of the *Papua New Guinea Medical Journal* on health system strengthening includes a series of health sector experiences of the last 10–15 years in Papua New Guinea (PNG) to identify gains made, changes attempted and paths travelled in order to improve the health and well-being of Papua New Guineans. The goal of the new National Health Plan (NHP) 2011-2020 will seek to achieve the same – improved quality of life for all Papua New Guineans. Although not comprehensive, the issue illustrates the breadth and depth of the reforms undertaken, and the various tools used by health managers, planners and implementers to guide decision-making for reform and planning. It has also illustrated the interrelatedness of various aspects of the health system, whole-of-government governance and reform, and the role of communities in shaping the health system. Reviewing the achievements and lessons of the recent past can assist in guiding the future of the health sector and provide some leads with regard to where, together, investments should continue – or be made to continue –

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in order to improve the outcomes of the system in the most effective, efficient and affordable manner.

What are the health problems – the numbers game?

The most fundamental task of health services is to prevent unnecessary deaths. The Demographic Health Survey (DHS) estimated maternal mortality to be 370/100000 live births in 1996 and 773/100000 live births in 2006. Maternal mortality is extremely susceptible to the availability and utilization of health services. As noted by the Ministerial Taskforce on Maternal Health in PNG, the poor state of the maternal health statistics is a proxy for the poor health of the health system.

Gains have been made in some aspects of mortality and morbidity over the last two decades (1). However, this has come at a price – declining mortality, but only slow decline in fertility, have led to an average annual growth rate in the order of 2.8%. Many – including the recent Ministerial Taskforce on Maternal Health in PNG – have noted that, if fertility declines only slowly, the population will reach 10 million soon after 2029. With an accelerated decline, the population will be about 1 million persons less in 2029. *The need to address the unmet need for family planning in PNG is obvious, and is categorically a priority for the next decade and beyond.*

Infectious diseases, which dominate the cause structure of mortality, should be susceptible to health service intervention. Prerequisites are an appropriate mix of interventions, high levels of coverage, and high quality monitoring and surveillance. These are well defined, and have been reiterated in many of the papers of this issue. These interventions are not new – they need to be implemented. *The most fundamental determinant of impact of an intervention is its coverage.* If an intervention does not reach the intended population, it can have no effect; Riley and Thomason et al. both emphasize this point (1,2). There is clear and abundant evidence that, if a basic package of health interventions is delivered, health will improve. What recent history has shown is that, when interventions are implemented well, performance and resultant outcomes do improve. For example, Milne Bay Province continues to have higher performance levels than other provinces, even though it is working within the same government structures, with similar financial and resource shortages as other provinces. However, the majority of the PNG health system is suffering from implementation failure.

At the simplest level, what needs to be provided by the health system (and what was previously provided by the health system before Independence) is:

1. Effective interventions for the main causes of morbidity and mortality, where and when required
2. Skilled health workers at the point of service who are able to provide those interventions (3)
3. Essential logistical elements to enable the health worker to provide the effective interventions: basic facilities; treatment manuals; drugs and medical supplies; radio communications; transportation for referral; and an equipped referral centre, able to manage emergency and trauma
4. Information, education and communication, and other health promotion initiatives and efforts directed at communities – to obtain their cooperation and acceptance of the interventions, and to support and empower their engagement in healthy behaviours
5. Population coverage.

Interventions include encouraging and supporting healthy behaviours and health-promoting environments. Understanding the perceptions of severity, the causes and risks of health problems, and the health-seeking behaviours related to these problems, is a critical element of program and intervention planning. Implementation of interventions – and ensuring the planned coverage of interventions – requires an insight into social, cultural and gender-related acceptability, affordability and accessibility of these services. Whittaker et al. (4) highlighted the importance of seeking this qualitative information for planning, monitoring and evaluation of PNG health programs.

It is critical that unsolved disease problems

be fully addressed; the combination of increasing urbanization, the AIDS (acquired immune deficiency syndrome) epidemic and an increasing prevalence of non-communicable diseases will place upward pressure on mortality rates**.** *The unsolved problems of infectious disease need to be addressed as expeditiously as possible to prevent the risk of health services being overwhelmed.* PNG has reached a critical point in terms of mortality change. Although infant mortality has continued to decline, upward pressure on mortality rates will be experienced in at least three areas. The first entails the effects of population growth, which will vary from province to province and from district to district. Thus far PNG has been spared the effects of rapid urban growth. However, once a point is reached where subsistence agriculture can no longer support rural populations, a greater and increased rate of migration to urban areas – and the resultant increased strain on already weak infrastructures, including those of health – is inevitable. Areas of high population density, such as the Highlands Region, parts of the Sepik and the Gazelle Peninsula, may well be the first to evidence these effects. Second, the HIV (human immunodeficiency virus) epidemic will increase mortality in young adults through its direct effects, and through increased transmission of tuberculosis. The third area of upward pressure on mortality relates to increased mortality from non-communicable diseases. The effects of increased obesity, and of the shift from traditional tobaccos to cigarettes, will become apparent in the cause structure of mortality.

PNG faces a future of being trapped between the unsolved problems of infectious disease and preventable maternal health problems on the one hand, and the diseases of the epidemiological transition on the other. These diseases are more difficult to treat than acute infections, and demands on health services will continue to increase and will change. The need to understand necessary changes in health and prevention behaviours during these social shifts will be important in terms of planning ahead for the new 'epidemics' (4). Added to this equation will be the threat of infectious disease outbreaks by new, emerging, re-emerging and established diseases in PNG. Whatever the precipitating causes – disasters, pandemics, climate change – the capacity to monitor, identify, respond to and contain these in a timely, effective manner will be increasingly required in the future.

Even more importantly, disease control programs require accurate data for monitoring and surveillance. Even with high levels of coverage, the application of interventions without careful monitoring is not likely to be sufficient for purposes of disease control. Health services need methods for estimating adult mortality, in particular, methods which have been validated in its own population. Health managers and planners need to be aware of the strengths and weaknesses of current estimates of mortality which, due to wide differentials in mortality and fertility, are inadequate for planning at provincial and district levels. *Health managers also need to have and maintain the capacity for decision-making based on high-quality health information.* Wide differentials in mortality among provinces indicate considerable variation in mortality change. These variations need to be managed. Local-level planning, by staff who are skilled in the use of data for public health action, is a key to ensuring this approach.

Resourcing the system

It is clear what needs to be done – but is it affordable? Probably not in the medium term. Despite enthusiasm about the forthcoming liquefied natural gas (LNG) project, PNG government agencies are expected to face a tight fiscal environment that will lead to reduced budget allocations in the near term (5).

A major achievement of the Medium Term Expenditure Framework (MTEF) was to translate resource allocation decisions into 2004 official budget programs, and provide budget ceilings for branches, when for the first time National Department of Health (NDoH) branches were given budget ceilings to produce affordable Annual Activity Plans (AAPs) and to plan ahead the activities that would be cut down due to funding shortages. This led to resources being shifted towards top health priorities and saw funding increase from K29 million to K73 million from 2002 to 2006 (6). A key policy question raised by the MTEF is whether the range of services is sustainable. The direct service provision costs in all key priority areas are expected to rise rapidly due to changes in population, changes in price in accordance with the

expected inflation rates, changes in coverage rates for the interventions, and changes in the intervention profile during the period – for example, the introduction of the Hib vaccine for *Haemophilus influenzae* type b. This raises the question of whether any new services are affordable. Merely keeping up with the pressure of population growth and some relatively modest coverage increases will subject PNG to substantial resource pressure. Consequently, careful thought needs to be given to the extent that new services can be resourced. Containing population increase would produce savings. For example, the savings from maintaining the number of infants requiring infant immunization at the 2006 level would itself fund increasing the level of contraceptive coverage by approximately 25% by 2008 (7).

Despite the considerable early potential of the MTEF (8), it seems to have evolved into a sophisticated costing model (7), and NDoH personnel still lack the necessary budgeting, costing and financial skills required to properly support the MTEF. Not only does this affect the quality of MTEF processes, but it also undermines the NDoH's negotiation power with development partners (DPs) and central agencies, as NDoH personnel are unable to suitably analyse the implications that proposals will have on government expenditure and health budgets (9). The MTEF does not now appear to be linked to the National Budget timetable or processes; nor does it appear to impact on resource allocation decisions. *This is a matter to be addressed if the limited pool of resources is to be used effectively*. New partners and funding from the Government of Papua New Guinea (GoPNG) for infrastructure in rural areas have not been included in the review process and priorities of the MTEF. The funds have just been added to the total available, but a serious critical review of priorities needs to be undertaken and has not been done systematically since 2002. This has led to distortions in spending in the first, second and third level priorities; in particular, there have been major increases in training and technical advisory costs and in infrastructure expenditure without clearly prioritized plans to guide the spending. The new NHP provides this opportunity.

The MTEF did not include the costs of recruiting, maintaining and improving the competency levels of human resources for the health sector. Limited by a clear medium-term human resource development plan, the MTEF focused mainly on the costs of scaling up coverage and keeping the doors of existing services open at the present level of quality and efficiency. However, clearly there is a need to address the health services' human resources needs. Aitken and Kolehmainen-Aitken (3) discuss the human resource gaps in geographic, cadre and specialization areas, noting in particular some of the immediate needs in terms of addressing maternal and child health and infectious disease control. They identify the need for careful mapping of the required and desired competency levels, and to analyse the workloads of various key positions in the health system. Using these tools, along with carefully considered engagement with other government sectors and the training sector, would help develop, and then cost, a human resource development plan for health.

The picture painted above suggests that, in many places in PNG, the basic requirements to deliver health outcomes are simply not there. Health improvement will only be achieved through partnerships. The NDoH has only limited direct responsibility for service provision. In addition to ensuring the timely and reliable delivery of drugs, equipment and medical supplies, and workforce planning and production, the NDoH needs to assume a strong role in advocacy and partner coordination.

Partnerships will be the key to success. Key partners for implementation include central agencies, provincial governments, local-level governments, hospital boards, churches and faith-based organizations, non-government organizations (NGOs) and the private sector. An absolutely vital group of partners for financing, and policy and technical support are the development partners. The framework established for the Sector Wide Approach (SWAp) (discussed in the section below) provides a model for partnerships. In reality, whether the partner is a donor, a provincial government, a church organization, a hospital, a non-government organization or the private sector, the same partnership framework and principles will be required (10). These include:

1. *Shared goals* – as outlined in the National Health Plan

2. *Capacity to contribute* – whether a funding partner, a technical partner or

an implementation partner, all partners need to bring something to the partnership table

3. *Develop agreements* – such as memoranda of understanding that define the formality of the relationship

4. *Documented expectations and commitments* of all partners to the tasks agreed upon

5. *Clarity about resource requirements* to develop, negotiate, implement, evaluate and sustain the planned action

6. *Development of an agreed way of working*, dealing with conflict and disagreement, and supplying feedback about program results and outcomes

7. *Defined communication channels and meetings*

8. *Ensure measurable outcomes* are meaningful to all partners involved

9. *Develop an evaluation framework* to measure progress towards outcomes.

DPs have grown in importance and prominence in the PNG health sector over the past 20 years. DPs contribute approximately 53% of the non-labour budget for the NDoH, and – though this is not carefully monitored – are increasingly financing human resource requirements through various means, such as through subcontracting NGOs. With increased reliance on DP support, aid predictability poses a major sector risk. For example, the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) has rated the HIV and malaria programs in PNG as "inadequate but with potential demonstrated". GFATM represents a major part of the funding for national programs for tuberculosis, HIV and malaria. Global Fund withdrawal of funds would pose a major risk for the successful implementation of programs.

Aid continuity also has a very real dimension. As DP support tends to be channelled in three- to five-year time horizons, and future support is uncertain, the resultant ambiguity threatens to destabilize the momentum achieved in programs thus far. A much longer time horizon is needed. Performance-based financing, being instituted by many development agencies, increases this uncertainty and unpredictability. Buying into funding of critical activities under these arrangements, without planning for the risks of needing contingency financing – for example, financing for essential malaria and tuberculosis drugs under Global Fund support – is a problem.

Other drivers of health sector reform

Other 'rationalities' and contexts impact upon health services planning and implementation and health sector reform. Day (11) highlighted the 'primacy of politics' and why political concerns invariably trump service delivery concerns. The evidence speaks for itself – that the implementation of the Organic Law on Provincial Governments and Local-level Governments (OLPGLLG) has drastically impeded improvements in service delivery is now essentially accepted as fact in both the government and development partner spheres. The health sector, however, did not sit back and accept the situation. Based on the Functional and Expenditure Review of 2002, strongly supported by the NDoH and the Public Service Reform Management Unit (PSRMU) (9), the health sector embarked on legislative reforms in a systematic and coordinated manner, and eventually – when politically opportune – these reforms to streamline health services within the provinces were implemented. Expressed in the simplest terms, the Provincial Health Authorities Act (PHAA) is an attempt to return health sector organization to a state similar to that which existed previously, where the Provincial Health Officer controlled curative health and rural health services and could direct staff and finances. The PHAA facilitates this by allowing for the creation of a Provincial Health Authority in the province (upon agreement of the Minister and the Governor) whose head is responsible for delivery of all health services in the province. We draw encouragement and hope from this change, and the possible health performance outcomes, which are embedded in PHAA and other whole-of-government reforms to basic services financing and human resources management at decentralized levels. The achievement of these objectives will once again be dependent on related political concerns and commitment. Careful engagement with political and community leaders throughout the rollout of these important reforms will be essential for

success and sustainability. Careful monitoring and evaluation of the reforms and their outcomes and risks will be important.

Tracing the implementation of the two key Organic Laws in PNG since Independence reveals that, in its simplest terms, the history of health sector governance is the story of the health sector responding as best it could to the prevailing legislative and administrative environments. The difficulties in health service delivery are inextricably linked to the broader political and governance context. The challenge for PNG's current and future politicians is to continue to walk the fine line between providing sufficient autonomy to local decision-makers and ensuring that the political and administrative structure this requires facilitates improved service delivery. The challenge for the PNG health sector is to understand this delicate balance, find and promote solutions to achieve both, and learn from the mistakes of the past.

Facilitating and improving service delivery should rightly be the priority of all levels of government in PNG for a long time to come. But policy-makers, and particularly those in health, have to be mindful that the political and administrative structures best able to improve service delivery may not simultaneously serve the political imperative of maintaining national unity. When these objectives clash, history – along with the unique construction of the PNG polity – shows that the primacy of politics ensures service delivery concerns are secondary. Rather than railing against this reality, those working to improve health outcomes in PNG must appreciate this and ensure they make progress despite it.

Not only is a reality check essential, as highlighted by Day, so is persistence, despite the odds. Elich (12) emphasized the importance of recognizing the catalytic power of discretionary behaviour; the importance of engendering commitment and motivation – and in turn persistence and innovation – in an environment where systemic support is weak is of equal if not greater importance to all health sector leaders and managers.

Key challenges for the future

There are key historical lessons to be learnt in which sound investments for the future of the health sector can be made.

A long-term systematic approach to getting the basics in place does work

An evaluation of a major program of assistance funded by AusAID (Australian Agency for International Development) found that the impact of capital works, the National Health Radio network and increased drug availability was significant on health service outcomes and patient satisfaction. The evaluation concluded that this first phase of the long-term development of the health system in PNG had achieved visible improvements that indicated the presence of a stronger foundation for rural service delivery. It noted that increased supervision and support to outreach activities of rural facilities needed to continue to be the main strategies for consolidating the benefits (13).

Means are not ends

The SWAp is a means to an end; it is not an end in itself. It is a way of delivering DP assistance to tackle the priority development issues of a given country. If the proceeds of the SWAp are not directed towards priority interventions which will deliver the greatest health gain, it will not have the desired effect. If the underlying poor capacity of the health system is not addressed, it cannot deliver the desired impact of the SWAp. A SWAp is another way of mobilizing already available resources to target health sector problems in a consolidated way. Similarly, the PHAA provides an environment and opportunities for addressing barriers to service delivery, but will not miraculously improve performance outcomes if interventions are not implemented and the desired coverage of health interventions not reached. It does not in any way mitigate the requirement to address any underlying sector problems, such as limited capacity, poor accountability and a weak human resource base. It needs careful monitoring to ensure it does not leave service delivery behind through the policy reform, but instead keeps the right balance between the two.

Find willing partners

Lack of partner capacity, receptiveness to change, commitment and responsiveness impacts on the effectiveness of support. Advisers can only be as effective as partners allow them to be. Development partners and government agencies need to recognize that

an investment in an adviser is not a quick fix – but needs to be carefully planned for and placed within an environment that will support and sustain the changes desired.

Experiences internationally in both developing and developed countries suggest that public-private partnerships (PPPs) may be a useful adjunct to resourcing and implementation of PNG's health services. PNG's experiences with some mining sector partners and church health services provide local examples to support these findings. However, there is a need to strengthen the basics of health sector governance, monitoring capacities and regulatory roles of the NDoH (14). There is a need to include these partners in the next phases of SWAps – not just as financial partners, but actively involved in sitting at the 'policy planning, implementation and monitoring table' under GoPNG leadership, helping to develop plans and performance frameworks and supporting the PNG health sector.

Utilize existing capacity

The health system may need more capacity, but it also already has significant levels of capacity. Health sector stakeholders have different strengths and weaknesses. The Capacity Building Service Centre (CBSC) has successfully used various methods (inter-provincial twinning, meetings, workshops with hospitals and rural services and so on) to share strengths across provinces. Partners – traditional and emerging – have more capacity than is often assumed, but they are operating in an environment where it is not utilized. Their environment may restrict utilization of capacities due to a lack of access to basic supporting resources (such as drugs, equipment and supervision).

Slow and steady wins the race

There is no quick fix. PNG's health outcomes will improve with systematic focus on getting the basics in place. There is a distinct tendency for funding (or the prospect of future funding) to drive strategy. For example, commitments to fund anti-retroviral therapy will place severe pressure on the NDoH's capacity and future recurrent expenditure, and potentially limit resources from being extended as planned in other priority areas. In this way, while a short-term funding prospect may be appealing and desirable, the long-term effects can be debilitating. However, once such an intervention has commenced, it may be unethical to withdraw it. Initial excitement about finally acquiring investments in basic rural health infrastructure under GoPNG allocations needs to be carefully planned, and there are significant and long-term recurrent financing, human resource and logistical implications of every building renovated, rehabilitated or built.

Focus on the basics

We emphasize the five basic elements to achieving improved health outcomes from the system, as previously discussed:

1. Effective interventions for the main causes of morbidity and mortality, where and when required
2. Skilled health workers at the point of service who are able to provide those interventions (3)
3. Essential logistical elements to enable the health worker to provide the effective interventions
4. Information, education and communication, and other health promotion initiatives and efforts directed at communities – to obtain their cooperation and acceptance of the interventions, and to support and empower their engagement in healthy behaviours
5. Population coverage.

Conclusion

PNG faces a uniquely difficult set of challenges. Provincial governments are responsible for delivering health services, but there are extreme differences in the cost of doing so, related to the transport constraints in reaching remote populations, while there are also extreme differences in the financial resources available to them. High transport costs of reaching services impede the poor from accessing services.

Some of the solutions to these problems lie outside the health sector. A review of the potential for a wide range of partnerships in the traditional and non-traditional arenas, and for a range of logistical, financing, service

delivery and training requirements, should be undertaken. Managing these partnerships will also need to be carefully planned, and their implications allowed for within the health sector, taking into account the whole-of-government reforms and structures of the central organizations.

Health financing will be constrained despite windfall gains from export prices, and there are difficult choices to be made in deciding what services can be provided in the medium to long term, and how best to deliver them in diverse environments. The time for talking, policy formulation and analysis is past – PNG needs a sensible, affordable, feasible plan to get the basic services to the population. This will require the mobilization of many partners, innovative approaches, and a slow, steady and uncompromising focus on getting the interventions to the people.

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List of Medical Research Projects in Papua New Guinea

Approved or Noted

By the Medical Research Advisory Committee in 2008

Intermittent preventive treatment with azithromycin-containing regimens for the prevention of malarial infections and anaemia and control of sexually transmitted infections in pregnant women in Papua New Guinea (IPTp)

Dr Ivo Mueller, Dr Stephen Rogerson, Prof. Peter Siba and Dr Clara Menendez (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Plasmodium vivax infection in pregnancy – PREGVAX

Dr Ivo Mueller and Dr Clara Menendez (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Collaborative research on *P. vivax* antigen discovery

Dr Ivo Mueller and Prof. Peter Siba (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Pharmacokinetics of sulfadoxine-pyrimethamine in infancy

Dr Ivo Mueller, Prof. Tim Davis and Prof. Ken Ilett (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Assessment of the acceptability of intermittent preventive treatment of malaria in infants (IPTi) in PNG

Dr Nicolas Senn and Dr Ivo Mueller (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

The genetics of immunoglobulin E (IgE) in parasitised and allergic individuals

Associate Professor Andrew Collins, Mr William Pomat, Dr Inoni Betuela and Associate Prof. William Sewell (School of Biotechnology and Biomolecular Sciences, University of New South Wales, Sydney, NSW 2052, Australia)

Collaborative research on malaria parasites (*Plasmodium* spp.) genomics

Dr Pascal Michon, Dr Ivo Mueller and Mr Livingstone Tavul (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Cost of delivering child health services in Papua New Guinea

Dr Job Hawap (Technical Health Services Division, Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

Study on waterborne causes in gastrointestinal tract infections in Papua New Guinea

Ms Monica Sungu, Dr Osea Gideon (School of Natural and Physical Sciences, Division of Biology, University of Papua New Guinea, PO Box 320, University PO, NCD 134, Papua New Guinea)

Improving tuberculosis treatment among HIV-infected people: a treatment cohort study in Madang Province, Papua New Guinea

Dr Suparat Phuanukoonnon and Prof. Peter Siba (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Community based health initiatives in 11 villages in Central and Gulf Provinces in PNG

Mr Warwick Dawson and Mr Russel Kitau (ChildFund PNG, PO Box 671, Gordons, NCD, Papua New Guinea)

A detailed assessment of severe malaria and severe non-malarial disease in Papua New Guinean children

Prof. Tim Davis and Dr Ivo Mueller (School of Medicine & Pharmacology, University of Western Australia, Fremantle Hospital, PO Box 480, Fremantle, WA 6959, Australia)

The role of health promotion and community participation in supporting tuberculosis and HIV/AIDS prevention and care: the Eastern Highlands of Papua New Guinea

Ms Geraldine Maibani-Michie (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

The evaluation of typhoid fever diagnostic systems for use in Papua New Guinea

Dr Andrew Greenhill (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Characteristics of blood immune and vascular growth factors in Papua New Guineans with lymphatic filariasis

Dr Kim Brustoski, Prof. Peter Siba and Dr James Kazura (Centre for Global Health and Diseases, Case School of Medicine, Wolstein Research Building, 10900 Euclid Avenue, Cleveland, Ohio 44106-7286, USA

Evaluation of Roche Amplicor kit in the early detection of human immunodeficiency virus infection in infants born to seropositive women in the Eastern Highlands Province

Mr Bangan John (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Assessment needs for Telehealth in Papua New Guinea

Ms Lucy Au (Department of Health Sciences, University of Canterbury, Christchurch, New Zealand)

Male circumcision for HIV prevention among at-risk men and women in Papua New Guinea: acceptability, epidemiological impact, cost effectiveness and options for future program implementation

Dr Andrew Vallely, Prof. Peter Siba and Prof. John Kaldor (School of Population Health, University of Queensland, Herston Road, Brisbane, QLD 4006, Australia)

Rapid ethnographic assessments of consent processes for MalariaGEN research

Dr Pascal Michon (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Prospective study on the co-infection with viral respiratory infection and malaria in a cohort of children aged 3-27 months in Madang Province

Dr Patricia Rarau and Dr Nicolas Senn (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Adherence to antiretroviral therapy at Heduru Clinic

Dr George Priwa (Port Moresby General Hospital, Private Mail Bag 1, Boroko, NCD 111, Papua New Guinea

Use of bioimpedance spectrophotometer, ultra-sound tonometry and vascular endothelial growth factors to detect and investigate filarial lymphoedema

Dr Wayne Melrose and Mr Leo Makita (WHO Collaborating Centre for Control of Lymphatic Filariasis, James Cook University, Townsville, QLD 4811, Australia)

Improving immunization service delivery and newborn survival at the aid post level in Papua New Guinea (Angoram District)

Dr Chris Morgan and Mr Albert Bunat (Burnet Institute, 85 Commercial Road, Melbourne, Victoria 3004, Australia)

Assessment of the adherence to HAART by HIV-positive patients in Port Moresby

Ms Lisa Ijape and Dr Victor Temple (Discipline of Biochemistry and Molecular Biology, Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Assessment of vitamin A status of infants and their mothers attending Paediatric Clinic in Port Moresby General Hospital

Ms Cecily Kaira and Dr Victor Temple (Discipline of Biochemistry and Molecular Biology, Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Assessment of knowledge, attitudes, belief and practice of UPNG students on HIV/AIDS

Ms Lindy Anton and Dr P. Kigodi (School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Assessment of the treatment costs of opportunistic diseases in HIV patients at Port Moresby General Hospital

Ms Nancy Bala and Dr P. Kigodi (Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Assessment of knowledge, attitudes, belief and practice of secondary school students towards HIV/AIDS in the Southern Highlands Province

Ms Linda Paita and Dr Victor Temple (Division of Basic Medical Sciences, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Measuring preventive drug efficacy of sulfadoxine-pyrimethamine plus 3 days artesunate in the context of intermittent preventive treatment in infants study in PNG

Dr Nicolas Senn (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Woman the hunter: protein procurement and household health in a foraging society

Dr David Tracer and Mrs Wila Saweri (Health and Behavioural Sciences, University of Colorado at Denver and Health Sciences Centre, Denver, Colorado 80217-3364, USA)

PneumoCarr microbiology project

Dr Suparat Phuanukoonnon, Prof. Deborah Lehmann, Prof. Kim Mulholland and Dr Andrew Greenhill (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Regulation of cellular immunity to malaria by *Plasmodium falciparum* erythrocyte membrane protein-1 (*Pf*EMP1) and glycosyl-phosphatidylinositol (GPI)

Dr Ivo Mueller, Dr Danielle Stanisic and Mr Jack Taraika (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Application of molecular immunology technologies to identify novel *Plasmodium* antigens for malaria vaccine development

Dr Denise L. Doolan, Dr Ivo Mueller, Dr Danielle Stanisic and Mr Jack Taraika (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Pharmacokinetics, safety and efficacy of artemisinin-naphthoquine in children with malaria

Prof. Tim Davis, Dr Kevin Batty, Dr Ivo Mueller and Prof. Francis Hombhanje (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Baseline study on lifestyle diseases in the National Capital District

Dr Thomas Vinit (Lifestyle Diseases, Disease Control Branch, National Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

Tobacco usage amongst health professionals in Papua New Guinea

Dr Thomas Vinit (Lifestyle Diseases, Disease Control Branch, National Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

Project ADDUP: are development discrepancies undermining performance?

Mr Leo Marai and Prof. Stuart Carr (School of Humanities & Social Sciences, University of Papua New Guinea, PO Box 320, University, NCD 134, Papua New Guinea)

Note:

These projects have been examined and cleared by the MRAC but they have not all started, nor is there any guarantee that they all will, since in many cases this still depends on funding. It should be noted that the project funds for the MRAC were deleted from the Health Budget from 1997 to 2008.

Information about these projects may be obtained from the investigators or from the Chairperson of the Medical Research Advisory Committee (Director of Research and Monitoring, Department of Health, PO Box 807, Waigani, NCD 131)

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PUBLICATIONS OF RELEVANCE TO PAPUA NEW GUINEA AND MELANESIA

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Antitreponemal antibodies leading to autoantibody production and protection from atherosclerosis in Kitavans from Papua New Guinea.
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The objective of our study was to determine the prevalence of anti-infectious agent antibodies and autoantibodies in a unique non-Westernized population from Kitava, Papua New Guinea (PNG), compared to Western populations. We matched 120 serum samples from Kitavans with 437 samples from four healthy control groups. Sera were tested for the presence of anti-infectious agent antibodies (treponema, toxoplasmosis, Epstein-Barr virus, cytomegalovirus, rubella) and autoantibodies [anti-double-stranded (ds) DNA, anti-chromatin, anti-ribonucleoprotein (RNP), anti-SSB, anti-SSA, anti-Scl-70, anti-Smith, anti-centromer, anti-SmRNP, anti-Jo-1 and anti-ribosomal-P] using the Bio-Rad BioPlex 2200. Antitreponemal antibodies were detected in 87% of PNG sera versus 0-6% of controls ($p < 0.0001$). Anti-dsDNA antibodies were detected in 31% of PNG samples, which was significantly higher than in three of the control groups (<10%). The outstanding high rate of antitreponemal antibodies detected in Kitavans possibly represents prior yaws disease. A low prevalence of cardiovascular disease was previously documented in Kitavans and has been attributed, in addition to their diet, to the high prevalence of natural cardioprotective autoantibodies (the IgM-antiphosphorylcholine antibodies) in this population. Treponemal infection has been shown to induce the appearance of antiphosphorylcholine antibodies. These protective autoantibodies may cross-react with the pathogenic anti-dsDNA antibodies. Thus, it is suggested that infection with treponema is associated with the presence of protective as well as pathogenic autoantibodies.

2. **Ashwell HE, Barclay L.**
Outcome evaluation of community health promotion intervention within a donor-funded project climate in Papua New Guinea.
Rural Remote Health 2009 Oct-Dec;9(4):1219. Epub 2009 Nov 21.

INTRODUCTION: The Australian Agency for International Development (AusAID)-funded Women and Children's Health Project sought to improve the health of women and children throughout Papua New Guinea between 1998 and 2004. The project utilised education, community development and health promotion interventions aimed to increase community support for the health of women and children. METHODS: An outcome evaluation in 2006 investigated the long-term impact of the project using a multi-methods approach and covering 10 selectively sampled provinces, 19 districts and 93 communities. Qualitative data were collected from 175 interviews (national to village level) and 77 community discussions. Quantitative data from national, provincial and district levels were examined to attempt to validate findings. RESULTS: The evaluation found new-health-knowledge initiated changes to lifestyle practices and improved physical health and social and economic well-being in villages where volunteers and staff had been trained. Factors influencing success were a health-motivated person acting as a catalyst for change, empowered leadership through new community governance structures, effective visual tools and village health volunteers linking community and rural health workers. Failure was attributed to poor understanding of community development, limited information sharing, a 'top down' approach to community development and weak community leadership. CONCLUSION: The project's community health interventions improved the interaction between the community and health system, and influenced improved use of maternal and child health services. Evaluation suggests sustainable improvements in health can be achieved through community-led and maintained activity.

3. **Atkinson JA, Bobogare A, Vallely A, Boaz L, Kelly G, Basifiri W, Forsyth S, Baker P, Appleyard B, Toaliu H, Williams G.**
A cluster randomized controlled cross-over bed net acceptability and preference trial in Solomon Islands: community participation in shaping policy for malaria elimination.
Malar J 2009 Dec 16;8(1):298.

BACKGROUND: A key component of the malaria elimination strategy in Solomon Islands (SI) is widespread coverage of long-lasting insecticidal nets (LLINs). The success of this strategy is dependent on LLIN acceptability and compliance. There has been unresolved debate among policy makers and donors as to which type of LLIN would be most appropriate for large-scale distribution in SI, and anecdotal reports of a lack of acceptability of certain brands of LLINs. A cluster randomized controlled cross-over bed net acceptability and preference trial was therefore carried out from July to September, 2008 to inform policy and to facilitate community engagement and participation in the selection of the most appropriate LLIN for use in SI. METHOD: A three-stage sampling method was used to randomly select the study population from Malaita Province, SI. Three brands of LLINs were assessed in this study: Olyset, PermaNet and DuraNet. Bed net acceptability and preference were evaluated through surveys at three defined time points after short and longer-term trial of each LLIN. RESULTS: The acceptability of PermaNet after short-term use (96.5%) was significantly greater than Olyset (67.3%, $p < 0.001$) and DuraNet (69.8%, $p < 0.001$). The acceptability of DuraNet and Olyset after short-term use was not significantly different at the 5% level.

LLINs that were perceived not to prevent mosquito bites were significantly less acceptable than LLINs that were perceived to prevent mosquito bites (OR 0.15; 95%CI 0.03 to 0.6). LLINs that allow a pleasant night's sleep (OR 6.3; 95%CI:3.3-12.3) and have a soft texture (OR 5.7; 95%CI:1.9-20.5) were considered more acceptable than those that did not. Olyset's acceptability decreased over time and this was due to net wrinkling/shrinkage after washing resulting in reduced efficiency in preventing mosquito bites. The increase in DuraNet acceptability was a result of a reduction in minor adverse events following longer-term use. CONCLUSION: This research was conducted to inform LLIN procurement as part of the national malaria control and elimination programme in SI. The success of malaria elimination in the Pacific and elsewhere relies on provision of acceptable interventions, consideration of local-level realities and engagement of communities in strategy development.

4. **Baldwin A.**
Applied theatre: performing the future.
Australas Psychiatry 2009 Aug;17(Suppl 1):S133-S136.

OBJECTIVE: This paper provides an introduction to applied theatre and performance as a body of practice that may enhance the wellbeing of Indigenous communities. Applied theatre forms are conceptualized along a continuum from 'performance-oriented' to 'participant-oriented'. Participant reflections are reported from a pilot workshop in Papua New Guinea, as a contribution to the evolution of theory and practice of applied theatre for health promotion in Indigenous communities. METHODS: Twelve Papua New Guinean nationals engaged in health promotion participated in the workshop. Participants were invited to reflect on the potential application of the theatre forms for their own health promotion practice. The workshop was qualitatively evaluated through a focus group at the conclusion of the workshop. RESULTS: Participants identified specific theatre forms which they could use in their own health promotion practice. Several participants articulated a view that participant-oriented forms were more likely to influence health-related behaviour than performance-oriented forms, in their cultural context. CONCLUSIONS: The theatre-for-development literature does not yet clearly articulate how specific theatre forms may be more or less efficacious in terms of influencing health-related behaviour across cultural contexts. More extensive research into this question will yield significant benefits in terms of focusing practice culturally.

5. **Barrows LR, Matainaho TK, Ireland CM, Miller S, Carter GT, Bugni T, Rai P, Gideon O, Manoka B, Piskaut P, Banka R, Kiapranis R, Noro JN, Pond CD, Andjelic CD, Koch M, Harper MK, Powan E, Pole AR, Jensen JB.**
Making the most of Papua New Guinea's biodiversity: establishment of an integrated set of programs that link botanical survey with pharmacological assessment in 'The Land of the Unexpected'.
Pharm Biol 2009 Aug 1;47(8):795-808.

An integrated and coordinated set of programs has been established to meet ICBG goals in Papua New Guinea (PNG). Here we give an overview of the PNG ICBG and focus on the key elements and major steps taken to establish a program necessary for the pharmacological assessment of botanicals and traditional medicines in PNG and, by extrapolation, in other developing countries.

6. **Carroll AR, Suraweera L, King G, Rali T, Quinn RJ.**
Guttiferones O and P, prenylated benzophenone MAPKAPK-2 inhibitors from *Garcinia solomonensis*.
J Nat Prod 2009 Sep;72(9):1699-1701.

Two prenylated benzophenones, guttiferones O (1) and P (2), were isolated from the stem bark of the Papua New Guinean plant *Garcina solomonensis*. The structures of these compounds and their relative configurations were determined by spectroscopic methods. Both compounds inhibited the phosphorylation of the synthetic biotinylated peptide substrate KKLNRTLSVA by the serine/threonine protein kinase MAPKAPK-2 with IC(50) values of 22.0 microM.

7. **Cavinta L, Cao G, Schaefer S.**
Description of a new hepatitis B virus C6 subgenotype found in the Papua Province of Indonesia and suggested renaming of a tentative C6 subgenotype found in the Philippines as subgenotype C7.
J Clin Microbiol 2009 Sep;47(9):3068-3069.

8. **Champagne A, Legendre L, Lebot V.**
Chemotype profiling to guide breeders and explore traditional selection of tropical root crops in Vanuatu, South Pacific.
J Agric Food Chem 2009 Nov 11;57(21):10363-10370.

The objectives of the present study were to characterize good-quality cultivars, identify relationships between local eating preferences and primary compound content, and reveal biofortification potential in tropical root crop species of aroids, yams, cassava and sweet potato. A core sample of about 500 cultivars was assembled to represent the widest agro-morphological diversity. Very high coefficients of variation were found within species for proteins, sugars, cellulose and mineral contents, whereas starch exhibited the lowest variation. Starch content was negatively correlated with other primary compound contents. For the national dish in Vanuatu, consumers prefer cultivars with high starch content. In contrast, preferences for daily consumption of boiled or roasted tubers are linked to average starch content, indicating great potential for improving primary compounds. Interestingly, relationships between flesh color and requirements for the traditional dish were revealed, suggesting opportunities for biofortification. The data produced will assist breeders in adopting appropriate biofortification strategies.

9. **Chaves LF, Kaneko A, Pascual M.**
Random, top-down, or bottom-up coexistence of parasites: malaria population dynamics in multi-parasitic settings.
Ecology 2009 Sep;90(9):2414-2425.

Epidemiological models concerned with the control of malaria using interventions such as bed nets and vaccines increasingly incorporate realistic aspects of malaria biology. The increasing complexity of these models limits their ability to abstract ecological processes and to address questions on the regulation of population dynamics using time-series data, particularly in regards to interactions between different pathogens and the

regulatory role of innate (bottom-up) and acquired (top-down) immunity. We use a theoretical framework to test hypotheses on the importance of population-level immunity and parasite abundance in regulating the population dynamics of malaria. We use qualitative loop analyses to examine the sign of the interaction between *Plasmodium falciparum* and *P. vivax* at the population level, and we discuss implications of this sign for the within-host regulation of parasites. Our analyses of monthly malaria time-series data from the island of Espirito Santo, Vanuatu (1983-1997) show that the dynamics of *P. falciparum* are not sensitive to *P. vivax*, whereas infections by the latter increase in response to those of the former. These results support a differential use of resources inside the hosts, a resource-consumer interaction between hosts and their immune system, and within-host regulation of parasites. Finally, our results emphasize the need to better understand factors regulating malaria dynamics before developing control strategies and call for the use of control strategies directed at the interruption of transmission, such as vector control and the use of bed nets.

10. **Clark G, Chapman Y, Francis K.**
Surveying health professionals' satisfaction with the Integrated Management of Adult and Adolescent Illness Chronic HIV Care training programme: the Papua New Guinea experience.
Int J Nurs Pract 2009 Dec;15(6):519-524.

This study reports findings from a survey of Papua New Guinean registered nurses who completed the Integrated Management of Adult and Adolescent Illness (IMAI) Chronic HIV Care training conducted between November 2005 and December 2006. The survey conducted is one component of a mixed method evaluation of the IMAI program in Papua New Guinea. Data from the questionnaires were entered into version 16 of the Statistical Package for the Social Sciences (SPSS) software program. The responses on the effect the IMAI training program had on various aspects of how care is provided, learning needs and other program outcomes were analysed with a chi-square test being applied to detect any difference in the response given by the different demographic subgroups in terms of gender, age, care status, current employer and past educational attainment. The survey revealed that all thirty-five respondents have a positive impression of the IMAI program and expressed the view that the IMAI program had a positive effect on various aspects of patient care and their learning and experience. Overall, the survey identified that registered nurses who participated in the IMAI Chronic HIV Care training program perceive the program to be beneficial for improving the way HIV care is provided.

11. **Clark IA, Alleva LM.**
Is human malarial coma caused, or merely deepened, by sequestration?
Trends Parasitol 2009 Jul;25(7):314-318. Epub 2009 Jun 21.

Much research into falciparum malaria coma assumes the primary event to be vascular obstruction by parasitized red blood cells. Recent evidence that vivax malaria, caused by a parasite traditionally thought not to block blood flow, seems to alter brain function to the same degree as falciparum malaria has seriously questioned this. These data are a timely call to reassess whether vascular obstruction should still be considered the primary cause of the coma of falciparum disease. They add to a growing literature that suggests that enhancement of brain-origin cytokines, such as tumour necrosis factor, by non-brain systemic inflammation and an appreciation of the degree to which neuronal homeostasis depends on them provide a more fruitful research direction.

12. **Cole-Tobian JL, Michon P, Biasor M, Richards JS, Beeson JG, Mueller I, King CL.**
Strain-specific Duffy binding protein antibodies correlate with protection against infection with homologous compared to heterologous *Plasmodium vivax* strains in Papua New Guinean children.
Infect Immun 2009 Sep;77(9):4009-4017. Epub 2009 Jun 29.

Individuals repeatedly infected with malaria acquire protection from infection and disease; immunity is thought to be primarily antibody-mediated and directed to blood-stage infection. Merozoite surface proteins involved in the invasion of host erythrocytes are likely targets of protective antibodies. We hypothesized that Papua New Guinean children (n = 206) who acquire high antibody levels to two *Plasmodium vivax* merozoite proteins, Duffy binding protein region II (PvDBPII) and the 19-kDa C-terminal region of *P. vivax* merozoite surface protein 1 (PvMSP1(19)), would have a delay in the time to reinfection following treatment to clear all blood-stage malaria infections. Ninety-four percent of the children were reinfected with *P. vivax* during biweekly follow-ups for 6 months. Since PvDBPII is polymorphic, we examined whether individuals acquired strain-specific immunity to PvDBPII. Children with high antibody levels to a prevalent PvDBPII allele (O) were associated with a delay in the time to reinfection with the same variant of *P. vivax* by 25% compared to parasites expressing other PvDBPII alleles (age-adjusted hazard ratio, 0.75 [95% confidence interval, 0.56 to 1.00 by Cox regression]) and 39% lower incidence density parasitemia (p = 0.01). Two other prevalent alleles (AH and P) showed a similar trend of 16% and 18% protection, respectively, against parasites with the same PvDBPII allele and reduced incidence density parasitemia. Antibodies directed to PvDBPII PNG-P and -O were both associated with a 21 to 26% reduction in the risk of *P. vivax* infections with higher levels of parasitemia (>150 parasites/μl), respectively. There was no association with high antibody levels to PvMSP1(19) and a delay in the time to *P. vivax* reinfection. Thus, anti-PvDBPII antibodies are associated with strain-specific immunity to *P. vivax* and support the use of PvDBPII for a vaccine against *P. vivax*.

13. **Cooper RD, Waterson DG, Frances SP, Beebe NW, Pluess B, Sweeney AW.**
Malaria vectors of Papua New Guinea.
Int J Parasitol 2009 Nov;39(13):1495-1501. Epub 2009 Jun 6.

Understanding malaria transmission in Papua New Guinea (PNG) requires exact knowledge of which *Anopheles* species are transmitting malaria and is complicated by the cryptic species status of many of these mosquitoes. To identify the malaria vectors in PNG we studied *Anopheles* specimens from 232 collection localities around human habitation throughout PNG (using CO_2 baited light traps and human bait collections). A total of 22,970 mosquitoes were individually assessed using a *Plasmodium* sporozoite enzyme-linked

immunosorbent assay to identify *Plasmodium falciparum*, *Plasmodium vivax* and *Plasmodium malariae* circumsporozoite proteins. All mosquitoes were identified to species by morphology and/or PCR. Based on distribution, abundance and their ability to develop sporozoites, we identified five species as major vectors of malaria in PNG. These included: *Anopheles farauti*, *Anopheles hinesorum* (incriminated here, to our knowledge, for the first time), *Anopheles farauti* 4, *Anopheles koliensis* and *Anopheles punctulatus*. *Anopheles longirostris* and *Anopheles bancroftii* were also incriminated in this study. Surprisingly, *An. longirostris* showed a high incidence of infections in some areas. A newly identified taxon within the Punctulatus Group, tentatively called *An. farauti* 8, was also found positive for circumsporozoite protein. These latter three species, together with *Anopheles karwari* and *Anopheles subpictus*, incriminated in other studies, appear to be only minor vectors, while *Anopheles farauti* 6 appears to be the major vector in the highland river valleys (>1500m above sea level). The nine remaining *Anopheles* species found in PNG have been little studied and their bionomics are unknown; most appear to be uncommon with limited distribution and their possible role in malaria transmission has yet to be determined.

14. **D'Alessandro U.**
Progress in the development of piperaquine combinations for the treatment of malaria.
Curr Opin Infect Dis 2009 Dec;22(6):588-592.

PURPOSE OF REVIEW: Dihydroartemisinin-piperaquine is a new and extremely promising artemisinin-containing fixed-combination antimalarial, about to be registered with international regulatory authorities such as the European Medicines Agency. A formulation produced according to good manufacturing practices should be available soon. RECENT FINDINGS: Piperaquine is characterized by a slow absorption, long mean terminal elimination half-life and large mean volume distribution. However, children, compared to the population mean profile, tend to have a smaller central volume of distribution, a shorter distribution half-life and a more rapid fall in early piperaquine plasma concentrations, suggesting that an increase of the weight-adjusted dosage in children may be required. In addition, the oral bioavailability of piperaquine improves when given with a high-fat meal, though this does not necessarily translate into a higher efficacy. Several clinical trials have repeatedly shown that dihydroartemisinin-piperaquine is well tolerated and efficacious, with the only exception of one trial recently carried out in Papua New Guinea. Patients treated with dihydroartemisinin-piperaquine may have a higher rate of person-gametocyte-weeks, though it is unclear whether this translates into a higher infectiousness to biting anophelines. SUMMARY: The dosage recommended for children may need to be reviewed and the usefulness of the coadministration with food should be determined. Establishing safety and efficacy of this treatment in pregnancy remains a priority.

15. **Falk N, Kaestli M, Qi W, Ott M, Baea K, Cortés A, Beck HP.**
Analysis of *Plasmodium falciparum* var genes expressed in children from Papua New Guinea.
J Infect Dis 2009 Aug 1;200(3):347-356.

BACKGROUND: The variable antigen *P. falciparum* erythrocyte membrane protein-1 (PfEMP1) is a major virulence factor in malaria. A large number of var genes encode PfEMP1, and we hypothesized that a restricted PfEMP1 repertoire determines clinical disease presentation. We conducted a case-control study in Papua New Guinea and analyzed transcribed var genes in naturally infected children. METHODS: var messenger RNA was isolated from 78 children with asymptomatic, mild, or severe malaria. We prepared complementary DNA from the upstream region into the DBL1alpha domain and picked, on average, 20 clones for sequencing. RESULTS: Twenty-five percent of centrally located var genes were shared between children, whereas only 5% of subtelomeric genes were shared, indicating lower diversity in the former group. Linkage between group B or C var upstream sequences and DBL1alpha groups was not observed, which impeded prediction by DBL1alpha analysis. A higher proportion of var group A sequences was detected in symptomatic malaria, and a subgroup of frequently encountered var genes with complex head structure seems to be associated with severe malaria. A subset of var group C genes was frequently expressed in older children with asymptomatic high levels of parasitemia. CONCLUSION: Despite this vast diversity, restricted disease-associated var genes were identified and might be used for innovative interventions based on PfEMP1.

16. **Forestieri R, Merchant CE, de Voogd NJ, Matainaho T, Kieffer TJ, Andersen RJ.**
Alotaketals A and B, sesterterpenoids from the marine sponge *Hamigera* species that activate the cAMP cell signaling pathway.
Org Lett 2009 Nov 19;11(22):5166-5169.

The new sesterterpenoids alotaketals A (1) and B (2) have been isolated from extracts of the marine sponge *Hamigera* sp. collected in Papua New Guinea. Their chemical structures were elucidated by analysis of spectroscopic data. Alotaketals A and B have the unprecedented alotane carbon skeleton, and they activate the cAMP cell signaling pathway with EC(50)s of 18 and 240 nM, respectively.

17. **Francis JP, Richmond PC, Pomat WS, Michael A, Keno H, Phuanukoonnon S, Nelson JB, Whinnen M, Heinrich T, Smith WA, Prescott SL, Holt PG, Siba PM, Lehmann D, van den Biggelaar AH.**
Maternal antibodies to pneumolysin but not to pneumococcal surface protein A delay early pneumococcal carriage in high-risk Papua New Guinean infants.
Clin Vaccine Immunol 2009 Nov;16(11):1633-1638. Epub 2009 Sep 23.

Immunization of pregnant women can be an efficient strategy to induce early protection in infants in developing countries. Pneumococcal protein-based vaccines may have the capacity to induce pneumococcal serotype-independent protection. To understand the potential of maternal pneumococcal protein-specific antibodies in infants in high-risk areas, we studied the placental transfer of naturally acquired antibodies to pneumolysin (Ply) and pneumococcal surface protein A family 1 and 2 (PspA1 and PspA2) in relation to onset of pneumococcal nasopharyngeal carriage in infants in Papua New Guinea (PNG). In this study, 76% of the infants carried *Streptococcus pneumoniae* in the upper respiratory tract within the first month of life,

at a median age of 19 days. Maternal and cord blood antibody titers to Ply (rho = 0.824, p <0.001), PspA1 (rho = 0.746, p <0.001), and PspA2 (rho = 0.631, p <0.001) were strongly correlated. Maternal pneumococcal carriage (hazard ratio [HR], 2.60; 95% confidence interval [CI], 1.25 to 5.39) and younger maternal age (HR, 0.74; 95% CI, 0.54 to 1.00) were independent risk factors for early carriage, while higher cord Ply-specific antibody titers predicted a significantly delayed onset (HR, 0.71; 95% CI, 0.52 to 1.00) and cord PspA1-specific antibodies a significantly younger onset of carriage in PNG infants (HR, 1.57; 95% CI, 1.03 to 2.40). Maternal vaccination with a pneumococcal protein-based vaccine should be considered as a strategy to protect high-risk infants against pneumococcal disease by reducing carriage risks in both mothers and infants.

18. **Gilbert M, Brindle R.**
El Niño and variations in the prevalence of *Plasmodium vivax* and *P. falciparum* in Vanuatu.
Trans R Soc Trop Med Hyg 2009 Dec;103(12):1285-1287. Epub 2008 Dec 13.

Malaria, both *Plasmodium falciparum* and *P. vivax*, is a major cause of morbidity in Vanuatu. *As P. vivax* is more prevalent in seasonal climates and *P. falciparum* in areas of more consistent rainfall, it is postulated that there will be a correlation between the ratio of vivax:falciparum and the El Niño Southern Oscillation (ENSO), which affects sea surface temperatures and rainfall. With changes in global climate, the frequency, duration and strength of the ENSO are expected to alter, influencing the pattern of malaria. The data showed no obvious correlation between ENSO and either cases of malaria or the vivax:falciparum ratio.

19. **Goarant C, Laumond-Barny S, Perez J, Vernel-Pauillac F, Chanteau S, Guigon A.**
Outbreak of leptospirosis in New Caledonia: diagnosis issues and burden of disease.
Trop Med Int Health 2009 Aug;14(8):926-929. Epub 2009 Jun 22.

A leptospirosis epidemic affected New Caledonia during the first semester of 2008. A total of 135 cases were diagnosed with a relatively low fatality rate of 3.7%. Heavy rainfalls, related to La Niña, favoured this epidemic. The PCR, routinely used, confirmed 54% of the cases, and the microagglutination test 56%. Epidemiological and economical data on this epidemic are presented and discussed.

20. **Gray RT, Heymer KJ, Hoare A, Kwon JA, Thein HH, Lote N, Siba P, Saramony S, Saphonn V, Worth H, Kaldor JM, Wilson DP.**
What impact might the economic crisis have on HIV epidemics in Southeast Asia?
Curr HIV Res 2009 Nov;7(6):656-665.

OBJECTIVE: To evaluate the potential impact of the current global economic crisis (GEC) on the spread of HIV. DESIGN: To evaluate the impact of the economic downturn we studied two distinct HIV epidemics in Southeast Asia: the generalized epidemic in Cambodia where incidence is declining and the epidemic in Papua New Guinea (PNG) which is in an expansion phase. METHODS: Major HIV-related risk factors that may change due to the GEC were identified and a dynamic mathematical transmission model was developed and used to forecast HIV prevalence, diagnoses and incidence in Cambodia and PNG over the next 3 years. RESULTS: In Cambodia, the total numbers of HIV diagnoses are not expected to be largely affected. However, an estimated increase of up to 10% in incident cases of HIV, due to potential changes in behavior, may not be observed by the surveillance system. In PNG, HIV incidence and diagnoses could be more affected by the GEC, resulting in respective increases of up to 17% and 11% over the next 3 years. Decreases in VCT and education programs are the factors that may be of greatest concern in both settings. A reduction in the rollout of antiretroviral therapy could increase the number of AIDS-related deaths (by up to 7.5% after 3 years). CONCLUSIONS: The GEC is likely to have a modest impact on HIV epidemics. However, there are plausible conditions under which the economic downturns can noticeably influence epidemic trends. This study highlights the high importance of maintaining funding for HIV programs.

21. **Gupta A, Reeves B.**
Fijian seasonal scourge of mango tree falls.
ANZ J Surg 2009 Dec;79(12):898-900.

BACKGROUND: Mango tree falls are a frequent presentation at any health facility in the South Pacific. This study aims to identify (i) the number of admissions because of falls from mango trees; (ii) epidemiology; (iii) seasonal trend; (iv) injury profile; and (v) hospital care provided. METHODS: Retrospective case review on all mango tree falls related injuries resulting in admissions at the Lautoka Hospital, Fiji during a 1-year period (2007). Patient records were analysed to identify specific injury patterns such as upper/lower limb fractures, spinal cord injury and head injury, caused by mango tree falls. RESULTS: Thirty-nine cases were identified. Eighty-two percent (n = 32) of the falls occurred in the mango season (June-November). Seventy-two percent (n = 28) of the patients were males and 28% (n = 11) were females. Seventy-six percent were aged 5-13 and only 21% were adults. Also, 77% (n = 30) of the patients were ethnic Fijians and 23% (n = 9) were Fijian-Indians. Sixty-four percent (n = 25) had closed fractures and 17% (n = 7) had open fractures. Fifty-six percent (n = 22) of the fractures were of the forearm. There were two cases of spinal cord injury, four cases of head injury, one ICU admission and one death. Average hospital stay was 7.56 days. CONCLUSION: All these injuries were recreational and the majority in the urban setting. They were all avoidable.

22. **Haditsch M.**
Management of snake bites in the tropics – based on the example of Papua New Guinea.
Wien Klin Wochenschr 2009 Oct;121 Suppl 3:53-56.

Snake bites by venomous snakes are a widely neglected topic despite the fact that they may cause severe tissue damage and lead to life-threatening situations resulting in death, mostly due to the lack of adequate medical help. Papua New Guinea hosts one of the most venomous snakes worldwide – the taipan. Medical facilities are limited, the one and only real hospital being located in Port Moresby. Transport facilities for patients are rare and comparably slow, the roads bad except the so-called highway which is in a mint condition. Besides first aid measures (compression and immobilization) the application of (specific) antivenom is the (life-saving) treatment of choice. This product is extremely expensive and therefore there is only a very limited

supply (mostly by products which have already passed the expiry date). Since in addition these products must be kept in a fridge vast areas lacking energy supply don't have storage facilities. Conclusions drawn from the experience in Port Moresby therefore cannot be extended to the rest of the country.

23. **Hasan AU, Suguri S, Sattabongkot J, Fujimoto C, Amakawa M, Harada M, Ohmae H.**
Implementation of a novel PCR-based method for detecting malaria parasites from naturally infected mosquitoes in Papua New Guinea.
Malar J 2009 Aug 1;8:182.

BACKGROUND: Detection of *Plasmodium* species in mosquitoes is important for designing vector control studies. However, most of the PCR-based detection methods show some potential limitations. The objective of this study was to introduce an effective PCR-based method for detecting *Plasmodium vivax* and *Plasmodium falciparum* from the field-caught mosquitoes of Papua New Guinea. METHODS: A method has been developed to concurrently detect mitochondrial cytochrome b (*Cyt* b) of four human *Plasmodium* species using PCR (Cytb-PCR). To particularly discriminate *P. falciparum* from *P. vivax*, *Plasmodium ovale* and *Plasmodium malariae*, a polymerase chain reaction-restricted fragment length polymorphism (PCR-RFLP) has further been developed to use with this method. However, due to limited sample numbers of *P. ovale* and *P. malariae*, this study was mainly confined to *P. vivax* and *P. falciparum*. The efficiency of Cytb-PCR was evaluated by comparing it with two 'gold standards': enzyme-linked immunosorbent assay specific for circumsporozoite protein (CS-ELISA) using artificially infected mosquitoes; and nested PCR specific for small subunit ribosomal RNA (SSUrRNA) using field-caught mosquitoes collected from three areas (Kaboibus, Wingei and Jawia) of the East Sepik Province of Papua New Guinea. RESULTS: A total of 90 mosquitoes were artificially infected with three strains of *Plasmodium*: *P. vivax*-210 (n = 30), *P. vivax*-247 (n = 30) and *P. falciparum* (n =30). These infected mosquitoes along with another 32 unfed mosquitoes were first checked for the presence of *Plasmodium* infection by CS-ELISA, and later the same samples were compared with the Cytb-PCR. CS-ELISA for *P. vivax*-210, *P. vivax*-247 and *P. falciparum* detected positive infection in 30, 19 and 18 mosquitoes respectively, whereas Cytb-PCR detected 27, 16 and 16 infections, respectively. The comparison revealed a close agreement between the two assays (kappa = 0.862, 0.842 and 0.894, respectively for Pv-210, Pv-247 and *P. falciparum* groups). It was found that the eight CS-ELISA-positive mosquitoes detected negative by Cytb-PCR were false-positive results. The lowest detection limit of this Cytb-PCR was 10 sporozoites. A highly concordant result was also found between nested PCR and Cytb-PCR using 107 field-caught mosquitoes, and both tests concordantly detected *P. falciparum* in an *Anopheles punctulatus* mosquito collected from Kaboibus. Both tests thus suggested an overall sporozoite rate of 0.9% (1/107) in the study areas. Subsequently, PCR-RFLP efficiently discriminated *P. falciparum* from *P. vivax* for all of the Cytb-PCR-positive samples. CONCLUSION: A single-step PCR-based method has been introduced here that is highly sensitive, efficient and reliable for identifying *P. vivax* and *P. falciparum* from mosquitoes. The reliability of the technique was confirmed by its ability to detect *Plasmodium* as efficiently as those of CS-ELISA and nested PCR. Application of the assay offers the opportunity to detect vector species of Papua New Guinea and may contribute to designing further vector control programmes.

24. **Hinton RL, Earnest J.**
Beyond risk factors to lived experiences: young women's experiences of health in Papua New Guinea.
Rural Remote Health 2009 Oct-Dec;9(4):1257. Epub 2009 Nov 5.

INTRODUCTION: The health of young women in rural Papua New Guinea (PNG) is often examined using individual-based risk factors which are decontextualized from the social and cultural relationships within which women's lives are embedded. Understanding the health meanings and perceptions of rural PNG women is important for bridging the gap between current health program delivery and the real needs of women. The objective of this study was to explore the health perceptions of rural PNG young women and to identify points in the lifespan where support may be required. METHODS: Thirty-three young women aged between 15 and 29 years were involved in the research. Multiple data collection methods were used within interpretive qualitative methodology and these included in-depth interviews, focus group discussions, photo narrative and ranking exercises. The study was conducted in a rural community in the Wosera District of the East Sepik Province of PNG from mid-2005 to early 2006. Following a community meeting and targeted awareness about the project to female youth, purposive and snowball sampling was used to recruit young women aged 15-24 years. The mean age of participants was 21 years. Single and married participants, unmarried mothers, school leavers and current school attendees were represented. Informed consent was obtained prior to the sharing of women's narratives. Data were categorized and analysed for emerging themes and cross-checked with participants for verification. RESULTS: Young women viewed their health in the context of their social and cultural world and in terms of their wider life experiences. The main theme uncovered young women's strong desires for independence. Young women depended on their parents for emotional support and material possessions, and positive parental support provided young women with the opportunity to move towards independence. Freedom from economic constraints was identified as important for autonomy, and having money was discussed as a requisite for good health. Young women discussed that building healthy relationships was integral to health. For single young women this was connected with having the freedom to spend time with friends and boyfriends. Married young women noted that their health was related to the quality of their marital and familial relationships and the level of support available to meet the demands of new roles and responsibilities. CONCLUSIONS: The young women's narratives document the importance of the connection between the diverse health needs of young women and the social and cultural environment in which they live. The role of connectedness with family, friends and community in young women's lives is an important issue and can provide opportunities for the delivery of culturally appropriate support to young women in

response to key transitional points in their health experiences. Health practitioners and policy-makers in PNG need to reconsider their assumptions underlying women's health programs and interventions in rural areas, and broaden their perspective of health to recognise the ways in which women's personal experiences influence health.

25. **Hombhanje FW, Linge D, Saweri A, Kuanch C, Jones R, Toraso S, Geita J, Masta A, Kevau I, Hiawalyer G, Sapuri M.**
Artemisinin-naphthoquine combination (ARCO) therapy for uncomplicated falciparum malaria in adults of Papua New Guinea: a preliminary report on safety and efficacy.
Malar J 2009 Aug 12;8:196.

BACKGROUND: The use of anti-malarial drug combinations with artemisinin or with one of its derivatives is now widely recommended to overcome drug resistance in falciparum as well as vivax malaria. The fixed oral dose artemisinin-naphthoquine combination (ANQ, ARCO) is a newer artemisinin-based combination (ACT) therapy undergoing clinical assessment. A study was undertaken to assess the safety, efficacy and tolerability of ANQ combination in areas of multi-drug resistance to generate preliminary baseline data in the adult population of Papua New Guinea. METHODS: The clinical assessment was an open-labeled, two-arm, randomized study comparing ANQ combination as a single-dose regimen and three-days regimen (10 mg/kg/day) of chloroquine plus single-dose sulphadoxine-pyrimethamine (CQ+SP) for the treatment of uncomplicated falciparum malaria with 28 days follow-up in an adult population. The primary outcome measures for efficacy were day 1, 2, 3, 7, 14 and 28-day cure rates. Secondary outcomes included parasite clearance time, fever clearance time and gametocyte carriage. The main outcome measures for safety were incidences of post-treatment clinical and laboratory adverse events. RESULTS: Between June 2005 and July 2006, 130 patients with confirmed uncomplicated *P. falciparum* were randomly assigned to receive ANQ and CQ+SP; only 100 patients (51 in ANQ group and 49 in CQ+SP group) were evaluated for clinical and parasitological outcomes. All the patients treated with ANQ and CQ+SP showed adequate clinical and parasitological response with 28 days follow-up. The cure rate for ANQ on day 1, 2, 3, 7, 14 and 28 was 47%, 86%, 92%, 94%, 94% and 94%, respectively. Recrudescence account for 6%; all were cleared on day 21. For CQ+SP-treated group the cure rates were 24%, 67%, 82%, 82%, 84% and 88%, respectively. Recrudescence accounted for 10%; all were cleared on day 21 except for one patient. Both regimens were well tolerated with no serious adverse events. The proportion of gametocyte carriers was higher in CQ+SP-treated group than ANQ treatment (41% versus 12%; $p < 0.05$). CONCLUSION: While these data are not themselves sufficient, they strongly suggest that the ANQ combination as a single-dose administration is safe and effective for the treatment of uncomplicated *P. falciparum* malaria in the adult population of Papua New Guinea and deserves further clinical evaluation.

26. **Jenney A, Tikoduadua L, Buadromo E, Barnes G, Kirkwood CD, Boniface K, Bines J, Mulholland K, Russell F.**
The burden of hospitalised rotavirus infections in Fiji.
Vaccine 2009 Nov 20;27 Suppl 5:F108-F111.

Rotavirus is the most common cause of acute severe dehydrating diarrhoea in young children worldwide. We describe the burden of rotavirus disease and the rotavirus types causing it in the largest city in Fiji. During 2006 and 2007, 592 children under 5 years of age were admitted to hospital in Suva, Fiji with acute diarrhoea. Of the 454 children for whom a stool specimen was tested, 39% were positive for rotavirus and the predominant strain found was the serotype G3[P8]. There is a significant burden of disease due to rotavirus in Fiji and the introduction of rotavirus vaccines into the national immunization schedule may drastically reduce inpatient diarrhoeal disease.

27. **Jin P, Kong F, Xiao M, Oftadeh S, Zhou F, Liu C, Russell F, Gilbert GL.**
First report of putative *Streptococcus pneumoniae* serotype 6D among nasopharyngeal isolates from Fijian children.
J Infect Dis 2009 Nov 1;200(9):1375-1380.

BACKGROUND: A putative *Streptococcus pneumoniae* serotype, 6D, resulting from the introduction of wciN(beta) into serotype 6B has been proposed. METHODS: We studied 98 unique serogroup 6 isolates from Fijian children, two-thirds of whom had received at least 1 dose of 7-valent pneumococcal conjugate vaccine, and 51 invasive isolates from Australian children. We used a polymerase chain reaction (PCR) system that targets both wciN(beta) and the single-nucleotide polymorphism that differentiates serotypes 6A and 6B – wciP584g (6A) and wciP584a (6B). RESULTS: Two (9%) of 22 Australian isolates and 24 (38%) of 64 Fijian isolates previously identified as 6A by the Quellung reaction and wciP584g PCR contained wciN(beta) and were designated as 6C; 14 (41%) of 34 Fijian isolates previously identified as 6B by the Quellung reaction and wciP584a PCR contained wciN(beta) and were designated as the new putative serotype 6D. A significantly smaller proportion of children from whom serotype 6D was isolated (2/14 [14%]) had not received PCV-7, compared with the proportion of those from whom serotype 6B was isolated (11/20 [55%]) ($p < 0.05$). CONCLUSION: This is the first report of naturally occurring *S. pneumoniae* serotype 6D.

28. **Karunajeewa HA, Salman S, Mueller I, Baiwog F, Gomorrai S, Law I, Page-Sharp M, Rogerson S, Siba P, Ilett KF, Davis TM.**
Pharmacokinetic properties of sulfadoxine-pyrimethamine in pregnant women.
Antimicrob Agents Chemother 2009 Oct;53(10):4368-4376. Epub 2009 Jul 20.

To determine the pharmacokinetic disposition of sulfadoxine (SDOX) and pyrimethamine (PYR) when administered as intermittent presumptive treatment during pregnancy (IPTp) for malaria, 30 Papua New Guinean women in the second or third trimester of pregnancy and 30 age-matched nonpregnant women were given a single dose of 1,500 mg of SDOX plus 75 mg of pyrimethamine PYR. Blood was taken at baseline and 1, 2, 4, 6, 12, 18, 24, 30, 48 and 72 h and at 7, 10, 14, 28 and 42 days posttreatment in all women. Plasma samples were assayed for SDOX, N-acetylsulfadoxine (NASDOX) and PYR by high-performance liquid chromatography. Population pharmacokinetic modeling was performed using NONMEM v6.2.0. Separate user-defined mamillary models were fitted to SDOX/NASDOX and PYR. When the covariate

pregnancy was applied to clearance, there was a significant improvement in the base model for both treatments. Pregnancy was associated with a significantly lower area under the concentration-time curve from 0 to infinity for SDOX (22,315 versus 33,284 mg x h/liter), NASDOX (801 versus 1,590 mg x h/liter), and PYR (72,115 versus 106,065 microg x h/liter; p <0.001 in each case). Because lower plasma concentrations of SDOX and PYR could compromise both curative efficacy and posttreatment prophylaxis in pregnant patients, IPTp regimens incorporating higher mg/kg doses than those recommended for nonpregnant patients should be considered.

29. **Kitamoto T.**
A history for 50 years of prion disease research. [Jp]
Rinsho Shinkeigaku 2009 Nov;49(11):936-938.

The history of the research on prion disease is consolidated in the 50 years after the Japanese Neurology Association started. It was proven that prion disease was infectious from work on kuru, which was a local disease of New Guinea. The history explains how CJD, the scariest disease for a neurologist, has come to be called a prion disease, and discussed the possibility of newly emerging prion diseases in the future.

30. **Koch M, Bugni TS, Pond CD, Sondossi M, Dindi M, Piskaut P, Ireland CM, Barrows LR.**
Antimycobacterial activity of *Exocarpos latifolius* is due to exocarpic acid.
Planta Med 2009 Oct;75(12):1326-1330. Epub 2009 May 14.

Lipophilic fractions of stem extracts from *Exocarpos latifolius*, native to Papua New Guinea, showed significant activity against *Mycobacterium tuberculosis* H37Ra. Bioactivity-guided fractionation yielded exocarpic acid (E-octadeca-13-ene-9,11-diynoic-acid) as the major active component. Several new exocarpic acid analogs were also shown to be active. Exocarpic acid has previously been reported active against gram-positive, but not gram-negative bacteria. Work presented here demonstrates the selective activity of exocarpic acid against *Mycobacterium tuberculosis* H37Ra.

31. **Lebouvier N, Jullian V, Desvignes I, Maurel S, Parenty A, Dorin-Semblat D, Doerig C, Sauvain M, Laurent D.**
Antiplasmodial activities of homogentisic acid derivative protein kinase inhibitors isolated from a Vanuatu marine sponge *Pseudoceratina* sp.
Mar Drugs 2009 Nov 23;7(4):640-653.

As part of our search for new antimalarial drugs in South Pacific marine sponges, we have looked for inhibitors of Pfnek-1, a specific protein kinase of *Plasmodium falciparum*. On the basis of promising activity in a preliminary screening, the ethanolic crude extract of a new species of *Pseudoceratina* collected in Vanuatu was selected for further investigation. A bioassay-guided fractionation led to the isolation of a derivative of homogentisic acid [methyl (2,4-dibromo-3,6-dihydroxyphenyl)acetate, 4a] which inhibited Pfnek-1 with an IC(50) around 1.8 µM. This product was moderately active in vitro against a FcB1 *P. falciparum* strain (IC(50) = 12 µM). From the same sponge, we isolated three known compounds [11,19-dideoxyfistularin-3 (1), 11-deoxyfistularin-3 (2) and dibromo-verongiaquinol (3)] which were inactive against Pfnek-1. Synthesis and biological evaluation of some derivatives of 4a are reported.

32. **Leggat PA, Wilks J.**
Overseas visitor deaths in Australia, 2001 to 2003.
J Travel Med 2009 Jul-Aug;16(4):243-247.

BACKGROUND: The health and safety of international visitors remain an important issue for Australia and other tourist destinations. The death of visitors remains an important indicator of safety. The aim of this study was to provide updated figures on deaths of overseas travellers in Australia. METHODS: Data were sourced from the Australian Bureau of Statistics concerning deaths of overseas visitors for the years 2001 to 2003. RESULTS: There were 1,068 overseas visitor deaths (701 males, 66%) during the study period 2001 to 2003. Death by natural causes increased with age, while deaths associated with accidents were more frequent among younger age groups. The majority of deaths were from natural causes (782, 73%), particularly ischemic heart diseases (26%). There were a total of 247 accidental deaths (23% of all deaths) with the main causes being transportation accidents (14% of all deaths) and accidental drowning/submersion (5% of all deaths). The countries contributing the most deaths were the UK (247, 23%), New Zealand (108, 10%) Melanesia/Micronesia (95, 9%), and the United States (57, 5%). CONCLUSIONS: Australia remains a relatively safe destination for international travellers, at least in terms of fatalities, which appear to be declining. Most deaths of overseas tourists in Australia are due to natural causes with cardiovascular disease being the predominant cause of death in this group. Accidents remain the most common preventable cause of death of travellers, with road and water safety being the major issues. It is important that tourism and travel medicine groups continue to advocate for improved health and safety of international travellers visiting Australia.

33. **Li M, McKelleher N, Moses T, Mark J, Byth K, Ma G, Eastman CJ.**
Iodine nutritional status of children on the island of Tanna, Republic of Vanuatu.
Public Health Nutr 2009 Sep;12(9):1512-1518. Epub 2009 Jan 20.

OBJECTIVE: To evaluate the iodine nutritional status of children living on the island of Tanna, Republic of Vanuatu. DESIGN: Cross-sectional study. Urine and household salt samples were collected for iodine measurement. Thyroid volumes were measured by ultrasound. A food consumption frequency survey was carried out, particularly in relation to salt, iodine-rich foods and foods that containing thiocyanate, a potentially goitrogenic substance. Urinary thiocyanate levels were also measured. SETTING: Island rural communities in Tanna, Vanuatu. SUBJECTS: One hundred and fifty-three schoolchildren between 8 and 10 years of age from four locations on the island participated. RESULTS: The median urinary iodine excretion (UIE) among the children was 49 mg/l, indicating moderate iodine deficiency. This was corroborated by 27% of boys and 33% of girls having thyroid glands greater than the international standard for their age, and 36% of boys and 45% of girls having thyroid glands greater than the international standard for their body surface area based on ultrasonography. There was a highly statistically significant inverse correlation between thyroid volume and UIE for boys and girls ($r = -0.444$, $p = 0.001$ and $r = -0.319$, $p = 0.005$, respectively). There

was no correlation between thiocyanate and UIE or thyroid volume. Only 34% of children reported to consume fish (tinned or fresh) on a weekly basis. CONCLUSIONS: Against the common perception, the study has demonstrated that the children on the island of Tanna were in a state of moderate iodine deficiency. More data need to be collected from other Pacific Island countries in order to provide evidence for formulating public policy in prevention and control of iodine deficiency disorders in these nations.

34. **Lumb R, Bastion I, Carter R, Jelfs P, Keehner T, Sievers A.**
Tuberculosis in Australia: bacteriologically confirmed cases and drug resistance, 2007. A report of the Australian Mycobacterium Reference Laboratory Network.
Commun Dis Intell 2009 Sep;33(3):298-303.

The Australian Mycobacterium Reference Laboratory Network collects and analyses laboratory data on new cases of disease caused by the *Mycobacterium tuberculosis* complex. In 2007, a total of 872 cases were identified by bacteriology, an annual reporting rate of 4.1 cases per 100,000 population. Isolates were identified as *M. tuberculosis* (n=867), *M. africanum* (n=4) and *M. bovis* (n=1). Fifteen children aged under 10 years had bacteriologically confirmed tuberculosis. Results of in vitro drug susceptibility testing were available for 871 of 872 isolates for isoniazid (H), rifampicin (R), ethambutol (E) and pyrazinamide (Z). A total of 98 (11.3%) isolates of *M. tuberculosis* were resistant to at least one of these anti-tuberculosis agents. Resistance to at least H and R (defined as multi-drug resistance, MDR) was detected in 24 (2.8%) isolates, all from overseas-born patients; 17 were from the respiratory tract (sputum n=16, endotracheal aspirate n=1). Thirteen patients with MDR-TB were from the Papua New Guinea-Torres Strait Islands zone. Of the 98 *M. tuberculosis* isolates resistant to at least one of the standard drugs, 54 (55.1%) were from new cases, 9 (9.2%) from previously treated cases, and no information was available on the remaining 35 cases. Seven were Australian-born, 90 were overseas-born, and the country of birth of 1 was unknown. Of the 90 overseas-born persons with drug-resistant disease, 66 (73.3%) were from 5 countries: India (n=16); Papua New Guinea (n=15); the Philippines (n=12); Vietnam (n=12); and China (n=11). No XDR-TB was detected in 2007.

35. **MacLaren D, Asugeni J, Asugeni R, Kekeubata E.**
Incorporating sociocultural beliefs in mental health services in Kwaio, Solomon Islands.
Australas Psychiatry 2009 Aug;17 Suppl 1:S125-S127.

OBJECTIVE: The aim of this paper is to describe the newly established mental health services at Atoifi Adventist Hospital, Solomon Islands, the sociocultural context in which it operates, and illustrate how the service is engaging with the Kwaio community to understand and incorporate local sociocultural beliefs into prevention, treatment and recovery journeys. METHOD: Five remote hamlets in East Kwaio, Malaita Province were visited in early 2008. Interviews were undertaken with 20 people with a history of buru spirit possession and 30 of their family members. RESULTS: Buru is a category of wild and malevolent spirits that possess people in East Kwaio and induce antisocial and unexpected behaviour. Signs of buru possession include mutism, suicidal ideas, delusion, aggression and social isolation. Traditional healers practice indigenous treatments with 50% of people receiving treatments described as cured, 30% temporary cured and 20% no effect from treatment. CONCLUSIONS: The new mental health service at Atoifi is taking steps to incorporate sociocultural beliefs, including of people possessed by buru, into routine practice. This provides a greater potential to support prevention, treatment and recovery journeys to advance the community's social, emotional and spiritual wellbeing.

36. **Maguire GP, Anstey NM, Ardian M, Waramori G, Tjitra E, Kenangalem E, Handojo T, Kelly PM.**
Pulmonary tuberculosis, impaired lung function, disability and quality of life in a high-burden setting.
Int J Tuberc Lung Dis 2009 Dec;13(12):1500-1506.

SETTING: Tuberculosis treatment clinic in Papua, Indonesia. OBJECTIVE: To document the impact of pulmonary tuberculosis (PTB) on lung function, exercise tolerance and quality of life (QOL). DESIGN: A prospective cohort study of 115 patients with smear-positive PTB followed for 6 months. Demographics, disease history, sputum microbiology, spirometry, 6-minute weight.walk distance (6MWWD) and QOL (modified St George's Respiratory Questionnaire) were measured at diagnosis and at 2 and 6 months. Analysis was restricted to the 69/115 (60%) subjects who attended all follow-up visits. RESULTS: Subjects who attended all visits were less likely than the full cohort to be of Papuan ethnicity ($p < 0.05$), were more likely to be cured ($p < 0.001$) and had better lung function at diagnosis ($p < 0.05$). Significant lung function impairment (forced expiratory volume in 1 second [FEV(1)] <60% predicted) was found in 27/69 (39%) at diagnosis. Although this fell during treatment ($p < 0.01$), 17/69 (24.6%) had persisting significant lung function impairment at treatment completion. As lung function recovered, exercise tolerance (6MWWD) rose by 12.3% ($p < 0.001$) and QOL improved ($p < 0.001$). CONCLUSION: In a high-burden setting, PTB causes prolonged, significant impairment of lung function, exercise tolerance and QOL. Current measures of disease burden are likely to underestimate the true impact of disease. Earlier diagnosis and disease-modifying treatments may reduce the long-term impact of PTB.

37. **Maillaud C, Sebat C, Pouradier F, Paladini L, Peres O, Durand F.**
Acute circulatory failure following a stonefish envenomation in New Caledonia: case report. [Fr]
Med Trop (Mars) 2009 Dec;69(6):591-594.

The purpose of this report is to describe a case of severe systemic envenomation with cardiac arrest following a sting by the stonefish *Synanceia verrucosa*. Although the exact mechanism underlying cardiac arrest is debatable, cardiovascular toxicity of stonefish venom appears to have been involved. This case supports the life-threatening potential of this type of accident, a much-debated topic in recent years.

38. **Manuelidis L, Chakrabarty T, Miyazawa K, Nduom NA, Emmerling K.**
The kuru infectious agent is a unique geographic isolate distinct from Creutzfeldt-Jakob disease and scrapie agents.
Proc Natl Acad Sci USA 2009 Aug 11;106(32):13529-

13534. Epub 2009 Jul 24.

Human sporadic Creutzfeldt-Jakob disease (sCJD), endemic sheep scrapie and epidemic bovine spongiform encephalopathy (BSE) are caused by a related group of infectious agents. The new UK BSE agent spread to many species, including humans, and clarifying the origin, specificity, virulence and diversity of these agents is critical, particularly because infected humans do not develop disease for many years. As with viruses, transmissible spongiform encephalopathy (TSE) agents can adapt to new species and become more virulent yet maintain fundamentally unique and stable identities. To make agent differences manifest, one must keep the host genotype constant. Many TSE agents have revealed their independent identities in normal mice. We transmitted primate kuru, a TSE once epidemic in New Guinea, to mice expressing normal and approximately 8-fold higher levels of murine prion protein (PrP). High levels of murine PrP did not prevent infection but instead shortened incubation time, as would be expected for a viral receptor. Sporadic CJD and BSE agents and representative scrapie agents were clearly different from kuru in incubation time, brain neuropathology and lymphoreticular involvement. Many TSE agents can infect monotypic cultured GT1 cells, and unlike sporadic CJD isolates, kuru rapidly and stably infected these cells. The geographic independence of the kuru agent provides additional reasons to explore causal environmental pathogens in these infectious neurodegenerative diseases.

39. **Mauta L, Vince J, Ripa P.**
Comparison of the use of liquid crystal thermometers with glass mercury thermometers in febrile children in a children's ward at Port Moresby General Hospital, Papua New Guinea.
J Trop Pediatr 2009 Dec;55(6):368-373. Epub 2009 Apr 24.

We compared the temperatures recorded, in febrile children admitted to a children's ward at Port Moresby General Hospital, by a doctor and by a group of nurses using glass mercury thermometers (GMT) and liquid crystal thermometers (LCT), Nextemp and Traxit. The mean difference (with 95% confidence intervals) in temperatures between GMT and Nextemp were –0.12 degrees C (–0.16 degrees C to –0.08 degrees C) for the doctor and 0.12 degrees C (0.04 to 0.20 degrees C) for nurses. The mean difference in temperatures between GMT and Traxit were –0.05 degrees C (–0.09 degrees C to –0.01 degrees C) for the doctor and 0.19 degrees C (0.10 to 0.28 degrees C) for the nurses. A similar result was obtained when one of the Nextemp thermometers used in the initial study was compared with GMT on a small sample of patients by the doctor 8 months later. Limited evaluation showed nursing staff were in favour of using the LCTs. Nextemp and Traxit thermometers can be used interchangeably with GMT in this setting.

40. **McCabe MP, Ricciardelli L, Waqa G, Goundar R, Fotu K.**
Body image and body change strategies among adolescent males and females from Fiji, Tonga and Australia.
Body Image 2009 Sep;6(4):299-303. Epub 2009 Jul 9.

The current study was designed to investigate the body image and body change strategies of adolescents from Fiji, Tonga and Australia. Participants were 628 Fijians, 463 Indo-Fijians, 598 Tongans and 535 European Australians. Adolescents completed measures of height, weight, body dissatisfaction, strategies to lose weight, increase weight and increase muscles. The results demonstrated that overweight adolescents were more dissatisfied with their bodies than those who were normal weight. Overweight Fijians and Tongans were more satisfied with their body than Indo-Fijian or Australian adolescents. Tongans, followed by Fijians and Indo-Fijians, were more likely to engage in strategies to lose weight, increase weight and increase muscles. These results are consistent with the focus in Fiji and Tonga on the value of the large body ideal, but may also reflect the recent focus on the attainment of a healthy body size.

41. **Mead S, Whitfield J, Poulter M, Shah P, Uphill J, Campbell T, Al-Dujaily H, Hummerich H, Beck J, Mein CA, Verzilli C, Whittaker J, Alpers MP, Collinge J.**
A novel protective prion protein variant that colocalizes with kuru exposure.
N Engl J Med 2009 Nov 19;361(21):2056-2065.

BACKGROUND: Kuru is a devastating epidemic prion disease that affected a highly restricted geographic area of the Papua New Guinea highlands; at its peak, it predominantly affected adult women and children of both sexes. Its incidence has steadily declined since the cessation of its route of transmission, endocannibalism. METHODS: We performed genetic and selected clinical and genealogic assessments of more than 3000 persons from Eastern Highland populations, including 709 who participated in cannibalistic mortuary feasts, 152 of whom subsequently died of kuru. RESULTS: Persons who were exposed to kuru and survived the epidemic in Papua New Guinea are predominantly heterozygotes at the known resistance factor at codon 129 of the prion protein gene (*PRNP*). We now report a novel *PRNP* variant – G127V – that was found exclusively in people who lived in the region in which kuru was prevalent and that was present in half of the otherwise susceptible women from the region of highest exposure who were homozygous for methionine at *PRNP* codon 129. Although this allele is common in the area with the highest incidence of kuru, it is not found in patients with kuru and in unexposed population groups worldwide. Genealogic analysis reveals a significantly lower incidence of kuru in pedigrees that harbor the protective allele than in geographically matched control families. CONCLUSIONS: The 127V polymorphism is an acquired prion disease resistance factor selected during the kuru epidemic, rather than a pathogenic mutation that could have triggered the kuru epidemic. Variants at codons 127 and 129 of PRNP demonstrate the population genetic response to an epidemic of prion disease and represent a powerful episode of recent selection in humans.

42. **Moffat K.**
Improving vision in Papua New Guinea.
Nurs NZ 2009 Dec-2010 Jan;15(11):22-23.

43. **Morris WE, Fernández-Miyakawa ME.**
Toxins of *Clostridium perfringens*. [Sp]
Rev Argent Microbiol 2009 Oct-Dec;41(4):251-260.

Clostridium perfringens is an anaerobic gram-positive spore-forming bacillus. It is a pathogen with

wide distribution in the environment; it can be isolated from soil and water samples, and also belongs to the intestinal flora of animals and humans. However, on some occasions it can act as an opportunistic pathogen, causing diseases such as gas gangrene, enterotoxemia in sheep and goats and lamb dysentery, among others. In human beings, it is associated with diseases such as food poisoning, necrotic enterocolitis of the infant and necrotic enteritis or pigbel in Papua New Guinea tribes. The renewed interest existing nowadays in the study of *C. perfringens* as a veterinary and human pathogen, together with the advance of molecular biology, has enabled science to have deeper knowledge of the biology and pathology of these bacteria. In this review, we discuss and update the principal aspects of *C. perfringens* intestinal pathology, in terms of the toxins with major medical relevance at present.

44. **Mueller I, Moorthy VS, Brown GV, Smith PG, Alonso P, Genton B; WHO Malaria**
Vaccine Advisory Committee (MALVAC).
Guidance on the evaluation of *Plasmodium vivax* vaccines in populations exposed to natural infection.
Vaccine 2009 Sep 18;27(41):5633-5643. Epub 2009 Jul 26.

In this paper we give guidance for the design and conduct of vaccine trials against *Plasmodium vivax* malaria. The paper supplements earlier guidelines on the planning of vaccine trials against *Plasmodium falciparum* malaria [WHO. Guidelines for the evaluation of *Plasmodium falciparum* vaccines in populations exposed to natural infections. Geneva: World Health Organization; 1997, http://www.who.int/vaccine_research/feuill_1_4-2.pdf], with further considerations in two later documents [Moorthy VS, Reed Z, Smith PG. Measurement of malaria vaccine efficacy in phase III trials: report of a WHO consultation. *Vaccine* 2007 Jul 9;25(28):5115-5123. Moorthy V, Reed Z, Smith P. MALVAC 2008: measures of efficacy of malaria vaccines in phase 2b and phase 3 trials – scientific, regulatory and public health perspectives. *Vaccine* 2009 Jan 29;27(5):624-628]. We deal specifically with study design and methodological issues for the assessment of pre-erythrocytic and blood-stage vaccines against *P. vivax*. The role of vaccines in blocking transmission of *P. vivax* is not considered as the methodological issues are similar to those for *P. falciparum*, though longer follow-up would be required because of the potential for relapse discussed below. In this paper we discuss the rationale and background to trials of *P. vivax* vaccines, requirements for Phase IIb and Phase III field trials, implementation of clinical trials, methods of measurement and analysis, and ethical aspects.

45. **Mueller I, Galinski MR, Baird JK, Carlton JM, Kochar DK, Alonso PL, del Portillo HA.**
Key gaps in the knowledge of *Plasmodium vivax*, a neglected human malaria parasite.
Lancet Infect Dis 2009 Sep;9(9):555-566.

Plasmodium vivax is geographically the most widely distributed cause of malaria in people, with up to 2.5 billion people at risk and an estimated 80 million to 300 million clinical cases every year – including severe disease and death. Despite this large burden of disease, *P. vivax* is overlooked and left in the shadow of the enormous problem caused by *Plasmodium falciparum* in sub-Saharan Africa. The technological advances enabling the sequencing of the *P. vivax* genome and a recent call for worldwide malaria eradication have together placed new emphasis on the importance of addressing *P. vivax* as a major public health problem. However, because of this parasite's biology, it is especially difficult to interrupt the transmission of *P. vivax*, and experts agree that the available methods for preventing and treating infections with *P. vivax* are inadequate. It is thus imperative that the development of new methods and strategies becomes a priority. Advancing the development of such methods needs renewed emphasis on understanding the biology, pathogenesis, and epidemiology of *P. vivax*. This review critically examines what is known about *P. vivax*, focusing on identifying the crucial gaps that create obstacles to the elimination of this parasite in human populations.

46. **Mustikawati DE, Morineau G, Nurhayati, Irmaningrum Y, Riono P, Priohutomo S, Magnani R.**
Sexual risk taking, sexually transmitted infections and HIV prevalence among four 'high-risk' occupational groups of Indonesian men.
Sex Transm Infect 2009 Sep;85(5):391-396. Epub 2009 Mar 8.

OBJECTIVES: This article reports new surveillance data on the prevalence of sexual risk taking, HIV and other sexually transmitted infections (STI) among four occupational groups of Indonesian men thought to be at elevated risk of infection. METHODS: Behavioural survey data were collected from 3008 men in 11 cities, among whom 2158 men were tested for HIV and syphilis and 1950 for gonorrhoea and chlamydia. Risk factors for STI were assessed using multivariable logistic regression. RESULTS: Thirty-six per cent of men had sex with a female sex worker (FSW) in the previous year and 20% with non-marital female partners. Consistent condom use was low with both sex workers (17%) and other non-marital partners (13%). HIV prevalence was 2% in Papua and less than 1% elsewhere, but was for the first time detectable in a non-core transmitter male population outside of Papua. STI rates were high for a non-core transmitter group, especially syphilis. Truck drivers were the most at risk. Multivariable analyses revealed exposure to FSW and inconsistent condom use, along with geographical location (Papua vs non-Papua) and unobserved factors associated with certain occupational groups, to be key risk factors for STI infection. CONCLUSIONS: The results confirm that men in the four occupational groups are reasonable proxies for 'high-risk men' for surveillance purposes in Indonesia. Although HIV prevalence was low, the extent of sexual risk-taking and the moderately high levels of STI among these men, along with rising HIV rates among FSW, indicate the potential for HIV/AIDS transmission in Indonesia to accelerate.

47. **Müller I, Genton B, Rare L, Kiniboro B, Kastens W, Zimmerman P, Kazura J, Alpers M, Smith TA.**
Three different *Plasmodium* species show similar patterns of clinical tolerance of malaria infection.
Malar J 2009 Jul 14;8:158.

BACKGROUND: In areas where malaria endemicity is high, many people harbour blood stage parasites without acute febrile illness, complicating the estimation of disease burden from infection data. For *Plasmodium falciparum* the density of parasitaemia that can be tolerated is low in the

youngest children, but reaches a maximum in the age groups at highest risk of infection. There are few data on the age dependence of tolerance in other species of human malaria. METHODS: Parasite densities measured in 24,386 presumptive malaria cases at two local health centres in the Wosera area of Papua New Guinea were compared with the distributions of parasite densities recorded in community surveys in the same area. We then analyse the proportions of cases attributable to each of *Plasmodium falciparum*, *P. vivax* and *P. malariae* as functions of parasite density and age using a latent class model. These attributable fractions are then used to compute the incidence of attributable disease. RESULTS: Overall 33.3%, 6.1% and 0.1% of the presumptive cases were attributable to *P. falciparum*, *P. vivax* and *P. malariae* respectively. The incidence of attributable disease and parasite density broadly follow similar age patterns. The logarithm of the incidence of acute illness is approximately proportional to the logarithm of the parasite density for all three malaria species, with little age variation in the relationship for *P. vivax* or *P. malariae*. *P. falciparum* shows more age variation in disease incidence at given levels of parasitaemia than the other species. CONCLUSION: The similarities between *Plasmodium* species in the relationships between parasite density and risk of attributable disease are compatible with the hypothesis that pan-specific mechanisms may regulate tolerance to different human plasmodia. A straightforward mathematical expression might be used to project disease burden from parasite density distributions assessed in community-based parasitological surveys.

48. **Narayan SA, Kool JL, Vakololoma M, Steer AC, Mejia A, Drake A, Jenney A, Turton JF, Kado J, Tikoduadua L.**
Investigation and control of an outbreak of *Enterobacter aerogenes* bloodstream infection in a neonatal intensive care unit in Fiji.
Infect Control Hosp Epidemiol 2009 Aug;30(8):797-800.

Ten neonates developed bloodstream infection with extended-spectrum beta-lactamase-producing *Enterobacter aerogenes* in a neonatal intensive care unit in Fiji. The source of the outbreak was traced to a bag of contaminated normal saline in the ward, which was used for multiple patients. All isolates recovered from patients were indistinguishable from the bacteria recovered from the normal saline by pulsed-field gel electrophoresis. The outbreak was controlled using simple infection control practices such as reinforcement of strict hand hygiene policy, provision of single-use vials of normal saline, and strict aseptic technique for injections.

49. **Newman AR, Moghaddam B, Yoon JM.**
A novel mutation in a Fijian boy with Shwachman-Diamond Syndrome.
J Pediatr Hematol Oncol 2009 Nov;31(11):847-849.

Shwachman-Diamond Syndrome (SDS) is an autosomal recessive disorder characterized by pancreatic insufficiency, bone marrow dysfunction and metaphyseal chondrodysplasia. SDS is associated with mutations in the Shwachman-Bodian-Diamond Syndrome gene, with 90% of reported mutations in exon 2. We present a Fijian boy with SDS who has a novel A>G substitution in exon 1 of the Shwachman-Bodian-Diamond Syndrome gene that has not been reported in the literature. This patient's unique clinical course includes the presence of a cleft lip and episodic hypoglycemia. SDS lacks a clear genotype-phenotype correlation, as is showed by the heterogeneity in its clinical presentation.

50. **Ortiz RH, Leon DA, Estevez HO, Martin A, Herrera JL, Romo LF, Portaels F, Pando RH.**
Differences in virulence and immune response induced in a murine model by isolates of *Mycobacterium ulcerans* from different geographic areas.
Clin Exp Immunol 2009 Aug;157(2):271-281.

Buruli ulcer (BU) is the third most common mycobacterial disease in immunocompetent hosts. BU is caused by *Mycobacterium ulcerans*, which produces skin ulcers and necrosis at the site of infection. The principal virulence factor of *M. ulcerans* is a polyketide-derived macrolide named mycolactone, which has cytotoxic and immunosuppressive activities. We determined the severity of inflammation, histopathology and bacillary loads in the subcutaneous footpad tissue of BALB/c mice infected with 11 different *M. ulcerans* isolates from diverse geographical areas. Strains from Africa (Benin, Ghana, Ivory Coast) induced the highest inflammation, necrosis and bacillary loads, whereas the strains collected from Australia, Asia (Japan, Malaysia, New Guinea), Europe (France) and America (Mexico) induced mild inflammation. Subsequently, animals were infected with the strain that exhibited the highest (Benin) or lowest (Mexico) level of virulence in order to analyse the local immune response generated. The Mexican strain, which does not produce mycolactone, induced a predominantly T helper type 1 (Th1) cytokine profile with constant high expression of the anti-microbial peptides beta defensins 3 and 4, in co-existence with low expression of the anti-inflammatory cytokines interleukin (IL)-10, IL-4 and transforming growth factor (TGF)-beta. The highly virulent strain from Benin which produces mycolactone A/B induced the opposite pattern. Thus, different local immune responses were found depending on the infecting *M. ulcerans* strain.

51. **Parks T, Kado J, Colquhoun S, Carapetis J, Steer A.**
Underdiagnosis of acute rheumatic fever in primary care settings in a developing country.
Trop Med Int Health 2009 Nov;14(11):1407-1413. Epub 2009 Sep 4.

OBJECTIVES: To determine the incidence rate, characterize the clinical features and assess the diagnostic evaluation of children presenting with features of acute rheumatic fever (ARF) at two clinics in a region of Fiji where rheumatic heart disease is known to be endemic. METHODS: We reviewed 5 years (2003-2008) of primary care records from 15,841 patients aged 4-20 years using a pre-determined case definition for ARF; and we reviewed detailed clinical data from 944 cases with features of possible ARF. RESULTS: The crude incidence of first episodes of definite ARF in this setting among patients aged 4-20 years was 24.9 per 100 000 person-years. Joint involvement suggestive of a potential first presentation of ARF but not sufficient for a definite retrospective diagnosis was documented in a further 94 records. There were another 514 cases of joint involvement less suggestive of ARF and 316 cases of unexplained fever with no evidence of localized infection. Patients

presenting with potential features of ARF seldom had a diagnostic evaluation sufficient to exclude its diagnosis. CONCLUSIONS: The incidence of ARF at these clinics is nearly twice that reported in a local hospital-based study, but it is likely to under-represent the actual number of cases presenting to primary care. There is a need for better surveillance for ARF and to develop simple and practical approaches to diagnosing ARF in primary care in low-resource settings.

52. **Pereira A, Cao Z, Murray TF, Gerwick WH.**
Hoiamide A, a sodium channel activator of unusual architecture from a consortium of two Papua New Guinea cyanobacteria.
Chem Biol 2009 Aug 28;16(8):893-906.

Hoiamide A, a novel bioactive cyclic depsipeptide, was isolated from an environmental assemblage of the marine cyanobacteria *Lyngbya majuscula* and *Phormidium gracile* collected in Papua New Guinea. This stereochemically complex metabolite possesses a highly unusual structure, which likely derives from a mixed peptide-polyketide biogenetic origin, and includes a peptidic section featuring an acetate extended and S-adenosyl methionine modified isoleucine moiety, a triheterocyclic fragment bearing two alpha-methylated thiazolines and one thiazole, and a highly oxygenated and methylated C15-polyketide substructure. Pure hoiamide A potently inhibited [^{3}H]batrachotoxin binding to voltage-gated sodium channels (IC(50) = 92.8 nM), activated sodium influx (EC(50) = 2.31 microM) in mouse neocortical neurons, and exhibited modest cytotoxicity to cancer cells. Further investigation revealed that hoiamide A is a partial agonist of site 2 on the voltage-gated sodium channel.

53. **Price RN, Douglas NM, Anstey NM.**
New developments in *Plasmodium vivax* malaria: severe disease and the rise of chloroquine resistance.
Curr Opin Infect Dis 2009 Oct;22(5):430-435.

PURPOSE OF REVIEW: Unlike *Plasmodium falciparum*, *Plasmodium vivax* rarely causes severe disease in healthy travellers or in temperate endemic regions and has been regarded as readily treatable with chloroquine. However, in tropical areas, recent reports have highlighted severe and fatal disease associated with *P. vivax* infection. We review the evidence for severe disease and the spread of drug-resistant *P. vivax* and speculate how these may be related. RECENT FINDINGS: Studies from Indonesia, Papua New Guinea, Thailand and India have shown that 21-27% of patients with severe malaria have *P. vivax* monoinfection. The clinical spectrum of these cases is broad with an overall mortality of 0.8-1.6%. Major manifestations include severe anaemia and respiratory distress, with infants being particularly vulnerable. Most reports of severe and fatal vivax malaria come from endemic regions where populations have limited access to healthcare and a high prevalence of comorbidity and where drug-resistant *P. vivax* strains and partially effective primaquine regimens significantly undermine the radical cure and control of this relapsing infection. The mechanisms underlying severe disease in vivax malaria remain poorly defined. SUMMARY: Severe, fatal and multidrug-resistant vivax malaria challenge our perception of *P. vivax* as a benign disease. Strategies to understand and address these phenomena are needed urgently if the global elimination of malaria is to succeed.

54. **Rees S, Silove D, Kareth M.**
Dua sakit (double sick): trauma and the settlement experiences of West Papuan refugees living in North Queensland.
Australas Psychiatry 2009 Aug;17 Suppl 1:S128-S132.

There is mounting evidence of systematic abuses, including torture, rape and extrajudicial killings, directed against independence activists as well as the civilian population in Indonesian-occupied West Papua. Refugees from West Papua have sought safety in neighbouring Australia, experiencing hazardous journeys during their flight. We report early observations from a mental health study among West Papuan refugees living in North Queensland, Australia. The project includes qualitative methods aimed at gathering histories of trauma and human rights violations as well as standard mental health assessments and indices of acculturation and resettlement stresses. We consider the emerging data from the vantage point of the Adaptation and Development After Persecution and Trauma model that identifies five psychosocial domains that require repair following exposure to gross human rights violations and refugee trauma. The model emphasizes the inter-relatedness of key challenges, the compounding of adversity, and the bivalent effects of complex experiences, with both positive and negative elements shaping the adaptive trajectory of displaced persons. Refugee groups have their own approaches to conceptualizing the complexity of their problems, with the term 'dua sakit' representing the expression used by West Papuans to identify the multiple challenges they face. The study highlights the importance of assessing each refugee group within its unique social and cultural context, taking into account such diverse factors as geographical location, employment and ongoing conflict in the homeland in designing appropriate interventions.

55. **Reesink G, Singer R, Dunn M.**
Explaining the linguistic diversity of Sahul using population models.
PLoS Biol 2009 Nov;7(11):e1000241. Epub 2009 Nov 17.

The region of the ancient Sahul continent (present day Australia and New Guinea, and surrounding islands) is home to extreme linguistic diversity. Even apart from the huge Austronesian language family, which spread into the area after the breakup of the Sahul continent in the Holocene, there are hundreds of languages from many apparently unrelated families. On each of the subcontinents, the generally accepted classification recognizes one large, widespread family and a number of unrelatable smaller families. If these language families are related to each other, it is at a depth which is inaccessible to standard linguistic methods. We have inferred the history of structural characteristics of these languages under an admixture model, using a Bayesian algorithm originally developed to discover populations on the basis of recombining genetic markers. This analysis identifies 10 ancestral language populations, some of which can be identified with clearly defined phylogenetic groups. The results also show traces of early dispersals, including hints at ancient connections between Australian languages and some Papuan groups (long hypothesized, never

before demonstrated). Systematic language contact effects between members of big phylogenetic groups are also detected, which can in some cases be identified with a diffusional or substrate signal. Most interestingly, however, there remains striking evidence of a phylogenetic signal, with many languages showing negligible amounts of admixture.

56. **Robinson SJ, Hoobler EK, Riener M, Loveridge ST, Tenney K, Valeriote FA, Holman TR, Crews P.**
Using enzyme assays to evaluate the structure and bioactivity of sponge-derived meroterpenes.
J Nat Prod 2009 Oct;72(10):1857-1863.

Enzyme screening of crude sponge extracts prioritized a 2005 Papua New Guinea collection of *Hyrtios* sp. for further study. The MeOH extract contained puupehenone and four puupehenone analogues (1, 2, 3, 5 and 7) along with a new diastereomer, 20-epi-hydroxyhaterumadienone (4), and a new analogue, 15-oxo-puupehenoic acid (6). The drimane terpene core of 4 and 6 was rapidly dereplicated, and the modified Mosher's method identified 4, while 1D and 2D NMR techniques were used to solve 6. These compounds plus noteworthy repository natural products and standards were tested against three lipoxygenase isozymes, human 5-, 12- and 15-lipoxygenases. Significant potency and selectivity profiles were exhibited in the human 5-lipoxygenase assay by puupehenone (1) and jaspaquinol (9) and structural factors responsible for activity identified.

57. **Ryan CB, Kama M, Darcy A, Aleksic E, Mirza T, Chaudhary A, Oelrichs RB, Rogers GD, Crowe SM.**
HIV type 1 in Fiji is caused by subtypes C and B.
AIDS Res Hum Retroviruses 2009 Dec;25(12):1355-1358.

The HIV epidemic in Fiji remains largely uncharacterized. By February 2009, there were 294 confirmed cases; the majority occurred among the 20- to 39-year old age group and resulted from heterosexual contact. There are currently no published data concerning HIV subtypes in Fiji. In this study, venous blood samples were collected as dried blood spots from 35 HIV-positive individuals in Fiji. HIV-1 subtype was determined for 27 (77%) samples and the presence of four different subtypes, with multiple introductions of two, was demonstrated. Subtype distribution was as follows: 16 (59%) were subtype C, 9 (33%) were subtype B, 1 (4%) was subtype A, and 1 (4%) was subtype G. Phylogenetic analysis showed a clear segregation of the Fijian subtype C isolates and previously published Papua New Guinea subtype C isolates as well as multiple introductions of subtype B. These findings represent the first HIV-1 subtype data from the Fiji Islands.

58. **Schoepflin S, Valsangiacomo F, Lin E, Kiniboro B, Mueller I, Felger I.**
Comparison of *Plasmodium falciparum* allelic frequency distribution in different endemic settings by high-resolution genotyping.
Malar J 2009 Oct 30;8:250.

BACKGROUND: The diversity of genotyping markers of *Plasmodium falciparum* depends on transmission intensity. It has been reported that the diversity of the merozoite surface protein 2 (msp2) is greater in areas of high compared to low endemicity; however, results for msp1 were inconsistent. These previous reports relied on low resolution genotyping techniques. METHODS: In the present study, a high-resolution capillary electrophoresis-based technique was applied to genotype samples from areas of different endemicity in Papua New Guinea and Tanzania. For both endemic settings, the diversity of msp1 and msp2 was investigated; the mean multiplicity of infection (MOI) and the FST values were determined to investigate whether more accurate sizing generates different results. RESULTS AND CONCLUSION: The results of the present study confirmed previous reports of a higher mean MOI for both marker genes and increased genetic diversity in areas of higher endemicity as estimated by the total number of distinct alleles for msp2. For msp1 a minor increase in diversity was observed. Measures of between population variance in allele frequencies (FST) indicated little genetic differentiation for both marker genes between the two populations from different endemic settings. MOI adjusted for the probability of multiple infections sharing the same allele was estimated by using the msp2 allele frequency distribution and the distribution of observed numbers of concurrent infections. For the high-resolution typing technique applied in this study, this adjustment made little difference to the estimated mean MOI compared to the observed mean MOI.

59. **Senn M, Baiwog F, Winmai J, Mueller I, Rogerson S, Senn N.**
Betel nut chewing during pregnancy, Madang Province, Papua New Guinea.
Drug Alcohol Depend 2009 Nov 1;105(1-2):126-131. Epub 2009 Aug 7.

INTRODUCTION: In Papua New Guinea, betel nut chewing is very common in the general population and in pregnant women. It has similarities in terms of use and complications of use to chewing tobacco (= smokeless tobacco), as its active agent, arecoline, is similar to nicotine. The present study investigates the habits of betel nut chewing and possible impact on pregnancy. METHODS: In a cross-sectional survey 310 pregnant women attending Alexishafen Health Centre (Madang Province) were interviewed with a survey measuring: detailed demographic data, betel nut chewing habits, other potential addictions (smoking, alcohol and drug use) and a medical examination (weight, height, blood pressure and hemoglobin level were recorded). Their babies have been assessed for birthweight and signs of prematurity. RESULTS: Among pregnant women, 94% regularly chew betel nut, 9% smoke and 1% used alcohol. 31% are heavy chewers (>10 nuts/day). The principal reasons for pregnant women to chew are: to prevent morning sickness (28%), to prevent having a smelly mouth (26%), the habit of chewing (20%), being addicted (10%). Primigravidity, betel nut chewing and low BMI had a statistically significant impact on birthweight reduction of 467 g ($p < 0.001$), 238 g ($p = 0.02$) and 175 g ($p = 0.005$) respectively. 80% of the women thought that chewing would not have any effect on the fetus. DISCUSSION: Given the high use of 'pure' betel nut among pregnant women, a significant impact on birthweight reduction and a poor knowledge about the adverse health effects of this substance, prevention programs in pregnant women should include betel nut chewing as a risk factor for poor pregnancy outcome.

60. **Soria-Mercado IE, Pereira A, Cao Z, Murray TF, Gerwick WH.**
Alotamide A, a novel neuropharmacological agent

from the marine cyanobacterium *Lyngbya bouillonii*.
Org Lett 2009 Oct 15;11(20):4704-4707.

Alotamide A (1), a structurally intriguing cyclic depsipeptide, was isolated from the marine mat-forming cyanobacterium *Lyngbya bouillonii* collected in Papua New Guinea. It features three contiguous peptidic residues and an unsaturated heptaketide with oxidations and methylations unlike those found in any other marine cyanobacterial metabolite. Pure alotamide A (1) displays an unusual calcium influx activation profile in murine cerebrocortical neurons with an EC50 of 4.18 microM.

61. **Steer AC, Magor G, Jenney AW, Kado J, Good MF, McMillan D, Batzloff M, Carapetis JR.**
emm and C-repeat region molecular typing of beta-hemolytic streptococci in a tropical country: implications for vaccine development.
J Clin Microbiol 2009 Aug;47(8):2502-2509. Epub 2009 Jun 10.

We designed a study to investigate the molecular epidemiology of group A streptococcal (GAS) and group C and G streptococcal (GCS and GGS) disease in Fiji, a country which is known to have a high burden of streptococcal disease. Molecular typing of the N-terminal portion (emm typing) of the M protein was performed with 817 isolates (535 GAS and 282 GCS/GGS). We also performed genotyping of the C-repeat region in 769 of these isolates to identify J14 sequence types. The profile of emm types for Fiji was very different from that found for the United States and Europe. There were no dominant emm types and a large number of overlapping types among clinical disease states. Commonly found GAS emm types in industrialized countries, including emm1, emm12 and emm28, were not found among GAS isolates from Fiji. Over 93% of GAS isolates and over 99% of GCS/GGS isolates that underwent J14 sequence typing contained either J14.0 or J14.1. Our data have implications for GAS vaccine development in developing countries and suggest that a vaccine based upon the conserved region of the M protein may be a feasible option for Fiji and potentially for other tropical developing countries.

62. **Taniguchi M, Kawabata M.**
KIR3DL1/S1 genotypes and *KIR2DS4* allelic variants in the AB KIR genotypes are associated with *Plasmodium*-positive individuals in malaria infection.
Immunogenetics 2009 Dec;61(11-12):717-730. Epub 2010 Jan 5.

The importance of innate immunity in malaria has been suggested for early protection from maturation and multiplication of *Plasmodium* parasites injected via infected mosquitoes. In this study, the killer cell immunoglobulin-like receptor (KIR) genes in innate immunity were investigated for an association with malaria in the comparison between *Plasmodium*-positive and *Plasmodium*-negative Melanesian individuals in the Solomon Islands, one of the most hyperendemic malaria regions in the world. The higher frequency of a pair of KIR3DL1 and KIR2DS4 was observed in the *Plasmodium*-positive individuals, which led to the investigation of *KIR3DL1/S1* genotypes in concert with *KIR2DS4* allelic variants. The positive individuals showed the highest frequency of *KIR3DL1/KIR3DS1* heterozygosity, which might suggest the masking of activating KIR3DS1 by inhibitory KIR3DL1 at allelic levels to maintain the KIR3DS1-driven activation of natural killer cells diminished in controlling *Plasmodium* proliferation. The extended analysis with A/B genotypes further revealed the trend of parasite-positive individuals to be *KIR3DL1/KIR3DS1* heterozygous in pair with *KIR2DS4* nondeleted variants in a set of KIR genes inheritable as the AB genotypes. To the best of our knowledge, this study is the first KIR investigation of the malaria-infected population, which strengthened the potential associations of KIR with malaria pathogenesis. The balance of inhibitory and activating KIR3D genes (*KIR3DL1/S1*) and membrane-bound or secreted status of *KIR2DS4* alleles in the interaction with the other KIR genes in the AB genotypes might constitute a part of KIR characteristics to determine resistance or susceptibility to *Plasmodium* parasitic infection.

63. **Tracer DP.**
Breastfeeding structure as a test of parental investment theory in Papua New Guinea.
Am J Hum Biol 2009 Sep-Oct;21(5):635-642.

Evolutionary parental investment theory predicts that parents invest preferentially in offspring best able to translate investments into fitness payoffs. It has also been proposed that where the reproductive prospects of offspring are directly correlated with parental investment and variance in fertility is higher for males than females, parents in better condition should bias investment toward males while those in poorer condition should bias investment toward females. Lactation is arguably among the costliest forms of investment expended by mothers and is thus expected to be allocated in ways consistent with fitness payoffs. Quantitative data collected among 110 Papua New Guinean mother-infant pairs during 470 h of focal follows on nursing frequency and duration and responses to infant demands, by maternal and offspring characteristics, are presented to provide empirically based descriptions of infant care and tests of evolutionary parental investment theory. Results indicate that mothers show very high levels of investment in offspring. However, although breastfeeding in developing countries is often characterized as on-demand, fussing and crying by infants were only attended to with breastfeeding about 30% of the time. Contrary to expectations of parental investment theory that parents should invest less in poorer quality offspring, mothers increased investment in offspring in poorer condition. The expectation that mothers in better condition would bias investment toward male offspring was also not supported; better nourished mothers biased investment toward female offspring. This study illustrates how infant feeding data may be used for testing larger evolutionary questions such as those derived from parental investment theory.

64. **Upcroft JA, Dunn LA, Wal T, Tabrizi S, Delgadillo-Correa MG, Johnson PJ, Garland S, Siba P, Upcroft P.**
Metronidazole resistance in *Trichomonas vaginalis* from highland women in Papua New Guinea.
Sex Health 2009 Dec;6(4):334-338.

BACKGROUND: The prevalence of the sexually transmissible protozoan parasite *Trichomonas vaginalis* in the highlands of Papua New Guinea (PNG) has been reported to be as high as 46% and

although not previously studied in Papua New Guinea, clinical resistance against metronidazole (Mz), the drug most commonly used to treat trichomoniasis, is well documented worldwide. This study was primarily aimed at assessing resistance to Mz in *T. vaginalis* strains from the Goroka region. METHODS: Consenting patients presenting at the Goroka Base Hospital Sexually Transmitted Diseases (STD) Clinic and local women were asked to provide two vaginal swabs: one for culturing of the parasite; and one for polymerase chain reaction detection of *T. vaginalis*, *Chlamydia trachomatis* and *Neisseria gonorrhoeae*. *T. vaginalis* isolates were assayed for Mz susceptibility and a selection were genotyped. RESULTS: The prevalence of *T. vaginalis* was determined to be 32.9% by culture and polymerase chain reaction of swabs among 82 local women and patients from the STD clinic. An unexpectedly high level of in vitro Mz resistance was determined with 17.4% of isolates displaying unexpectedly high resistance to Mz. The ability to identify isolates of *T. vaginalis* by genotyping was confirmed and the results revealed a more homogeneous *T. vaginalis* population in Papua New Guinea compared with isolates from elsewhere. CONCLUSION: *T. vaginalis* is highly prevalent in the Goroka region and in vitro Mz resistance data suggest that clinical resistance may become an issue.

65. **van den Biggelaar AH, Prescott SL, Roponen M, Nadal-Sims MA, Devitt CJ, Phuanukoonnon S, Pomat W, Tulic MK, Lehmann D, Siba PM, Richmond PC, Holt PG.**
Neonatal innate cytokine responses to BCG controlling T-cell development vary between populations.
J Allergy Clin Immunol 2009 Sep;124(3):544-550. Epub 2009 Jun 4.

BACKGROUND: The protective effect of *Mycobacterium bovis* BCG vaccination against infection and atopy varies between populations. OBJECTIVE: To identify differences in neonatal responses to BCG between diverse populations and study longitudinal associations with memory T-cell responses. METHODS: Cord blood mononuclear cells were collected from Papua New Guinean (PNG) and Western Australian (WA) newborns. Toll-like receptor (TLR)-2, TLR4 and TLR9 mRNA expression and in vitro BCG-stimulated (±IFN-gamma priming) innate cytokine responses were compared. When PNG infants were 3 months old, PBMCs were stimulated in vitro with *Mycobacterium* purified protein derivative (PPD) to determine memory T-cell responses. RESULTS: BCG-induced IL-10 and IFN-gamma responses were significantly higher in cord blood mononuclear cells of PNG newborns, and TLR2 and TLR9 expression was significantly higher and TLR4 expression lower compared with WA newborns. High neonatal IL-10 and low IFN-gamma responses to BCG were found to promote the development of PPD-memory T(H)2 responses in infancy, whereas neonatal BCG-TNFalpha responses inhibited the development of PPD-IL 10 responses. When primed with IFN-gamma, BCG-induced TNF-alpha, IL-12p70 and in particular IFN-gamma responses were enhanced to a significantly higher extent in WA than in PNG newborns. In response to IFN-gamma priming and BCG stimulation, natural killer cells of WA newborns produced IFN-gamma, whereas natural killer cells of PNG newborns contributed only indirectly to this response. CONCLUSION: Neonatal BCG-related innate immune responses control the differentiation of T(H) memory responses and vary between populations. This may explain differences in the effects of BCG vaccination between populations.

66. **Yeo TW, Lampah DA, Tjitra E, Gitawati R, Kenangalem E, Piera K, Granger DL, Lopansri BK, Weinberg JB, Price RN, Duffull SB, Celermajer DS, Anstey NM.**
Relationship of cell-free hemoglobin to impaired endothelial nitric oxide bioavailability and perfusion in severe falciparum malaria.
J Infect Dis 2009 Nov 15;200(10):1522-1529.

BACKGROUND: Hemolysis causes anemia in falciparum malaria, but its contribution to microvascular pathology in severe malaria (SM) is not well characterized. In other hemolytic diseases, release of cell-free hemoglobin causes nitric oxide (NO) quenching, endothelial activation and vascular complications. We examined the relationship of plasma hemoglobin and myoglobin to endothelial dysfunction and disease severity in malaria. METHODS: Cell-free hemoglobin (a potent NO quencher), reactive hyperemia peripheral arterial tonometry (RH-PAT) (a measure of endothelial NO bioavailability), and measures of perfusion and endothelial activation were quantified in adults with moderately severe (n = 78) or severe (n = 49) malaria and control subjects (n = 16) from Papua, Indonesia. RESULTS: Cell-free hemoglobin concentrations in patients with SM (median, 5.4 micromol/L; interquartile range [IQR], 3.2-7.4 micromol/L) were significantly higher than in those with moderately severe malaria (2.6 micromol/L; IQR, 1.3-4.5 micromol/L) or controls (1.2 micromol/L; IQR, 0.9-2.4 micromol/L; p <0.001). Multivariable regression analysis revealed that cell-free hemoglobin remained inversely associated with RH-PAT, and in patients with SM there was a significant longitudinal association between improvement in RH-PAT index and decreasing levels of cell-free hemoglobin (p = 0.047). Cell-free hemoglobin levels were also independently associated with lactate, endothelial activation and proinflammatory cytokinemia. CONCLUSIONS: Hemolysis in falciparum malaria results in NO quenching by cell-free hemoglobin, and may exacerbate endothelial dysfunction, adhesion receptor expression and impaired tissue perfusion. Treatments that increase NO bioavailability may have potential as adjunctive therapies in SM.

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3 **Garner PA, Hill G.** Brainwashing in tuberculosis management. *PNG Med J* 1985;28:291-293.

4 **Cochrane RG.** A critical appraisal of the present position of leprosy. In: Lincicome DP, ed. International Review of Tropical Medicine. New York: Academic Press, 1961:1-42.

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