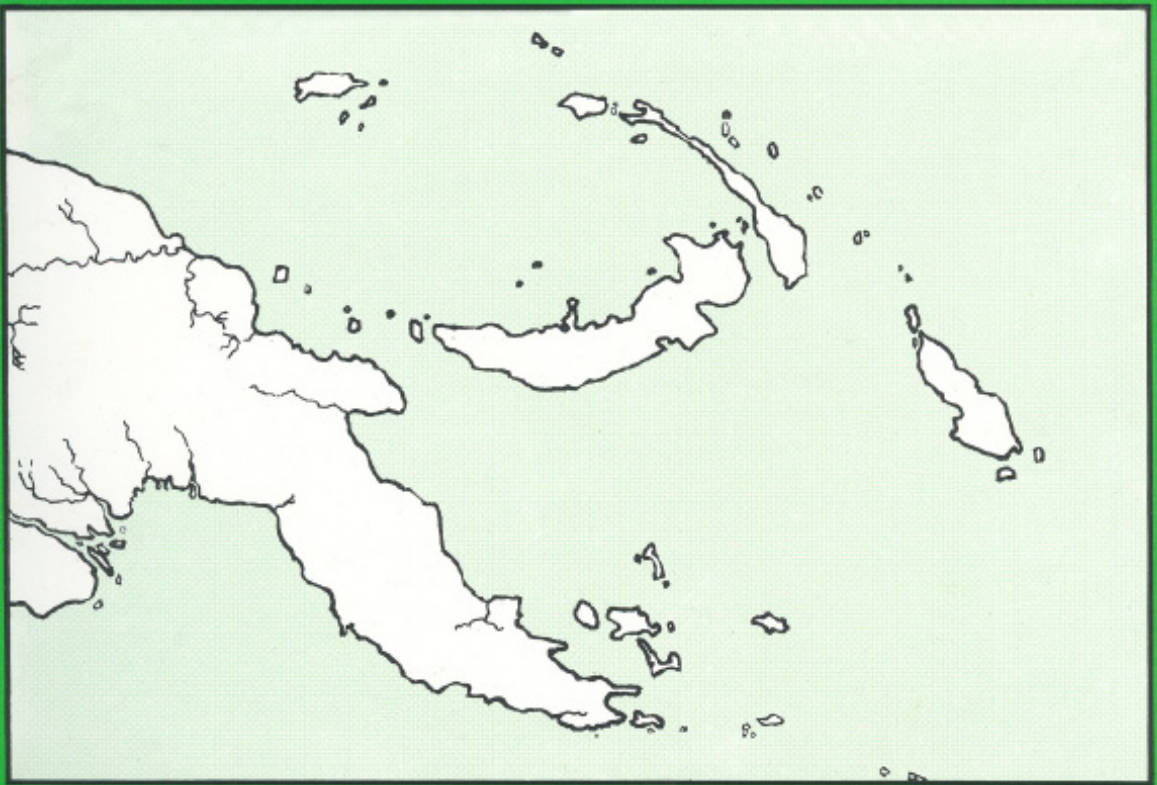


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EDITORIAL

Achieving control of cervical cancer in Papua New Guinea: what are the research and program priorities?

Human papillomavirus is the cause of cervical cancer

Cervical cancer is believed to be the most common form of cancer in women in many parts of the world, including Papua New Guinea (PNG) (1,2). It has been recognized for several decades that a very high proportion of cervical cancer cases are caused by chronic genital infection with human papillomavirus (HPV). There are over 120 types of HPV, of which an estimated 40 infect the anogenital tract (3). These have been categorized into high-risk (HR) or low-risk (LR) types based on their ability to cause cervical cancer. Infection with high-risk types of human papillomavirus (HR-HPV) leads to cervical intraepithelial neoplasia (CIN disease or 'pre-cancer'), which can progress to invasive cancer of the cervix if untreated. HPV types 16 and 18 are the ones most commonly associated with cervical cancer, but HPV types 31, 33, 35, 39, 45, 52, 58 and 73 can also be oncogenic (4-7). HPV-16 and -18 are estimated to be responsible for around 70% of all cervical cancers worldwide (5,8). HPV-16 and other high-risk types have also been associated with other cancers of the genital tract, anal cancer, and head and neck cancers, particularly oesophageal cancer (9).

Surveys of HPV prevalence among women in many countries have demonstrated a peak in infection under 25 years, followed by a decline with age and, in some settings, a second peak among older women (6,10,11). These findings are considered to be due to a high incidence of HPV infection in younger women who have recently become sexually active that is then followed by the clearance of HPV infection in the majority of those infected (10-13). The time lag between first infection and the development of CIN disease can be just a few years, but progression to cervical cancer is usually several decades.

Although infection with HPV is the primary cause of cervical cancer, not all women with the infection develop cancer. A variety of other factors have been found to be associated with the risk of HPV-induced cervical cancer

(14), including cigarette smoking (15-19) and sexually transmitted infections, such as genital warts, chlamydia, trichomonas and genital herpes (20-31).

The acquisition of genital infection with HPV is entirely due to sexual intercourse. A number of studies have found that the risk of infection is increased in women who have an earlier age of sexual debut, perhaps because of a longer duration of exposure but also possibly due to a higher susceptibility to infection at a younger age. Infection rates are also higher in women with higher parity, and higher numbers of sexual partners (4,32-34). These behavioural factors in turn are associated with a higher risk of cervical cancer.

Large-scale surveys have demonstrated considerable heterogeneity in the occurrence of HPV at the population level, both between and within countries. For example, the age-standardized prevalence of HPV (HR and LR types combined) varied from 1.4% in Spain to 25.6% in Nigeria (35). In Vietnam an almost seven-fold difference in all-type HPV prevalence was observed between women in Hanoi and Ho Chi Minh (1.6 and 10.6% respectively) (35). The distribution of HR-HPV types also varies significantly between different populations, with HPV-16 most common in Asia (14%), Europe (21%) and South America (15%); however, in Sub-Saharan Africa HPV-42 was more prevalent (HPV-42, 11%; HPV-16, 8%) (35).

Too little is known about HPV and cervical cancer occurrence in Papua New Guinea

There is very limited information available on the occurrence of HPV or cervical neoplasia in Papua New Guinea. However, the best available estimates suggest that PNG has among the highest rates of cervical cancer in the world, with an age-standardized incidence of 23.7/100,000 compared to 5.0/100,000 in Australia and New Zealand (1).

An estimated 1500 women die every year

in PNG due to cervical cancer. A review of the PNG National Cancer Registry (1958 to 1980) (36) found a total of 5060 recorded female cancers of which 762 (15%) were cervical cancer notifications, constituting two-thirds of all recorded gynaecological cancers. The proportion of cervical cancers rose to 50% of total cancers for the last 5-year period in the series (1975-1979). In 1999 Halder, Bannick and Moreweya reported that 48% of all cancers in women were cancers of the cervix for the period 1979-1999 (37). Poor local-level cancer case reporting and the absence of robust national-level coordination and management were highlighted in a 2001 Australian Agency for International Development (AusAID)-funded review of cancer services in PNG (38). Despite some progress in the past 10 years, the quality and completeness of cancer case reporting remain significant concerns and PNG still lacks a National Cancer Registry (39), hindering the development and implementation of evidence-based public health policy.

Despite the apparent burden of cervical cancer in PNG, no large-scale surveys have been conducted to establish the prevalence of HPV or specific subtypes among women in the general population. The only survey published to date, conducted among 114 women attending a gynaecology clinic in Goroka in the mid-1990s, reported a 33% prevalence of HPV-16/18 according to a previous editorial in the *PNG Medical Journal* (40).

Cervical biopsies obtained over the period 2006-2009 from 70 women in PNG with cervical cancer were recently analysed for HPV infection (41). HPV-DNA was found in all cases with HPV-16, 18, 33 and 31 the most prevalent HR types (57%, 26%, 10% and 4% respectively). These findings suggest that the currently available and highly effective vaccines against HPV types 16 and 18 have the potential to significantly reduce the burden of HPV-related cervical cancer in PNG, if distribution and cost issues can be resolved.

HPV vaccines are highly effective and can prevent cervical cancer

A definitive breakthrough in the control of cervical cancer came with the development of highly efficacious vaccines that generate robust immunity to HPV-16 and -18 (the bivalent GSK vaccine and the quadrivalent

Merck vaccine, which also protects against HPV types 6 and 11 that cause genital warts). A number of high-income countries have now implemented national HPV vaccination programs for primary cervical cancer prevention, while several developing countries have completed sub-national vaccination programs or conducted formative research to evaluate the potential cost-effectiveness, impact, acceptability and operational feasibility of future vaccine introduction (42-49). Mathematical models in a variety of settings (50-55) have suggested that vaccinating 90% of girls against HPV-16/18 prior to sexual debut could prevent up to 90% of HPV type-specific cervical cancers. The introduction of the quadrivalent vaccine in Australia in 2007 has already resulted in significant decreases in the prevalence of high-grade CIN disease among young women in Victoria compared to non-vaccinated age cohorts (56), suggesting that vaccination will ultimately have a significant impact in preventing new cases of cervical cancer in future.

For many developing countries, including Papua New Guinea, population-wide HPV vaccination programs are urgently needed for the long-term prevention of cervical and other types of cancer, but face substantial implementation challenges. Cost of the vaccine is one barrier, which has been substantially alleviated for many countries by recent agreements between the Global Alliance for Vaccines and Immunization (GAVI Alliance) and vaccine manufacturers that will make HPV vaccine available to developing countries at US\$ 5.00 per dose, compared to the full commercial price of around US\$ 100 per dose (57), but the question of how the vaccine should be delivered on a large scale will, if anything, present a larger issue. The current versions of the vaccine are aimed at adolescents or young adults, and have been delivered through school-based programs. It may be difficult for this approach to achieve high coverage in countries such as PNG, where school retention remains at low levels. The long-term impact of HPV vaccination is also difficult to predict or to evaluate in many developing country settings largely due to a lack of HPV type-specific prevalence data.

Screening and early detection can reduce morbidity and mortality in women with HPV

In many industrialized countries, the control

of cervical cancer was revolutionized from the 1960s by the introduction of cytological screening using the Papanicolaou (Pap) test, which enabled precancerous lesions to be detected and effectively treated. Organized screening programs, such as the National Cervical Screening Program introduced in Australia in 1991 (58), have been very successful, if resource-intensive public health strategies, but few developing countries have been able to adopt this approach because of the high level of laboratory capacity required, as well as the necessity for comprehensive clinical follow-up and treatment of detected cases.

A Pap test-based cervical screening initiative for women in PNG was established in 1999 by a non-governmental charity (the MeriPath program) and currently provides a service from more than 30 health facilities in 16 provinces in PNG (59). Around 2.5% of the 45,000 women screened in the past 10 years have been diagnosed with a high-grade epithelial abnormality, but only 30-50% of these have attended follow-up and received further treatment, and the testing coverage of women at risk remains very low and unlikely to be expanded with current resources. Accordingly, the *Ministerial Task Force on Prevention and Treatment of Cancer of the Cervix in PNG* recommended in its Final Report (2009) that alternative, locally appropriate models of cervical screening and early treatment be evaluated in PNG, particularly the 'see and treat' approach based on visual inspection of the cervix with acetic acid (VIA) plus cryotherapy (60). This approach has proven highly effective in a variety of resource-limited countries and found to compare favourably with Pap test and histological biopsy (61-76).

An important recent development in early detection has been the incorporation of testing for HPV. A landmark study in 2009 showed that in the low-resource setting of India, a treatment algorithm based on a single round of HPV testing significantly reduced the number of advanced cervical cancers and deaths compared with treatment based on either Pap test or VIA (77). Recent research in China (78), India (77) and Thailand (32,79) also suggests that HPV testing could be a valuable adjunct to cervical screening programs in developing countries, particularly now that rapid, point of care (POC) diagnostic assays for resource-limited settings, such

as *careHPV*TM (Qiagen Inc, USA), are being developed (80-83).

Research is needed for evidence-based public health policy on cervical cancer

With the recent major changes in technological strategies for primary and secondary prevention of HPV infection and its malignant sequelae has come the need for public health and clinical research to guide the implementation of these strategies in PNG. The health systems and policy environment within which such research (and future control programs) will be conducted will alter significantly in 2012, due to a number of encouraging developments: (a) a Cancer Unit will be established within the National Department of Health (NDoH), headed by a dedicated full-time program manager; (b) the National Cervical Cancer Task Force will be re-established by the NDoH and jointly convened with the Port Moresby Cancer Relief Society (POMCRS); (c) a National Cancer Control Consultative Workshop will be held in Port Moresby in August 2012 attended by health professionals, policy makers, academic researchers, development partners and other key stakeholders, and will culminate in the development of a draft National Cancer Control Policy.

In order to develop an evidence-based and locally appropriate cervical cancer control program in PNG, the following research priorities need to be addressed:

1) Surveys to better describe the distribution of HPV infection

The marked heterogeneity in HPV epidemiology observed both between and within countries (6,35) means that it is difficult to estimate HR-HPV prevalences in PNG based on earlier research in other settings. Robust, country-specific HPV prevalence data are therefore needed to estimate the epidemiological impact and cost-effectiveness of HPV vaccine introduction in PNG, and to provide a baseline for evaluation of future interventions.

Large-scale HPV surveys among women attending antenatal clinics, well woman clinics and sexual health clinics in PNG are now underway. Study recruitment in Central, Eastern Highlands and Western Highlands Provinces will commence in early 2012, with

clinical sites in the National Capital District and Southern Highlands and Madang Provinces to be added in 2012-2013. Preliminary data are expected to be available by mid-2013.

2) *Implementation research for introduction of HPV vaccination*

Research in a variety of developing and developed country settings has indicated the need for vaccine introduction to take account of country-specific sociocultural contexts and health systems realities (42-49). Pilot vaccination programs and highly focused operations research are therefore essential to inform future vaccine introduction in PNG, should the government decide to proceed with this strategy based on epidemiological and cost-effectiveness data.

A pilot HPV vaccination program among young girls in West New Britain Province (WNB) implemented by the provincial department of health to be carried out in 2012 has been met with high levels of acceptance by participants, parents, community members and other local stakeholders (D. Wood, personal communication). Definitive vaccine coverage and uptake data from the WNB pilot are expected by the end of 2012. Further operations research is urgently required to establish vaccine acceptability and options for future implementation in other sociocultural and epidemiological settings in PNG.

3) *Research to establish the performance, acceptability and operational feasibility of alternative approaches to cervical screening and treatment of precancerous lesions*

National cervical cancer screening programs in several resource-limited countries, including India, Bangladesh and Thailand, are based on the 'see and treat' VIA approach, primarily due to difficulties implementing effective cervical screening and early treatment based on Pap smear cytology in such settings (61-76). Several countries have, however, experienced difficulties in the delivery of an effective population-level intervention, in maintaining quality assurance, and in ensuring adequate staff training and support supervision (65,71), highlighting the need for 'see and treat' programs to be tailored to country-specific contexts.

Following the Ministerial Task Force

recommendation on new approaches to cervical screening (60), VIA plus cryotherapy services will be established at Well Woman Clinics in Goroka and Mt Hagen in May 2012. This research will establish the acceptability of the 'see and treat' approach among women and their sexual partners, and the operational feasibility of service delivery in urban and rural communities. Further research is planned in 2013 to investigate the impact, acceptability, health systems feasibility and cost-effectiveness of different options for the inclusion of novel, portable HPV-DNA point of care testing in the PNG cervical cancer screening program.

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Male circumcision for HIV prevention in Papua New Guinea: a summary of research evidence and recommendations for public health following a National Policy Forum

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SUMMARY

In 2005, a clinical trial in South Africa found that circumcision of young men could reduce their risk of acquiring HIV (human immunodeficiency virus) infection by over 60%. In the following year, two more trials in Africa confirmed this finding, leading the World Health Organization to recommend male circumcision as a public health strategy for HIV prevention in high-incidence countries. In order to inform public health policy in Papua New Guinea (PNG), two major research projects were initiated with the goals of investigating the status of penile cutting practices and assessing understandings, acceptability, feasibility and cost-effectiveness of male circumcision for HIV prevention. In addition, behavioural surveillance surveys systematically asked questions on penile cutting practices and an ethnographic literature review informed historical perspectives of penile cutting in PNG. Key findings from these research activities were presented at a National Policy Forum on Male Circumcision for HIV Prevention held in Port Moresby in November 2011. The Forum made three key recommendations: (1) the formation of a joint National Department of Health/National AIDS Council Secretariat Policy Committee on male circumcision; (2) the establishment of an integrated harm reduction program; and (3) that future policy on wide-scale roll-out of male circumcision for HIV prevention in PNG be informed by a combination of data from (a) male circumcision intervention pilot programs and (b) research on the potential protective effect of other forms of penile cutting.

Introduction

Interest in male circumcision (MC) has attracted unprecedented attention since it was shown in large-scale clinical trials in Africa to have a protective efficacy of around 60% in preventing HIV (human immunodeficiency virus) acquisition in heterosexual men (1-3), confirming earlier observational and ecological studies (4,5). This led World Health Organization (WHO) and UNAIDS (Joint United Nations Programme on HIV/AIDS) to recommend MC be considered an essential component of comprehensive HIV prevention in high-prevalence settings (6). Mathematical modelling by several independent groups has shown that MC, even with partial uptake, would be highly cost-effective and could avert up to 5.7 million new HIV infections and 3 million deaths over 20 years in Sub-Saharan Africa alone (7-10). The greatest impact of MC on HIV prevention is likely to be observed in communities where HIV is primarily transmitted via heterosexual intercourse, where HIV incidence is high and rates of MC are low, such as in many countries in East and Southern Africa (9,11,12). Targeting core groups of men at risk is also likely to be highly effective in many settings (8,12).

Research in African countries suggests that MC is generally regarded positively in both non-circumcising and circumcising populations (13-21). Among non-circumcising populations, factors influencing the acceptability of male circumcision include:

improved genital hygiene; a reduction in HIV, sexually transmitted infection (STI) and penile cancer risk; and low cost. Barriers to acceptability include: cultural tradition; fear of pain; excessive bleeding; safety concerns; and high cost. In communities that practise traditional male circumcision (full removal of the foreskin, carried out in infants, young children or men in their teenage years), key incentives to continuing these practices appear to be a desire to maintain ethnic traditions; to enhance male sexual pleasure and performance; genital hygiene; and aesthetic considerations. In many non-circumcising populations, women were more strongly in favour of MC than men and, among both sexes, the willingness to have male infants circumcised was greater than that of adult males to undergo circumcision themselves (16,17,19). Following their review of MC acceptability studies in Sub-Saharan Africa, Westercamp and Bailey (19) recommended that no further research on notional acceptability be conducted in Africa but that researchers and policy makers instead focus on pilot studies and phased intervention roll-out as part of comprehensive national HIV prevention strategies. Others have suggested a more cautious approach reasoning that complex cultural, ethical, medical and strategic issues need to be addressed before such interventions can be rolled out (20,22,23). For example, there are concerns that MC could displace pre-existing prevention measures such as condoms or behavioural risk reduction strategies

(20,24), although a recent phase III trial in Kenya observed no such behavioural risk compensation (2).

HIV and male circumcision in Papua New Guinea (PNG)

Recent national adult prevalence estimates suggest that the HIV epidemic may be progressing less rapidly in PNG than previously feared, with 0.9% of the adult population currently estimated to be infected (25). National HIV prevalence, however, remains among the highest in the Asia-Pacific region. Roughly equal numbers of male and female cases of HIV have been diagnosed in PNG, suggestive of a heterosexually driven epidemic. The epidemic exhibits substantial geographic heterogeneity, with cases clustered in a number of key provinces (25-26). Innovative strategies for HIV prevention, treatment and care are urgently needed to address this complex public health issue in a country with unparalleled geographical, linguistic and cultural diversity (27-28). Such tremendous diversity in a country experiencing a moderate-prevalence epidemic means that it is difficult to translate research findings from other contexts into public health policy for HIV prevention in PNG, and necessitates that country-specific research be conducted to guide future strategy (28).

There is limited published literature on MC in PNG and little contemporary information on penile cutting, associated penile practices and their sociocultural contexts (29-32). It is acknowledged in the available literature that MC (ie, full removal of the foreskin) is uncommon, and that most ethnic groups do not traditionally circumcise men (33,34). Earlier ethnographic literature indicates that while circumcision was less common than other forms of penile cutting in the context of initiation, it was documented in three regions and five provinces in this initial literature review (35). A variety of penile cutting practices have been described in PNG, including different types of dorsal longitudinal foreskin slits (36,37), but only limited research has been conducted on the diversity of these practices, and their historical and cultural contexts, derivation or meanings in terms of male initiation, sexuality and constructions of masculinity (29,31,35,38-40). Many traditional penile cutting practices and initiation rituals that appeared to have been discontinued over the last few decades now appear to have

persisted or been revived, adapted and re-interpreted (31,35,38,40).

Recently there has been acknowledgement of the spread of non-traditional types of penile cutting, penile inserts and other practices among men, eg, the insertion of ball bearings, beads and other objects into the skin of the penile shaft (31,32,34,35,41,42). As discussed elsewhere (36,43,44), a greater in-depth understanding of these practices and their motivators is required in order to develop culturally nuanced HIV prevention policies and programs, especially in relation to MC.

Research to date has appropriately focussed on the role of MC for HIV prevention in African countries experiencing high-burden epidemics. The lack of research from moderate-burden settings, such as PNG and many countries in the Asia-Pacific region (45-49), however, means that the acceptability, operational feasibility and potential epidemiological impact of MC remain unclear in these settings.

In order to clarify the potential role of MC for HIV prevention in PNG, two independent and complementary research projects have recently been conducted. In 2007, AusAID (Australian Agency for International Development) (through their Australian Development Research Award [ADRA] initiative) approved funding for a 4-year program of research conducted by the PNG Institute of Medical Research (PNGIMR) in collaboration with the University of Queensland (UQ) and the University of New South Wales (UNSW) in Australia – the ADRA Male Circumcision Acceptability and Impact Study (MCAIS). This multidisciplinary project was carried out in four separate, linked components using a variety of research methods in 6 provinces (National Capital District and East Sepik, Eastern Highlands, Madang, Western Highlands and West New Britain Provinces) (Figure 1). A complementary 3-year study conducted by Pacific Adventist University (PAU), Divine Word University (DWU) in PNG and James Cook University (JCU) in Australia was awarded funding under the Australian National Health and Medical Research Council (NHMRC) Global Health Initiative in 2009 – the NHMRC Acceptability of Male Circumcision for HIV Prevention in PNG Study. This multimethod study was carried out in 4 provinces (National Capital District and Enga, Oro and Madang Provinces) (Figure 1).

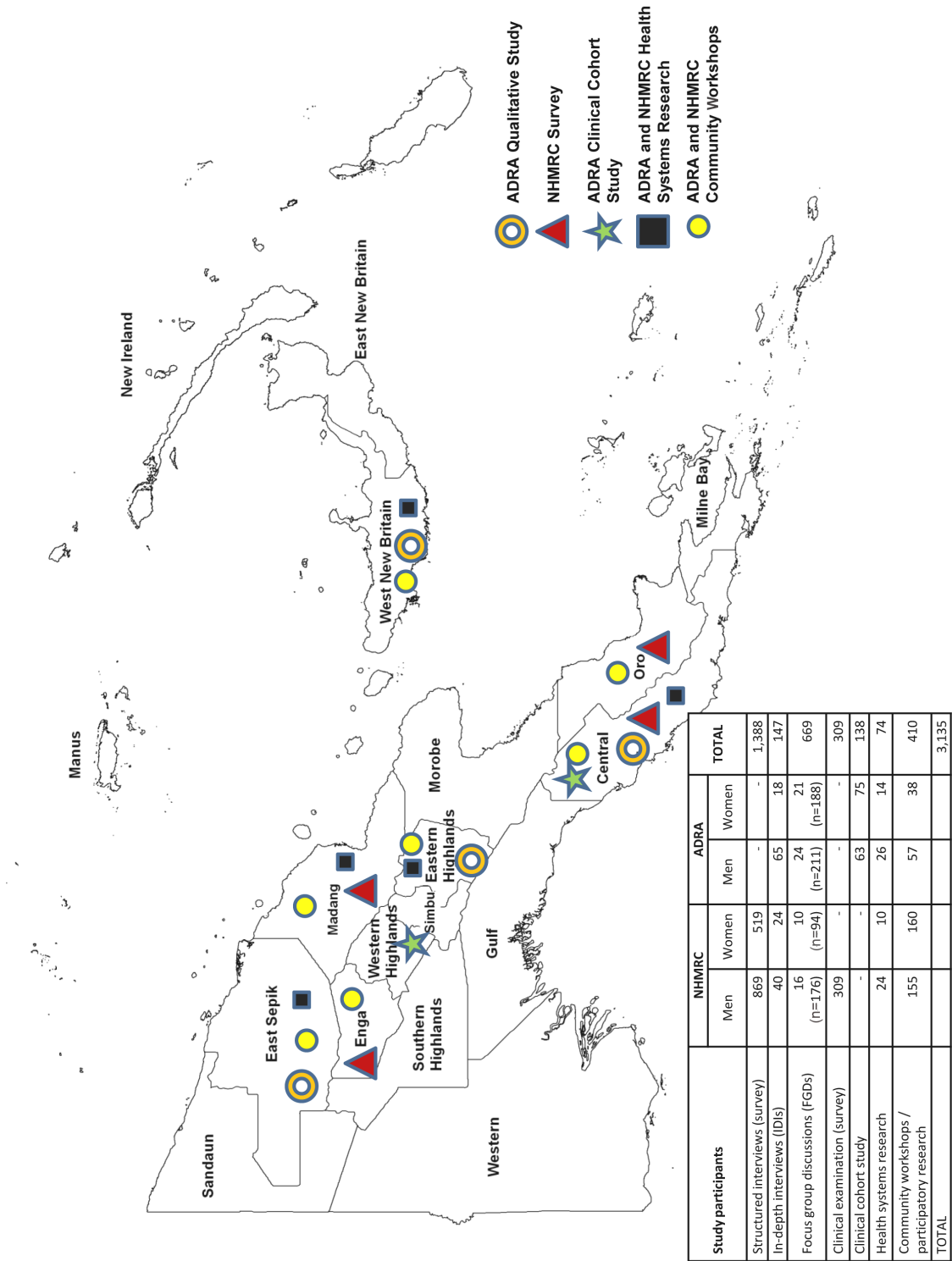


Figure 1. Study sites in Papua New Guinea for research projects on the potential role of male circumcision for the prevention of HIV infection, funded by ADRA (the Australian Development Research Award initiative of the Australian Agency for International Development) and NHMRC (the National Health and Medical Research Council of Australia).

In recognizing the need to understand the sociocultural contexts of penile cutting in PNG, including the potential risk of HIV transmission through the reuse of unsterile cutting or injecting equipment, questions on penile modification practices were included in behavioural surveillance surveys (BSS) conducted between 2008 and 2010 in 41 sites in 9 provinces (Eastern Highlands, Western Highlands, Southern Highlands, Jiwaka, Hela, Gulf, Sandaun, Morobe and Madang Provinces) (29,32,50-53). The development and strengthening of behavioural surveillance at the National Research Institute (NRI) has been supported by the National Department of Health, the Asian Development Bank through their HIV Prevention in Rural Enclaves project and AusAID.

National Policy Forum on Male Circumcision for HIV Prevention in PNG

A National Policy Forum was convened by the National AIDS Council Secretariat (NACS) and the PNG Sexual Health Society (PNGSHS)

in Port Moresby on 21-22 November 2011. The purpose of the Forum was to promote the translation of research evidence into public health policy for the prevention of HIV in PNG (Table 1). The Forum was attended by 65 delegates comprising policy makers, health care professionals, research teams from PNG and Australia, representatives of development agencies and non-government organizations, and an international public health consultant previously involved with the World Health Organization's policy and programming on MC for HIV prevention in Africa.

In this paper we present a synthesis of key findings from the research projects funded by ADRA and NHMRC and from behavioural surveillance research, and summarize recommendations for public health policy arising from the National Policy Forum.

Research methods and key findings

The ADRA and NHMRC studies, conducted from 2008 to 2012, used a combination

TABLE 1

KEY OBJECTIVES OF THE NATIONAL POLICY FORUM ON MALE CIRCUMCISION AND HIV PREVENTION

- To review research evidence from African countries on the protective effect of male circumcision on HIV infection and to consider the relevance of these data to PNG.
- To review the experience in implementing intensive male circumcision interventions in high-HIV-incidence settings in Africa and draw lessons for future program implementation in countries such as PNG that are experiencing HIV epidemics with low or moderate burden.
- To review the findings of formative research recently completed in PNG on penile cutting, inserts, injection and other practices; the acceptability of male circumcision for HIV prevention; health systems research to investigate potential options for future male circumcision roll-out in PNG; the historical contexts of penile cutting in initiation; and epidemiological mathematical modelling to estimate the impact of male circumcision on the HIV epidemic in PNG under different intervention and uptake scenarios.
- To make evidence-based recommendations on next steps with regard to policies, programming and research on male circumcision and penile modification practices in PNG, in order to minimize harm, promote sexual health and prevent new HIV infections.

HIV = human immunodeficiency virus
PNG = Papua New Guinea

of qualitative and quantitative behavioural research methods, mathematical modelling, health systems research and clinical research, and involved over 3000 participants in 8 provinces (Figure 1). Key findings from the two research projects (Tables 2-4) were presented to stakeholders at the National Policy Forum, where a joint briefing document was also launched by the Director of NACS, Mr Wep Kanawi (54).

In addition, a critical review and synthesis of over 100 years of ethnographic research on initiation and penile cutting in PNG was presented by researchers from the PNGNRI (Table 5), as well as key findings about contemporary penile modification practices

from BSS surveys in 9 provinces from 1859 men, illustrating both historical continuities and change in contemporary practices, including recently introduced insert and injection practices (Table 6). Health professionals from Wewak presented a summary of the MC program in East Sepik Province (ESP), which has been widely accepted by both men and women in local communities.

National Policy Forum: summary and recommendations for public health

1. Translating research evidence into public health action

Delegates recommended that a *Policy*

TABLE 2

SUMMARY OF KEY FINDINGS FROM THE PROJECTS FUNDED BY ADRA AND NHMRC

1. There are a wide range of traditional and contemporary penile cutting, insert and injection practices in Papua New Guinea.
2. A substantial proportion of young men have a dorsal longitudinal foreskin slit where the foreskin has been cut but not removed (known as a *straight cut*), while a smaller proportion have a circumferential foreskin cut where the foreskin has been totally removed (known as a *round cut*).
3. Cutting practices are more common in men from New Guinea Islands and Momase, and less common in men from the Highlands and Southern Regions.
4. A high proportion of men expressed an interest in male circumcision for HIV prevention and said they would be willing to consider the intervention for their sons.
5. Women expressed views that male circumcision may be good for health and for cultural and religious reasons but many were concerned that men may increase their risk behaviour if they felt protected by circumcision.
6. Health officials expressed concern about providing circumcision services widely if a policy recommendation endorsed the strategy, due to the potential impact on the delivery of other essential services.
7. Mathematical modelling suggests that male circumcision could have a moderate impact in reducing the incidence and prevalence of HIV in PNG. The expected level of impact depends on the level of protection conferred by current penile cutting practices, which is unknown. Other interventions could have a greater impact on HIV incidence but they may be less feasible, and their long-term costs could be greater than male circumcision.

ADRA = Australian Development Research Award

NHMRC = National Health and Medical Research Council

HIV = human immunodeficiency virus

PNG = Papua New Guinea

Committee on Male Circumcision, jointly convened by the National Department of Health (NDoH) and the National AIDS Council Secretariat (NACS), be established in order to formalize the recommendations arising from the National Policy Forum.

2. Making penile practices safer

It was highlighted throughout the forum that many penile cutting, insert and injection practices are associated with significant risks, including blood loss and infection, transmission of HIV and other blood-borne viruses (due to sharing unsterile razor blades and other cutting or injecting tools), sexual activity prior to wound healing, penile deformity, urethral blockages and sexual dysfunction.

Delegates recommended that an integrated *Harm Reduction Program* be established that combines public information and education campaigns, health provider training, provision of clinical services to men suffering complications from non-medical forms of penile cutting, insertions and injection, and support for reducing harm through safer cutting and injecting procedures outside the formal health sector (Table 7).

3. Male circumcision for HIV prevention in PNG

Although the MC program in ESP appears to have been accepted by both men and women in local communities, the cost-effectiveness, operational feasibility and public health impact of MC in other geographical locations and population groups in PNG remain unclear. In addition, a country-specific mathematical model (55,56) suggests that MC could have a significant impact on the HIV epidemic in PNG but that increasing condom use and early initiation of antiretroviral therapy could have a greater impact (Table 3). Health systems research also suggests that strengthening existing HIV prevention and care strategies may be more feasible in a vulnerable health systems context than attempting to initiate and roll out new prevention technologies (57,58).

No research has been carried out to investigate whether other types of penile cutting that are common in PNG (such as slitting of the foreskin or 'straight cut') could provide some level of protection against HIV infection. Anecdotal evidence suggests that cutting practices that result in lateral retraction

of the foreskin and exposure of the underlying surface could result in epithelial keratinization, which has been hypothesized as a key biological mechanism by which circumcision protects against HIV (59-61).

On the basis of the current research evidence and experience to date implementing MC programs in PNG, delegates agreed that wide-scale roll-out of MC for HIV prevention cannot currently be recommended. A decision on whether to proceed with roll-out in the future should be based on additional information from formative research and pilot intervention projects, carried out in the context of a national health education campaign to disseminate appropriate and accurate information to communities and health workers in order that men can make an informed choice about undergoing MC or other forms of penile cutting (Table 8).

Conclusions

Male circumcision has the potential to play an important role in HIV prevention in PNG. Current research evidence and experience from pilot implementation programs, however, indicate that wide-scale roll-out cannot currently be recommended. Given the cultural, linguistic and geographical diversity of the country, the variety of traditional and contemporary penile cutting and other practices, and the heterogeneity of the HIV epidemic in PNG, it is essential that future public health programs on male circumcision for HIV prevention are informed by the best research evidence, and designed in collaboration with stakeholders at all levels to ensure the highest possible acceptability, uptake and epidemiological impact.

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TABLE 3
SUMMARY OF METHODS USED AND KEY FINDINGS FROM THE ADRA MALE CIRCUMCISION (MC) ACCEPTABILITY AND IMPACT STUDY (MCAIS)

Study component	Methods	Key findings
Qualitative MC acceptability study	<ul style="list-style-type: none"> A qualitative community-based study in four provinces (Eastern Highlands, East Sepik, West New Britain and National Capital District). A total of 24 focus group discussions (FGDs) and 65 in-depth interviews (IDIs) were carried out among 276 men; and 21 FGDs and 18 IDIs were conducted among 206 women. Tools adapted from participatory learning and action (PLA) were used to validate key study findings and to engage communities in a participatory research dissemination process. 	<ul style="list-style-type: none"> Most men were in favour of MC for HIV prevention and cited improved genital hygiene, enhanced sexual pleasure and cultural appropriateness as key factors. A minority of men were against MC, primarily due to concerns that sexual risk behaviour could increase and that MC went against prevailing cultural and religious beliefs. The majority of women objected to MC because they considered that it would result in increased sexual risk behaviour, that it was against Christian faith and that it was culturally inappropriate. A minority of women supported MC for prevention of HIV and other STIs, penile hygiene and health, and for its role in reducing HIV transmission.
Longitudinal clinical cohort study	<ul style="list-style-type: none"> A longitudinal clinical cohort study among men and women attending Tininga Sexual Health Clinic, Mt Hagen and Nine-Mile Sexual Health Clinic, Port Moresby. Following an initial screening visit, a total of 138 participants (63 male, 75 female) were enrolled and attended clinical follow-up visits every 3 months for 1 year. 	<ul style="list-style-type: none"> Penile modifications were common, with one-third of men having a dorsal longitudinal foreskin slit, 6% a circumferential foreskin cut and 3% a penile insert. The acceptability of MC for HIV prevention was high among both men and women. Prevention of HIV and STIs, religious and cultural appropriateness, and concerns regarding sexual risk compensation were key factors influencing acceptability among both men and women.
Health systems research	<ul style="list-style-type: none"> A multimethod qualitative study with community representatives from Eastern Highlands, East Sepik, West New Britain and National Capital District, and with key health workers and upper health system officials involved in sexual and reproductive health in PNG. A total of 40 key informant interviews (KIs), 	<ul style="list-style-type: none"> Participants expressed concern about health facility capacity to conduct MC programs in various parts of PNG due to insufficient medical supplies, limited staff and inadequate clinical space. Review of comparable national health programs in PNG reveals a history of uneven service delivery, difficulties with securing a workforce and inadequate information systems. Despite these limitations, health workers are already directly or indirectly involved in penile cutting services, through the provision

21 FGDs and 6 clinical audits were carried out.

- A modified Delphi approach with a panel of 7 sexual health experts was also conducted.
- Participatory community workshops used PLA tools to validate results and gain further insights.

Mathematical modelling

- An age-structured mathematical model was developed based on available research findings and calibrated to represent the HIV epidemic in PNG.

of scalpels, dressings and medications, or performing procedures either in their workplace or community locations, with longitudinal dorsal slit being the most popular type of cut.

- A classification or typology of penile cutting practices in PNG was developed and provides a universal language for health practitioners and policy makers to inform the debate on future public health policy.

- The PNG HIV Model predicts that MC could have a moderate impact in reducing the incidence and prevalence of HIV in PNG. For example, assuming 5% of men already have a circumferential ('round') cut, 45% already have a longitudinal cut and the preventive efficacy of a longitudinal cut is 20%, then conducting circumferential cuts on 20% of men over the next 5 years will avert 6% of new HIV infections by 2020.
- The population-level impacts of MC are highly dependent on the current proportion of men with longitudinal dorsal slits or other forms of penile cutting and their efficacy in HIV prevention. Whether such cuts confer protection is currently unknown.
- Prioritizing uptake to younger men and men with higher levels of sexual activity would be the most efficient and cost-effective way to implement MC for HIV prevention.
- Other interventions, including increasing condom use and the early initiation of antiretroviral therapy (ART), could have a much greater impact in reducing HIV incidence than MC but they may be less feasible, and their long-term costs could be greater than MC.

ADRA = Australian Development Research Award
HIV = human immunodeficiency virus
STIs = sexually transmitted infections
PNG = Papua New Guinea

TABLE 4

SUMMARY OF METHODS AND KEY FINDINGS FROM THE NHMRC ACCEPTABILITY OF MALE CIRCUMCISION FOR HIV PREVENTION IN PNG STUDY

Study component	Methods	Key findings
<i>Pilot study</i>	<ul style="list-style-type: none"> A multimethod study was conducted with staff and students of the Koiari Park Campus of Pacific Adventist University (PAU). Questionnaires from acceptability studies in Africa were adapted to suit the PNG context. A total of 59 male and 37 female self-administered questionnaires (SAQs), 4 male and 4 female semi-structured interviews (SSIs) and 2 male and 1 female focus group discussions (FGDs) were conducted with staff and students. Clinical examination was used to verify self-reported genital cutting status for 13 men. 	<ul style="list-style-type: none"> A total of 45 men reported on their foreskin status, of whom 25% had no penile cut, 61% had a longitudinal cut (foreskin cut but not removed) and 14% a circumferential cut (complete removal of foreskin). Reported names of penile cuts included: banana cut, butterfly cut, cobra cut, dorsal slit, long cut, round cut, sepiak way, straight cut, V cut, helmet cut. Most men had their foreskin cut between the ages of 15 and 19, in a bush or village setting and by a friend or family member. Foreskin cutting was done for reasons of hygiene, peer influence, cultural practice, to avoid sexually transmitted infections, to increase sexual pleasure and to release maternal blood. In men with a penile cut, 86% reported no regrets. In men with no penile cut, 85% reported a desire for circumcision with most wishing the procedure to occur in a health facility. All men who self-reported foreskin cutting were confirmed to have a penile cut on clinical examination. Women had varying views on the acceptability of MC for the prevention of HIV including that it improved health, hygiene, sexual pleasure and masculinity but also had concerns about increased sexual arousal and risk behaviour.
<i>Multisite cross-sectional study</i>	<ul style="list-style-type: none"> A cross-sectional survey with people resident at four sites: Pacific Adventist University (PAU; National Capital District), Divine Word University (DWU; Madang Province), Porgera Joint Venture (PJV; Enga Province) and Higaturu Oil Palms (HOP; Oro Province). 	<ul style="list-style-type: none"> A total of 857 men reported foreskin status: 43% no cut; 47% longitudinal cut; 10% circumferential cut. Average age at longitudinal cut was 17.0 years and circumferential cut 14.8 years. Most men had their foreskin cut by a friend or family member in a village or bush setting with a razor blade from a store or a scalpel blade sourced from a health facility. Injecting the penis with oil or other substances was reported

- Questionnaires were adapted from African studies, the earlier PNG pilot study and PNG National Research Institute Behavioural Surveillance Survey (NRI BSS) tools to incorporate specific issues related to penile cutting in PNG.
- A total of 869 men and 519 women completed questionnaires, 40 men and 24 women participated in SSIs and there were 36 male and 10 female FGDs. Clinical examination was conducted with 309 men.
- by 7.3% of men, with much higher rates from the Higaturu site (18.5%).
- Condom use at last sex was reported by around one-third of men, and did not vary by cutting status.
- Reasons for men having their foreskin cut included: culture, health, sexual, biblical, peer influence, partner's influence and parent decision.
- A willingness to fully remove the foreskin if it reduced the risk of HIV was reported by 71% of men with no cut (additional 13% stating maybe) and 84% of men with a longitudinal cut.
- The willingness to remove the foreskin of a child was reported by 73.8% of women and 86.8%, 93.4% and 91.4% of men with no foreskin cut, a longitudinal cut and circumferential cut respectively.
- Women described the positive aspects of MC as health, sexual pleasure, religion, cultural, masculinity/maturity and sense of happiness/satisfaction/safety. They expressed concerns that circumcision may lead to men being more sexually aroused/active, wanting sex with many women, unsafe cutting practices outside health facilities, pain and healing difficulties and the potential of increasing STIs and domestic violence.
- Health practitioners and senior leaders reported the health system including staff, facilities, procurement, training and information systems are all currently challenged to provide existing programs and circumcision would be an additional burden on the health system. Some questioned the appropriateness of circumcision for HIV prevention in PNG and that resources may be better used in other areas of HIV prevention programs. Other practitioners supported MC for HIV prevention but recommended a comprehensive awareness program.

NHMRC = National Health and Medical Research Council
 PNG = Papua New Guinea
 HIV = human immunodeficiency virus
 STIs = sexually transmitted infections

TABLE 5**SUMMARY OF LITERATURE REVIEW — HISTORICAL PERSPECTIVES OF PENILE CUTTING, INJECTION AND INSERTION PRACTICES IN PNG**

1. In Papua New Guinea, penile cutting practices are embedded within longer histories and male initiation traditionally involved penile modification, which included beliefs and practices surrounding masculinity, the penis and the body.
2. Depending on the geographic area and remoteness, groups and customs have been affected differently and at different times through a variety of contact and influences, contributing to rapidly changing sociocultural environments and changing ideologies, sexualities and penile cutting practices inside and outside of initiation.
3. Ethnographies and historical documents illustrate the commonness and diversity of male initiation rituals across broad geographic and sociocultural areas, with elaborate rituals, including penile cutting, as initiates moved through initiation.
4. Traditional male initiations included a varied range of restrictions, tests of endurance and physical pain to transform a boy into a man and a warrior, while reinforcing the power of older men over the initiates. Knowledge was passed to initiates about codes of sexual and marital relations and about practices of purification.
5. Sexuality and sexual fluids were regarded as powerful, sacred and dangerous. The avoidance of menstrual blood and women's sexual fluids, and pollution taboos were part of male rituals. The penis was seen as power, masculinity and virility, and purification from the bad blood from one's mother or other female pollution was done through penile cutting.
6. Cutting in initiation rituals could include: the full removal of the foreskin or circumcision; the slitting of the foreskin longitudinally with a 'superincision' or dorsal slit; a round cut that removed the foreskin that exposed the head of the penis; subincisions cutting into or perforating the glans penis or piercing the foreskin. Other incisions made elsewhere on the body for scarification and piercing were commonly performed, and in combination with penile bloodletting and penile cutting.
7. Despite sustained pressure to stop male ritual initiation, practices continued out of view, with evidence in the 1990s of widespread male initiations and penile cutting, and development of informal cutting outside of the contexts of male initiations and the 'hausman'. Present penile modifications reflect traditional initiations, clinical involvement in and outside of the clinic, informal penile cutting, and introduced penile insertion and injection practices.
8. Historically objects were sometimes inserted into the penis temporarily, and foreskin piercings could have objects inserted. More recently, insert practices have been introduced by mobile Asian workers, and from a flow of products and ideas facilitated by the movement of people, trade and development in PNG. Penile inserts were documented in PNG male sexual cultures in the 1990s.
9. Salient to the HIV epidemic in PNG, contemporary penile cutting, inserts, bloodletting, scarification and tattooing practices have their links to the contexts of male initiation and the 'hausman' and to globalization and change.

PNG = Papua New Guinea

HIV = human immunodeficiency virus

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TABLE 6

SUMMARY OF METHODS AND KEY FINDINGS FROM SELECTED BEHAVIOURAL SURVEILLANCE SURVEYS (BSS) IN PNG 2008-2010

BSS samples, sites and methods**STI clinic clients****Site:** Lae Friends STI Clinic, Morobe Province**Sample size:** n = 300 (128 men, 172 women)**Sampling:** A 'catch all' approach of consecutive consenting attendees at an STI clinic during integrated bio-behavioural sentinel surveillance in 2008
Collection: Sep-Oct 2008**Coffee and tea plantation workers****Sites:** WR Carpenters Coffee & Tea Estates, in Jiwaka and Western Highlands Provinces**Sample size:** n = 460 (299 men, 161 women)**Sampling:** Random sampling from employer's lists – proportional and stratified to 2 types of work and by gender across 8 sites**Collection:** Oct 2008**Petroleum development workers****Sites:** Oil Search petroleum development sites in Hela, Gulf and Southern Highlands Provinces**Sample size:** n = 463 (444 men, 19 women)**Sampling:** Random sampling from employer's lists – proportional and stratified to 3 types of work across 7 sites
Collection: Oct 2008-Jan 2009**Higher-risk youth****Sites:** Vanimo, Vanimo Green District, Sandaun Province (West Sepik)**Sample size:** n = 380 (237 men, 143 women)**Sampling:** Respondent-driven sampling (RDS) used to draw out more vulnerable and hidden segments of populations
Collection: Jun-Jul 2009**Key findings from surveys among 1859 men in 9 provinces****Circumcision**

- Overall, a fifth (371/1859) of men and male youth had their penis foreskin fully removed (range of 3.3% to 55.5% across BSS samples)
- Circumcision was performed as part of initiation and in the 'hausman' rather than in clinical settings or more informal community settings
- Circumcision mixes clinical ideas of hygiene and cleanliness with traditional initiation practices and ideas about female pollution, preventing sickness and becoming a man
- The desire to create mutual pleasure and satisfaction during sex with a circumcised man, not part of traditional ideologies around circumcision historically, has become a feature of contemporary discourses around circumcision

Dorsal slitting

- The dorsal slit was the most commonly practised type of penile cutting, and overall was reported by 37.7% (701) of men aged 15 to 62 years (range of 23.7% to 62.7% across BSS samples) with some reporting multiple incisions
- Slitting was carried out in the 'hausman', associated with initiation, conducted informally and less commonly carried out in clinical settings
- Performed by friends, relatives, elders or health workers, less so by oneself or other peers
- Instruments used for slitting were mostly razor blades or scalpels; two-fifths reused a cutting tool that was not cleaned
- Peer influence, health, hygiene, custom, initiation, pleasure and satisfaction contributed to men and male youth having a slit, and less than 5% found it painful or painful for a woman

Penile inserts

- Inserts were less common than cutting, with 6.1% (113/1859) having had inserts (range of 0.8% to 20.8% by BSS samples); many respondents had multiple types of inserts and/or a combination of penile cut and inserts

Highway truck drivers

Sites: Eight trucking companies and 16 sites in Mt Hagen, Lae and Goroka, located in Morobe, Eastern Highlands and Western Highlands Provinces

Sample size: n = 257 men

Sampling: 'Catch all' from employee lists during collection period

Collection: Mar-Dec 2010

Oil palm, sugar and beef plantation workers

Sites: Ramu Agri-industries, sugar, beef and oil palm plantations in Morobe and Madang Provinces

Sample size: n = 602 (494 men, 108 female)

Sampling: Random sampling from employer's lists – proportional and stratified to 3 types of work across 6 sites

Collection: Jul-Aug 2010

- Inserts were made from locally available and natural materials, including ball bearings, toothbrush pieces, string, wire, rubber, plastic, ceramic, silicon, rings, feathers or leaves
- Cutting instruments mostly used were razor blades, scalpel-like blades and sharp toothbrushes and all said that they had used sterile cutting equipment during insertions
- Male peer group influence and to increase pleasure and satisfaction for women were the main reasons

Penile injection

- 75 men (5.2%; 75/1432) reported injecting their penis from four BSS samples (range 0.4% to 15.6% across BSS samples)
- Penile injecting substances are imported from Indonesia, imported products not intended for injecting, or substances locally made from leeches but reminiscent of Javanese (Indonesian) traditions
- Most wanted to enlarge and enhance their penis to fulfil desires for a larger penis linked to pleasure, masculinity, reputation and status – to be a big boy – a big man – and have more women desire them
- Reusing a needle for penile injection from someone else and not cleaning it was reported by male youth

PNG = Papua New Guinea
STI = sexually transmitted infection

TABLE 7

RECOMMENDATIONS FOR A HARM REDUCTION PROGRAM

- Urgent action is required to reduce specific penile cutting and modification practices known to be harmful, particularly those that increase the risk of HIV and blood-borne virus infection (eg, due to the reuse of non-sterile cutting instruments) or which lead to serious and/or long-term complications (eg, traditional variants of the 'V' cut that extend to the base of the penis and injection of oils and gels into the penile shaft).
- Public health information campaigns should emphasize that only complete removal of the foreskin (male circumcision; 'round cut') has been proven to provide protection against HIV infection and that it remains unclear whether other types of cutting offer any protection against HIV.
- Health care workers and service providers should be provided with training and information materials to enable them to give appropriate and non-judgemental guidance both to men considering medical male circumcision and those considering other forms of penile cutting, and when providing services for clinical complications.
- The responsibilities of the National Department of Health and of individual health care workers to provide sterile cutting tools, dressings and antibiotics to those conducting penile cutting outside of formal clinical settings need to be clarified and formal guidelines developed.

HIV = human immunodeficiency virus

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TABLE 8

RECOMMENDATIONS REGARDING MALE CIRCUMCISION FOR HIV PREVENTION IN PNG

1. **Formative evaluation of the male circumcision program in East Sepik and new male circumcision pilot programs in other provinces are recommended:**
 - To enable the acceptability of male circumcision among men and women, the cost-effectiveness of different implementation models, and the impact of male circumcision on male and female sexual behaviour, to be established in different epidemiological, sociocultural and health system contexts.
 - To evaluate the feasibility and impact of providing male circumcision services within a wider sexual and reproductive health framework that includes risk reduction counselling, avoidance of gender-based violence, and support for family planning and women's reproductive choices.
 - To inform future decisions on whether to launch intensive male circumcision programs for adult men in other settings in the country.
2. **Highly focussed policy-relevant research is urgently required to establish whether other types of penile cutting (eg, 'straight cut') provide protection against HIV infection** in order to promote practices that are protective against HIV and to discourage those that are not.
3. **Health education campaigns are urgently required to disseminate information to communities, health care workers and service providers on the evidence that 'round cut' reduces the risk of men acquiring HIV infection through vaginal intercourse.**
 - Dissemination should stress that that only complete removal of the foreskin (medical circumcision; 'round cut') has been proven to provide protection against HIV infection; that risk is not reduced by 100%; and that it remains unclear whether other types of cutting (such as the 'straight cut') offer any protection against HIV.
 - Messages about male circumcision and penile cutting should be disseminated within a comprehensive behavioural approach to HIV prevention that includes other key risk reduction strategies such as consistent condom use.

HIV = human immunodeficiency virus

PNG = Papua New Guinea

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Health workers, health facilities and penile cutting in Papua New Guinea: implications for male circumcision as an HIV prevention strategy

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SUMMARY

There has been increasing interest in Papua New Guinea (PNG) in male circumcision (MC) for HIV (human immunodeficiency virus) prevention following compelling evidence from ecological studies and clinical trials in Africa, and the World Health Organization's recommendation in 2007 that MC be considered part of comprehensive HIV prevention programs in high-prevalence settings. Though no national policy has been established in PNG, East Sepik Province (ESP) commenced a formal program of MC in 2006, and there is evidence that PNG health workers are involved in other penile foreskin cutting activities in many areas. As part of a wider Male Circumcision Acceptability and Impact Study in PNG, we conducted an audit at a sample of PNG health facilities to assess their suitability for implementing a national MC program, and to identify issues that may arise in any future roll-out. The clinical audits demonstrated the difficulties with procurement and availability of equipment for general services around PNG, shortage of staff and capacity, and limitations of available clinical space. Results show that the ESP program has been successful; however, the success relies heavily on commitment from key workers to volunteer their time and services. A review of penile cutting activities by health care workers outside of the ESP program showed that the PNG health system is already involved in contemporary and traditional penile cutting practices via formal and informal arrangements: for example, by responding to complications from penile cuts performed by non-health workers, assisting community members to perform penile cutting through provision of equipment and advice, or providing regular penile foreskin cutting services for contemporary and traditional practices.

Introduction

Three large-scale phase III clinical trials in Africa have demonstrated that male

circumcision (MC) has a protective efficacy of around 60% in preventing heterosexual HIV (human immunodeficiency virus) acquisition in men through vaginal intercourse (1-4).

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This resulted in a recommendation in 2007 by the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) for MC to be considered an integral component of comprehensive HIV prevention in high-burden settings (5). Papua New Guinea (PNG) has among the highest adult HIV prevalence in the Asia-Pacific region (6-12); however, recent national adult prevalence estimates have suggested the epidemic may be progressing less rapidly than previously feared, with 0.9% of the adult population currently estimated to be infected (13). Despite the moderate epidemic, it is difficult to translate research findings on MC from other contexts into public health policy in PNG, a country of unparalleled geographical, linguistic and cultural diversity (8,14). Therefore country-specific research needs to be conducted to understand acceptability, operational feasibility and potential epidemiological impact of an MC program in a country experiencing only a moderate-prevalence epidemic (14).

Adult penile foreskin cutting appears to be common in many parts of PNG within various sociocultural contexts (15-17). A survey among 869 men in National Capital District (NCD), Madang Province, Enga Province and Oro Province found that 47% had a longitudinal cut or dorsal slit (foreskin cut but not removed) and 10% a circumferential cut (complete removal of foreskin) (18). Other research has also shown that men from a variety of different settings in PNG are notionally supportive of MC for HIV prevention (17). However, acceptability and success of a possible future intervention will depend not only on local-level contemporary (penile modifications not related to cultural rituals and traditions) and traditional (penile cutting completed for male initiation rituals or other cultural traditions) customs, but on health system capacity as well (17,19).

A program such as MC relies significantly on the strength of a country's health system (20,21). PNG's health system is complex and difficulties have already been observed in the implementation of even simple health programs (19). Country-specific research will assist in guiding the development of locally appropriate public health policy that takes account of the potential impact such a program might have on an already vulnerable health system (14). Furthermore, evidence that the health system is already involved to varying

degrees in penile foreskin cutting practices, undertaken for a variety of social, cultural and health reasons, highlights the importance of understanding the health system context in which this MC for HIV prevention program is being proposed and the impact that this will have on policy and planning (15-17).

Male circumcision programs – an international perspective

WHO has defined a minimum package for the implementation of MC services in order to reduce HIV acquisition (22). This package includes the following:

- HIV testing and counselling
- Diagnosis and treatment of sexually transmitted infections (STIs)
- Provision of other preventive methods such as condoms
- Defined MC surgical procedure (23).

Several countries in Sub-Saharan Africa have started implementing large-scale MC programs since the 2007 WHO/UNAIDS recommendation (5,21). However, a number of difficulties have arisen, including the readiness of national health systems to implement a relatively complicated intervention in resource-poor environments (24,25). Comparing the minimal equipment and service requirements with the current state of health facilities in PNG will assist in identifying gaps and ensuring implementation of a safe and sustainable program, should the government of PNG choose to go ahead with an MC program. It will also provide assistance in informing discussions about the feasibility of introducing an MC program at this point in the HIV epidemic in PNG.

The availability of health care workers (HCWs) and the ability to train and supervise HCWs are also key issues. Significant numbers of clinicians, counsellors and support staff are needed to implement even a modest program, given the relative technical difficulty of the surgery compared to other programs such as immunization (26,27). In Sub-Saharan Africa it has been estimated that, over the first 5 years, about 0.25 full-time circumcisers would be required per 10,000 adults (28). HCW density in PNG has been shown to be comparably lower than

other Asia-Pacific countries and there are significant variations in health resources and staffing between and within provinces in PNG, with some districts extremely limited in terms of access to health services (29-31). With this in mind, there is also likely to be diverse challenges across PNG in the implementation and sustainability of an MC program should the government of PNG decide to proceed with such a policy in the future.

In this paper we review a sample of health facilities across PNG to determine their readiness to undertake a potential national adult MC program. We also report the results of an investigation of the health system involvement in penile foreskin cutting activities, including the East Sepik Province MC program. This study was undertaken as part of a multidisciplinary, community-based research program to investigate the acceptability, epidemiological impact, cost-effectiveness and options for program implementation of MC in PNG: the Male Circumcision Acceptability and Impact Study (MCAIS), conducted by the PNG Institute of Medical Research (PNGIMR) in collaboration with the University of Queensland (UQ) and the University of New South Wales (UNSW) in Australia and funded by the Australian Agency for International Development (AusAID).

Methods

Data collection

A multimethod qualitative study was conducted in four provinces: East Sepik Province (ESP), West New Britain Province (WNB), Eastern Highlands Province (EHP) and National Capital District (NCD) of PNG, each representing one of the four regions of the country (Figure 1). ESP and WNB are areas with a history of traditional penile cutting practices (32,33) whereas EHP and NCD are considered non-traditional penile cutting culture areas. Data were collected from 2009 to 2011 and combined a case study analysis of the MC for HIV prevention service currently operating in ESP; clinical audits at health facilities at each of the sites visited; in-depth interviews (IDIs) and focus group discussions with HCWs at these facilities; and field notes of unstructured observations. An iterative, purposive sampling technique was used to identify study facilities for clinical audits and to identify potential participants. Facilities were audited if they provided some surgical

intervention, or were a clinic or health centre involved in delivering sexual and reproductive health services, or were the only health service in the area visited. Data on infrastructure, workforce and equipment available for MC were collected at each site visited.

Data analysis

Clinical audits were evaluated using the WHO MC facility survey from the MC Situation Analysis Toolkit (22). In-depth interviews and focus group discussions were digitally recorded, transcribed and, where necessary, translated from Tok Pisin into English at the PNGIMR in Goroka. Data were triangulated with field notes taken by the research team and used to interpret the results of clinical audits. The data underwent thematic analysis and were coded to describe key features of the health system in relation to penile foreskin cutting activities within the health system.

Ethical considerations

Ethical approval was obtained from the Medical Research Advisory Committee (MRAC) in PNG and the UNSW and UQ Human Research Ethics Committees in Australia. Written informed consent was sought from all individuals prior to study participation. Confidentiality was maintained in the data transcription process, which used pseudonyms to identify respondents. Consideration was given by all researchers to the customs, practices and legal systems in PNG, potential for language barriers, and the provision of a clear understanding of research objectives to all participants involved in this study.

Results

In all, 8 clinical audits, 1 focus group discussion and 34 in-depth interviews were conducted with frontline HCWs, including medical officers (MOs), nursing officers (NOs), health extension officers (HEOs), community health workers (CHWs) and counsellors, and program coordinators involved in sexual and reproductive health services in PNG (Table 1). Clinical audits were completed at a variety of health care settings including three provincial hospitals, two health centres and three urban outpatient clinics to provide a cross-section of facilities considered likely to maintain the WHO-recommended minimal package of equipment required to implement a future MC

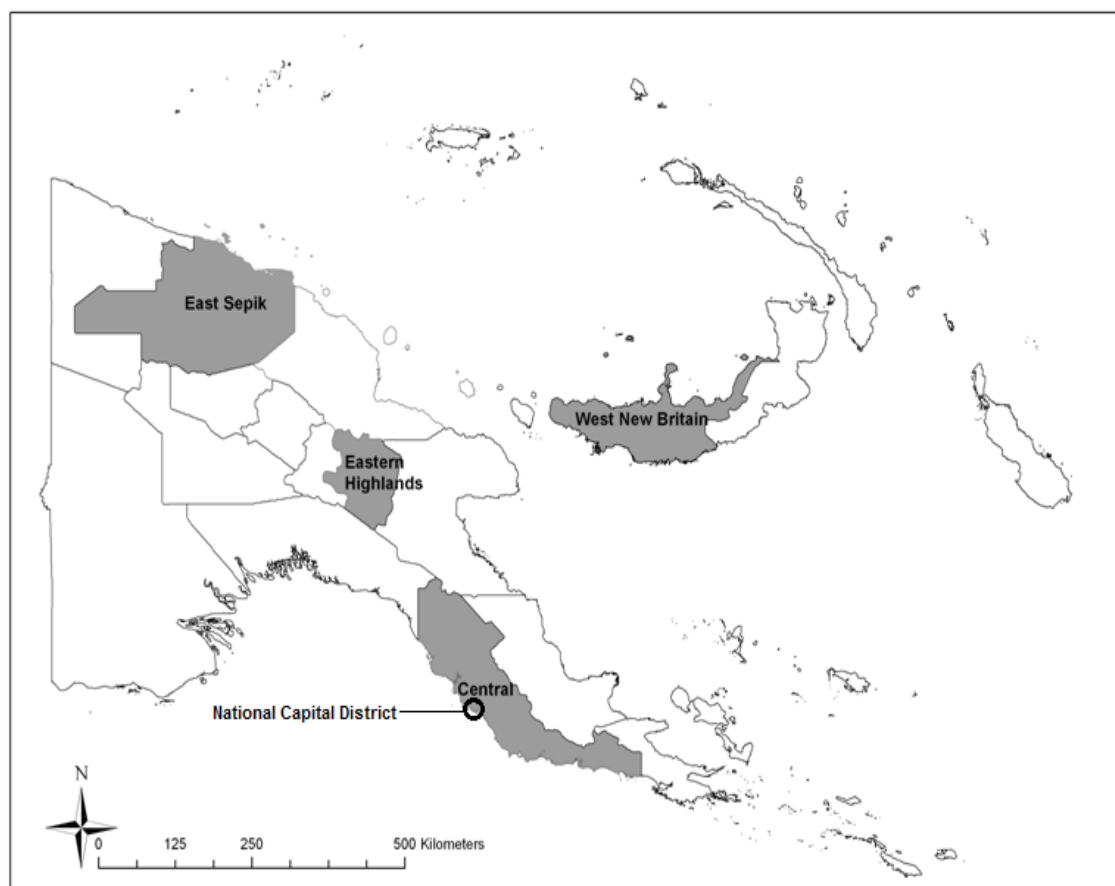


Figure 1. Map of Papua New Guinea with study provinces highlighted.

service (22). Health facilities and HCWs were located in a number of different provinces around PNG including NCD, WNB, EHP and ESP (Figure 1).

Health facility audits

Incorporating an additional surgical procedure into an already vulnerable health system requires careful review of the current functioning and capacity of the workforce, infrastructure, equipment and access. Results of the clinical audits (Table 2) reveal the lack of availability of surgical equipment and medicines in PNG generally, but more so in rural and remote areas. Delays in accessing equipment due to the failure of autoclaves were also reported as an important issue. Access to basic surgical care and anaesthesia was limited, particularly in rural settings. Other constraints included the shortage of human

resources, limited infrastructure, lack of basic materials and supplies, and unreliable water supply systems.

Both health centres had facilities for minor surgical services; however, the audits and discussions with HCWs confirmed shortfalls in supplies and limited service capacity at these district-level health facilities. Clinical space was limited in both rural and urban facilities, not just for the introduction of an additional procedure but also for the privacy required to offer counselling and STI screening, a recommended part of the WHO minimum MC service package (34). Hospitals had facilities for minor surgery; however, due to limited clinical space and the restricted time that HCWs and management could commit to what would likely be considered an elective service, there would be significant restrictions on the capacity of the service.

TABLE 1

SUMMARY OF ALL PARTICIPANTS BY CADRE AND GENDER

Health worker	Females	Males	Total
Community health worker	0	5	5
VCT counsellor	0	1	1
Health extension officer	2	2	4
Medical doctor	4	10	14
Nursing officer	6	1	7
Other frontline health worker	1	1	2
Health program adviser	1	3	4
Total	14	23	37

VCT = voluntary counselling and testing

Communication systems among the clinics audited were also erratic, with frequent interruptions in telephone lines and difficulties with servicing breakdowns, particularly in more remote areas. Patients reportedly accessed health facilities by a number of means including local buses, walking, interprovincial flights and boats, which are also subject to interruptions by weather and civil disturbances. Two of the facilities reviewed advised that they were currently or had previously provided a mobile minor surgical service including vasectomy or MC, but encountered difficulties with financing and supporting this on a continuing basis.

With over 80% of the population living in rural areas, the priority for the PNG health system is primary health care. Health centres are staffed by NOs, HEOs and CHWs who are often called upon to perform minor surgical procedures. However, considerable variance existed in the training and experience in MC for HCWs at different facilities (Table 3). Most CHWs reported skills and training in administering local anaesthetic and suturing; however, there was no specific universal training in MC. There were, however, some CHWs who reported confidence in undertaking penile foreskin cutting. These CHWs were typically working in isolated services and in communities which considered penile foreskin cutting a part of their tradition. HEOs reported specific training in MC for the management of phimosis (inability to retract the distal foreskin over the glans penis) or paraphimosis (the

entrapment of a retracted foreskin behind the coronal sulcus). Female CHWs, NOs and HEOs were less likely to report experience with penile foreskin cutting, but many indicated that they were aware of male counterparts performing such procedures.

In both urban and rural settings, access to male health workers could not be guaranteed, due to either a permanent lack of male HCWs or their availability only for limited sessions (for example, a visiting male doctor). Considerable concern was expressed by HCWs during the clinical audits about the impact that the introduction of another service would have on already scarce resources and fragile health systems infrastructure. Visiting specialists to more remote rural areas also expressed concern about the feasibility of conducting a surgical intervention at peripheral health facilities given the poor conditions of the facility, limited clinical space, geographical isolation, and the limited medicines, equipment and human resources at such health facilities.

East Sepik Province Adult MC Program

Despite the lack of a national MC policy, ESP commenced a formal MC program in Wewak in 2006 with support from the ESP Department of Health and led by surgeons at Wewak General Hospital. The program is managed by a provincial MC coordinator and has had intermittent funding from a variety of sources including private industry and the

TABLE 2

CLINICAL AUDITS: SUMMARY OF EQUIPMENT AND CLINICAL SPACE

	Provincial hospital ESP*	Provincial hospital WNB*	Provincial hospital NCD*	Urban outpatient clinic NCD	Urban outpatient clinic NCD	Urban outpatient clinic EHP	Health centre WNB	Health centre EHP
Surgical scissors (curved)	✓	✓	✓	✗	✓	✓	✗	✗
Suture scissors (straight)	✓	✓	✓	✗	✗	✗	✓	✓
Straight artery forceps	✓	✓	✓	✓	✗	✗	✗	✗
Tissue forceps	✓	✓	✓	✓	✓	✓	✓	✓
2 x needle holder	✓	✓	✓	✓	✗	✗	✗	✗
Curved artery forceps	✗	✓	✓	✓	✗	✗	✓	✓
Lancet blade carrier and blades	✗	✓	✓	✗	✓	✓	✓	✗
Black silk 3-0 or 4-0 sutures	✓	✓	✓	✓	✗	✗	✓	✓
4-0 catgut	✓	✓	✓	✓	✗	✗	✓	✓
Autoclave/pressure cooker	✓	✓	✓	✓	✗	✓	✗	✗
Running water	✓	✓	✓	✓	✓	✓	✗	✓
Specific minor surgical space	✓	✓	✓	✓	✗	✗	✓	✓
HIV testing and counselling space	✗	✗	✗	✓	✓	✓	✓	✓

*HIV testing and counselling were provided in outpatient clinics on hospital campus

ESP = East Sepik Province

WNB = West New Britain Province

NCD = National Capital District

EHP = Eastern Highlands Province

HIV = human immunodeficiency virus

TABLE 3

CLINICAL AUDITS: HEALTH WORKERS AND EXPERIENCE

Health facility	Surgeon	Health worker available			CHW	Reported penile cutting experience			
		Other doctor	Nurse (theatre)	Nurse (other)		Vasectomy	Circumferential MC	Dorsal slit*	Dorsal slit*
Provincial hospital ESP	✓	✓	✓	✓	-	✓	✓	✓	×
Provincial hospital WNB	✓	✓	✓	✓	-	✓	✓	✓	✓
Provincial hospital NCD	✓	✓	✓	✓	-	✓	✓	✓	×
Urban outpatient clinic NCD	Visiting	-	✓	✓	✓	✓	✓	✓	×
Urban outpatient clinic NCD	×	✓	×	✓	✓	×	×	×	×
Urban outpatient clinic EHP	×	×	×	✓	✓	✓	×	×	×
Health centre WNB	×	×	×	×	✓	×	✓	✓	✓
Health centre EHP	×	×	×	✓	✓	×	✓	✓	✓

*Longitudinal incision or dorsal slit of the foreskin, with no foreskin removed

HEO = health extension officer
 CHW = community health worker
 MC = male circumcision
 ESP = East Sepik Province
 WNB = West New Britain Province
 NCD = National Capital District
 EHP = Eastern Highlands Province

AusAID health sector improvement program (HSIP). The program relies on collaboration between the hospital for the surgical procedure and East Sepik Centre of Hope for testing and counselling, with patients needing to be transported by bus for 20 minutes between facilities.

Since its inception, over 1500 men have accessed the service, which is promoted during dedicated campaigns over National Health Week and during the lead-up to World AIDS Day in December. Rural outreach services including counselling and clinical services have been conducted to health centre level but not to aid post level due to their lack of appropriate facilities. HCWs involved in the program suggest that future plans should include having a dedicated full-time surgeon for the program who would also be available to participate in a mobile service. The improvement of facilities and increased staffing levels around ESP, particularly in peripheral health facilities, were also noted as important components of the ongoing success of the program. The success of implementing the program is credited to three factors:

1. Negotiation of clinical space, particularly at the hospital
2. Procedures undertaken by trained surgeons and surgical registrars
3. Volunteering of staff to work after hours and on weekends, at times unpaid.

Other health system participation in penile cutting practices in PNG

Formal health system participation in penile cutting

During the discussions 23 (79%) of 29 frontline HCWs interviewed (not including the ESP MC Program) revealed that they had participated in some sort of penile foreskin cutting practice while working within the PNG health system. There was no marked difference in numbers of male or female HCWs reporting this (Table 4). On further discussion with the HCWs it was apparent that health system staff were involved with a range of penile cutting practices that were either provided formally within the boundaries and rules of the health system or informally outside the regulations of the health system (Figure 2).

These HCWs (not including staff of the ESP MC Program) reported a number of services that they provide within the formal framework of the health system including:

- Responding to and treating complications resulting from penile cutting completed in the community by a non-health worker, such as infection, excessive bleeding, haematoma, wound dehiscence, swelling, pain, excessive scarring, erectile dysfunction, other penile damage and dissatisfaction regarding appearance (Table 5: quote 1)

TABLE 4

REPORTED PARTICIPATION IN FORMAL AND INFORMAL PENILE CUTTING PRACTICES BY GENDER OF FRONTLINE HEALTH CARE WORKER

Participation in penile cutting	Female HCW	Male HCW	Total
No participation in penile cutting	3	3	6
Participation in formal health system penile cutting practices (other than ESP)	9	14	23
Participation in informal health system penile cutting practices (including ESP)	0	7	7

HCW = health care worker
ESP = East Sepik Province

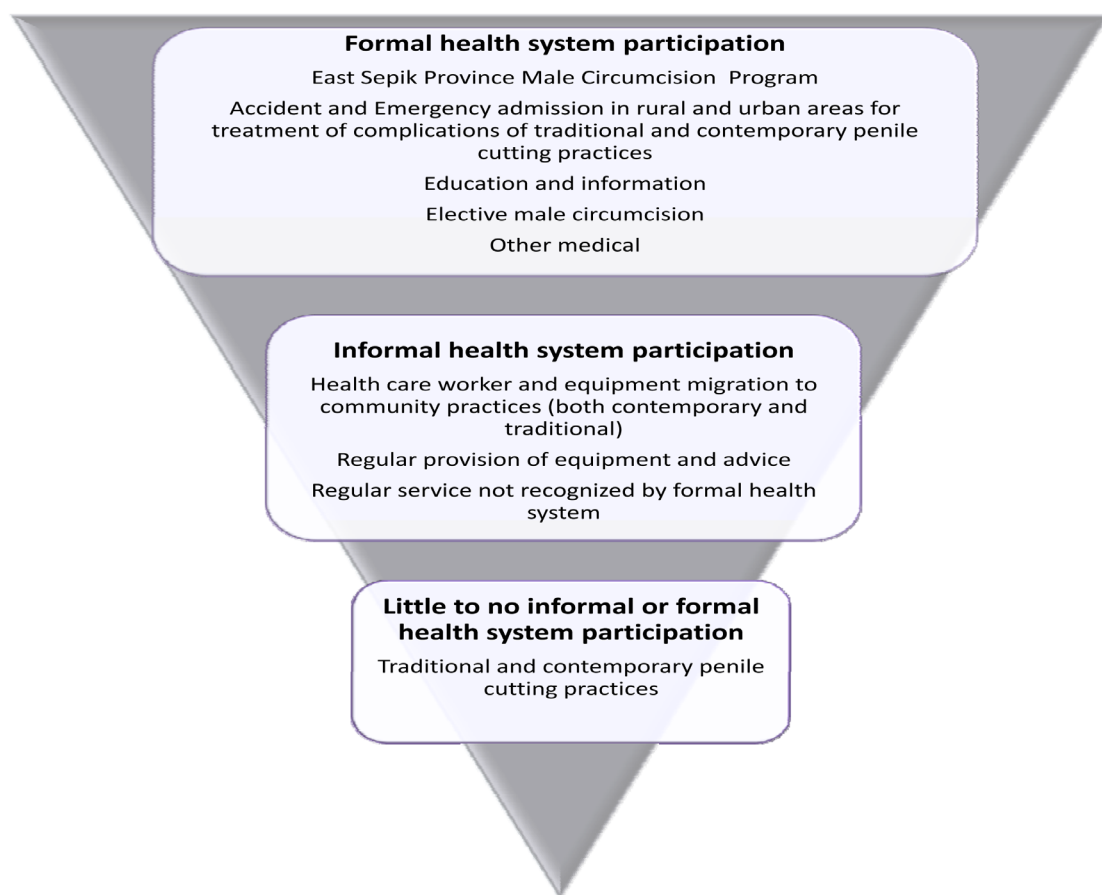


Figure 2. Degree of health system participation in penile cutting practices.

- Providing information to communities about adult MC for HIV prevention
- Carrying out MC for medical reasons (eg, for phymosis or paraphymosis).

A number of respondents from all levels of the health system reported that they were frequently asked about the benefits of MC for HIV prevention, but were uncertain about how they should respond. This included medical officers who advised that they were waiting on clear advice from the National Department of Health (NDoH) (Table 5: quotes 2 and 3).

Health staff involvement in traditional and contemporary practices

Of all 33 frontline HCWs interviewed including those from ESP, 7 (21%) revealed that they were involved in a range of penile

foreskin cutting activities that operated outside of the formal rules of the PNG health system. All HCWs who reported this were male (Table 4). These activities involved HCWs using health system resources to actively engage in traditional and contemporary practices within their community. While high levels of HCW involvement were common in communities where traditional penile cutting was present (eg, WNB), there were also a number of HCWs from communities without traditional penile cutting who provided assistance with contemporary practices, with the dorsal slit being the most commonly performed procedure (Table 3; Table 5: quotes 4 and 5). The practices described included:

- Providing instructions to community members on how to perform a penile cut

TABLE 5

**HEALTH CARE WORKERS' EXPERIENCE OF PARTICIPATION IN PENILE CUTTING IN PAPUA NEW GUINEA
(ILLUSTRATIVE QUOTES)**

Quote 1: *There was one patient that came they had circumcised at home and attempted to do a circumcision which was a dorsal slit. Instead of just cutting the top, they went further on down the inside of the penis. The penis was exposed and the skin sort of like retracted back so he was bleeding. So they called me to the accident and emergency room and I went there and I cleaned up the wound which was bad, because they had tried to stop the bleeding with some algae or some sort of moss from the trees, and that really made it dirty so I had to clean it and then suture that whole thing up.*

Medical Officer (ESP)

Quote 2: *There are a lot of questions asked about circumcision. And we are not really sure which answer is right to give. Whether it is safe for them to do circumcision or whether it is not. We are just not sure yet.*

Volunteer (NCD)

Quote 3: *At the medical school we were not actually told to take up circumcision as one of our practices. But it is something, wherever you are in the country practising your field, you get asked to do. We've been asked several times, but we don't have that clear-cut advice if you like. I don't know how (the Government) wants it to be. Some of us don't have that green light so we are a little bit afraid to venture into it.*

Medical Officer (NCD)

Quote 4: *Many come to the health centre and ask me for scalpel blade and they want to do it (penile cut) by themselves at home. We help them. We supply them with scalpel blade, dressings and bandages, spatula, and just advise them how they should do it. That's all.*

Health Extension Officer (EHP)

Quote 5: *We don't actually do full circumcision here at the health centre. We only do what we call 'dorsal slit'. We cut the top skin and the skin drops down or to the side.*

Health Extension Officer (EHP)

ESP = East Sepik Province

NCD = National Capital District

EHP = Eastern Highlands Province

- Supplying equipment such as spatulas, scalpels, plasters, bandages, antibiotics and gauze from the health facility to men to perform a penile cut outside the clinic
- Providing penile foreskin cutting as a recognized, regular and elective service for community members. These services were typically provided after hours with the use of health facility equipment at the clinic, or in community settings, but were not formally documented or recognized by the Department of Health as part of the health facility services.

A number of HCWs who were not engaging in these practices indicated that they were aware of colleagues within their health facility who were, suggesting that the practice was relatively common and mainly for reasons other than HIV prevention. Health service coordinators and government officials, however, indicated that they had no knowledge of these informal activities.

Discussion

This review of health facilities and exploration of current involvement of HCWs in penile cutting has three important findings for the development of policy around MC as an

HIV prevention strategy in PNG:

- The review demonstrates that it is possible to mount an MC for HIV prevention program at provincial level, such as the ESP MC Program, with the support of health authorities and the commitment of trained surgical staff.
- The clinical audits confirm the unpredictable availability of equipment and supplies and limited human resource capacity in health clinics, where an MC program might reasonably be delivered. Despite this, it is clear that some HCWs are already active in services including MC for phimosis or paraphimosis and in the management of the complications of penile cutting undertaken by other practitioners.
- Also, in the absence of clear NDoH directives, some HCWs are participating in contemporary and traditional penile cutting activities that have not yet been demonstrated to reduce the risk of HIV acquisition and often for reasons other than prevention of HIV.

These findings call for action on a number of fronts to build capacity within the health sector that would make an MC for HIV prevention service more feasible, should the PNG government decide to incorporate the intervention into its national HIV program, and reduce the risks associated with current penile cutting practices both within the health services and in the community.

Strengthening human resource and health facility capacity

It is now widely accepted that access to adequate surgical care is an essential component for achieving the Millennium Development Goals (MDGs) (35). The audit results suggest that basic surgical capacity currently needs development. The introduction of a national MC program for HIV prevention in PNG would require significant efforts to ensure that it did not impinge on other essential services. The optimal approach would be to conceptualize the development of MC as one component of essential surgical capacity, ensuring sustainability and maintenance of surgical skills and equipment for a range of surgical interventions including minor operations, vasectomy and tubal

ligation. However, care will need to be taken to ensure that the demand for MC services by communities who participate in penile cutting practices for reasons other than HIV prevention is moderated and does not detract from other important services.

The alternative approach, introducing a targeted MC program but minimizing disruptions to the other key health services, has been implemented in African programs. This includes the use of pre-packaged kits to reduce problems with instrument processing and fluctuating supplies (26). Although in some African countries non-physicians are restricted from performing MC due to the countries' regulatory and legal frameworks (36), task shifting – the delegation of surgical steps to a trained non-physician clinician such as a nurse or clinical officer – has also been utilized to greatly expand the size of the workforce available (26). Experience from a previous investigation of the non-scalpel vasectomy service currently in operation in PNG has revealed that the training of lower-level providers such as CHWs is feasible for MC (19), but an important component of a successful program will be the sustainability of the supervision capacity and monitoring of these trained HCWs. It will also be necessary to ensure that HCWs are all well supported to provide the necessary HIV testing and counselling that is integral to any MC program for HIV prevention.

However, even without commitment of a national MC program for HIV prevention, there are a number of key issues that need to be addressed. Given the evidence that direct and indirect participation in penile cutting practices is common among health staff at all levels, there is an urgent demand for consistent and accurate information. Education programs to all HCWs and support staff that clearly explain the links between MC and the reduction in HIV acquisition for males, but the need for continued safe sex practices, should be seen as a first priority. Supporting HCWs to deliver sexual health education to communities that focuses on risk reduction for traditional and contemporary practices of penile cutting is also of high importance.

Health system involvement in penile cutting practices

The ESP model shows that it is possible to mount a successful adult MC program

with existing resources in PNG. However, this currently relies on a significant amount of motivation from key workers such as surgeons and registrars to be involved in after-hours work and often in a voluntary capacity, and the continued investment of interested donors and provincial health authorities. Despite the success, gaps still exist and the sustainability of the program in the long term will require ongoing commitment from a range of stakeholders. The transferability of such a program to other provinces would require similar levels of investment, and the requirement for trained surgeons to undertake all procedures may not be feasible. Current involvement of lower levels of health workers in penile cutting, and the demonstrated capacity of CHWs in vasectomy programs, suggest that task shifting may be a viable option for PNG.

Study limitations

The research project involved mainly qualitative research methods which by their nature are limited in their ability to be generalized to the wider population (37). However, the results presented provide a general picture of the situation of the health system and an opportunity to better understand potential limitations, opportunities and concerns. The case study of the ESP MC program for HIV prevention also did not include investigation of the epidemiological impact that the program had for HIV prevention. However, this was a study of the PNG health system's capacity to undertake an adult MC program for HIV prevention and not a review of sexual health behaviour or intervention effectiveness. Mathematical modelling of the epidemiological impact of a national MC program is being conducted as part of the broader study investigating the acceptability, epidemiological impact, cost-effectiveness and options for program implementation of MC in PNG.

Conclusion

With almost half of the frontline HCW participants reporting that they had been involved in responding to complications from penile cutting performed by non-health workers, there is an immediate need for a harm reduction policy that will reduce the risks of community-based penile cutting, and offer an appropriate alternative. In the context of a moderate-burden HIV epidemic, where the

role of MC for population-level HIV prevention remains uncertain, the risks associated with unregulated penile cutting present a significant threat to current sexual health programs. The PNG NDoH needs to provide clear direction to its staff who are currently involved directly or indirectly in penile cutting practices. The urgent priorities are in risk reduction: ensuring that those involved practise global infection control principles, can prevent and manage haemorrhage, and undertake safe surgical practices. Clarification of the potential for the longitudinal incision (dorsal slit) procedure to reduce HIV acquisition will determine the appropriate policy action for this form of cutting.

There are also health system impacts that need to be confronted. The research has focussed on the capacity of an already vulnerable health system to incorporate MC into its programs, recognizing WHO and UNAIDS warnings that the development and expansion of MC services should not disrupt health systems and implementation of other health programs (34). But the blurred boundaries between the health system and the varied penile cutting practices in the community are already making their claim on health services: formally, through the provision of informed counselling, the management of complications and providing MC where medically indicated; and informally, through the provision of supplies to community cutters, or through the provision of their own services. This is a reality that the NDoH can no longer ignore.

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‘Stret tokers’ – taking sexual health promotion to the village level in East New Britain Province, Papua New Guinea

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SUMMARY

The East New Britain Sexual Health Improvement Project (ENBSHIP) partners with the East New Britain Provincial Health Office. The project supports initiatives at the provincial, district and community levels to strengthen health services and expand the community response to sexually transmitted infections (STIs). Community mobilization is based on a lengthy engagement process with local leadership structures at district, local level government and village levels. At the village level, ENBSHIP works through community activators called ‘stret tokers’ [straight talkers]. These individuals are selected by their communities and trained to raise awareness of sexually transmitted infections and build a bridge between communities and health services. Training includes simple, gender-sensitive community development principles and basic information about STI transmission and prevention. ‘Stret tokers’ are supported to understand the complex issues that underpin STI transmission and treatment-seeking behaviour, and to mobilize their communities to respond to these issues. ENBSHIP has highlighted the value of taking sexual health promotion to the village level while also strengthening health services. The initiative has been met with great enthusiasm and has received excellent support from host communities. At the same time there have been many challenges and lessons learned of potential value to other community-based initiatives in Papua New Guinea.

Background

Sexually transmitted infections (STIs) are an important public health issue in Papua New Guinea (PNG). Pooled prevalence rates for the most common bacterial STIs (from community-based studies) are detailed in a recent systematic review and meta-analysis of the epidemiology of STIs in PNG. Trichomoniasis is the most common STI (40.8% women, 12.3% men), followed by chlamydial infection (women 24.8%, men 20.2%), gonorrhoea (16.3% women, 10% men) and syphilis (7.9% women, 12.9% men) (1).

STIs can have a serious health impact on those affected, especially women.

Men and women with asymptomatic or undiagnosed STIs act as sources of infection for their sexual contacts. STIs enhance the transmission and acquisition of HIV (human immunodeficiency virus) between sexual partners (2), and increase the risk of mother-to-child transmission of HIV (3).

Interventions that improve STI treatment services have been shown to reduce HIV incidence in certain settings: specifically, environments characterized by an emerging HIV epidemic (low and slowly rising prevalence), where STI treatment services are poor and where STIs are highly prevalent (4). A similar context exists in PNG and influenced the inception of the PNG-Australia Sexual Health Improvement Program (PASHIP)

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The East New Britain Sexual Health Improvement Project (ENBSHIP)

The ENBSHIP was one of five initiatives funded under PASHIP. The project was designed on the premise that any strengthening of STI treatment services must be complemented by effective community engagement and primary prevention strategies that were specific and targeted to the local context.

The purpose of this paper is to describe the community mobilization component of ENBSHIP and share lessons learned that may be of relevance to other community-level interventions in PNG. This paper does not seek to describe the totality of the work supported by the ENBSHIP (which notably also focussed on strengthening STI service delivery) or to present detailed outcome or impact data.

The ENBSHIP approach to community engagement is built on peer education principles, which assume that peers share a level of trust that supports open discussion on sensitive topics, are able to reach 'hidden' populations (such as young people) that may have limited access to health services, have a strong influence on individual behaviour, and have the potential to create a sense of commonality and collective action (5). In PNG, where high levels of gender inequality persist, peer education provides an ideal opportunity to develop a critical consciousness of the ways in which socially constructed norms of femininity and masculinity negatively influence sexual health (6).

Supporting community dialogue can be a particularly effective strategy for sexual health promotion. People find ways to change their behaviour far more readily through discussion of their needs and situations with peers than they do through receiving messages from external agents. In fact, some of the most effective responses to HIV result when information is passed between people rather than directed at them (7). In this case, community mobilization efforts were built around a group of community activators called 'stret tokers' [straight talkers] and designed to raise awareness about STIs, spark community conversation about traditionally 'sensitive'

topics, distribute condoms and build a bridge between communities and health facilities. The intention was to build sexual health as an issue of community, rather than individual, concern.

These considerations – around peer education, gender and community engagement – contributed to the conceptual framework for the ENBSHIP and found their expression in the role of the community activators – the 'stret tokers': village-based women and men trained to support sexual health promotion. An integral part of the project's delivery, stret tokers are local people with access to and knowledge of their community whose valued involvement reflects the intent of ENBSHIP to build upon community strengths. Selecting and developing these individuals thus forms the basis for developing a locally appropriate response to STIs.

Methods

The ENBSHIP was rolled out in four districts of East New Britain Province. The project worked with up to five local level government (LLG) areas in each district and up to four wards within each LLG. Figure 1 outlines the community engagement process (spanning approximately three months) that was undertaken by the ENBSHIP community engagement workers (CEWs).

The CEWs (one female and one male health worker) work as a team and guide community engagement with all levels of formal leadership in communities. Sensitive to the fact that men may dominate many of these traditional leadership roles, the CEWs model active participation of women and men (by consistently presenting as a gender-balanced team) and look to encourage the participation of both women and men while working within existing cultural frameworks.

Communities wishing to engage with ENBSHIP are asked to demonstrate markers of 'community commitment' towards active participation. For example, they may demonstrate willingness to host a stret toker workshop, accommodate stret tokers within their homes or assist with catering.

Ward councillors and health workers are then engaged to nominate stret tokers. This process is guided by certain criteria, and aims to result in a group that is equitably

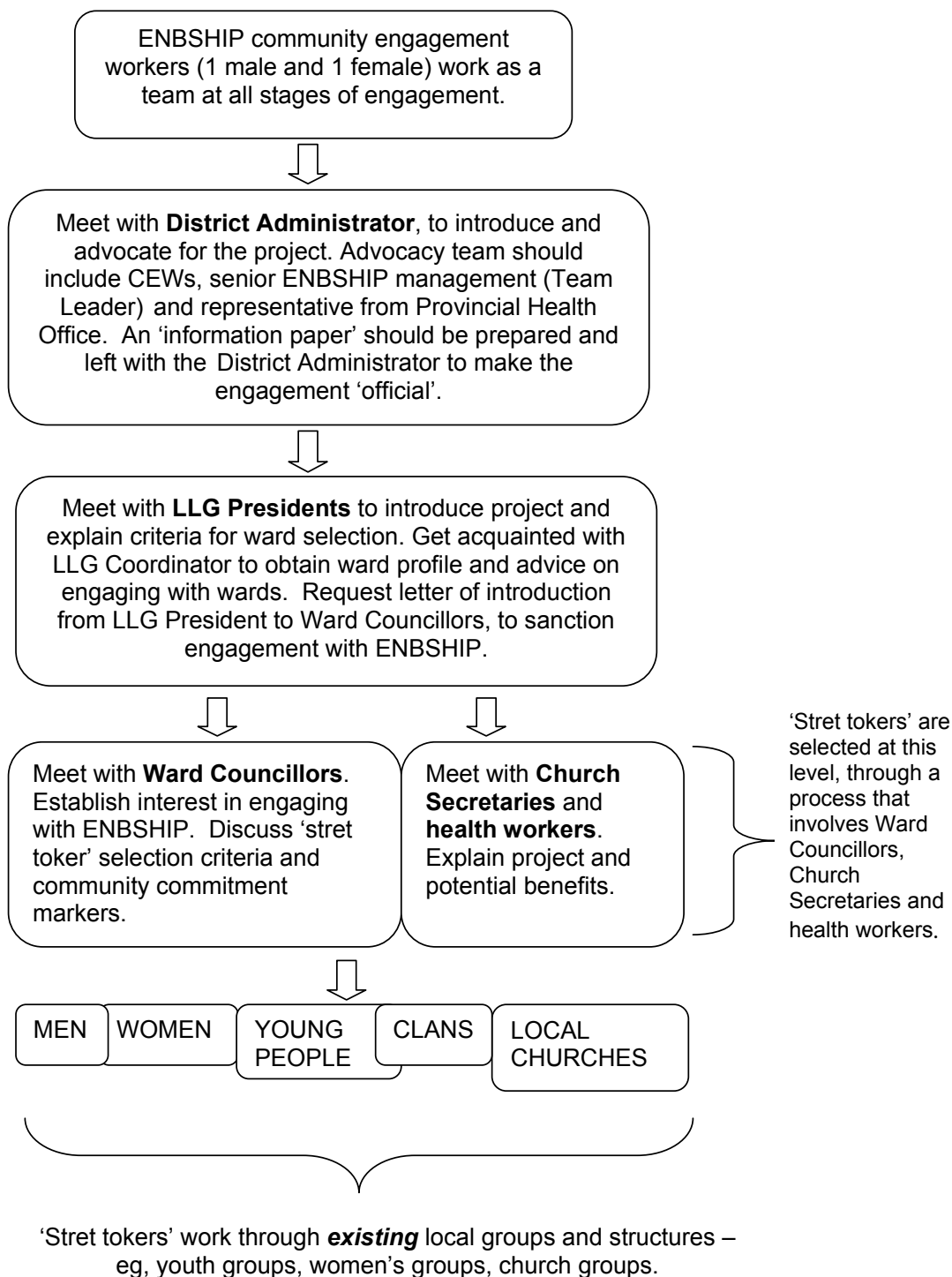


Figure 1. Ideal model of community engagement as experienced by East New Britain Sexual Health Improvement Project (ENBSHIP).

CEWs = community engagement workers
LLG = local level government

representative of younger and older females and males. Selected stret tokers participate in a series of five workshops, ranging in duration from three to five days each. Training occurs at the village level over approximately 18 months, facilitated by the CEWs. Training modules were developed in partnership with the International Women's Development Agency and Barefoot Community Services. The training content develops basic knowledge of gender-aware community development, STI transmission and prevention and effective communication. Attention is given to highlighting the complex beliefs, norms and 'enabling factors' that influence personal behaviour (8) and put individuals at risk of acquiring STIs or failing to seek appropriate clinical care. Over the course of the training, stret tokers are supported to mobilize their communities to respond to these issues.

Early in the training process, stret tokers are supported to gather information from their community, and to document reported barriers and enablers to accessing STI services. Information is analysed to highlight the issues faced by women and men of different age groups. This information is then used in a joint planning session with local health workers. Together, stret tokers and health workers develop a set of 'user friendly' criteria to guide improvement of STI services. Health workers are then supported to achieve the criteria through the health system strengthening component of ENBSHIP.

'Stret' language (such as using accurate rather than 'sanitized' or euphemistic terms to describe sexual and reproductive body parts) is encouraged and practised. This is important as some Tok Pisin or vernacular words may have a double meaning and confuse the message being conveyed or reinforce social norms of 'shame' that create barriers to women's and men's ability to access appropriate care. Only when women and men are supported to become more comfortable hearing and using 'stret' language can we go some of the way toward normalizing discussion around sexual health-related issues and assist behavioural change.

Two-way communication is facilitated during training, and stret tokers are encouraged to utilize such an approach when communicating with their peers. For effective communication to occur, the audience needs support to make sense of the information being provided to

them, through discussion and questions and answers.

Starting 'inwards' to better focus 'outwards', the project initially supported CEWs to better understand issues of gender with regard to both sexual health and community development, and therefore be better able to train stret tokers. The project took a range of formal approaches to gender (eg, gender analysis, collection of gender-disaggregated data and constitution of gender-balanced teams) and informal approaches (eg, responding to locally identified circumstances, making ad hoc adjustments to lessons learned). This represents a genuine attempt to tackle gender-related vulnerability to STIs, and to highlight other complex issues which underpin STI transmission and treatment-seeking behaviour.

A local advisory group (LAG) was established to oversee ENBSHIP to help ensure the project is relevant and accountable. The LAG is chaired by the Provincial Health Adviser and includes representatives from various levels of government extending down to the LLG level.

Results

At the end of 2011, planned community activities had been completed in Gazelle, Kokopo and Pomio Districts. Activities in Rabaul District will be completed in June 2012.

In Gazelle, Kokopo and Pomio stret tokers distributed approximately 34,000 condoms and referred almost 800 women and men to health facilities. At the completion of training, close to 75% of the stret tokers in Gazelle, 50% in Kokopo and 70% in Pomio were considered to be 'active'.

Positive outcomes, identified through thematic analysis of Most Significant Change Stories (9) and monitoring data, include:

- Improved knowledge in relation to STIs;
- Shifts in religious and cultural beliefs and values relating to sexual health, such as condom promotion and talking about sensitive issues;
- Recognition of family violence as an important gender issue impacting on

sexual health;

- Strengthened relationships between stret tokeners and health workers, leading to informal referral pathways;
- Improved levels of trust between health workers and villagers;
- Stret tokeners achieving respect and support of the community and its leaders as a result of their community outreach and education;
- Development of individual stret tokener's capacity to speak publicly about traditionally sensitive issues; and
- Reported behaviour change such as health-care-seeking behaviour, condom use and partner reduction.

In some LLGs there are indications of ownership of stret tokener activities and sustainability. For example, stret tokeners have formed their own 'association' in a number of LLGs or have joined forces with existing community-based organizations. Several communities have lobbied local leadership for continued support and some LLGs, ward development committees and churches have budgeted for a continuation of stret tokener activities in their annual plans.

In some wards, the link and partnership between stret tokeners and health workers has been very positive. In Kokopo District, one female stret tokener commented on collaboration with local maternal and child health staff: *"We travel with them while they were doing ANC [antenatal clinic] and immunization roles. We would talk to mothers openly and then spend time in small groups allowing opportunity for those who had some questions they might not have had the courage to raise in the general discussions. There are more requests coming in now, especially from wards that have had no contact with stret tokeners but who hear about us from mothers who met us on these trips."* Due to the focussed nature of their training, stret tokeners are often more adept and comfortable with performing condom demonstrations and discussing sensitive sexual-health-related topics than health workers themselves. They are usefully complementing health workers during outreach activities.

Stret tokeners are achieving community

respect and being asked to take on additional responsibilities. Many have been given roles in church congregations, ward committees, women's committees and school committees. The corporate sector has also recognized the value of stret tokener collaboration. For example, Coconut Products Limited involves local stret tokeners to conduct awareness sessions with plantation staff and residents.

Discussion

Overall, communities have responded favourably to engagement by ENBSHIP staff, suggesting this has been the first time they have been meaningfully involved in a development project, and have a say about who gets trained, where training occurs and how the community responds to STIs. Despite this and other recognized successes, the project has encountered numerous challenges, and important lessons have been learned. Key challenges and lessons are discussed below.

Working with local leadership structures

The ENBSHIP approach to engagement with local leadership changed over the course of the project. In districts one and two, early engagement was focussed at the LLG level, neglecting consultation with the district administration. This was a significant oversight. In districts three and four we strengthened communication with the District Administrator (DA), and utilized the District AIDS Council as a conduit for regular communication at the district level.

Planned engagement processes at the LLG and ward level were also modified based on early project experiences. LLG presidents proved to be an important entry point to engaging with ward councillors. They also required regular updates during project implementation. The LLG Council meetings are an obvious forum for this to occur, although bureaucratic processes (for example, visitors may sit in on meetings but not contribute, depending on the local chairman) sometimes made it difficult for CEWs or stret tokeners to contribute.

The requirement for ward councillors to demonstrate markers of support or 'community commitment' before ENBSHIP committed to working with them was a helpful strategy. Having some understanding of 'community

readiness' has previously been identified as an important consideration when engaging with and strengthening civil society in PNG (10).

Following up LLG and ward-level consultation with 'leader' training was an initiative trialled in Kokopo District. This has proven valuable, helping leaders to understand the project and possible benefits and how they can support stret tokeners in achieving planned outcomes. In addition, inviting key leaders (such as LLG leaders, ward councillors, health workers and community development officers) to 'sit in' on stret tokener training helped to develop a 'whole of community' understanding of STI-related issues and strengthened local support for stret tokeners.

Whilst it was not the intention of ENBSHIP that stret tokeners' role would be sustained in the long term, genuine engagement with local leadership has resulted in leaders advocating for ongoing stret tokener activity in some places. While this is a positive reflection on the project, it has also created additional challenges for project staff, such as identifying sustainable mechanisms for local funding and support for stret tokeners.

Overall, the achievement of potential project outcomes has relied on the active participation and support of leaders as well as communities. This has come at a significant time cost, especially when changes in leadership require additional investment of time with new appointees.

The challenge of stret tokener selection and distribution across wards

Ward councillors and health workers are involved in stret tokener nomination. Undoubtedly, our greatest challenge has been to ensure representation of young people (15-19 year olds and those up to and including age 24) among stret tokeners. This is probably influenced by the differing concepts of 'youth' in PNG, with 'youthfulness' often determined by social factors rather than age alone (11). Young people are disproportionately affected by STIs across the Pacific and STI prevalence decreases with increasing age (1,12). If we are to reach young people at the community level with sexual health promotion messages, it is critical that they have a role in the delivery of such information (5).

Another issue relating to stret tokener selection has been a tendency for leaders to spread stret tokeners thin on the ground, in order to include stret tokeners from many wards, rather than concentrate them in four to five wards as suggested. However, project experience suggests 'strength in numbers'— that stret tokeners can be most effective and active if they work in a team.

On reflection, it might have been helpful for the stret tokener selection and support process to incorporate an understanding of the community-popular opinion leader (C-POL) approach (13). C-POL-based interventions aim to facilitate social change alongside peer education. It could be argued that ENBSHIP has sparked social change in some areas of ENB, but these outcomes might have been more widely achieved or further strengthened with an appreciation of the C-POL approach.

Maintaining the quality of stret tokener awareness-raising activities

Maintaining the quality of stret tokener awareness activities has been an ongoing concern, as the provision of inaccurate health communication may have serious consequences. The STI-related content of stret tokener training is deliberately restricted to 'must know' information, and relatively new technical content is introduced after workshop two. 'Must know' information is repeated across the five workshops in different ways, and stret tokeners learn creative ways of communicating (for example, use of drama, story-telling and personal testimonies) and have repeated opportunities to practise skills (such as condom demonstration). Blending entertainment and social messages (such as through drama) is known to enhance the effectiveness of health communication, and personal testimonies of affected people can be far more compelling than other forms of communication, such as scare tactics (14). A page of 'key STI messages' is provided to stret tokeners to guide communication. Over time we work with stret tokeners to develop a list of frequently asked questions and agreed responses to strengthen quality and maintain consistency in communication.

Ongoing resistance to condom promotion

Whilst stret tokeners have often been met with great enthusiasm, both stret tokeners

and CEWs have observed – and been part of – a persistent undercurrent of resistance to condom promotion and the use of ‘stret’ language that continues to limit sexual health promotion in PNG.

Sometimes, this subconscious opposition to condom promotion is shared amongst our staff, who may find that they are not comfortable with advocating condom use in all contexts, preferring instead to support condom promotion in ‘appropriate circumstances’. Project programmers, managers and team members need to be sensitive to the fact that staff may share certain cultural and/or religious biases and be open to discussing this with their teams, while reinforcing a rights-based approach to condom promotion. The team has found it valuable to have a safe space for them to consider their own cultural background and values, which assists them in working with community members.

Working with stret tokers to understand the most common community concerns about condoms (such as opposition on religious, moral or cultural grounds) and equipping them with accurate and well-reasoned counter-arguments has been effective. The ENBSHIP has found that resistance to condom promotion is often more evident with older members of the community and in more remote geographic locations. In our experience, communication with elders has been strengthened by including an ‘older’ member of staff on the CEW team.

Volunteerism in PNG

It is widely acknowledged that the western concept of volunteering does not have a direct equivalent in traditional PNG cultures (15), and that community members’ experiences with donor projects have sometimes created a cargo mentality around project activities. During the design phase of ENBSHIP, there was exhaustive discussion about the ethics, practicalities and impact of whether or not stret tokers would receive a financial stipend. The project did not wish to undermine efforts to build a spirit of local volunteerism, or to create unrealistic community expectations as to the possible financial benefit of involvement in the project.

Ultimately, the project was guided by provincial policy and elected not to pay volunteer allowances, opting instead for small

incentives (eg, t-shirts) and reimbursement for reasonable costs through the payment of the equivalent of a government allowance when stret tokers are away from home during training. Whilst some funding has been allocated to stret toker initiatives that are ‘approved’ by ENBSHIP under limited criteria, the project encourages awareness activities that are sustainable, locally based and managed, simple and appropriate to the technical resources of the community, and cost-neutral for participants. This may include, for example, incorporating sexual health information into conversations with peers or through story-telling or drama. Wherever possible, stret tokers generate reciprocal support from communities, for example, through in-kind or financial contributions to stret toker travel or group refreshments.

In practice, the training itself and the kudos and community respect that comes from being a stret toker has proved an incentive in its own right for many. Nevertheless, stret toker expectations for reimbursement of some costs persist, and over time the project has established clear guidelines around the funding of activities. The aim of these guidelines is to balance issues of equity, sustainability and dependency. Particularly for women, who typically have less access to the formal economy and may have considerable resource constraints to their participation, it is important to consider these issues sensitively. Where possible, it is beneficial to have guidelines about the financial implications for participants in place prior to implementation to help set reasonable expectations with communities.

Gender

The stret toker training attempts to build an understanding of entrenched gender norms and the various social and cultural practices that influence vulnerability to STIs (16). The complexity that surrounds these norms is significant. It is positive – if at times challenging – for staff to observe that issues such as family/domestic violence, marital rape, child sexual assault and women’s lack of control over their fertility are being talked about in communities in ENB, particularly in relation to sexual health. There is also awareness about the relationship between alcohol consumption and gender-based violence and inequality. The time is ripe to address the considerable challenges of gender-based violence both

in ENB and PNG more broadly. However, there is a lack of referral capacity in relation to gender-based and sexual violence, including in relation to children. Consequently, attempting to address gender-based violence remains challenging and, arguably, unethical.

Regrettably, there are several reported instances where stret token activities have been met with very strong negative and potentially violent opposition from communities. This has occurred where a stret token has sought to communicate outside their peer network (eg, a young female stret token talking to a group of older boys about issues of sexual health), which often confronts established gender norms regarding with whom and how matters of sex, sexuality and sexual health are traditionally discussed. Ultimately, the project has sought to minimize any risks to stret tokens individually by seeking to reinforce the concept of peer awareness, and has worked within this framework to reduce potential threats. Although the team is conscious of some of the benefits of working through a gender-sensitive lens, underlying issues of gender-based violence and its attendant relationship to STI vulnerability remain of considerable concern both in ENB Province and PNG more generally.

Conclusions

The project has developed and tested a model for taking sexual health promotion to the village level in East New Britain Province. The approach is built upon basic community development principles, has been well received and appears to be contributing to a range of positive outcomes for those involved. Important lessons have been identified and may be useful to consider in the planning of other community-based initiatives in PNG.

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Epidemiological surveillance of human papillomavirus prevalence and type distribution in Papua New Guinea: the selection of an appropriate laboratory tool

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SUMMARY

Cervical cancer is one of the most common cancers among women worldwide and is a leading cause of cancer death in Papua New Guinea (PNG). It is well established that persistent infection with high-risk types of human papillomavirus (HPV) is necessary for the development of cervical cancer. The recent licensing of two vaccines for the prevention of the two most common high-risk HPV types has prompted renewed interest in the prevention of cervical cancer and HPV in PNG. This review aims to assess and compare available technologies suitable for the epidemiological surveillance of HPV in PNG. Data from the surveillance exercise will provide critical information to the National Department of Health to make an informed decision regarding the introduction of a preventive HPV vaccine.

Introduction

Cervical cancer is one of the most common cancers among women worldwide. It is estimated that there are 530,000 new cases of cervical cancer per year, and approximately 275,000 deaths globally (1). Papua New Guinea (PNG) is estimated to have one of the highest rates of cervical cancer in the world, with an estimated 1500 deaths/year, corresponding to an age-standardized incidence of 40/100,000 (2). It is now well established that persistent infection with certain high-risk types of human papillomavirus (HPV) is necessary for the development of cervical intraepithelial neoplasia (CIN) and cancer of the cervix.

There are over 120 types of HPV and of these an estimated 40 infect the anogenital tract (3). These HPV types are classified as either high-risk (HR) or low-risk (LR) types. The most notable HR-HPV types are type -16 and -18 which are present in 70% of invasive cervical cancers (1,4). The LR-HPV types (for cervical cancer) are responsible for genital

warts and include HPV-6 and HPV-11 (3).

Two recombinant HPV vaccines were licensed in 2006 – the quadrivalent Gardasil® vaccine (Merck, New Jersey, USA), which is protective against HR-HPV -16 and -18 and LR-HPV -6 and -11; and the bivalent Cervarix® vaccine (GSK, Middlesex, United Kingdom), which includes HR-HPV -16 and -18 only. Gardasil has been available in the Australian public health system since 2006. The vaccine has been highly effective, as demonstrated by the virtual disappearance of genital warts and significantly lower rates of high-grade cervical abnormalities in the vaccinated population compared to non-vaccinated age cohorts (5,6). Also in Oceania, Gardasil was trialed in Fiji after seminal work found that of 296 cervical cancer and precancerous tissue samples, 99% were positive for an HR-HPV type and of these, 77% were positive for HPV-16 or -18 (7). There are no data concerning HPV prevalence or type distribution in the general population of PNG. A 2009 analysis of cervical biopsies (n = 70) from women with cervical cancer in PNG found that 82.8%

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were positive for HR-HPV types 16 (57.1%) and 18 (25.7%) (8). As yet, neither HPV vaccine is available in PNG's public health system. A key factor restricting the decision to introduce the vaccine to PNG is a lack of robust epidemiological data concerning HPV type distribution in the general population.

Laboratory-based surveillance of the circulating HPV types is required to understand HPV epidemiology within PNG. HPV DNA testing can also be used clinically as an indicator of a woman's risk of developing cervical cancer. There are many commercial HPV testing kits available and all enable some level of HPV detection or typing at a molecular level. HPV is a small DNA virus of approximately 8000 base pairs with six early (E) genes responsible for replication and transcription and two late (L) structural genes. HPV genotyping is typically performed using molecular tools that most commonly compare all or part of the major capsid protein of the virus encoded by the L1 gene but can be done by targeting the non-structural, regulatory proteins, E6/E7, or using technology employing RNA probes.

Some HPV tests are designed to screen for groups of HR-HPV types only, and will not provide information on specific genotypes, while others are capable of specifically typing all mucosal HR and LR HPV types. The most commonly used clinical assays screen for all HR-HPV types but will only differentiate between the vaccine-specific types, HPV-16 and -18. Some assays utilize standard laboratory equipment only and others require dedicated machinery and a highly sophisticated molecular laboratory. There are a number of HPV tests that have been approved for clinical use by the US Food and Drug Administration (FDA) and the European Union Conformité Européenne (CE), whilst others are designated for research purposes only.

As the PNG Institute of Medical Research (PNGIMR) is currently gearing up to lead a comprehensive program of research on cervical cancer and HPV epidemiology, the wide range of HPV test kits available has prompted us to assess which would be most suitable for HPV surveillance in PNG. The choice of test kit can markedly affect the quality of results generated and as the planned work is the most comprehensive investigation into HPV prevalence and type distribution in the

country, the need to generate results that can be standardized internationally is paramount. This review therefore focuses on assessing commercially available HPV testing kits, and specifically compares their genotyping ability, specific technology required and previous performance in other published laboratory-based surveillance programs. This will help to determine the most appropriate HPV test for use in PNG.

Methods

A list of currently available commercial HPV test kits was compiled and adapted from those cited in Poljak and Kocjan (2010) and in Tabrizi (2010) (9,10). Test kits for which we could not identify two or more independent peer-reviewed publications or those for which we could not obtain information from the company website or through communication with the company were not included in this list or considered for use.

Test kits were identified as either being HR-HPV-based screening assays, which refers to those that detect groups of HR-HPV, or HPV genotyping assays, those which allow for individual typing of HR and LR HPV types. Tests were further differentiated based on technology. We compiled information about the required dedicated machinery and the HPV types detected from company-provided product inserts, and assessed the test performance from peer-reviewed publications. The number of peer-reviewed publications concerning each test kit was determined from a search using the test kit name as the key search term in PubMed, and restricted to those concerning genital screening only.

Test kits were shortlisted to be considered useful for epidemiological surveillance in PNG if they met the following three criteria: 1. The test kit could specifically genotype a wide range of HR and LR HPV types; 2. The test kit required only standard laboratory equipment, including a standard or real time thermocycler, centrifuges, water baths, incubators, heating blocks, rotators and plate readers; and 3. There were at least two independent peer-reviewed publications describing its use.

Results

We compiled a list of 11 commercial HPV test kits (Table 1), and from this we identified 7 as HR-HPV-based screening assays and 4

TABLE 1
SHORT LIST OF CANDIDATE HPV TYPING AND SCREENING ASSAYS

Name	Company	HR HPV	LR HPV	Target	Certifications	Non-standard laboratory equipment	Number of original research papers†
HR-HPV screening assays (some with limited genotyping)							
RNA:DNA hybridization with chemiluminescent detection							
Hybrid capture II HPV DNA	Qiagen	16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68	None		FDA	Dedicated machine	>50
careHPV	Qiagen	16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68	None		Not yet	Dedicated machine (low cost)	3
Cervista HPV HR Test	Hologic	16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68	None		FDA	No	~20
Transcription-mediated amplification							
Aptima HPV	GenProbe	16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68	None	E6/E7	CE-IVD	Dedicated machine	~15
PCR with nucleic acid hybridization detection system (PCR-EIA)							
Amplicor HPV Test	Roche	16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68	None	L1	CE-IVD	No	~30
COBAS 4800 HPV Test	Roche	16*, 18*, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68	None	L1	FDA	COBAS machine	~15
RealTime High Risk HPV Test	Abbott	16*, 18*, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 66, 68	None	L1	CE-IVD	m2000 real time PCR system	~15

Specific HPV genotyping assays

Reverse hybridization assays using a microarray detection system

PapilloCheck HPV Screening Test	Greiner Bio-One	16,18,31,33,35,39,45,51,52,53,56,58,59,66,68,73,82	6,11,40,42,43,44,55,70	E1	CE-IVD	Microarray Reader	~15
CLART Human Papillomavirus 2	Genomica	16,18,31,33,35,39,45,51,52,53,56,58,59,66,68,73,82	6,11,26,40,42,43,44,54,61,62,70,71,72,81,83,84	L1	CE-IVD	Microarray Reader	2

Reverse hybridization using a line blot detection system

INNO-LiPA HPV	Innogenetics	16,18,31,33,35,39,45,51,52,53,56,58,59,66,68,73,82	6,11,26,40,43,44,54,69,70,71,74	L1	CE-IVD	No, but can be automated	~40
Linear Array HPV Genotyping Test	Roche	16,18,31,33,35,39,45,51,52,53,56,58,59,66,68,73,82	6,11,26,40,42,54,55,61,62,64,67,69,70,71,72,81,83,84,IS39,CP6108	L1	CE-IVD	No, but can be automated	>50

[†]restricted to papers concerning genital screening only

*specifically genotypes types 16 and 18

HPV = human papillomavirus

HR = high risk

LR = low risk

RNA = ribonucleic acid

DNA = deoxyribonucleic acid

FDA = United States of America Food and Drug Administration

CE-IVD = Conformité Européenne in Vitro Diagnostics

PCR-EIA = polymerase chain reaction – enzyme immunoassay

as being HPV genotyping assays. In the latter group, all four assays detected the same 17 HR-HPV types, but differed in their ability to detect LR-HPV types. All assays capable of detecting LR-HPV types detected types 6 and 11. Based on our criteria to select a test for epidemiological surveillance of HPV in PNG, the following tests were shortlisted as suitable candidates: Linear Array HPV Genotyping Test (Roche Diagnostics, Mannheim, USA), 37 types including 20 LR types; PapilloCheck HPV Screening Test (Greiner Bio-One, Frickenhausen, Germany), 25 types including 8 LR types; INNO-LiPA (Innogenetics, Gent, Belgium), 28 types including 11 LR types; and CLART Human Papillomavirus 2 (Genomica, Coslada, Spain), 33 types including 16 LR types. For the remainder of this article, these tests will be referred to simply as Linear Array, PapilloCheck, INNO-LiPA and CLART HPV, respectively.

The four suitable candidate assays were reverse hybridization assays. The PapilloCheck and CLART HPV assays utilized DNA microarray technology for the result read-out, and the INNO-LiPA and Linear Array assays used a line blot detection system. Microarrays require a specific machine to analyse the results, and these two assays were therefore deemed unsuitable for use in PNG. The line blot detection assays can be operated using standard laboratory equipment and therefore the suitable candidate assays for HPV surveillance in PNG were the INNO-LiPA and Linear Array.

The INNO-LiPA and Linear Array assays have CE approval as *in vitro* diagnostics and have been widely published in the international literature. Direct comparisons of these two assays indicate comparable performance in many studies. Specifically, a large study using cervical scrapes ($n = 573$) found that over 80% of all sample results were concordant between the two assays, and a further 11% were compatible (at least one type matching in multiple infections) (11). Sensitivity has been reported to be higher for INNO-LiPA than Linear Array, although one study reporting this was specifically investigating HPV types in archival tissue samples up to 10 years old, and hypothesized that the shorter amplification target of INNO-LiPA serves as an advantage in this situation (12). In contrast, Sabol et al. (2008) reported that Linear Array was more sensitive than INNO-LiPA in detecting less prevalent HPV

types, and was more effective in detecting multiple infections from cervical DNA samples (13). The superior ability of Linear Array to detect multiple genotypes was confirmed in a further study comparing the two assays (14).

Discussion

We have compiled a list of available HPV testing kits and assessed them for use in the PNG context based on the number and types of HPV detected, the specific machinery required and their performance in published studies. The use of an appropriate HPV test kit is imperative for data generation on HPV prevalence and genotype distribution in PNG. These data are required to build upon the evidence base that the National Department of Health needs in order to make informed decisions regarding the introduction of the HPV vaccine into the country.

The genotyping tests that best met our selection criteria were Linear Array and INNO-LiPA. These tests have a wide HPV detection range for HR and LR types, require standard molecular biology tools and have been extensively used in previous investigations. The Linear Array assay has been utilized to type HPV for epidemiological studies in many diverse settings, including, but not limited to, Romania (15), Switzerland (16), China (17), Botswana (18) and Honduras (19). Similarly, INNO-LiPA has been used in studies focused on archived specimens in Sri Lanka (20) and Fiji (7) as well as large epidemiological studies in Thailand (21) and France (22) and the first HPV investigation in Sardinia, Italy (23).

Our choice of test was guided by our purpose and the setting in PNG. Firstly, HPV tests in PNG are currently required for epidemiological surveillance rather than for clinical management and therefore the ability of the test to specifically genotype a large number of HPV types is of critical value. Secondly, only tests requiring standard laboratory equipment were considered as maintenance and support of specialized equipment can be very challenging in PNG. Further, conducting the testing in PNG, rather than opting to send the samples internationally, has a number of advantages, including the growth in capacity of local scientists, laboratory technicians and the laboratory facilities themselves. In addition, managing testing and surveillance in-country will build knowledge in this area of medical research, and facilitate PNG ownership and

use of these data to inform policy regarding the introduction of an HPV vaccine and cervical cancer prevention programs.

Efforts to introduce a vaccine must occur alongside the continual improvement of the cervical cancer screening program in PNG. An effective cervical cancer screening program can reduce the cervical cancer mortality by more than 50% in settings in which it is optimally introduced. The two most commonly accepted screening protocols are cytology (Papanicolaou smear or 'Pap smear') and visual inspection of the cervix with acetic acid (VIA).

HPV DNA testing offers a major advance in cervical cancer screening programs, especially in resource-limited settings. HPV testing allows the identification of women who are at higher risk of developing cervical cancer who can then be monitored and treated appropriately, eg, by VIA and cryotherapy. Previously limited by high cost and the need for sophisticated molecular laboratories, HPV testing now promises to become accessible for clinical screening in resource-limited settings with the release of newly developed assays that can be undertaken using closed units in field settings. Such assays are in various stages of development and implementation, but could be very useful in the future by increasing access to cervical cancer screening and early treatment programs in PNG.

In conclusion, our assessment of available HPV testing kits has indicated that there are two wide-range HPV genotyping kits (Linear Array and INNO-LiPA) suitable for use within the HPV and cervical cancer research program in PNG. This program will provide the first data on the distribution of HPV types in a geographically diverse sample within PNG. The results from this work will be imperative to inform decisions regarding the future introduction of a preventive HPV vaccine into PNG.

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The contribution of church health services to maternal health care provision in Papua New Guinea

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SUMMARY

Access to maternal health services is one key to the reduction of maternal mortality in Papua New Guinea. Church health services (CHS) are known to administer around 45% of rural health facilities. We undertook a descriptive analysis based on health facility service provision data for 2009 from the National Health Information System (NHIS), supported by document review and interviews. We recoded NHIS data on facilities by administration by CHS or government health service, judged their capacity for emergency obstetric care (EmOC) and analysed service provision for 2009. For rural services (ie, outside of provincial capitals), CHS were recorded as providing 58% of health facility childbirth care and 38% of first antenatal visits. Obstetric referral patterns and facility capacity suggested many facilities were likely to have only basic EmOC and limited referral options. Nationally, CHS provided 21% of temporary methods of contraception (measured in couple-year protection) but 85% of referrals for permanent contraception. There was marked variation across provinces with clear implications for where health system strengthening could be beneficial to maternal survival. Our findings also disclosed gaps in the NHIS around monitoring of complicated childbirth and inclusion of community-based care.

Introduction

Maternal mortality is a high priority for the national government, communities and development agencies working in Papua New Guinea (PNG) – as expressed in the National Health Plan (1) and the Ministerial Task Force on Maternal Health in PNG (2). Access to maternal and reproductive health services is essential to the reduction of maternal mortality (3). For example, in China UNICEF (United Nations Children's Fund) data record a dramatic fall in maternal deaths from 110 per 100,000 live births in 1990 to 38 per 100,000 in 2008, while over the same period the proportion of women delivering in a health facility in China rose from 51% to

92% (4). The proportion of women in PNG who accessed a supervised birth at a health facility in 2009 was 42%; this has remained relatively static for more than five years (5). Poor access to contraception is also linked to high maternal mortality (6) and the United Nations Population Fund estimates that PNG's contraceptive prevalence rate is low: at 36% of women aged 15-49 using any contraceptive method, similar to other 'least developed countries' (average 30%) and well below the Asia-Pacific regional average of 67% (7). PNG's National Health Information System (NHIS) indicator for contraceptive use is couple-years protection (CYP), which measures usage of 'modern methods' of contraception including permanent male or

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female sterilization, intra-uterine devices, oral contraceptive pills and hormonal implants and injections, but not including condom use. This indicator has also remained static in recent years (81 per 1000 women aged 15 to 44 years in 2009) (5).

Churches in PNG are known to be widespread providers of health care. Commonly termed church health services (CHS), they are often cited as responsible for approximately 50% of services in rural areas and 45% of services overall (8). Rural health care services are particularly important in PNG, as approximately 85% of the population lives outside cities or towns, and rural infrastructure is markedly undeveloped (1). Churches are also active in training health care workers: administering 2 of 3 universities providing health worker education, 5 of 8 general nurse training institutions and all 12 community health worker training schools in the country (8,9). When considering how to increase women's access to care, CHS contribution is likely to be critical.

Recent work by the Health Policy and Health Finance Knowledge Hub at the University of Melbourne (10), as well as other commentators (8,11,12), has documented the diversity of these providers in different provinces. However, the size and nature of their specific contribution to maternal health care provision are not routinely reported.

Our aim in this short report is to provide a national snapshot, from routinely collected health information, of the relative contribution of CHS to the provision of maternal and reproductive health care services that are important to maternal survival.

Methods

A descriptive analysis was undertaken in Port Moresby in 2011 comprising document review, secondary analysis of national health information monitoring data and interviews. We reviewed published and grey literature documents on CHS in PNG, linking this to a broader literature review on church-government relationships (10) and sought reports from CHS peak bodies and the government's National Department of Health (NDoH) CHS liaison office.

The following indicators of maternal service provision were selected: childbirth in a health

facility; first visit for antenatal care; and provision of contraceptive services for family planning, as measured by the couple-years protection (CYP) rate. The NDoH Monitoring and Research Branch supplied data on these indicators for 2009 (the most recent complete dataset available in mid-2011), disaggregated by province, district and health facility. This reflected publicly available data collated in the Annual Health Sector Review (5). We attempted to triangulate this with nationally collated data held by CHS bodies, but meaningful comparison was not possible because the CHS dataset was not population-based and was collected for a different purpose.

We manually coded each health facility listed in the NHIS report as run by CHS or the government, based on a CHS health facility inventory and Geobook mapping. We then re-analysed the service provision data, using simple proportions, to compare provision by CHS-run facilities with that by government-run facilities. There is no national collation of statistics in the NHIS on services for complicated childbirth (such as caesarean section). Instead we estimated the likelihood that emergency obstetric care (EmOC) was available at a facility based on the number of hospitals with a resident medical officer, the opinions of key informants (see below) and the annual reports supplied. We reviewed caesarean section rates reported to the Obstetrics Society, but these could not provide a CHS and government comparison.

We also interviewed senior staff in maternal health in NDoH, country offices of the World Health Organization (WHO) and UNICEF, the Specialist Society for Obstetrics and Gynaecology, the CHS National Office, and in rural CHS facilities providing maternal health care including those run by the Evangelical Church of PNG, Catholic Health Services, Anglican Health Services and Nazarene Health Ministries. These interviews were to provide additional information to support our interpretations and judgements, which remain the responsibility of the researchers, and may not reflect the opinions of those interviewed.

Results

Table 1 displays our breakdown of CHS and government health services (GHS), summarizing total facilities in health system categories; we note that all aid posts, and the

TABLE 1

FACILITIES RUN BY CHURCH HEALTH SERVICES (CHS) AND GOVERNMENT HEALTH SERVICES (GHS) IN PAPUA NEW GUINEA, 2009

Agency	Aid posts	Health centres	District/rural hospitals	Provincial/general hospitals
Government	-	411	4	22
Churches	236	340	16	-
Total	236	751	20	22

Source: National Health Information System, 2009 and Papua New Guinea Geobook, 2008

great majority of health centres, are located in rural areas.

Childbirth in a health facility

Of supervised childbirths in a health facility in 2009 (a total of 76,498 deliveries in our dataset), 30% were in CHS facilities and 70% in GHS. There was significant variation between provinces, as displayed in Figure 1. To describe the situation in rural areas, we also present health facility deliveries outside of provincial hospitals or Port Moresby General Hospital; for these rural births 58% took place in CHS facilities. This shows greater variation by province (Figure 2), with a number of provinces recording that more than two-thirds of their rural health facility deliveries take place in CHS facilities, namely Gulf, Western Highlands, Madang, Sandaun (West Sepik), West New Britain and East New Britain provinces.

Based on the data available we judged that in 2009 38% of the identified 21 rural and district hospitals in the CHS had demonstrated capacity for comprehensive EmOC (those facilities with medical doctors and adequate facilities capable of doing caesarean section and organizing blood transfusion). Estimation of basic EmOC facilities (those with doctors or skilled midwife who can provide the 6 signal WHO EmOC functions) is a more difficult judgement and we estimated that 62% of the CHS facilities reporting deliveries could do this (Table 2). It was not possible to make judgements about service quality or the degree to which services are always available.

The NHIS also records referrals to higher centres for obstetric complications. Of all

such referrals in 2009, 31% were done by CHS facilities. These vary greatly from province to province (Figure 3), and may give some indication of both the activity of CHS compared with GHS (similar to that seen in Figure 1) and the availability of a viable referral pathway.

Provision of first antenatal care visits

Nationally, 38% of first antenatal care (ANC) visits were conducted in CHS, as compared with GHS. When provincial hospitals and urban clinics are excluded, CHS facilities provided 48% of first-visit ANC services. This also varies by province, as shown by Figure 4. In some provinces, such as Gulf or Sandaun (West Sepik), around 80% of first ANC visits are provided by CHS.

Provision of contraceptive services for family planning

The proportion of family planning services, measured as CYP per 1000 women aged 15-44 years, provided by CHS was 21% nationally in 2009. There is considerable variation by province, as illustrated by Figure 5. This may correlate with denominational affiliations of CHS: our qualitative information suggests that Catholic CHS providers predominate in provinces, such as East and West New Britain, New Ireland and the Autonomous Region of Bougainville (termed North Solomons in NHIS data), where CYP is relatively lower. However, Catholic CHS providers are also present in other provinces where CYP is higher. The NHIS also records referrals from health facilities for permanent contraception; the CHS provide the majority of these referrals (85% in 2009).

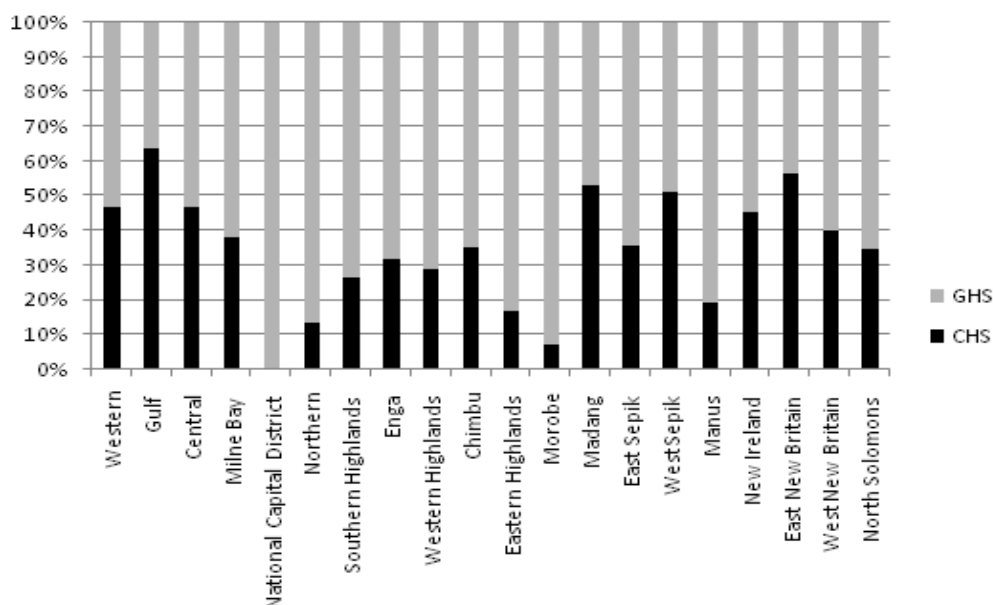


Figure 1. Supervised childbirth in health facilities by province, 2009, expressed as the percentage of total health facility deliveries in government health services (GHS) as compared with church health services (CHS) for each province. Note: this figure uses province names as they are expressed in the National Health Information System dataset.

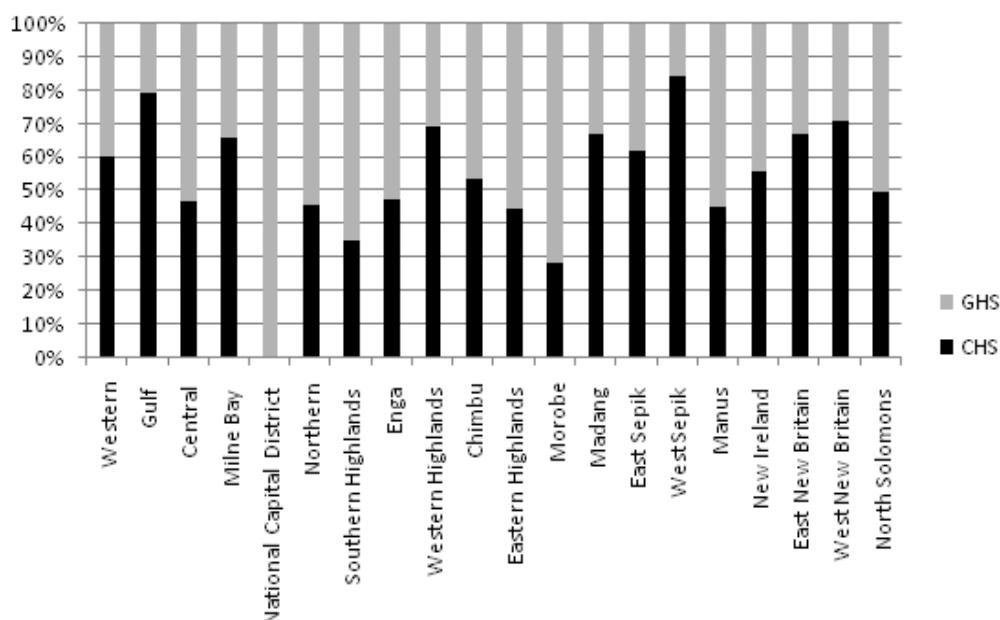


Figure 2. Supervised childbirth in rural health facilities by province, 2009, excluding provincial hospitals. Note: this figure uses province names as they are expressed in the National Health Information System dataset. GHS = government health services
CHS = church health services

TABLE 2

CHURCH HEALTH SERVICES FACILITIES CAPABLE OF EMERGENCY OBSTETRIC CARE (EmOC) IN 2009*

EmOC status	Facilities	Province	Region
Basic	Balimo	Western	Southern
Basic	Kikori	Gulf	Southern
Basic	Kanabea	Gulf	Southern
Basic	Kapuna	Gulf	Southern
Basic	Watulum	Enga	Highlands
Basic	Opiam	Enga	Highlands
Basic	Tinsley	Western Highlands	Highlands
Basic	Kotna	Western Highlands	Highlands
Basic	Migendi	Simbu	Highlands
Basic	Tookena	Eastern Highlands	Highlands
Basic	Telefomin	West Sepik	Momase
Basic	Kimadan	New Ireland	Islands
Basic	Yagaum	Madang	Momase
Comprehensive	Ruminginae	Western	Southern
Comprehensive	Nazarene, Kudjip	Western Highlands	Highlands
Comprehensive	Braun Memorial	Morobe	Momase
Comprehensive	Raihu, Aitape	West Sepik	Momase
Comprehensive	St Mary, Vunapope	East New Britain, Kokopo	Islands
Comprehensive	Gaubin	Madang	Momase
Comprehensive	Mambisanda Emmanuel	Enga	Highlands
Comprehensive	Kopiam	Enga	Highlands

*This classification is also based on staff and hospital capacity and opinions of key informants

Discussion

These data, drawn largely from the government NHIS, demonstrate that CHS play a significant role in provision of maternal health services for PNG's rural majority, accounting for close to 60% of health facility childbirth outside the provincial towns and capital. They provide important access to basic emergency obstetric care and are active referrers of women with complications. However, there is wide variation by province, and when considering the location of comprehensive EmOC capacity it is clear that there are many situations where women are delivering in CHS facilities with basic emergency obstetric care,

but have no feasible options for referral if a complication requiring comprehensive EmOC (for example, a caesarean section) becomes necessary. A number of provinces have CHS that are conducting a large proportion of health facility deliveries, but are not recorded as active in obstetric referrals; this may indicate areas where particular attention to upgrading referral pathways for CHS facilities that are obstetrically active could assist in reducing maternal deaths. Some examples include Gulf, Oro (Northern in NHIS data), Enga, Madang and Sandaun (West Sepik in NHIS data). These data demonstrate the need for national and provincial planners to carefully examine what childbirth care services are

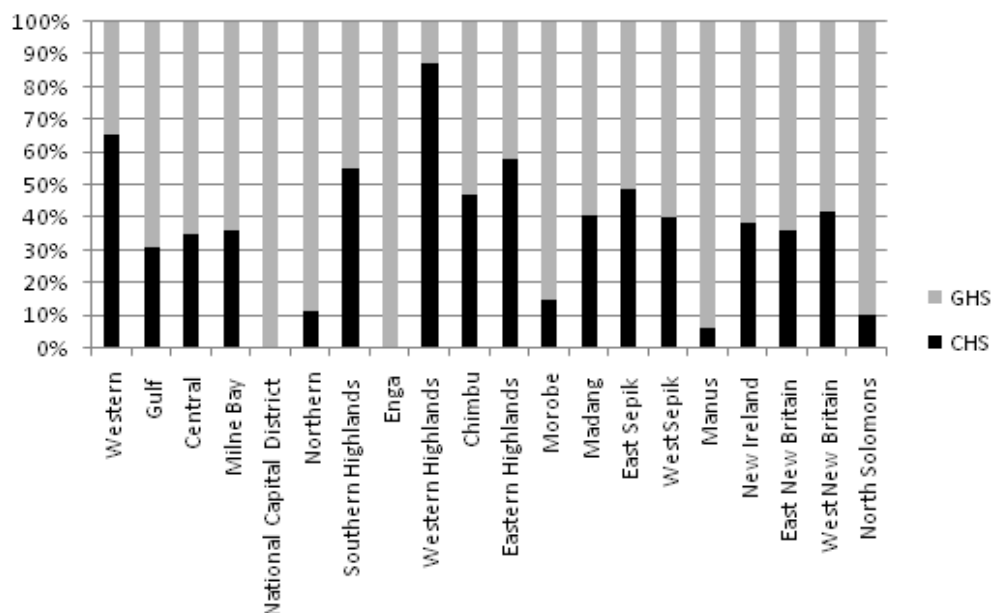


Figure 3. Obstetrics referrals in 2009, from government health services (GHS) and church health services (CHS), by province. Note: this figure uses province names as they are expressed in the National Health Information System dataset.

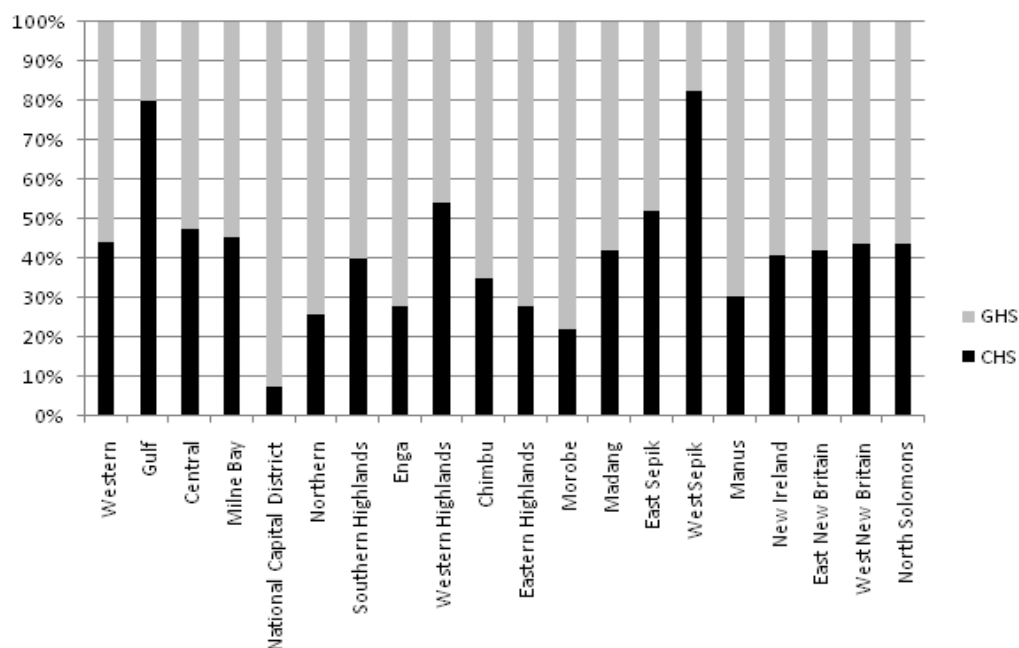


Figure 4. Antenatal care (first visit) services by government health services (GHS) and church health services (CHS) in all health facilities (including provincial hospitals and urban clinics) by province. Note: this figure uses province names as they are expressed in the National Health Information System dataset.

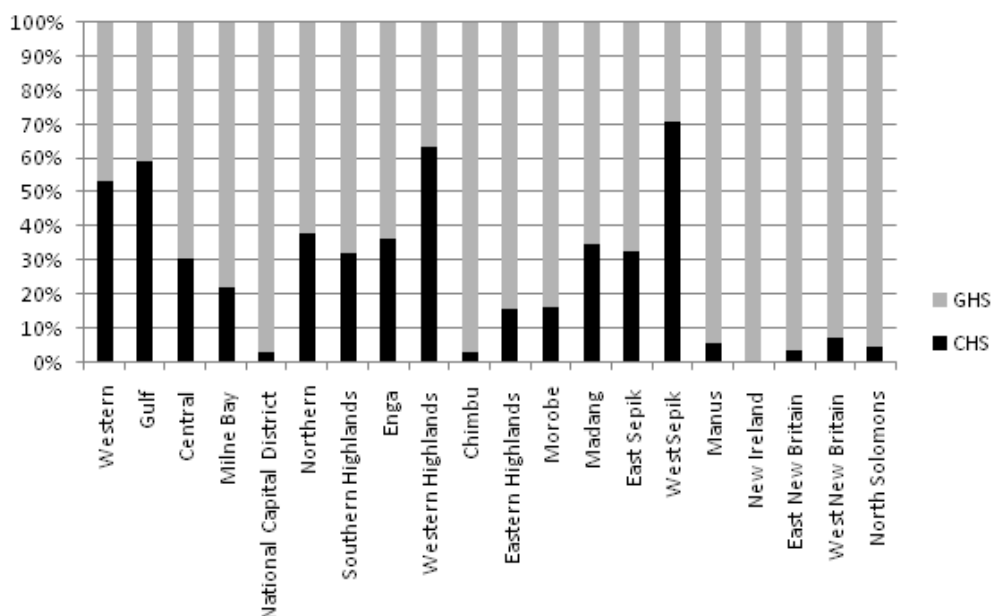


Figure 5. Proportion of couple-years protection per 1000 women aged 15-44 years offered through government health services (GHS) and church health services (CHS), 2009, by province. Note: this figure uses province names as they are expressed in the National Health Information System dataset.

being provided by CHS and to ensure their integration in health planning. Other recent studies (10,11) support greater attention to the detail of provincial and national partnership arrangements between GHS and CHS.

CHS have a different role in extension of family planning services. While they are more active providers of contraception in some provinces than others, nationally they are recorded as providing the great majority of referrals from rural areas for permanent contraception. This suggests that, even in the presence of real or perceived barriers to institutional support for contraception, there are mechanisms for providing access to family planning that could perhaps be expanded.

CHS have different systems for financing, staffing and organization of services, when compared with GHS, although they are intended to work to the same national standards and report in the same NHIS. Our quick snapshot suggests that there would be value in carrying out a more in-depth review of the systems deployed by those CHS that are active in maternal health care. A review of the

submissions to the Ministerial Task Force (2) shows relatively few from CHS organizations, and there may be benefit in a more targeted study of CHS systems.

The National Health Plan (1) and the Ministerial Taskforce (2) envisage a role for CHS in the delivery of maternal health care. Our analysis demonstrates that their role goes well beyond preventive or first-line care, and it is notable that they provide a larger proportion of rural health facility deliveries than they do of antenatal care. CHS are also well known to play an active role in providing other community care services, including education, nutrition, aid post support and support to village health volunteers. This includes some areas where aid post staff or village birth attendants are supported to promote maternal health, including attendance at home births where a facility delivery was not possible. It was not possible in our analysis of the NHIS to reliably report the CHS contribution to community care. A national conference on village health volunteers (12) demonstrated that CHS, and other non-government organizations, support a large cadre of lay health workers, but that

their contribution to maternal or newborn health care is not sufficiently captured in the NHIS (13,14).

There are a number of limitations in our analysis, the main one being the potential for under- or over-reporting of services within the NHIS. The estimate of whether women had access to EmOC reflected our own judgement, based on limited data on the facilities in question. These limitations illustrate the difficulty that the current form of the NHIS has in providing information useful for maternal health planning, especially the lack of monitoring data on obstetric complications and their response, and the incomplete inclusion of community care noted above. These are currently being addressed by NDoH, including provincial visits for audit and review (2), and represent an essential step towards better maternal health care coverage.

Conclusion

Church health services provide the majority of health facility childbirth care in rural areas, and a substantial proportion of antenatal care, obstetric referral and family planning services. Their contribution, and the systems that underpin it, warrant more detailed study in support of strengthening maternal health care. The National Health Information System provides useful data on relative service provision, but could be strengthened further to include information on obstetric complications and community-based care.

DISCLOSURES

The authors declare they have no conflicts of interest. An abbreviated version of this paper was presented in an open session at the PNG Medical Symposium in 2011.

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Formal and informal maternal health care: comparing the service provision of health facilities and village health volunteers in East Sepik Province

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SUMMARY

Maternal health across Papua New Guinea (PNG) is of extreme public health concern. In response, the National Department of Health explicitly prioritized improving maternal, neonatal and child health services, envisaging increased collaboration between the formal health system and community-based initiatives as one method for achieving this. This study examined the patterns of formal and non-formal service utilization during pregnancy and childbirth in one province. We analysed the activity database of the East Sepik Women and Children's Health Project's Village Health Volunteer (VHV) program, an informal health service in East Sepik Province of PNG, estimating VHV activity and coverage for two maternal health care services (first antenatal care visit and VHV-attended deliveries) and comparing these to the volume and estimated coverage of these services delivered by the formal health system in East Sepik over the years 2007 to 2010. We found a significant increase in women's utilization of VHVs for first antenatal care and for an attended delivery. Reported coverage of these services delivered by the formal health service declined or at best remained static over the same time period. Our data cannot illuminate the causes of an apparent and highly concerning decline in health facility usage for assisted delivery, nor the reasons for increased usage of VHVs. The factors contributing to these trends in service provision require urgent study, to improve our understanding of the drivers of utilization of critical maternal health services. Our study demonstrates that VHVs deliver a substantial proportion of maternal health services in East Sepik. This finding alone highlights the importance of considering this cadre when planning health service improvements and suggests that a national VHV policy that builds on the work of the National Health Plan in defining the most appropriate role for VHVs in maternal health care is long overdue.

Introduction

Maternal health indicators across Papua New Guinea (PNG) are of extreme public health concern. National maternal mortality rates in PNG are the highest in the Pacific region at 733 per 100,000 (1) (as reported by the government's most recent survey) compared to other Pacific Island countries

(eg, Fiji 210 per 100,000) (1). In the National Health Plan for 2011-2020 (1), the National Department of Health (NDoH) explicitly prioritized improving maternal, neonatal and child health, recognizing poor coverage and quality of existing rural health services. The Plan envisages increased collaboration between the formal health system and community-based initiatives, with community

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partners seen as having a prime role in encouraging families to use formal health services.

PNG has an informal, unpaid, cadre of trained lay health workers known as village health volunteers (VHVs) scattered across the country in extremely varied programs, usually run by non-government organizations (NGOs), each with their own unique history and objectives (2). The first attempt to standardize VHV functions was undertaken by the NDoH in 2002, but was not fully adopted into national health policy. The generic term 'village health volunteer' is an umbrella term for a variety of lay health workers, including village birth attendants who provide antenatal care and attend women during and after delivery, community-based distributors who mostly distribute family planning supplies, and 'marasin meri' and 'marasin man' who provide treatment for a range of common illnesses.

In East Sepik Province, the East Sepik Women and Children's Health Project (ESWCHP) was established by the NGO Save the Children in 1998. There has been a steady increase in the numbers of VHVs trained, and East Sepik Province now has more than 1200 VHVs. The aim of the ESWCHP is to improve basic health services in isolated locations where the permanent health system is unable to reach people. For care during pregnancy and childbirth, some VHVs are trained as 'village birth attendants'. Internationally, controversy remains regarding the role of VHVs in care during pregnancy and childbirth (3). Evidence indicates that skilled birth attendance in a health facility is safest for mothers and newborns. However, an estimated 60 million women per year worldwide, and some 60% of women in PNG, give birth at home or in the village (4,5). For these women, international evidence suggests that training VHVs can improve utilization of prenatal services and, when the VHV is linked to a health facility, improve skilled birth attendance and referrals for obstetric emergencies (3,6-8). In East Sepik, VHVs are trained to provide basic antenatal care, to encourage women to attend the health facility for subsequent antenatal care and childbirth, to identify and refer women who experience health concerns in the antenatal period, and to attend deliveries for those women who continue to deliver in the village. This last service is with the intention of earlier recognition and referral of women with

complications, although it is well recognized that referral is often extremely difficult and that VHVs have very few medical resources with which to manage complications themselves. VHVs trained as birth attendants receive an initial training period of four weeks using an adaptation of the 2002 NDoH training materials, followed by two weeks of practical placement at the provincial hospital, under supervision in the labour ward and the family planning/antenatal clinic. However, in cases of deliveries with complications, the ability of VHVs to provide adequate assistance is negligible.

Rarely are VHVs included in descriptions of health service coverage; however, a recently available database from ESWCHP makes this possible for East Sepik Province. This study examines the maternal health care provision by VHVs in East Sepik Province for two services: attendance of first antenatal care (ANC) visit and attended deliveries, defined as attendance during childbirth by a trained lay health worker (noting that this is not equivalent to the term 'skilled birth attendance'). We then compared these to health facility data. We aimed to describe the relative contribution over time by the VHV program to province-wide maternal health services.

Methods

Source of data – VHV database

The VHV activity database collating reports by ESWCHP VHVs provided VHV activity data. This database compiles VHV tally sheet reports, submitted on a monthly basis by each operating VHV. Tally sheet reports are similar in structure to those used by first-line health facilities. At the time of analysis, there were over 33,000 monthly reports submitted between 1998 and 2010, allowing for a detailed picture of VHV services and trends over time. Tally sheets are entered into a computer database maintained by Save the Children.

Data cleaning and analysis

VHV data were transferred from the Microsoft Access database to STATA version 10 for analysis. Data cleaning removed duplicate entries and those considered invalid (for example if date of data entry preceded date of collection) and standardized variable names. Summary indicators condensed

records to one summary line per year, district and catchment. This study provides analysis of only ANC visits and attended deliveries data, focusing on trends from 2007 to 2010. ANC and attended deliveries were then estimated as proportions of all pregnant women and all live births in the province respectively, using population estimates described below.

Estimation of population-based service delivery measurements

The estimated population sizes of each district for the years 2007 to 2009 were extrapolated from data included in the 2000 Census data, whilst population estimates for 2010 were sourced from the Monitoring and Research Branch of the NDoH. Total provincial population numbers were used to calculate estimated numbers of pregnant women and births across the whole province, using proportions derived from figures provided by the NDoH in the National Health Plan demographic annexes (estimated number of births = 3.9% of the total population; estimated number of pregnant women = 16% of the number of women of child-bearing age). These figures were used as denominators in the calculation of total provincial population-based service delivery for VHVs.

Source of data – health facility

Formal health facility data were derived from the coverage reports in the Annual Sector Review for East Sepik Province (Momase Region report) for 2006 to 2010, produced by the NDoH with data sourced from the National Health Information System (5). The report presents proportions as measures of coverage and does not include raw measures of activity nor information on how denominators were calculated.

Statistical analysis

Royston's test for trend in proportions was used to determine if there was a difference in the number of maternal health services provided over time by VHVs. Tests for significance were not performed on reported health facility proportions due to uncertainty regarding denominators utilized in their calculation by the NDoH. All reported *p* values are exact and for all analyses *p* < 0.05 was considered significant. All analyses were performed using STATA version 10 (StataCorp, College Station, Texas).

Results

Over the study period, the total number of VHVs reporting provision of care increased from 951 in 2007 to 1215 in 2010. In population terms, this represents one VHV per 429 people in 2007 and one VHV per 364 people in 2010. The total number of health facilities reporting to the National Health Information System remained constant.

Antenatal care visits (Figure 1)

The recorded number of women receiving their first ANC visit from a VHV increased from 898 in 2007 to 2407 in 2010. This represented an increase in coverage from 6% of the estimated pregnant women in 2007 to 15% in 2010. This trend was significant (*p* < 0.001). The reported coverage for health facilities decreased from 71% in 2007 to 55% in 2010. Figure 1 displays these services as a proportion of estimates of the total number of pregnant women in the province.

Attended deliveries (Figure 2)

The recorded number of women whose childbirth was attended by a VHV increased from 1207 in 2007, equivalent to 8.0% of estimated births, to 2272 in 2010, equivalent to 13.2% of estimated births. This trend was significant (*p* < 0.001). Reported health facility coverage of women attending a health facility for childbirth decreased from 28% in 2007 to 22% in 2010. Figure 2 displays these services as a proportion of estimates of the total number of births in the province.

Discussion

When our estimates of VHV services are examined in conjunction with coverage by formal health services, it is clear that the majority of women, approximately 65%, are missing out on attendance at childbirth, and a significant proportion, approximately 30%, are going without any antenatal care. These deficiencies in access to care are acknowledged as a major contributor to continuing high maternal mortality rates in rural PNG (1). The first conclusion to be drawn from our work is that increasing access to good-quality antenatal and childbirth care, including emergency obstetric care, must remain a national priority (9).

We found a significant increase in the

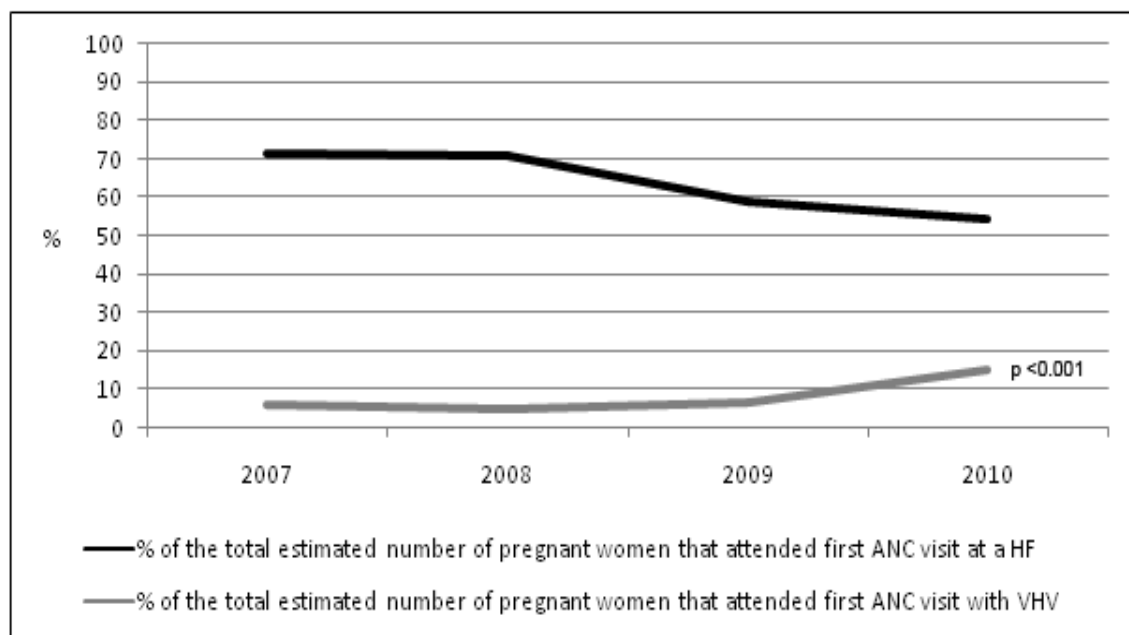


Figure 1. Proportion of the total estimated number of pregnant women in East Sepik Province attending first antenatal care (ANC) visit at a health facility (HF) or with a village health volunteer (VHV), 2007-2010.

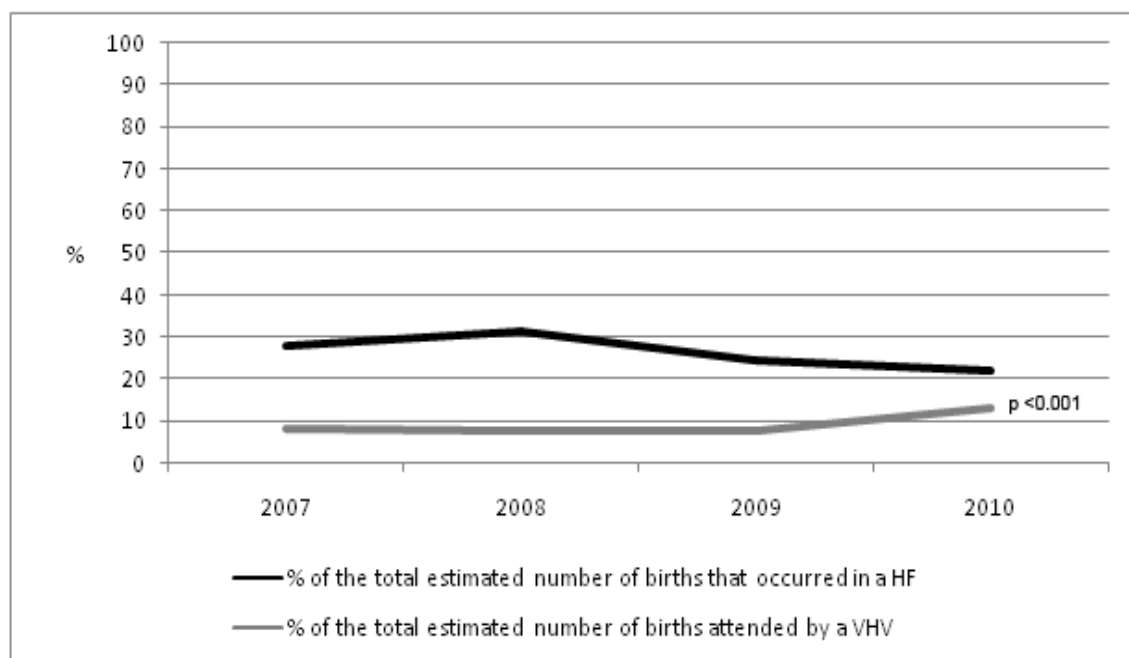


Figure 2. Proportion of the total estimated number of births in East Sepik Province attended in a health facility (HF) or by a village health volunteer (VHV), 2007-2010.

maternal health services that are being provided by VHVs in East Sepik Province: in the period 2007 to 2010 the proportion of all pregnant women receiving their first antenatal visit from VHVs has more than doubled and the proportion of all births assisted by VHVs has increased by more than half. This is likely to be at least partly attributable to the rapid increase in the number of trained VHVs in East Sepik over this time-frame. If VHVs are delivering services in accordance with their training and as intended by ESWCHP, the increase in volume of services delivered by VHVs should increase families' access to better information on pregnancy and childbirth and be accompanied by an increase in health facility usage. It is highly concerning, then, that health facility utilization over the same period declined, albeit by a small percentage and from an already low starting point. Our study cannot provide evidence, one way or another, to determine whether there is a direct causal link between these two changes. Also, because our estimates are for coverage across the whole province, while the VHV program focuses on specific areas within districts, it would be incorrect to deduce from our data that the increase in VHV activity has actually caused the decline in health facility usage.

Our findings contradict several international experiences where increased community-based care is accompanied by increased usage of health facilities for childbirth (10-12). East Sepik is a difficult environment, with dispersed communities and very limited transport infrastructure. It may be that women simply cannot reach formal health services and VHVs are perceived to be filling a gap in service provision. It is possible that both the NGO and communities feel that some degree of trained birth attendance is better than none at all, a perspective that is understandable even when this does not match with national maternal health policy. There may also be social or cultural barriers to childbirth in health facilities, possibly including a preference for VHVs over formal service providers. There is potential for VHVs to help overcome cultural and social barriers in support of facility-based childbirth, a role envisaged for them in national health strategies. Our study cannot illuminate these factors and there is an urgent need to pursue our findings further, perhaps through rigorous qualitative research in East Sepik Province, to better understand why families are not using health facilities. Finding

ways to redress this is of highest importance to reducing maternal mortality (9,13).

The ESWCHP has been able to generate a sizeable cadre of VHVs, with the potential to improve maternal health through provision of basic health promotion messages, identification of pregnancy complications and referral to a health facility for antenatal and intrapartum care. This success represents the mobilization of considerable community desire for better maternal outcomes. Through this, VHVs have increasing access to a significant proportion of women during pregnancy and childbirth. It is important that this cadre provide those evidence-based services proven to be the most effective in mortality reduction (2), and the best match for their training, mandate and supervisory support. The National Health Plan proposes that their major role is in education and health promotion (1); however, this study reveals that VHVs conduct roughly as many attended deliveries as they do first antenatal care visits. This suggests that greater provincial attention is needed to enable women to receive skilled birth attendance at health facilities and to reinforce the role of VHVs as promoters of health facility usage (both routinely and in referral). Where facility-based care is not feasible VHVs should be enabled to support families (such as by distribution of clean birth kits) and their potential role re-examined. For example, East Sepik may benefit from community distribution of other medicines, such as uterotonics for prevention of postpartum haemorrhage (14,15), under carefully monitored pilot activities.

This study makes use of an unusual NGO database collected at the grass-roots level. These datasets are important in PNG and rarely reported, but require significant time for data cleaning. These initial findings demonstrate the potential of further analysis of this dataset, and of others that may exist in VHV programs in PNG.

Lastly, this study demonstrates the importance of including the VHV cadre in health planning, and the urgent need to update national policy to standardize the roles and training of VHVs in relation to pregnancy and childbirth. Where VHV programs are active, district health planners will benefit from integrating them into health information, supervision and other systems. VHV program managers will also benefit from monitoring

trends, not only in VHV activities, but also in associated health facility usage. If such usage is static or declining, as is the case here, then broader health system strengthening is imperative. An extension to ESWCHP is taking up this challenge, investing simultaneously in both VHVs and first-level health facilities.

Limitations

The process used to collect ANC data in East Sepik Province is likely to result in some women being recorded as having received a first ANC visit from both a VHV and a health facility. Health facility staff are likely to record a pregnant woman as receiving first ANC even if that woman has previously received ANC from a VHV (which is why we did not sum these figures). More generally, there is the potential for inconsistent recording by VHVs on data entry sheets; some errors were excluded by our validity tests, but some may be impossible to eliminate. Lastly, accurate province-wide population denominators for all years under investigation were unavailable. Therefore, population projections based on Census data were used.

Conclusions

This study shows that, between 2007 and 2010, VHVs mobilized by ESWCHP delivered an increasing proportion of antenatal care and attended births in East Sepik Province, while health facility usage declined. A large proportion of women continue to miss out on any care, especially during childbirth. It is important that VHV services are considered during health service planning, that there is simultaneous investment in first-level health facilities, and that both health facility and VHV service activity are monitored and evaluated closely to make sure that their programs are in keeping with national health policy.

COMPETING INTERESTS

The authors declare that they have no competing interests. Initial analyses of the dataset were funded by Save the Children Australia; however, the organization had no role in the conduct or conclusions of this study.

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Sociodemographic factors associated with maternal health care utilization in Wosera, East Sepik Province, Papua New Guinea

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SUMMARY

This retrospective study sought to describe the utilization of maternal health services in a rural community in Wosera, East Sepik Province, Papua New Guinea. Interviews were undertaken with a convenience sample of 391 women of reproductive age. We examined the relationship between socioeconomic and demographic characteristics and the use of antenatal clinic services and delivery at a health centre. Despite uptake of antenatal care services by 79% of women, two-thirds of women gave birth at home. Women's education was an independent predictor for maternal health care utilization, for both antenatal care and delivery at a health facility. At least one visit to an antenatal clinic was the strongest predictor of delivering at a health care facility. Women expressed barriers to assisted childbirth such as distance to health facilities, especially when labour came fast, and feelings of shame in presenting to a facility to give birth. This study provides important information relating to the uptake of maternal health care services. Despite the uptake of available antenatal care services, intrapartum services are not well accessed.

Introduction

With only three years left to achieve the Millennium Development Goals (MDGs), many countries are focusing their population health efforts on reducing the number of maternal and child deaths (1). Globally, declines in maternal mortality have been reported (2) as have declines in child mortality (3). However, the rates of decline are not consistent over time or between and within countries and regions (3). Of the 342,900 maternal deaths that take place every year, 99% occur in developing countries (2). The majority of these deaths are in rural areas with the poorest and most remote communities bearing the biggest burden (4,5). The main causes of maternal deaths are haemorrhage, sepsis, unsafe abortion and pregnancy-related hypertension (6). The major factors associated with maternal deaths are absence of skilled health professionals during childbirth, lack of services to provide emergency obstetric care and to deal with complications of unsafe abortion, and ineffective referral systems (6).

A maternal death is frequently accompanied by either a stillbirth or early neonatal death (4). Every year an estimated three million infants are stillborn; one-third of these stillbirths occur during labour. An estimated four million neonatal deaths occur every year (7), three million within the first week of life, of which one million occur in the first twenty-four hours (7,8). As with maternal deaths, 98% of all neonatal deaths occur in low-income and middle-income countries (7,8). Therefore to make any further significant impact on infant and maternal mortality, health care during the perinatal period is a crucial factor and must be addressed (9).

In developing countries an estimated 79% of women attend antenatal care at least once during a pregnancy, yet only 59% of births are attended by skilled birth attendants (7). Lack of antenatal care and skilled attendants at the time of birth are predictors of a poor outcome for both the mother and infant (4). In various regions of the world studies have shown that sociodemographic characteristics influence

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the use of maternal health services (10-21). However, findings are not always consistent. For example, the association between maternal age and use of health services varies: while some studies have found a positive correlation with age (12,13,19) others have found a more complicated relationship with age (12,15). Similarly for education attainment: studies from South America (14,17) have shown that higher levels of education predicted greater utilization of health care, while others in Asia (10,18,19) showed no difference across the different education levels. Distance to health facility (from place of residence) and parity have often been found to have a strong negative correlation with health service utilization (11,21). Marital status, culture and ethnicity have also been noted to play an important role in the use of maternal health services (16,20).

With 733 maternal deaths per 100,000 live births, Papua New Guinea (PNG) has the second highest maternal mortality ratio (MMR) in the Asia-Pacific region and one of the highest in the world (22). This high and increasing MMR is likely to be due to deteriorating rural health services and poor uptake of available health services (23). The cultural and geographical diversity in PNG is an added barrier to availability, access and uptake of professional skilled health care during pregnancy and delivery (23).

In PNG an estimated 78% of women receive antenatal care at least once from a health provider and just over half report attending for the minimum recommended four visits (7,22). According to National Department of Health data, only 37% of women are assisted during labour and childbirth by a skilled health professional; one-third of women report being assisted by a female relative during childbirth and 7% report giving birth with no assistance at all (22). Serious birth complications, including excessive bleeding, prolonged labour, vaginal infection, fever and convulsions were reported by 43% of women in the most recent demographic and health survey (DHS) in 2006 (23). As with the MMR, the neonatal mortality rate (NMR) in PNG is high with 29 deaths per 1000 live births (23). In PNG 10% of neonates are of low birthweight (LBW); these newborn infants are particularly vulnerable and at risk of neonatal death.

Maternal and infant mortality remains a health priority in PNG (23). Current estimates

of burden are likely to be underestimated, with the majority of morbidity and mortality occurring in the rural and remote areas of PNG where they remain unreported (23). In order to strive towards improving outcomes for women and their newborn infants there is a need to understand the determinants of utilization of maternal health services, particularly in the more remote and rural locations.

The overall objective of this study was to describe the utilization of maternal health services and to examine some of the individual factors related to these trends among women in Wosera, East Sepik Province, PNG.

Methods

Study area and population

The study was conducted from June 2009 to December 2009 through the Wosera Health and Demography Surveillance System (HDSS) in the Wosera/Gawi District in East Sepik Province, PNG. The Wosera HDSS is located 75 km west-southwest of the provincial capital Wewak and is situated at 50-100 m above sea level on the large alluvial plain situated between the Torricelli Mountains in the north and the flood plain of the Sepik River in the south; it covers an area of 12 km by 16 km (24,25).

The Wosera HDSS was initially set up as part of a large Malaria Vaccine Epidemiology and Evaluation Project for PNG in the early 1990s (24,25). It started baseline investigations into malaria epidemiology and immunology in nine villages surrounding the Kunjingini Health Centre (26, 27). The value of the Malaria DSS and other health research was realized and in order to have capacity to concurrently run other studies in the area, the DSS area was rapidly expanded (28) and now comprises 30 villages with 23,000 registered inhabitants.

People in the Wosera are Abelam speakers and are predominately subsistence farmers. Health services in the area are provided through one government health centre (Wombisa), two church health subcentres (Kaugia and Kunjingini) and six government aid posts. Antenatal clinics are held once a week at the health centre and subcentres. At the time of this study, services offered at the aid post were hampered by insufficient staff and medical supplies. Poverty in the area was

and remains pronounced and the population health status is poor (29,30).

Study population

The present study examined the utilization of maternal health care services among women of reproductive age in rural PNG. The Wosera HDSS dataset was used to identify women who had given birth in the previous five years. A convenience sample of women aged between 15 and 49 years was selected for inclusion in the study. Women were interviewed in their homes by trained nursing officers using a structured questionnaire. Information relating to uptake of antenatal services, delivery and care practices of the newborn was collected.

Data processing and analysis

Socioeconomic and demographic predictors including age of the woman at interview, her educational attainment, parity and marital status were included as predictor variables in this study. The woman's age at interview was categorized into three groups. The youngest mothers were between 19 and 24 years of age at the interview and about a third of these were under 18 when they gave birth to their first child. The extent of missing dates of birth and ages of children prevented a full analysis of the women's age at time of first birth. Women's educational attainment was categorized into 'no education', '1-6 years' corresponding with primary education in PNG and '7-12 years' which corresponds to secondary education. Only one woman reported being divorced. Marital status was therefore categorized as either currently married or currently single. All women included in the study had given birth to at least one child in the last five years.

Completed questionnaires were entered into MySQL by a research assistant. Bivariate analysis using chi-squared tests of significance were employed to identify associations between the selected socioeconomic and demographic characteristics and utilization of maternal health care services. Binary logistic regression was applied to examine which characteristics best predict antenatal clinic (ANC) attendance and the use of a health care facility for childbirth. Multivariate regression was also employed to account for the relationship between the factors of interest. Estimated odds ratios with 95%

confidence intervals (CIs) are presented. All analyses were performed using Stata version 11.

Ethical approval

The Wosera HDSS operated under the PNG Institute of Medical Research (PNGIMR). All medical studies conducted within the HDSS are reviewed and approved by the IMR Internal Review Board (IRB) and the PNG Medical Research Advisory Committee (MRAC).

Results

Population demography

A total of 391 women between the ages of 15 and 49 were interviewed during the six-month period of the study; 1 was dropped in analysis due to missing data. Very few younger mothers were identified or were willing to be interviewed. The youngest woman interviewed was 19 years old. Nearly two-thirds of the women interviewed (60%) were aged between 25 and 34 years; a similar proportion (67%) had given birth to between two and five infants. More than half of the women (55%) interviewed reported having had no formal education and the majority (96%) were married (Table 1).

Uptake of antenatal care

79% (307/390) of women reported attending ANC at least once during their last pregnancy (Table 2) and two-thirds reported attending more than three times (Figure 1). Of all the women who attended ANC, 48% (148/307) stated that they knew how often they should attend ANC. Only 25% reported attending antenatal clinic in the first trimester (Figure 2). Primary level education and marriage were significantly associated with ANC clinic attendance (Tables 2 and 3). Education was also significantly associated with giving birth in a health centre. ANC clinic attendance strongly predicted the subsequent use of a health care facility for childbirth: $\chi^2 = 33.69$ (Table 2) and OR = 10.22 (CI 4.02-25.98) (Table 3). The relationship with primary education extends to the number of ANC visits a woman makes. Education and age were significantly associated with women's likelihood to have attended an ANC clinic more than three times during their pregnancy: OR 1.76 (CI 1.29-2.41) and OR 0.63 (CI 0.45-

TABLE 1

BACKGROUND SOCIODEMOGRAPHIC CHARACTERISTICS OF THE STUDY SAMPLE

Variable	Categories	Frequency (n = 390)	Percentage
Maternal age at interview (years)	19-24	35	9.0
	25-34	235	60.3
	≥35	120	30.8
Years of education	0	214	54.9
	1-6	138	35.4
	7-12	38	9.7
Marital status	Currently married	375	96.2
	Currently single	15	3.8
Parity	1	32	8.2
	2-3	126	32.3
	4-5	135	34.6
	≥6	97	24.9

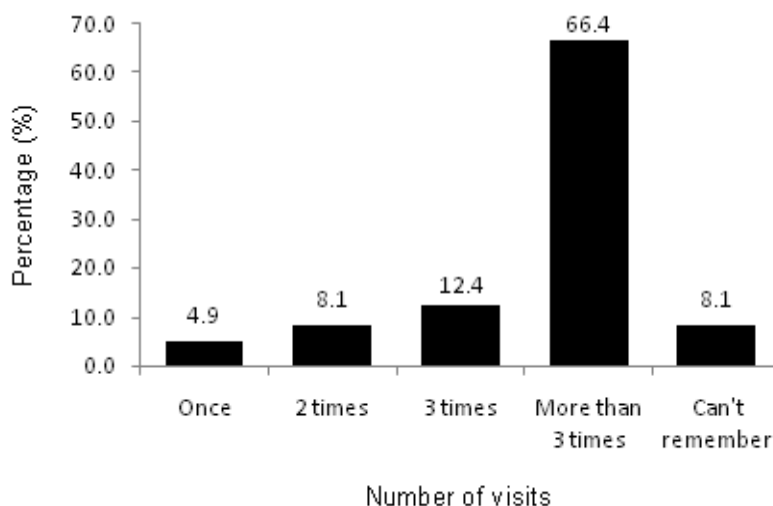


Figure 1. The number of antenatal clinic visits during the last pregnancy.

0.89), respectively.

Table 4 presents the significant predictor variables using both a bivariate analysis and a multivariate analysis of ANC attendance and delivery in a health care facility. Women's education remained an independent

predictor of maternal health care utilization in both cases and marital status remained significantly associated with ANC attendance. At least one previous visit to an ANC clinic was the strongest predictor of delivering at a health care facility while age did not reveal a significant relationship with the decision to

TABLE 2

PERCENTAGE OF WOMEN WHO HAD AT LEAST ONE BIRTH IN THE LAST FIVE YEARS PRECEDING THE SURVEY
BY ANTENATAL CARE CLINIC ATTENDANCE AND DELIVERY AT A HEALTH CARE FACILITY BY BACKGROUND
SOCIODEMOGRAPHIC CHARACTERISTICS

	Antenatal clinic attendance	Delivery at health centre
Age (years)	(1.32) ns	(3.36) ns
19-24	85.7	45.7
25-34	78.7	33.2
35+	76.7	29.2
Education (years)	(12.92)***	(35.93)***
0	72.0	22.2
1-6	87.0	40.2
7-12	86.8	68.4
Marital status	(6.00)**	(0.29) ns
Single	53.3	26.7
Married	79.7	33.3
Parity	(5.28) ns	(5.34) ns
1	65.6	45.2
2-3	82.5	36.8
4-5	76.3	26.7
6+	81.4	33.3
ANC attendance		(33.69)***
Never attended	-	6.2
Attended ANC at least once	-	40.2
Total	78.7	33.1

Note: Figures in parentheses are the chi-squared statistics

Level of significance: *p <0.10; **p <0.05; ***p <0.01

ns = not significant

ANC = antenatal clinic

seek a professionally assisted birth.

Assistance during home births

Two-thirds of all women interviewed (257/390) reported giving birth to their last infant at home. Of these 46% gave birth alone, 27% were assisted by their mother or mother-in-law and 11% were assisted by a village birth attendant (Table 5). Of all the women who delivered outside a health facility 53% had attended the antenatal clinic three

times or more (Figure 3).

Of the individual factors examined, older women and those of higher parity were more likely to give birth at home, without assistance. Our analysis also indicates that the mother's age and parity played significant predictive roles in deciding whether the mother would give birth at home without assistance.

When asked why they gave birth at home only 46% (117/257) of women gave a

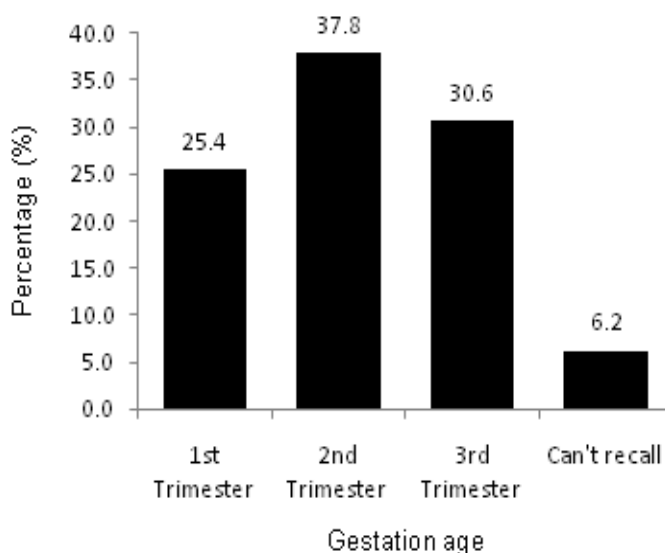


Figure 2. Women attending antenatal clinic for first time, by trimester.

TABLE 3

BIVARIATE ANALYSIS SHOWING ODDS RATIO (95% CONFIDENCE INTERVAL) FOR RECEIVING SOME ANTENATAL CARE AND FOR DELIVERING A BABY AT A HEALTH CENTRE AMONG WOMEN WHO HAVE HAD AT LEAST ONE BIRTH IN THE LAST FIVE YEARS PRECEDING THE SURVEY

	Antenatal clinic attendance Odds ratio (95% CI)	Delivery at health centre Odds ratio (95% CI)
Year of education		
0 ®	1	1
1-6	2.60*** (1.46 - 4.63)	2.36*** (1.47 - 3.77)
7-12	2.57* (0.96 - 6.90)	7.61*** (3.57 - 16.21)
Marital status		
Single ®	1	1
Married	3.93** (1.34 - 11.56)	1.25 ns (0.38 - 4.07)
ANC attendance		
Never ®	-	1
Attended ANC at least once	-	10.22*** (4.02 - 25.98)
Number of ANC visits	-	1.18 ns (0.92 - 1.50)

Note: ® Reference category

Level of significance: *p <0.10; **p <0.05; ***p <0.01

ns = not significant

ANC = antenatal clinic

TABLE 4

BIVARIATE AND MULTIVARIATE ANALYSIS OF THE DETERMINANTS OF ANTENATAL CLINIC (ANC) ATTENDANCE AND DELIVERY AT A HEALTH CARE FACILITY

	ANC attendance		Delivery at a health care facility	
	Bivariate analysis	Multivariate analysis	Bivariate analysis	Multivariate analysis
Age	0.81 ns (0.53 - 1.22)	NI	0.74* (0.52 - 1.06)	0.89 ns (0.60 - 1.32)
Education	2.02*** (1.32 - 3.11)	1.99*** (1.30 - 3.06)	2.60*** (1.87 - 3.63)	2.37*** (1.67 - 3.36)
Marital status	3.93** (1.34 - 11.56)	3.78** (1.25 - 11.44)	1.25 ns (0.38 - 4.07)	NI
Parity	1.11 ns (0.86 - 1.45)	NI	0.85 ns (0.68 - 1.08)	NI
ANC attendance	NA	NA	10.27*** (4.04 - 26.12)	9.04*** (3.50 - 23.36)

NA = not applicable

NI = not included because of non-significance

Level of significance: *p < 0.10; **p < 0.05; ***p < 0.01

ns = not significant

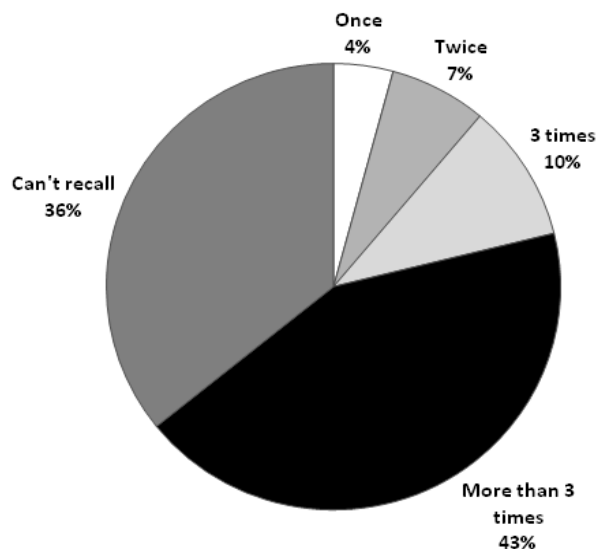


Figure 3. Percentages of deliveries outside a health facility by antenatal clinic attendance.

response. Of these women, 45 (38%) stated that the clinic was too far or they were too lazy to make the trip. A further 22 (19%) indicated that either labour came on too fast or they did not feel much pain. The issue of 'shame' arose in only 9 (8%) of the responses. This referred to either the shame of being a single

mother or because a male nurse was present at the health centre.

Discussion

The study found that while there was high attendance at antenatal clinics, only one-third

TABLE 5

BIVARIATE ANALYSIS SHOWING ODDS RATIO (95% CONFIDENCE INTERVAL) FOR TYPES OF ASSISTANCE DURING HOME DELIVERIES

	No assistance/self n = 117	Mother/mother-in-law n = 69	VBA n = 27	Friend n = 44
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age at interview (years)				
15-24 ®	1	1	1	1
26-34	3.68** (1.09 - 12.45)	1.28 ns (0.50 - 3.26)	0.72 ns (0.23 - 2.25)	0.55 ns (0.21 - 1.47)
≥35	8.73*** (2.53 - 30.06)	0.64 ns (0.23 - 1.81)	0.20** (0.04 - 0.94)	0.64 ns (0.23 - 1.81)
Mother's education				
None ®	1	1	1	1
Primary	0.58** (0.36 - 0.93)	0.62* (0.35 - 1.09)	1.74 ns (0.77 - 3.94)	0.63 ns (0.32 - 1.26)
Secondary	0.33** (0.13 - 0.83)	0.31* (0.09 - 1.06)	0.93 ns (0.20 - 4.33)	0.17* (0.02 - 1.25)
Marital status				
Single ®	1	1	1	1
Married	5.38 ns (0.69 - 41.82)	0.71 ns (0.19 - 2.66)	0.89 ns (0.11 - 7.15)	0.69 ns (0.15 - 3.24)
Parity				
1 ®	1	1	1	1
2-3	2.95 ns (0.65 - 13.34)	0.81 ns (0.34 - 1.93)	1.50 ns (0.32 - 7.10)	1.14 ns (0.36 - 3.65)
4-5	8.28*** (1.90 - 36.12)	0.52 ns (0.21 - 1.27)	1.79 ns (0.38 - 8.31)	0.91 ns (0.28 - 2.94)
≥6	15.50*** (3.51 - 68.42)	0.28** (0.10 - 0.77)	0	0.66 ns (0.19 - 2.35)
ANC				
Never ®	1	1	1	1
Attended ANC at least once	0.35*** (0.21 - 0.59)	0.59* (0.33 - 1.07)	0.75 ns (0.31 - 1.84)	0.90 ns (0.43 - 1.91)

VBA = village birth attendant

Note: ® Reference category

Level of significance: *p < 0.10; **p < 0.05; ***p < 0.01

ns = not significant

ANC = antenatal clinic

of women returned to the health facility to give birth. For the women who attended the ANC but delivered outside a facility, most had attended antenatal clinic three times or more. Attendance at the antenatal clinic was likely to be influenced by the mother's educational level, marital status and parity. These findings are similar to those reported elsewhere in PNG that indicate that women attend antenatal care as a means of ensuring that all is well with the pregnancy, and that once antenatal care has been initiated women do tend to return for further visits (31,32).

Within this study population 66% of all births took place at home, findings that reflect national data for supervised deliveries (23). This emphasizes the need for health care workers in antenatal clinics to focus on assisting women to understand the critical importance of facility-based supervised births. Attending ANC clinics was the strongest predictor of giving birth in a health facility, followed by the years of education attained by the mother. Marriage played a significant role in ANC attendance but was not significantly associated with delivery at a health facility. This raises questions about the role of the husband in decisions made to visit clinics for antenatal care but not for the birth. Future research should examine the husband's perspective on health facilities as well as his background characteristics such as educational attainment.

Women who gave a reason for giving birth at home mostly stated that distance (from home to the health facility) was a barrier to their health-care-seeking behaviour; shame at being cared for by a male health care worker was also mentioned. Other studies both from PNG and in the international literature have identified similar findings; other factors that play important roles include road quality, transport availability, cultural barriers (16,31-34) and a lack of perception by both health workers and women of the dangers of home birth and how even a first-level health centre can have a significant impact on preventing both maternal and neonatal death.

This retrospective study has a number of limitations worth noting. Firstly, recall bias may have influenced the responses from women. Those who had given birth more recently or those who had experienced problems during their pregnancy or childbirth may be more accurately able to recall events. In reality it

may be difficult for a woman to remember whether she attended antenatal clinic three or four times. Secondly, convenience sampling was conducted to select the 391 women included in the study presented here. Largely due to cultural attitudes about young and single mothers no women under the age of 19 were interviewed. This age group is likely to be at particular risk of under-utilization of maternal services. Furthermore, due to the small sample size in this study the survey did not collect information on birth or infant health outcomes. Such information would have added substantially to our analyses and provided some indication of the extent of protection afforded by maternal services in Wosera.

Lastly, women who gave birth at home were asked about their reasons for not using a health centre. Many women did not answer this open-ended question and this may have biased our analysis. A more in-depth qualitative study of women in this region may be warranted. Educational attainment is particularly low in this sample and a better understanding about the motivations and barriers experienced in this community may help to develop better services and more appropriate health messages about the importance of supervised births.

Conclusions

This study provides important information relating to the utilization of maternal health care services in this setting. While the results suggest that women appear to be aware of available antenatal services they do not utilize them to maximum benefit, especially at the time of birth. While it could be argued that there is a need for further in-depth research in this area, especially in relation to the reasons why women do or do not utilize maternal health services to give birth, this study does highlight several policy-relevant issues that could be addressed within the current health system. Initial contact with the health care workers at the antenatal clinic needs to be utilized to its full potential. This opportunity needs to be seized by the health care workers to educate the mothers about the potential dangers associated with childbirth, especially in the community setting, and the need for birth planning with particular attention to distance to health facilities and access and availability of transport. In addition health care workers need to be considerate of the

educational level and cultural and traditional beliefs of women in their care and provide care and advice appropriate to the individual's needs.

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Poor weight gain in late third trimester: a predictor of poor perinatal outcome for term deliveries?

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SUMMARY

In many parts of the world weighing women in antenatal clinics is no longer thought to be important. At Port Moresby General Hospital we noticed that failure to gain weight in the third trimester (or weight loss) was associated with poor perinatal outcomes. To investigate this issue we designed a prospective case-control study to determine whether poor weight gain in the third trimester is a useful clinical indicator of poor placental function by being associated with intrauterine growth restriction (IUGR) or inadequate placental function in labour by being significantly associated with suspected intrapartum fetal compromise, birth asphyxia, meconium aspiration syndrome and neonatal intensive care unit admission. We found that a failure to gain weight for more than three weeks preceding the onset of labour was significantly associated with intrapartum fetal compromise (OR 2.24), IUGR (OR 2.88), meconium aspiration syndrome (OR 4.19), the presence of thick meconium or the passage of meconium during labour (OR 2.26) and the need for admission to the neonatal intensive care unit for more than 24 hours (OR 2.22). Weighing women in the antenatal clinic setting is a useful way of screening for deteriorating or inadequate placental function, and is particularly relevant in settings where more sophisticated modalities of screening and diagnosis of placental function are not available.

Introduction

Antenatal care was introduced in the United Kingdom after World War 1: it was one of the first public health intervention programs. Early antenatal care was somewhat mechanistic. From the beginning monitoring of maternal weight was an integral part of the antenatal care consultation. By the 1960s expected weight gain in a normal pregnancy was defined and accepted as 9-12 kg. Subsequently in the sixties and seventies much research was done on deviations from 'normal' maternal weight gain in pregnancy and it was shown that static or decreasing maternal weight or abdominal fundal height in late pregnancy could be alerting signs to the possibility of placental insufficiency (1).

In developed countries many antenatal

care providers have discontinued repeated weighing of pregnant women. The reasons for this are various. Studies have shown that about 1 in 5 pregnant women in western countries are obese (2,3); overweight women undergo weight fluctuations for a variety of reasons and under these circumstances it can be difficult to separate the role of the pregnancy in the cause of weight trends. Consequently, in the overweight woman, lack of maternal weight gain loses its relevance as an alerting factor for poor or deteriorating placental function (4). It has also been suggested that regular weighing may cause unnecessary anxiety and therefore should cease (5). The developed country consensus is that a wide range of maternal weight gain in pregnancy is compatible with good clinical outcomes and that departure from 'normal' is nonspecific and not a very useful predictor of

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risk for any adverse effect in an individual (1,6). There is even a view espoused by some that overweight problems are a disability like other physical challenges such as sight and hearing impairment (2,7).

On the other hand in most parts of the developing world (particularly in rural districts) most women are not overweight; indeed many women begin pregnancy with very low body weight. Moreover, in developing countries problems associated with low maternal weight and weight loss such as tuberculosis, human immunodeficiency virus (HIV) infection, hyperreactive malarious splenomegaly, worm infection and severe anaemia are common. Heavy physical work has also been associated with poor weight gain in pregnancy (8). All these problems are common in women attending the Port Moresby General Hospital and other urban clinics in the National Capital District of Papua New Guinea (PNG) (9). For all these reasons weighing women has significant clinical value.

Many studies have established that low booking maternal weight is a predictor of poor pregnancy outcome. It has been observed to be an effective screening method for detection of small for gestational age infants (4,10-12). Very low maternal weight is associated with increased rates of perinatal mortality and morbidity (13). However, the issue of failure to gain weight in the third trimester has received little attention in the medical literature.

In a resource-rich setting there are usually a range of sensitive and specific tools, such as the capacity to make detailed measurements of the fetus and monitor growth and liquor volume by ultrasound, antenatal cardiotocography (CTG) assessment and Doppler flow studies of the umbilical and fetal middle cerebral arteries, for the diagnosis of placental function deterioration and failure. Such monitoring modalities are rarely available in developing countries. A simple monitoring tool like maternal weight monitoring could be very useful if it was found to be significantly associated with poor or deteriorating placental function.

Elder et al. in 1970 (14) evaluated the association between maternal weight and abdominal size change in late pregnancy and placental insufficiency. When static or decreasing maternal weight and girth were recorded, fetal distress occurred in 23% of

the babies with intrauterine growth restriction (IUGR) and 8% of the babies with normal birthweights for gestation.

At Port Moresby General Hospital (PMGH) the booked perinatal mortality rate (PMR) is about 20/1000 births. About 40% of perinatal deaths are typically classified as deaths due to placental function issues from 'unknown' causes; 31% of perinatal deaths are term and 69% are low-birthweight preterm babies (9,15). Given the limited facilities in PNG to assess placental function antenatally it was decided to perform this study to determine whether a failure of maternal weight gain in the last few weeks of pregnancy is a useful predictor of increased perinatal risk.

Methods

Objective

The objective of this study was to determine whether failure to gain weight (ie, static weight) or weight loss in the late third trimester is associated with subsequent diagnosis of suspected fetal compromise (ominous cardiotocography, thick meconium) or poor perinatal outcome (intrauterine growth restriction, neonatal morbidity and perinatal mortality) in otherwise normal pregnancies.

Study design

This was a case-control study. For each mother who either failed to gain weight or lost weight in the late third trimester a control was selected by choosing the next woman who came for delivery in the same service who had 'normal weight gain' in the late third trimester.

Sample population and recruitment

Women were recruited from 01 January 2007 to 31 December 2008. The recruitment was done when the women presented to the labour ward in labour. All the women recruited had completed 37 weeks of gestation.

The cases were women who had either failed to gain weight or lost weight in the preceding three visits to the antenatal clinic before delivery according to the definition stated below. The controls were women who did not have static or decreasing weight in the three visits preceding delivery and were therefore considered to have had 'normal' late third trimester weight gain.

The study was set up to mimic real-life health care scenarios in developing countries: women were eligible regardless of when they booked, whether or not they had an ultrasound scan in the first trimester or the type of foot scales that had been used to weigh them (the standard error of the typical foot scale is ± 1 kg).

Inclusion criteria

- booked at Port Moresby city antenatal clinics before 34 completed weeks of gestation
- have a singleton pregnancy
- attended antenatal clinics five times or more
- reached 37 completed weeks of gestation and had a 'normal' pregnancy (according to their antenatal care providers) with maternal weights recorded at all their antenatal visits.

Exclusion criteria

- premature labour and delivery (ie, before 37 completed weeks of gestation)
- medical conditions associated with IUGR and poor perinatal outcome, such as hypertensive diseases, preeclampsia, diabetes mellitus, gestational diabetes, collagen vascular diseases (such as systemic lupus erythematosus (SLE) and thrombophilias), chronic renal disease, all types of congenital heart disease
- antepartum haemorrhage secondary to placenta praevia or abruption
- obstetric conditions such as cord prolapse, obstructed labour, birth trauma, intrauterine infections and uncertain dates.

Data sources and recording

The data sources were interviews with the subject and the subject's antenatal, labour delivery and neonatal record. The information was recorded in a standardized pretested questionnaire (data collection sheets).

The women who were selected had their antenatal data collated by interview, and

information extracted from their antenatal records and recorded in the data collection sheets; delivery details and information concerning the neonate were added later.

Clinic nurses weighed the women on foot scales in their street clothes but without shoes, as is the usual practice in PNG antenatal clinics. Fundal height measurements were made using a cloth tape measure and measuring from the upper border of the symphysis pubis to the top of the uterine fundus.

Variables

The independent variable was failure to gain weight (static weight) or weight loss in the late third trimester. Outcome variables were suspected fetal distress in labour (interpreted by the duty consultant obstetrician), the passage of meconium in the first stage of labour, and conditions associated with perinatal outcome, including the following: IUGR, stillbirth, Apgar score, special care nursery (SCN) admission, duration of SCN admission, neonatal morbidity and early neonatal death.

Definition of terms

Late third trimester is after 34 completed weeks of gestation to delivery.

Estimation of gestation was assessed from the date of the last menstrual period, sometimes supported or modified by early scans (<20 weeks) or best clinical estimate based on fundal height at first visit and quickening history. Further assessment was done using Dubowitz score assessment after delivery; the Dubowitz score was accepted to indicate the true gestation of the infant if the Dubowitz score was at variance with the clinical dating of the pregnancy by more than 2 weeks.

Static weight or failure to gain weight was considered to be present when the woman was found to have the same or declining weight on three or more consecutive visits after 34 weeks, while accepting a standard error of ± 1 kg.

Weight loss was considered to be present when weight at two or more consecutive visits was less by more than 1 kg.

Static or diminishing fundal height was

considered to be present when the same or a diminishing fundal height measurement was recorded (using a tape measure reading from the symphysis pubis to the top of the fundus) on three or more consecutive visits after 34 weeks. Significantly discrepant fundal height at delivery was defined as being >3 cm less than that expected from the gestational age.

An IUGR baby was a neonate born at term weighing less than 2.5 kg. Although there are no gestational-age-adjusted percentile graphs for the various genetic groups in PNG, 2.5 kg is less than 2 standard deviations below the mean birth weight (3.2 kg) of babies born at PMGH.

Prolonged labour was defined as a labour where the progress of labour graph crossed the 'action line' on the standard PMGH partograph – the action line is drawn 4 cm down from the plot of the cervix when the woman is first found to be in the active phase of labour.

Suspected fetal compromise was considered if the following were present in labour:

- Suspected fetal compromise was diagnosed according to the assessment of the duty obstetrician (CTGs were available in the labour ward for some of the time during this study).
- Thick meconium (mec++) at any time, or the passage of meconium during the labour as noted on the birth record.

Poor perinatal outcome was considered if the following were present:

- IUGR
- Low Apgar (Apgar score of less than 7 at 5 minutes)
- Diagnosis of meconium aspiration or birth asphyxia by the paediatric team in the SCN
- Stillbirth
- Early neonatal death (ENND).

Data analysis

Univariate analyses were performed with

the Epi Info version 3.4.3 statistical package. The means of continuous variables were compared by the Kruskal–Wallis H test whilst frequencies of categorical variables were compared by the Mantel-Haenszel chi-squared test and odds ratio. Differences were taken as significant if the p value was <0.05 or the 95% confidence interval of the odds ratio did not include 1.

Results

During the study period a total of 700 pregnant women who fulfilled the criteria for poor weight gain were seen at the antenatal clinic. Of these, 593 women were enrolled and 107 (15%) excluded, most (n = 63) because they were premature births; 27 had incompletely filled questionnaires by the research assistants, 6 had their charts misplaced and 11 absconded before the questionnaires were completed.

A total of 1186 pregnancies and their outcomes were analysed (593 cases and 593 controls).

Sociodemographic and antecedent characteristics

Table 1 shows the sociodemographic characteristics of the women with poor weight gain and those with normal weight gain. There were no significant differences between the cases and the controls with regard to marital status, home ownership, husband's region of origin, maternal formal level of education, maternal employment, type of maternal employment and fortnightly income.

Antenatal, labour and maternal anthropometric characteristics

Table 2 shows antenatal, labour and delivery and anthropometric characteristics of study participants. There was no difference between cases and controls for parity, whether pregnancy was planned or unplanned, maternal height, whether the amniotic membranes were ruptured artificially or spontaneously, maternal haemoglobin, maternal syphilis serology or HIV status, duration of active and second stage of labour, action line crossed in labour or the mode of delivery.

Mean maternal booking weight was significantly greater among cases than

TABLE 1

SOCIODEMOGRAPHIC CHARACTERISTICS OF CASES AND CONTROLS

Characteristics		Cases (N = 593) n (%)	Controls (N = 593) n (%)	Odds ratio (95% CI)	p value
Maternal age*		26.6 ± 5.7	25 ± 5.4		0.015
Marital status	Married	571 (96.3)	571 (96.3)	1.00 (0.53-1.90)	1.0
Maternal origin	Highlands	156 (26.3)	185 (31.2)	0.79 (0.61-1.02)	0.06
	Islands	29 (4.9)	30 (5.1)	0.96 (0.55-1.68)	0.9
	Momase	48 (8.1)	55 (9.3)	0.86 (0.56-1.32)	0.7
	Southern	360 (60.7)	323 (54.5)	1.29 (1.02-1.64)	0.03
Residency	Urban	220 (37.1)	261 (44.0)	0.75 (0.59-0.95)	0.01
	Slum	251 (42.3)	210 (35.4)	1.34 (1.05-1.70)	0.014
	Village	122 (20.6)	122 (20.6)	1.02 (0.76-1.37)	0.9
House	Own	341 (57.5)	253 (51.4)	0.91 (0.72-1.16)	0.44
	Relatives	252 (42.5)	239 (48.6)	1.09 (0.86-1.39)	0.44
Formal education	Nil	73 (12.3)	54 (9.1)	1.40 (0.95-2.07)	0.07
	Primary	273 (46.0)	256 (43.2)	1.12 (0.89-1.42)	0.3
	Secondary	210 (35.4)	228 (38.4)	0.88 (0.69-1.12)	0.3
	Tertiary	37 (6.2)	55 (9.3)	0.65 (0.41-1.03)	0.05
Formal employment	Employed	104 (17.5)	97 (16.4)	1.09 (0.86-1.39)	0.59
	Housewife	432 (72.8)	431 (72.9)	1.01 (0.77-1.31)	0.9
	Unemployed	57 (9.6)	63 (10.7)	0.89 (0.60-1.33)	0.65
Type of employment**	Skilled	42/98 (42.9)	41/97 (42.3)	1.19 (0.66-2.16)	0.56
	Semi-skilled	25/98 (25.5)	26/97 (26.8)	0.88 (0.44-1.73)	0.6
	Unskilled	31/98 (31.6)	30/97 (30.9)	0.92 (0.48-1.74)	0.7
Paternal employment	Employed	373 (64.5)	410 (71.2)	0.76 (0.59-0.97)	0.02
	Unemployed	205 (35.5)	166 (28.8)	1.36 (1.05-1.75)	0.01
Subsistence living		138 (23.3)	95 (16.0)	1.50 (1.18-2.15)	0.001
Family income per fortnight	<K200.00	270 (45.5)	244 (41.3)	1.20 (0.94-1.51)	0.1
	K200-K600	228 (38.4)	242 (40.9)	0.91 (0.71-1.15)	0.4
	>K600.00	95 (16.0)	105 (17.8)	0.89 (0.65-1.22)	0.36

CI = confidence interval

p value obtained for continuous variable using the Kruskal-Wallis H test and for categorical variables using the Mantel-Haenszel chi-squared test

*Continuous variable means compared using the Kruskal-Wallis H test (mean ± standard deviation)

** Total number in the denominator in analyses for the employment type was only for those employed and not the overall total

controls (64.7 ± 12.6 kg vs 62.4 ± 11.3 kg; $p < 0.001$); likewise the mean booking maternal body mass index (BMI) for the cases was greater than controls (25.3 ± 4.5 vs 24.5 ± 4.5 ; $p = 0.003$).

Mean maternal weight gain among cases was significantly less than in controls (4.9 ± 4.6 kg vs 7.6 ± 4.6 kg; $p < 0.001$). Mean maternal BMI at delivery was significantly less among cases than controls (26.8 ± 4.6 vs 27.4 ± 4.9 ; $p = 0.03$). Mean birthweight of babies born to cases was significantly less than that of those born to controls (3028 ± 500 g vs 3152 ± 441 g; $p = 0.002$).

Poor maternal weight gain in the late third trimester was significantly associated with decreasing fundal height (OR 6.04, 95%CI: 4.44-8.22), fundal height significantly less than that expected from the gestational age at delivery (OR 2.21, 95%CI: 1.70-2.86) and delivery at gestational age between 40 and 41 weeks (OR 1.38, 95%CI: 1.08-1.77).

Significantly more of the women with poor weight gain in the late third trimester were from the Southern Region (OR 1.29, 95%CI: 1.02-1.64) or from urban squatter settlements (OR 1.34, 95%CI: 1.05-1.70), and significantly fewer of them were permanent residents of the city (OR 0.75, 95%CI: 0.59-0.95). Women with poor weight gain were more likely to have husbands who were unemployed (OR 1.36, 95%CI: 1.05-1.75) or to have a subsistence lifestyle (OR 1.50, 95%CI: 1.18-2.15).

Women with poor weight gain were less likely to have latent phase of labour greater than 8 hours (OR 0.50, 95%CI: 0.35-0.68), to deliver at a younger gestational age (OR 0.71, 95%CI: 0.56-0.91) or to have their labours augmented with oxytocin (OR 0.72, 95%CI: 0.53-0.98).

Outcome variables

Table 3 compares suspected fetal distress and perinatal outcome in cases and controls. There was a significantly higher frequency of suspected fetal distress in labour and thick meconium staining (both in the first stage of labour and on delivery) among the women who had poor weight gain than among those who gained weight normally.

Women with poor weight gain were significantly more likely to have intrauterine

growth restriction (OR 2.88, 95%CI: 1.83-4.75), to deliver an infant with an Apgar score of less than 7 at 5 minutes (OR 2.57, 95%CI: 1.38-4.33), to have an infant requiring admission to SCN (OR 2.42, 95%CI: 1.67-3.53) or to deliver an infant with meconium aspiration syndrome (OR 4.19, 95%CI: 1.73-10.60).

There were no significant differences between cases and controls with regard to perinatal death (2.9% vs 1.7%; $p = 0.20$), stillbirth (1.7% vs 0.8%; $p = 0.20$), birth asphyxia (2.2% vs 1.5%; $p = 0.38$) or early neonatal death (1.2% vs 0.9%; $p = 0.24$).

Discussion

In this study we excluded all mothers with conditions known to be associated with poor placental function and also such conditions that can challenge a normally functioning placenta such as maternal infection and birth trauma. In short, this study concentrates on apparently normal pregnant women.

In our setting the capacity to investigate for poor placental function is limited: high patient turnover and a shortage of midwives sometimes does not allow us the time or privilege to carefully monitor them. This study was done to see if weight gain in the last few weeks of pregnancy as a screening tool can identify pregnancies at risk.

The study was modelled on the study done by Elder and associates in 1970 (14). They studied the association between maternal weight and abdominal size changes in late pregnancy and placental insufficiency in apparently normal pregnant women. They demonstrated that IUGR occurred in 15% of women who failed to gain weight or lost weight versus 5% of those who had a normal weight gain, and fetal distress occurred in 12% of the women who failed to gain weight or lost weight versus 7% of those who had a normal weight gain. However, with that study none of the associations were considered significant on statistical analysis.

A limitation of this study was accurate measurement of maternal weight. It was not feasible to use calibrated and standardized weighing scales since these types of scales are not available routinely in antenatal clinics in PNG; this is also the case in most other developing countries. For this reason

TABLE 2

ANTENATAL, LABOUR AND MATERNAL ANTHROPOMETRIC CHARACTERISTICS

Characteristic	Poor weight gain n (%)	Normal weight gain n (%)	Odds ratio (95% CI)	p value
Parity*	1.5 ± 1.5	1.3 ± 1.4		0.7
Unplanned pregnancy	137 (23.1)	127 (21.4)	1.10 (0.83-1.46)	0.5
Clinic attended:				
NCD urban health centre	391 (65.9)	341 (57.5)	1.43 (1.12-1.82)	0.03
PMGH	157 (26.5)	209 (35.2)	0.66 (0.51-0.85)	0.001
Referred	45 (7.6)	43 (7.3)	1.05 (0.67-1.66)	0.82
Gestational age at delivery:				
37-39 weeks	306 (51.6)	359 (60.5)	0.71 (0.56-0.91)	0.004
40-41 weeks	236 (39.8)	190 (32.0)	1.38 (1.08-1.77)	0.008
≥42 weeks	51 (8.6)	44 (7.1)	1.12 (0.72-1.74)	0.6
Fundal height decrease or static in the third trimester	265 (44.7)	70 (11.5)	6.04 (4.44-8.22)	<0.001
Fundal height <GA at delivery	226 (38.1)	129 (21.8)	2.21 (1.70-2.86)	<0.001
Positive syphilis serology	18 (3.0)	22 (3.7)	1.27 (0.65-2.50)	0.46
HIV positive	4 (0.7)	2 (0.3)	0.47 (0.06-3.01)	0.38
Maternal haemoglobin g/dl*	10.4 ± 1.7	10.0 ± 2.9		0.45
Membranes:				
ARM	404 (68.1)	383 (64.6)	1.17 (0.91-1.50)	0.19
SRM	189 (31.9)	210 (35.4)	0.85 (0.67-1.09)	0.19
ROM to delivery interval*	5.0 ± 6.9	5.5 ± 7.6		0.17
Augmentation (oxytocin)	93 (15.7)	122 (20.6)	0.72 (0.53-0.98)	0.03
Latent phase >8 hours	78 (13.2)	126 (21.7)	0.50 (0.35-0.68)	<0.001
Active phase >4 hours	157 (26.5)	162 (27.5)	0.93 (0.71-1.21)	0.5
Second stage >1 hour	34 (5.7)	38 (6.4)	0.89 (0.54-1.47)	0.4
Action line crossed	51 (8.6)	59 (9.9)	0.85 (0.56-1.28)	0.4
Delivery:				
Assisted	24 (4.0)	25 (4.2)	0.96 (0.52-1.76)	0.9
Caesarean	44 (7.4)	43 (7.3)	1.03 (0.60-1.62)	1.0
SVD	525 (88.5)	521 (87.9)	1.07 (0.74-1.54)	0.9
Birthweight g*	3028 ± 500	3152 ± 441		0.002
Maternal height cm*	159.8 ± 6.6	160.4 ± 6.5		0.1
Booking weight kg*	64.7 ± 12.6	62.4 ± 11.3		<0.001
Total weight gained kg*	4.9 ± 4.6	7.6 ± 4.6		<0.001

Booking BMI*	25.3 ± 4.5	24.5 ± 4.5		0.003
BMI on delivery*	26.8 ± 4.6	27.4 ± 4.9		0.03
BMI not increased	107 (18.0)	4 (0.7)	32.42 (11.4-104.0)	<0.001

CI = confidence interval

p value obtained for continuous variables using the Kruskal-Wallis H test and for categorical variables using the Mantel-Haenszel chi-squared test

*Continuous variable means compared using the Kruskal-Wallis H test (mean ± standard deviation)

NCD = National Capital District

PMGH = Port Moresby General Hospital

GA = gestational age

HIV = human immunodeficiency virus

ARM = artificial rupture of membranes

SRM = spontaneous rupture of membranes

ROM = rupture of membranes

SVD = spontaneous vaginal delivery

BMI = body mass index

TABLE 3

SUSPECTED FETAL COMPROMISE AND PERINATAL OUTCOME

Perinatal outcome	Poor weight (N = 593) n (%)	Normal weight (N = 593) n (%)	Odds ratio (95% CI)	p value
Perinatal death	17 (2.9)	10 (1.7)	1.72 (0.74-4.07)	0.20
Total stillbirth	10 (1.7)	5 (0.8)	2.02 (0.63-6.81)	0.20
Fresh stillbirth	3 (0.5)	2 (0.3)	1.50 (0.30-12.86)	0.65
Macerated stillbirth	7 (1.2)	3 (0.5)	2.35 (0.55-11.50)	0.20
Thick meconium or passage of meconium in the first stage of labour	102 (17.2)	50 (8.4)	2.26 (1.90-3.53)	<0.001
Suspected fetal distress	82 (13.8)	40 (6.7)	2.24 (1.48-3.39)	<0.001
Thick meconium on delivery	171 (28.8)	80 (13.5)	2.60 (1.19-3.53)	<0.001
IUGR (<2500 g)	79 (13.3)	30 (5.1)	2.88 (1.83-4.75)	<0.001
	(n = 583) [†]	(n = 588) [†]		
Apgar score <7 at 5 minutes	46 (7.9)	19 (3.2)	2.57 (1.38-4.33)	<0.001
SCN admission	113 (19.4)	47 (8.0)	2.42 (1.67-3.53)	<0.001
SCN admission >24 hours	64 (11.0)	30 (5.1)	2.22 (1.40-3.53)	<0.001
Meconium aspiration syndrome	29 (5.0)	7 (1.2)	4.19 (1.73-10.60)	<0.001
Birth asphyxia	13 (2.2)	9 (1.5)	1.47 (0.58-3.75)	0.38
ENND	7 (1.2)	5 (0.9)	2.03 (0.55-8.05)	0.24

CI = confidence interval

p value obtained using the Mantel-Haenszel chi-squared test

[†] The total cases of 583 and controls of 588 exclude the number of stillbirths

IUGR = intrauterine growth restriction

SCN = special care nursery

ENND = early neonatal death

the size of the study was augmented and a large weight deficit (>1 kg) or failure to gain weight over three antenatal visits were used as the criteria for defining poor weight gain. As such, however, this limitation reflects the reality of antenatal care practice in developing countries. Another important limitation is the lack of statistical analysis capacity in-country, which meant that it was not possible to conduct multivariate analysis.

Our study has shown that failure to gain weight or weight loss late in the third trimester is significantly associated with intrauterine growth restriction.

Suspicion of fetal distress by ominous cardiotocography, the presence of thick meconium or the passage of meconium in labour were significantly more frequent among women with a history of poor weight gain. The presence of significant meconium associated with intrauterine hypoxia leads to meconium aspiration syndrome, which is the commonest cause of early neonatal death in term infants at PMGH (16).

Other indicators of poor condition of the infant at birth such as low 5-minute Apgar score and the need for special care nursery admission for more than 24 hours were also more common in women with poor weight gain than in women who had normal weight gain.

The study did not demonstrate any significant association between poor weight gain and perinatal mortality, stillbirth (both fresh and macerated) or early neonatal death. However, there was a small increase in perinatal deaths in women who had poor weight gain compared to those who gained weight normally. A larger study population may be required to fully test this association.

It is not entirely clear why women with poor weight gain in pregnancy were less likely to be augmented in labour or to have a prolonged latent phase of labour; however, it may be that the team looking after these women in labour were more hesitant to allow labour to be prolonged or to augment contractions because of concern for the well-being of the fetus in labour.

We are not able to explain why it was that the women who had poor weight gain in this study had significantly greater booking

weights and BMIs than the control group; however, the lack of increase in the BMI in the poor weight group was quite dramatic.

Maternal pre-pregnancy weight and weight gain in pregnancy both independently influence the birthweight of babies (1). A significant proportion (about 50%) of the weight increase, namely fluid retention, amniotic fluid, blood volume and placenta, can be physiologically linked to fetal well-being.

Blood volume expansion increases uteroplacental circulation and placental perfusion (1,17,18). A failure of maternal fluid accumulation and blood volume expansion results in poor placental perfusion and reduced fetal growth. It is well documented that this occurs commonly in pregnancies complicated by hypertensive disorders or vascular disease and results in a number of poor perinatal outcomes, including IUGR, neonatal morbidity or death (17,18).

Good placentation in pregnancy is necessary for adequate maternal fluid and blood volume expansion. Associations between poor placentation and suboptimal maternal volume expansion, increased vascular reactivity and 'flat' glucose tolerance have been described (17). Abnormal placental development is a relatively common problem affecting about a third of patients with IUGR or about 3% of all pregnancies (17). Placental dysfunction affects several aspects of maternal adaptation to pregnancy.

Investigators who studied the prognostic significance of poor maternal weight gain in late pregnancies complicated by hypertension found significant associations between poor weight gain and light-for-dates babies and perinatal loss (14,19).

Placentas with abnormal development may further deteriorate towards term and may not meet the demands of the growing fetus. Amniotic volume also reduces as pregnancy advances. However, morbid oligohydramnios is usually a reflection of poor fetal urine production, which, in turn, is caused by a reduced cardiac output in the fetus leading to reduced renal perfusion (18). A vicious circle can develop with oligohydramnios causing cord compression, resulting in further hypoxia, oligohydramnios and fetal heart rate abnormalities. Under these circumstances, fetal hypoxaemia may induce relaxation

of the fetal anal sphincter and passage of meconium. Intrauterine hypoxia leading to meconium aspiration and/or birth asphyxia may result.

Conclusion

This study demonstrates that poor maternal weight gain in late pregnancy increases the likelihood of IUGR, fetal compromise in labour and other indicators of poor neonatal outcome such as low Apgar score at 5 minutes, the need for SCN admission for >24 hours and meconium aspiration syndrome.

A simple definition of poor weight gain, namely failure to gain weight on three successive occasions or weight loss of more than 1 kg on two successive visits is sufficient to identify a risk of poor perinatal outcome.

Antenatal clinics should carefully weigh women at every visit and nurses should refer women to a doctor or to the nearest hospital if a woman fulfils these criteria for poor weight gain. Monitoring maternal weight is a simple, cheap and practical screen for poor placental function.

Close observation of maternal weight and proactive intervention (admission for more detailed assessment and planned delivery) may save babies from poor neonatal outcomes: in fact this is what happens in western countries when deteriorating placental function is diagnosed with sophisticated tools such as umbilical artery and middle cerebral Doppler flow studies. Poor maternal weight gain can also serve to alert those who are responsible for monitoring the fetus in labour of the need for more intensive fetal surveillance in labour.

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Operative vaginal delivery at Port Moresby General Hospital from 1977 to 2010

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SUMMARY

This paper presents 35 years of history of operative vaginal delivery at the Port Moresby General Hospital (PMGH). From the early 1970s when Dr G.C. Bird was appointed as Head of Obstetrics at PMGH, vacuum extraction has been the preferred method of assisted vaginal delivery. In the early 1970s, Dr Bird began to experiment with more effective configurations of the then standard metal Malmstrom vacuum extraction cup: the Bird anterior cup was introduced in 1973 and the posterior cup in 1974. These modifications to the vacuum extractor cup allowed for more effective placement of the cup on the flexion point on the fetal head thereby facilitating more successful vacuum-assisted delivery. Between 1977 and 2010 there were a total of 11,458 vacuum extractions (average rate 3.9%) performed, with an average failure rate of 2.5%. During the same period there were 565 vaginal forceps deliveries (rate 0.2%), 11,550 caesarean sections (rate 3.9%) and 182 symphysiotomies (all for failed vacuum extraction procedures) performed. Over the period trends that are noted include a slowly rising caesarean section rate from 2% in the 1970s to nearly 5% in the current decade. Over the same period the assisted vaginal delivery rate has dropped from 10-15% in the 1970s to 3-4% since 2000. The combined fresh stillbirth and early neonatal mortality rate for infants ≥ 1.5 kg and ≥ 2.5 kg for the period was 11.3/1000 and 9.5/1000 respectively, and compares to a combined fresh stillbirth and early neonatal mortality rate of 8.7/1000 for assisted vaginal delivery.

Introduction

Assisted (or 'operative') vaginal delivery (AVD) when a fetus presents by the vertex may be advised in the following situations:

- i. a woman is unable to safely deliver her baby by maternal effort alone, or
- ii. it is inadvisable for her to make substantial expulsive efforts, or
- iii. it is necessary to expedite vaginal delivery because of suspected fetal compromise ('fetal distress').

The means of assistance available are obstetrical forceps or the vacuum extractor (ventouse); symphysiotomy is occasionally

employed in addition if there is some degree of cephalopelvic disproportion preventing easy delivery of the head.

For the past 50 years English-speaking developed country rates of AVD have remained static at about 10% (1-4). The reasons for continuing high rates of assisted vaginal delivery in some western countries include the extensive use of epidural analgesia in labour, allowing the second stage to go on for longer periods of time leading to maternal exhaustion, and the trend not to allow 'organized' expulsive efforts to help women deliver. However, in many parts of the world AVD rates have fallen to less than 1% (5). In some developed countries dropping AVD rates have largely been driven by 'consumerism' in the community and medico-legal concerns on

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the part of doctors (6,7), whereas very low rates of AVD in developing countries often reflects deskilling of the medical workforce (7,8).

Recently there has been a spate of international papers reporting vacuum extraction failure rates as high as 15-30% across a wide variety of obstetrical services (9-12).

Assisted vaginal delivery at Port Moresby General Hospital (PMGH) has remained between about 2% and 5% for the past 30 years – 95% of these have been performed by vacuum extraction. Failure rates have generally been less than 3%.

This paper reports the experience of assisted vaginal birth at PMGH from 1977 to 2010, and analyses outcomes and issues in relation to assisted vaginal birth in the setting of a large teaching hospital in Papua New Guinea (PNG).

Methods

Labour ward registers and annual reports of the maternity service at the PMGH were analysed for the period 1977 to 2010 and the results tabulated using MS-Excel spreadsheets and the Epi Info 5 statistical package.

At PMGH, analysis of perinatal death according to birthweight commenced in 1984, and since 1988 the World Health Organization (WHO) definition of a 'birth' has been adopted, ie, ≥ 400 g or ≥ 22 weeks gestation. Before 1988 the definition of a 'birth' was delivery of a fetus weighing more than 1 kg or at greater than 28 weeks gestation.

Unfortunately the labour ward registers for the periods November to December 2004, all of 2003, January to March 2000, March to October 1997, March to May 1984 and January to May 1980 are missing. Where these registers were unavailable for detailed data access, the basic figures have been obtained from annual reports of PMGH Department of Obstetrics and Gynaecology (O&G).

Results

The annual number of births increased from 5215 in 1977 to 12,109 in 2010 (a 132%

increase) (Table 1). In spite of this significant increase in workload there has been no corresponding increase in midwifery and nursing support staff in the labour and delivery suites of the hospital.

During the period 1981-2010 vacuum-assisted delivery rates have been fairly steady at between 2% and 5%; however, between 1977 and 1980 the rate ranged from 8.6% to 15.8%. Failure of vacuum extraction has ranged from 0.5% to 5.4% for the whole period. The mean rate of vacuum extraction failure for the whole period was 2.5% – the failure rate in 2010 was 2.2% (Table 2).

Caesarean section (CS) delivery rates rose steadily from 2.2% in 1977 to 5.1% in 1993, but since that time have been relatively steady at around 4-5%. The CS rate in 2010 was 4.5%, the vacuum-assisted delivery rate 2.3% and the forceps-assisted delivery rate 0.1% (Table 1, Figure 1).

The perinatal mortality rate (PMR) (using the WHO definition of a birth) came down from 60/1000 in 1984 to 27/1000 in 1994, and since that time has been fairly steady at 25-32/1000. HIV (human immunodeficiency virus) was first recorded in Papua New Guinea in 1987 and the first antenatal case was diagnosed in 1994. The PNG National Department of Health estimates that around 0.9% of adults in the general population are living with HIV, based on antenatal HIV surveillance data.

Between 1989 and 2010 the perinatal mortality rate (fresh stillbirths plus early neonatal deaths) for babies of birthweight more than 1499 g has ranged from 7.3/1000 to 14.5/1000 with a mean of 11.3 – it was 11.7 in 2010. The fresh stillbirth and early neonatal death rate for babies with birthweights in excess of 2499 g has ranged from 4.9/1000 to 14.7/1000 in the same period with a mean of 9.5, and was 7.3 in 2010. These perinatal deaths of babies more than 2499 g have been fairly evenly divided between fresh stillbirths (FSBs) and early neonatal deaths (ENNDs) (Table 1).

Table 2 sets out complications related to vacuum extraction in terms of the method-specific perinatal mortality rate, associated shoulder dystocia, severe perineal trauma (3rd and 4th degree tears), failure of vacuum extraction and the ultimate method to effect delivery when vacuum extraction failed.

TABLE 1
TOTAL OPERATIVE DELIVERIES, SERIOUS PERINEAL TRAUMA AND PERINATAL DEATHS, 1977-2010*

Year	Total deliveries	Total vacuum extractions No (%)	Total forceps deliveries No (%)	Total caesarean sections No (%)	Total 3rd/4th degree tears No (%)	Number ≥1.5 kg ENNDs	Number ≥1.5 kg fresh SBs	PMR for fresh SBs and ENNDs ≥1.5 kg	Number ≥2.5 kg fresh SBs	PMR for fresh SBs and ENNDs ≥2.5 kg	PMR for all weight categories combined
1977	5215	645 (12.4)	51 (1.0)	113 (2.2)	4 (0.08)						36.2
1978	5417	857 (15.8)	62 (1.1)	154 (2.8)	2 (0.04)						38.2
1979	6079	687 (11.3)	43 (0.7)	158 (2.6)	9 (0.15)						34.7
1980	6291	542 (8.6)	19 (0.3)	111 (1.8)	4 (0.06)						11.4
1981	6042	351 (5.8)	26 (0.4)	209 (3.5)	3 (0.05)						19.4
1982	6045	400 (6.6)	25 (0.4)	166 (2.7)	2 (0.03)						17.9
1983	6148	271 (4.4)	16 (0.3)	209 (3.4)	2 (0.03)						20.7
1984	7086	277 (3.9)	12 (0.2)	211 (3.0)	1 (0.01)				50	15.9	60.0
1985	7947	282 (3.5)	12 (0.2)	238 (3.0)	8 (0.10)				40	13.8	89.0
1986	7367	261 (3.5)	10 (0.1)	195 (2.6)	5 (0.07)				66	20.6	54.0
1987	7465	300 (4.0)	8 (0.1)	243 (3.3)	5 (0.07)				50	18.8	32.9
1988	7976	246 (3.1)	13 (0.2)	208 (2.6)	3 (0.04)				89	21.3	36.0
1989	7910	253 (3.2)	11 (0.1)	254 (3.2)	4 (0.05)	63	52	14.5	55	12.1	31.6
1990	8321	167 (2.0)	7 (0.1)	357 (4.3)	3 (0.04)	51	39	10.8	31	7.3	32.0
1991	8745	277 (3.2)	25 (0.3)	422 (4.8)	7 (0.08)	44	48	10.5	19	5.8	30.9
1992	8909	294 (3.3)	33 (0.4)	446 (5.0)	4 (0.04)	41	44	9.5	75	14.7	32.4
1993	9473	276 (2.9)	17 (0.2)	485 (5.1)	3 (0.03)	52	66	12.5	19	5.8	34.6
1994	9193	304 (3.3)	9 (0.1)	428 (4.7)	10 (0.11)	28	39	7.3	40	6.6	27.0
1995	9336	304 (3.3)	15 (0.2)	387 (4.1)	14 (0.15)	59	60	12.7	36	7.7	32.5

1996	9251	267 (2.9)	12 (0.1)	260 (2.8)	2 (0.02)	54	49	11.1	36	32	7.4	29.9
1997	9465	218 (2.3)	7 (0.1)	321 (3.4)	3 (0.03)	64	46	13.9	56	42	11.9	31.0
1998	9469	184 (1.9)	4 (0.04)	377 (4.0)	14 (0.15)	66	52	12.5	41	28	7.3	28.9
1999	8910	206 (2.3)	23 (0.3)	342 (3.8)	8 (0.09)	39	54	10.4	24	38	7.0	25.7
2000	9703	209 (2.2)	13 (0.1)	401 (4.1)	8 (0.08)	58	50	11.1	36	34	7.2	32.2
2001	9693	251 (2.6)	9 (0.1)	346 (3.6)	12 (0.12)	44	52	9.9	23	36	6.1	25.9
2002	10192	230 (2.3)	26 (0.3)	429 (4.2)	8 (0.08)	49	48	9.5	32	32	6.3	25.7
2003	10299	228 (2.2)	10 (0.1)	530 (5.1)	5 (0.05)	48	61	10.6	27	34	5.9	27.3
2004	10190	340 (3.3)	2 (0.02)	493 (4.8)	9 (0.09)	73	53	12.4	45	28	7.2	28.5
2005	10124	374 (3.7)	13 (0.1)	510 (5.0)	11 (0.11)	61	71	13.0	37	51	8.7	29.7
2006	10517	395 (3.8)	13 (0.1)	527 (5.0)	9 (0.09)	58	56	10.8	27	25	4.9	27.0
2007	11413	479 (4.2)	3 (0.03)	572 (5.0)	9 (0.08)	73	49	10.7	45	29	6.5	28.2
2008	10974	435 (4.0)	5 (0.05)	445 (4.1)	30 (0.27)	72	55	11.6	35	28	5.7	32.8
2009	11157	375 (3.4)	2 (0.02)	461 (4.1)	9 (0.08)	66	66	11.8	34	46	7.3	28.4
2010	12109	273 (2.3)	9 (0.1)	542 (4.5)	17 (0.14)	63	79	11.7	31	57	7.3	27.9
Total	294,431	11,458 (3.9)	565 (0.2)	11,550 (3.9)	247 (0.08)	1226	1189	11.3	1099	1184	9.5	

*The definition of a birth (and therefore the basis of the calculation of PMR) changed from ≥ 1 kg to ≥ 400 g in 1984

ENNDs = early neonatal deaths: deaths in the first 7 days of life

SBs = stillbirths

PMR = perinatal mortality rate: fresh stillbirths plus early neonatal deaths per 1000 births

TABLE 2

VACUUM FAILURE RATES AND SUBSEQUENT METHODS INSTITUTED TO EFFECT DELIVERY AFTER A FAILED VACUUM EXTRACTION, AND COMPLICATIONS OF OPERATIVE VAGINAL DELIVERY (PERINATAL DEATHS, SPHINCTER INJURIES AND SHOULDER DYSTOCIA)

Year	Total vacuum extractions No (%)	Total vacuum extraction failures No (%)	Vacuum-extraction-specific PMR No (rate/1000)	Vacuum-extraction-associated 3rd/4th degree tear No (%)	Vacuum-extraction-associated shoulder dystocia	Failed vacuum extraction, delivered by: Symphysiotomy No (%)	Forceps No (%)	Caesarean section No (%)
1977	645 (12.4)	11 (1.7)	0	0	0	8 (73)	1 (9)	2 (18)
1978	857 (15.8)	16 (1.9)	3 (3.5)	1 (0.1)	0	14 (88)	0	2 (12)
1979	687 (11.3)	19 (2.8)	10 (14.6)	0	0	17 (89)	0	2 (11)
1980	542 (8.6)	10 (1.8)		0	0	10 (100)	0	0
1981	351 (5.8)	9 (2.6)	9 (25.6)	0	0	9 (100)	0	0
1982	400 (6.6)	9 (2.3)	5 (12.5)	0	0	5 (56)	2 (22)	2 (22)
1983	271 (4.4)	4 (1.5)	2 (7.4)	0	0	3 (75)	0	1 (25)
1984	277 (3.9)	8 (2.9)	3 (10.8)	1 (0.4)	0	2 (25)	0	6 (75)
1985	282 (3.5)	6 (2.1)	3 (10.6)	0	0	2 (33)	0	4 (67)
1986	261 (3.5)	9 (3.4)	1 (3.8)	0	0	0	0	9 (100)
1987	300 (4.0)	13 (4.3)	6 (20.0)	1 (0.3)	0	10 (77)	0	3 (23)
1988	246 (3.1)	9 (3.7)	6 (24.4)	0	0	5 (56)	2 (22)	2 (22)
1989	253 (3.2)	8 (3.2)	2 (7.9)	0	0	5 (63)	2 (25)	1 (12)
1990	167 (2.0)	9 (5.4)	2 (12.0)	0	2	4 (44)	1 (11)	4 (44)
1991	277 (3.2)	12 (4.3)	6 (21.7)	2 (0.7)	2	8 (67)	1 (8)	3 (25)
1992	294 (3.3)	14 (4.8)	4 (13.6)	0	2	9 (64)	3 (21)	2 (14)
1993	276 (2.9)	11 (4.0)	2 (7.2)	0	1	7 (64)	1 (9)	3 (27)
1994	304 (3.3)	10 (3.3)	1 (3.3)	1 (0.3)	0	3 (30)	4 (40)	3 (30)
1995	304 (3.3)	15 (4.9)	3 (9.9)	2 (0.7)	1	9 (60)	2 (13)	4 (27)

1996	267 (2.9)	6 (2.2)	2 (7.5)	1 (0.4)	1	4 (67)	0	2 (33)
1997	218 (2.3)	5 (2.3)	0	0	0	2 (40)	2 (40)	1 (20)
1998	184 (1.9)	4 (2.2)	1 (5.4)	0	0	3 (75)	0	1 (25)
1999	206 (2.3)	6 (2.9)	1 (4.9)	1 (0.5)	1	3 (50)	1 (17)	2 (33)
2000	209 (2.2)	6 (2.9)	4 (19.1)	3 (1.4)	2	5 (83)	1 (17)	0
2001	251 (2.6)	5 (2.0)	3 (12.0)	1 (0.4)	0	4 (80)	0	1 (20)
2002	230 (2.3)	8 (3.5)	4 (17.4)	1 (0.4)	0	6 (75)	2 (25)	0
2003	228 (2.2)	4 (1.8)				2 (50)	0	2 (50)
2004	340 (3.3)	4 (1.2)	0	2 (0.6)	2	0	0	4 (100)
2005	374 (3.7)	5 (1.3)	3 (8.0)	1 (0.3)	2	2 (40)	1 (20)	2 (40)
2006	395 (3.8)	2 (0.5)	3 (7.6)	2 (0.5)	2	1 (50)	0	1 (50)
2007	479 (4.2)	9 (1.9)	0	0	1	4 (44)	1 (11)	4 (44)
2008	435 (4.0)	5 (1.1)	2 (4.6)	4 (0.9)	1	4 (80)	0	1 (20)
2009	375 (3.4)	7 (1.9)	1 (2.7)	4 (1.1)	1	7 (100)	0	0
2010	273 (2.3)	6 (2.2)	1 (3.7)	9 (3.3)	2	5 (83)	0	1 (17)
Total	11,458 (3.9)	284 (2.5)	93 (8.7)	37 (0.3)	23 (0.2%)	182 (64)	27 (10)	75 (26)

PMR = perinatal mortality rate: fresh stillbirths plus early neonatal deaths (deaths in the first 7 days of life) per 1000 births

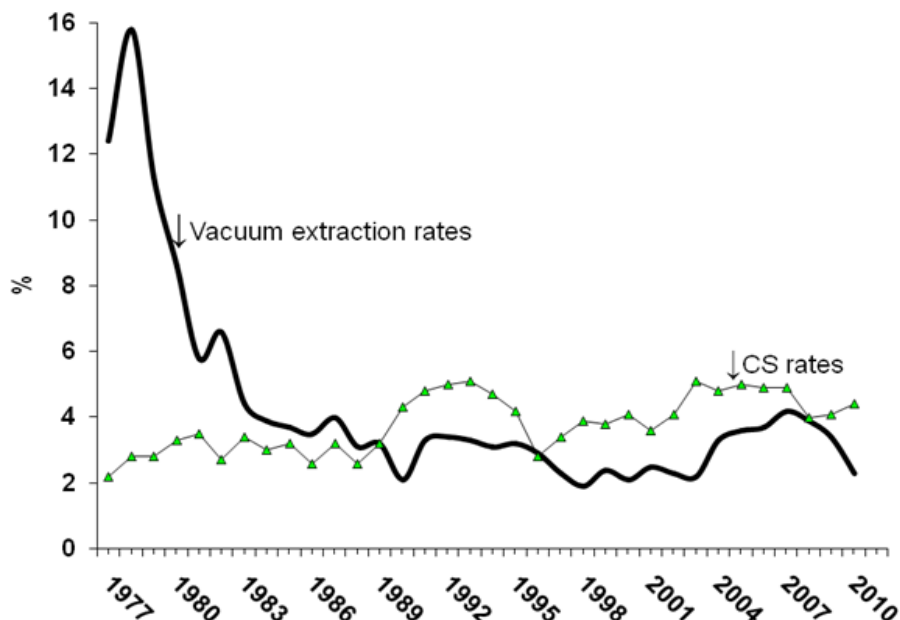


Figure 1. Vacuum extraction and caesarean section (CS) rates at Port Moresby General Hospital, 1976-2010.

Failure rates have varied from 0.5% to 5.4% with an average of 2.5% for the whole period. The vacuum-extraction-specific PMR has ranged from 0 to 26/1000, with a mean of 8.7/1000 for the period. The PMR for infants weighing more than 2499 g for this period averaged 9.5/1000. Around 98% of the vacuum extractions performed in the PMGH service were for infants with birthweights more than 2499 g. The rates of severe perineal trauma varied from 0 to 1.4% in the vacuum extraction group compared to 0.08% for all births combined.

Discussion

Assisted delivery rates in various parts of the world and trends with regard to the use of vacuum extraction and forceps

In 1989 Chalmers advocated the vacuum extractor as the instrument of first choice when vaginal delivery needs to be assisted or expedited (13). Forceps have been shown to be associated with higher rates of maternal trauma (14,15), and soft cup vacuum devices associated with higher failure rates (16,17). In Australia, United Kingdom, New Zealand and

the USA assisted vaginal delivery rates have remained fairly steady at 8-12%, but there has been a steady, increasing trend (from the 1990s to the present day) favouring the use of the vacuum extractor over forceps for assisted vaginal delivery (1-4). In some parts of the developing world, however, assisted delivery rates have remained less than 1% (5,8). AVD rates are also very low in parts of Europe, Asia and South America (6-8,18,19).

The very great difference between commonly higher rates of failure with vacuum extraction in western countries (15-30%) and the PMGH experience (2-3%) is of considerable interest. Some forms of epidural analgesia, especially when placed late in labour for primigravidae, mean that women may have little or no pelvic floor sensation and are much less able to bear down effectively. If weaker expulsive efforts are countered by stronger traction from the accoucheur then cup detachments, failure to achieve delivery and trauma of the fetal scalp are more likely. There is no epidural service available in the PMGH labour and delivery area. Consumerism and 'medico-legally defensive obstetrics' related to childbirth in many western countries also mean that

women may choose to have a CS rather than an assisted vaginal delivery, or indeed no attempt at vaginal delivery at all (6-8).

In some 'first world' settings the assisted delivery rates have decreased to very low levels due to the fact that obstetricians have come to perform caesarean section for all problems in the second stage, and because specialist trainees have little opportunity to get experience in assisted delivery during their training.

In developing countries this trend has sometimes been fueled by a view that following 'western' trends is 'modern' and a 'superior' way to practise. Such views may not take into account local circumstances which can make caesarean section a relatively dangerous procedure both for the index pregnancy and in subsequent pregnancies, particularly if the woman is not able to access supervised labour and delivery in hospital next time. In several countries visited in Africa between 2000 and 2007 one of us (GDLM) observed that public hospital consultants are permitted the right of private practice and when on-call for labour ward are not always physically available to provide hands-on training for resident junior staff.

When the consultant does not come to the labour ward to do hands-on teaching of trainees, the rates of CS will of course be higher – it is not possible to teach the management of second stage problems or assisted vaginal delivery over the telephone. Under such conditions of training and supervision the next generation of obstetricians will not develop operative vaginal delivery skills and caesarean section becomes the standard management for problems in labour, leading to high and rising CS rates and very few assisted vaginal births. Further impediments to appropriate use of AVD include fear of failure, lack of experience with symphysiotomy (which can be performed easily in the labour ward if there is an AVD failure) and difficulty in getting to theatre quickly for caesarean section when there is an AVD failure.

All the above problems also pertain to PMGH in some measure. However, the lower AVD rates over the past 25 years have also been in part due to severe midwifery staff shortages which lead to an inability to monitor labouring women according to protocol – this means that second stages are sometimes

unobserved, become prolonged and therefore are not assisted in a timely manner.

The development of the modern vacuum extractor cups at PMGH in the 1970s by Dr G.C. Bird

At PMGH the vacuum extractor has been the preferred instrument for assisting vaginal delivery for the past 40 years; this was largely due to the legacy of Dr G.C. Bird, who was the head of Obstetrics and Gynaecology from 1968 to 1980. During his time at PMGH, Dr Bird developed modifications to the original Malmstrom vacuum extraction cups in an attempt to lessen the risk of cup detachments ('pop-offs') and facilitate placement of the vacuum cup on the infant's head so that traction will increase flexion, by:

- i. separating the suction and traction systems, and
- ii. placing the suction port on the cup eccentrically on the dome of the cup (20).

Bird was also one of the first to recognize the importance of correct identification of the 'flexion point' on the fetal head. He subsequently designed the 'posterior' cup to facilitate placement of the vacuum cup over the flexion point in occiput transverse and posterior positions (21).

Nursing standards in PNG recommend that there should be one midwife available for the care of no more than four labouring women. The international best practice recommendation for midwifery care in the second stage of labour is that the attendant should listen to the fetal heart with every contraction. Clearly this will not be possible if one midwife is assigned many women to care for in labour. In the PNG maternity services, staffing shortages are common, which mean that one midwife may be assigned to care for 6-12 women in labour. Under these circumstances it is not logistically possible to listen to the fetal heart during the second stage with any regularity or reliability. Therefore, to keep unexpected birth asphyxia to a minimum, it is necessary to have rules about duration of labour (particularly the length of the second stage) and standard protocols for the management of prolonged labour. Since the 1970s the PMGH standard labour ward protocol has been to allow apparently normal

primigravidae 60 minutes of active pushing to deliver their baby and multigravidae 30 minutes. If these time limits are exceeded, primary carers are instructed to refer the woman for assessment and possible delivery assistance.

It is interesting to note that during Dr Bird's time as head of Obstetrics at PMGH the rate of vacuum extraction ranged between 8.6% and 15.8%; the year after he left (1981) the rate dropped to 5.8% (see Table 1). This significant fall in the rate of assisted delivery was in part due to the very close personal supervision that Dr Bird maintained in the labour ward. After Dr Bird's departure in 1980, supervision of labour and delivery care practice in the PMGH labour ward reverted to the more common situation where midwives and interns call registrars when a problem is recognized, and communicate with the consultant on duty when they deem this to be necessary. The practicalities of this 'system' of referral and consultation, in the face of significant understaffing, necessarily increase the time that some women spend in a prolonged expulsive phase of the second stage, and lessen the opportunity to offer them timely assistance. Indeed, it has been noted that when a visiting specialist obstetrician is present in the PMGH labour ward for substantial portions of the day (and applies the above standard protocol) the vacuum-assisted delivery rate increases from 2-4% (as was typical for the period 1983-2010) to 8-10%. If one calculates a vacuum delivery rate for the period between 9.30 and 11 am (when there is a consultant-supervised ward round taking place) the vacuum delivery rate for this time is also about 10%, indicating that there have been unrecognized indications to assist women overnight when staffing levels are particularly suboptimal.

Timely deployment of vacuum extraction can also lessen the risk of postpartum haemorrhage and postpartum incontinence

Longer second stages are also associated with increased risk of postpartum haemorrhage (PPH) – still the commonest cause of maternal death in PNG – and continence problems later in life for the woman. It is not possible from the labour ward registers to determine whether the rates of these problems increased as the rate of vacuum-assisted delivery decreased in the 1980s.

Hands-on training in assisted vaginal delivery is essential if vacuum extraction failures are to be minimized and skills handed on to the next generation of obstetricians

Lack of practical training on the floor of the labour and delivery suites is a common problem in many hospitals (11); training has been linked in a number of studies to the likelihood of success for vacuum extraction (22,23). All doctors in PNG receive introductory training in vacuum extraction as medical students, get practical experience as interns in the compulsory four-month O&G residency rotation, and receive more detailed training in the finer points of vacuum extraction, including how to conduct trials of vacuum extraction in problematic cases, if they pursue postgraduate training in O&G. Most of this training takes place at PMGH.

In addition to the above, specific attention to detail with regard to contractions and technique are critical to achieving success with vacuum-assisted delivery. We believe it should be standard practice to augment contractions for all primigravidae undergoing vacuum extraction and selected multigravid women whose contractions are not optimal in the second stage. Also the coordination of traction and an assistant performing fundal pressure during contractions and expulsive efforts can minimize failure rates in trials of vacuum extraction.

It might be assumed that if vacuum extractions are being performed in more challenging clinical scenarios, as is the case at the PMGH (rotational procedures, trials of vacuum extraction when there is significant moulding and in cases where there is still some head palpable above the pelvic brim), and when many procedures are being performed by junior practitioners in training, there might be higher rates of maternal and fetal complications. Table 2 shows that the vacuum-extraction-specific PMR has ranged from 0 to 26/1000, with a mean of 8.7 for the whole period. Small numbers mean that the rate per annum has fluctuated widely over the period. Nevertheless, it is clear that the vacuum-specific PMR is not very different to the PMR for infants of birthweight >2499 g (average 9.5 for the same period) (Table 1). It is not possible from the labour ward register to ascertain whether the vacuum extraction had anything to do with the actual demise of

individual babies.

The rates of severe perineal trauma varied from 0 to 1.4% in the vacuum extraction group and compares with an overall recorded severe perineal trauma rate of 0.08% – these figures are very low and possibly an underestimate. Small audit surveys of perineal trauma in the PMGH service have revealed recently that rates of 3rd degree trauma have been underestimated by up to 100%. However, vacuum extraction in the PMGH service is largely performed by doctors who should have more experience in assessing the degree of perineal trauma associated with the delivery they have conducted, and therefore severe perineal trauma rates for cases of vacuum extraction should not be greatly underestimated.

The ultimate delivery method in cases of failed vacuum extraction was most commonly by symphysiotomy (64%) (Table 2). Few failed vacuum extractions resulted in delivery by caesarean section. Competence in symphysiotomy also means that operators have more confidence to begin 'trials' of vacuum extraction as the delivery can always be completed in the labour ward with minimum delay if the 'trial' fails.

Conclusion

Port Moresby General Hospital has a unique 30+ years documented experience with the use of modern methods of vacuum extraction. This has resulted in very low failure rates of vacuum extraction, and has also contributed to the maintenance of low perinatal mortality and low caesarean section rates in the obstetrical service.

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Outcome of infants born to unbooked mothers: a short report from Goroka General Hospital, Eastern Highlands Province, Papua New Guinea

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SUMMARY

Despite the increasing availability of antenatal care in Papua New Guinea (PNG), women continue to present for confinement without having previously attended antenatal clinic. In this brief report we present the findings of a five-year retrospective study conducted at Goroka General Hospital, Eastern Highlands Province, PNG. Mothers who had not previously accessed antenatal care ('unbooked mothers') were more likely to experience stillbirth or early neonatal death of their infant than booked mothers.

Introduction

99% of all maternal deaths and 98% of all neonatal deaths occur in developing countries (1,2). Lack of antenatal care and lack of skilled care at the time of birth are key risk factors of poor health outcomes for both mothers and their infants (3-5). In developing countries, an estimated 79% of women attend antenatal care and only 59% of births are attended by a skilled birth attendant (1).

Papua New Guinea (PNG) has the second highest maternal mortality ratio (MMR) in the Asia-Pacific region (Afghanistan is ranked highest) and one of the highest MMRs in the world, with an estimated 733 maternal deaths per 100,000 live births (6-8). Neonatal mortality is also high with 29 neonatal deaths per 1000 live births (6). An estimated 22% of women in PNG do not receive any antenatal care during their pregnancy (6); and only 37% of women had a supervised birth in 2010 (7). Lack of education and financial constraints have been identified as key factors contributing to the non-use of antenatal care services in PNG (9,10). Outcomes of neonates admitted to the special care nursery (11) and neonatal deaths and related factors have also been reported, with an association found between lack of antenatal care and early neonatal deaths (12,13).

Methods

This retrospective study took place over a six-month period at Goroka General Hospital (GGH). The overall aims of this study were to identify the proportion of unbooked mothers admitted for confinement at GGH over a five-year period and to identify the proportion of infants born to unbooked mothers admitted to the special care nursery and the reason for their admission.

The obstetric register in the labour ward and the admission register in the special care nursery at GGH were reviewed for the five-year period January 2006 to December 2010. In the labour ward, data were collected for all births. The mothers' status for having received antenatal care was also noted and categorized as either booked or unbooked (ie, had or had not attended antenatal care). For those mothers who were booked, their HIV (human immunodeficiency virus) status was also noted. In the special care nursery, admission registers were used to identify all neonates admitted directly from the labour ward for the same time period.

This study was undertaken as part of a training program on research for hospital-based health care workers. Approval was gained from the GGH Medical Advisory

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Committee. All data collection was undertaken by the principal investigator (MM) and data were entered into an MS Excel database. Univariate data analysis was undertaken in Epi Info by GS.

Results

Labour ward

19,532 women were admitted to the labour ward for confinement at GGH during the study period; 2337 women (12%) were unbooked. Of all booked mothers, 1.1% (197/17,195) were HIV positive. There were 381 stillbirths at GGH during the study period, giving a stillbirth ratio of 19.5 per 1000 births (Table 1). Of all stillbirths 214 (56%) were fresh stillbirths. Stillbirths were significantly higher in unbooked than in booked mothers (OR 4.37, 95% CI: 3.52-5.43; $p < 0.0001$).

Special care nursery

3742 neonates were admitted directly from the labour ward to the special care nursery (19% of all births), including all infants born to HIV+ mothers, following the hospital protocol for management of HIV-exposed infants. 28% (1031/3742) of all admissions were to unbooked mothers. Admission of neonates born to unbooked mothers was significantly higher than those born to booked mothers (OR 4.22, 95% CI: 3.85-4.63; $p < 0.0001$). Of all neonates admitted to the special care nursery,

46% were born to primiparous women; 60% of all neonates admitted were born to women aged 15-25 years.

While all causes for admission to the special care nursery could not be identified in this study, among those for whom an admission diagnosis was available (2691/3742; 72%), 49% ($n = 1310$) were admitted due to neonatal sepsis, 20% ($n = 547$) due to birth asphyxia and 18% ($n = 494$) due to prematurity and/or low birthweight. All of these conditions are recognized as leading causes of neonatal death (2,12,14,15). In relation to the outcome of neonates once admitted to the special care nursery, findings from this hospital-based study are similar to those found elsewhere in PNG (Table 2).

Over the five-year period there were 585 neonatal deaths (16% of all admissions) in the special care nursery. A total of 41% (241/585) of all neonatal deaths occurred among the infants of unbooked mothers; neonatal deaths were significantly higher among unbooked mothers than among booked mothers (OR 2.10, 95% CI: 1.74-2.53; $p < 0.0001$).

Discussion

In PNG, lack of antenatal care and late presentation to hospital (ie, by women who are in established labour) have been identified as predictors for poor maternal and neonatal outcome (9,11-13). Around 10% of all

TABLE 1

BOOKED AND UNBOOKED MOTHERS AND OUTCOME OF INFANT, GOROKA GENERAL HOSPITAL (GGH), JANUARY 2006 TO DECEMBER 2010

	Booked mothers	Unbooked mothers	OR (95% CI) p value	Total
All births at GGH	17,195 (88%)	2337 (12%)	-	19,532
Live births at GGH	16,956	2195	-	19,151
Stillbirths	239 (63%)	142 (37%)	4.37 (3.52-5.43) $p < 0.0001$	381
All admissions from labour ward to special care nursery	2711 (72%)	1031 (28%)	4.22 (3.85-4.63) $p < 0.0001$	3742
Infant deaths in special care nursery	344 (59%)	241 (41%)	2.10 (1.74-2.53) $p < 0.0001$	585

OR = odds ratio
CI = confidence interval

TABLE 2

COMPARISON OF 5-YEAR HOSPITAL-BASED REVIEWS OF THE NEONATAL OUTCOME IN MADANG AND GOROKA HOSPITALS

	Hospital births	Stillbirths	Admitted to special care nursery	Neonatal death among infants admitted to special care nursery
Modilon Hospital, Madang: 5-year review noting neonatal outcome (11)	9152	352 (3.8%)	650 (7.1%)	121/650 (18.6%)
Goroka General Hospital, Goroka: 5-year retrospective study	19,532	381 (2.0%)	3742 (19.2%)	585/3742 (15.6%)

newborns in PNG are low birthweight (LBW) (<2500 g), putting them at significant risk for neonatal or early infant death. Duke et al. (12) reported that very LBW infants (<1800 g) were at increased risk of neonatal death and were more frequently born to mothers who had not previously attended antenatal clinic (ANC).

Despite its limitations this study highlights the correlation between lack of antenatal care and poor newborn health outcomes. Infants of unbooked mothers are at increased risk of being stillborn, being admitted to the special care nursery and of early neonatal death. The findings from our study correlate with recent data from Port Moresby General Hospital, where, in 2011, 8.4% of all births were to unbooked mothers and 30% of all stillbirths were to unbooked mothers (16).

In 2002, Duke et al. (12) identified all-cause mortality in children admitted to GGH. However, a study looking specifically at all hospital births, over a defined period of time, together with the mothers' booked or unbooked status, and the outcome in the infants has not previously been conducted. Through a retrospective approach this study attempted to identify all women admitted for confinement and follow-up and determine the outcome in their neonates through review of admission and discharge registers. As is frequently the case with retrospective study designs, data were frequently incomplete thus hindering the collection of clinical data. While this study was not able to clearly identify all causes of admission to the special care nursery and

all causes of death among the neonates, it clearly highlights the increased risk to infants born to unbooked mothers. A more thorough design at the early stages of planning could have led to a more comprehensive review of records enabling a more robust study to have been carried out.

Conclusion

Despite the availability of antenatal services throughout PNG, women continue to be admitted for confinement at provincial hospitals without having previously received antenatal care (13). This lack of antenatal care not only poses risks to unbooked mothers but also leaves newborn infants vulnerable to increased risk of stillbirth and early neonatal death.

PNG is a signatory to the Millennium Development Goals (MDGs). While indicators towards MDG4 (child health) are slowly improving, MDG5 (maternal health) is lagging behind and PNG's commitment to achieving progress towards MDG5 is clearly under threat (8). There is an urgent need to focus and prioritize maternal and neonatal health in PNG if we are to begin to work towards achievement of the MDGs. Given the cultural and geographical diversity, and the differences between availability, access and uptake of health care services across PNG, there is a need to focus attention towards identifying and targeting local level (provincial, district and ward level) problems and issues, and to develop both short- and longer-term

sustainable strategies for improving maternal and neonatal health.

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- 10 **Larsen G, Lupiwa S, Kave HP, Gillieatt S, Alpers MP.** Antenatal care in Goroka: issues and perceptions. *PNG Med J* 2004;47:202-214.
- 11 **Jimmy S, Kemiki AD, Vince JD.** Neonatal outcome at Modilon Hospital, Madang: a 5-year review. *PNG Med J* 2003;46:8-15.
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- 14 **Lawn JE, Zupan J, Begkoyian G, Knippenberg R.** Newborn survival. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mills A, Musgrove P, eds. *Disease Control Priorities in Developing Countries*. Second edition. New York: Oxford University Press, 2006:531-550.
- 15 **United Nations Children's Fund.** Progress for Children: A World Fit for Children Statistical Review. Number 6. New York: UNICEF, Dec 2007.
- 16 **Amoa B.** Port Moresby General Hospital: Division of Obstetrics and Gynaecology Annual Report 2011. Port Moresby: Port Moresby General Hospital, in press.

List of Medical Research Projects in Papua New Guinea

Approved or Noted

By the Medical Research Advisory Committee in 2010

Men's perception of pregnancy: a study of the views of Lufa men from Papua New Guinea

Ms Loto Losenamo (Faculty of Health, Social Work and Human Services Program, Queensland University of Technology, Kelvin Grove Campus, Kelvin Grove, QLD 4059, Australia)

Epidemiology of tuberculosis: active case detection in sentinel sites across PNG

Prof. Peter Siba, Prof. Hans-Peter Beck, Ms Serej Ley, Dr Suparat Phuanukoonnon, Mr Kichawen Chakumai and Dr Paul Harino (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Phylogenic and geographic attribution analysis of *Burkholderia pseudomallei* derived from Papua New Guinea

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

Nosocomial infection control at Goroka Base Hospital

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

An investigation into HIV drug resistance and subtype distribution in the Eastern Highlands and Western Highlands of PNG

Dr Claire Ryan, Prof. Peter Siba, Ms Janet Gare, Mr Bangan John and Dr Angela Kelly (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

The in vitro and in vivo assessment of antimalarial drug resistance to first-line (AL) and second-line (DHA-PQ) drugs for uncomplicated malaria in Papua New Guinea

Mr Livingstone Tavul, Dr Ivo Mueller, Dr

Manuel Hetzel and Prof. Peter Siba (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

The prevalence of methicillin-resistant *Staphylococcus aureus* (CA-MRSA) in Papua New Guinea

Dr Laurens Manning, Dr Moses Laman, Dr Andrew Greenhill, Dr John Maihua and Prof. Tim Davis (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

Viral infections including dengue in the aetiology of febrile seizures in Papua New Guinea

Dr Moses Laman and Dr Laurens Manning (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

The aetiology of diarrhoea in Goroka, Papua New Guinea

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

Investigation of serotype-specific antibody persistence and B-cell memory at age 3-4 years following 23-valent pneumococcal polysaccharide vaccine at 9 months in Papua New Guinean children previously primed with 7-valent pneumococcal conjugate vaccine

Dr Sarah Moberley and Mr William Pomat (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Pneumonia in children and adults in the Eastern Highlands of Papua New Guinea: a prospective case-control aetiology study (pneumonia conjugate vaccine study follow-up)

Dr Sarah Moberley (Papua New Guinea Institute of Medical Research, PO Box 60,

Goroka, EHP 441, Papua New Guinea)

PNG & GFATM Round 8 Malaria Control Programme Evaluation Plan 2009-2014

Dr Manuel W. Hetzel and Dr Ivo Mueller (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, Papua New Guinea)

Determining the effect of betel nut chewing on fetal growth in pregnancy through ultrasound scanning

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

Safety, tolerance and pilot efficacy of short-course, high-dose primaquine treatment for liver stages of *Plasmodium vivax* infection

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

Health and demographic surveillance (HDSS) in Wosera, East Sepik Province, Papua New Guinea

Dr Suparat Phuanukoonnon (Papua New Guinea Institute of Medical Research, PO Box 400, Maprik, ESP 533, Papua New Guinea)

An investigation of optic neuropathy occurring in adult prisoners in Madang, Papua New Guinea

Dr Benoit Tousignant (Post Graduate Research Centre, Divine Word University, PO Box 483, Madang, Madang Province 511, Papua New Guinea)

The PNGIMR/PNG LNG partnership in health project

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

Askim na save (Ask and understand): a mixed method study of people who sell or exchange sex in Port Moresby

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

Epitope-based identification of novel *Plasmodium* antigens for malaria vaccine development

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

Male circumcision acceptability and impact study, Papua New Guinea: qualitative study to assess the feasibility of conducting longitudinal clinic research at Nine-Mile and Lawes Road Clinics, Port Moresby

Dr Andrew Vallely (Australian Centre for International and Tropical Health, School of Population Health, University of Queensland, Australia)

Hyponatraemia in Kokoda evaluation: a prospective observational study of exercise-associated hyponatraemia on the Kokoda track

Dr David Rosengren (Staff Emergency Physician, Royal Brisbane and Royal Women's Hospital, Butterfield Street, Herston, Queensland 4029, Australia)

Pharmacokinetics of piperazine in pregnancy

Prof. Tim Davis (Department of Medicine, Faculty of Medicine and Dentistry, University of Western Australia, Nedlands, Western Australia 6009, Australia)

Strengthening disease surveillance in Papua New Guinea

Mr Alex Rosewell (WHO Office, PO Box 5896, Boroko, NCD 111, Papua New Guinea)

Trichinella survey in Kaipuna, Balimo, Ihu and Kanabea Districts, Papua New Guinea

Dr Ifor Owen (PO Box 5539, Boroko, NCD 111, Papua New Guinea)

Exploring the use of maternal waiting houses in Kairuku/Hiri District, Central Province: a study in PNG

Mrs Roslyn Melua (Social and Community Health, School of Population Health, University of Auckland, Private Mail Bag 92019, Auckland, New Zealand)

Lihir demographic health survey

Dr Billy Selve (Lihir Gold Mine, PO Box 380, Kavieng, New Ireland Province 631, Papua New Guinea)

Follow-up of paediatric HIV/AIDS in NCD

Ms Gebo Nanu (Division of Nursing, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Monitoring of ART of HIV/AIDS patients in the Port Moresby General Hospital by CD4 and viral load

Dr Jessica Markby (Clinton Foundation, PO Box 431, Konedobu, NCD 125, Papua New Guinea)

Strengthening health leadership and management capacity – what can we learn from high performing districts

Ms Margaret Samei (Divine Word University, PO Box 483, Madang, Madang Province 511, Papua New Guinea)

A survey of the barriers to consistent condom use amongst STI and HIV/AIDS attendees at Port Moresby General Hospital and other sites in NCD

Ms Helen Kigodi (Division of Public Health, School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Non-communicable disease stepwise survey in the East Sepik Province

Dr Thomas Vinit (National Health Services Division, Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

Study into local production and pilot feeding of supplementary food to malnourished and HIV-exposed children

Mrs Wila Saweri (Nutrition Unit, Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

Epidemiological study of nutritional status of children in PNG

Dr Job Hawap (National Health Service Standards Division, Department of Health, PO Box 807, Waigani, NCD 131, Papua New Guinea)

A study of relationships between government and cultures of care in Papua New Guinea hospitals

Dr Alice Street (Flat 4, 111 Marine Parade, Brighton, East Sussex BN2 1AT, United Kingdom)

Evaluating the causes of perinatal illness and death in Papua New Guinea

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

Characterisation of new vaccine development candidates against *Plasmodium vivax*

Mr Livingstone Tavul, Dr Ingrid Felger, Dr

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

Humoral immunity to *Plasmodium vivax* and *Plasmodium falciparum*

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

Artesunate-pyronaridine and artemisinin-naphthoquine combination therapies for Papua New Guinean children exposed to high transmission of multiple *Plasmodium* species (Standard Treatment Trial II)

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

Prevalence and risk factors of *Neisseria gonorrhoeae*, *Chlamydia trachomatis* and *Trichomonas vaginalis* in pregnant women in Madang District, PNG: using self-collected high vaginal swabs in comparison with first void urine

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

Investigation of polymorphism in *Plasmodium falciparum* *hrp2*, *hrp3*, *aldolase* and *Idh1* genes and their predicted impact on malaria rapid diagnosis tests' performance

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

Laboratory evaluation of DNA extraction kits

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

Health worker performance improvement: evidence from an intervention in Papua New Guinea

Mr Kichawen Chauka (Divine Word University, PO Box 483, Madang, Madang Province 511, Papua New Guinea)

A laboratory evaluation of rapid point of care tests for syphilis

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

Mosquito-parasite interactions and filariasis transmission in Papua New Guinea

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

A clinico-diagnostic study of yaws in Sumkar District of Madang Province, Papua New Guinea

Prof. Francis Hombhanje (Director, Health Research Centre, Divine Word University, PO Box 483, Madang, Madang Province 511, Papua New Guinea)

Assessment of obesity among working personnel, as a major contributing factor of type 2 diabetes

Dr Phillip G.K. Kigodi (School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Identifying a cost-effective treatment for rhinoscleroma

Dr Paki Molumi (School of Medicine and Health Sciences, University of Papua New Guinea, PO Box 5623, Boroko, NCD 111, Papua New Guinea)

Intermittent preventive treatment with azithromycin-containing regimens for the prevention of malarial infections and anaemia and the control of sexually transmitted infections in pregnant women in Papua New Guinea. Supplementary protocol on field and laboratory procedures, and the host immune response to malaria in pregnancy

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

Monocytes in malaria in pregnancy

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

Investigation of aetiological agents concurrently infecting people with HIV and associated risk factors

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

A safety, tolerability, pharmacokinetic and preliminary efficacy study of azithromycin plus piperazine as intermittent preventive treatment in pregnant Papua New Guinean women

Prof. Tim Davis, Dr Ivo Mueller and Dr John Benjamin (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

The molecular epidemiology of *Vibrio cholerae* in Papua New Guinea

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

Diversity of *Plasmodium falciparum* and naturally acquired immunity to malaria

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

Does malaria impair nutrient transport across the placenta?

Prof. Stephen Rogerson, Dr Ivo Mueller, Prof. Peter Siba, Dr Philippe Boeuf, Ms Paula Samol and Ms Elizabeth Aitken (Papua New Guinea Institute of Medical Research, PO Box 378, Madang, Madang Province 511, Papua New Guinea)

A Phase IIb randomised, open-label, comparative clinical study to assess safety and efficacy of a fixed-dose granule formulation of pyronaridine artesunate (60:20 mg sachet) versus a fixed-dose formulation of artemether/lumefantrine dispersible tablets in infants and children with acute uncomplicated *Plasmodium vivax* malaria and mixed infections of malaria

Dr Inoni Betuela, Dr Ivo Mueller and Prof. Tim Davis (Papua New Guinea Institute of Medical Research, PO Box 60, Goroka, EHP 441, 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 2010.

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)

MEDLARS BIBLIOGRAPHY

PUBLICATIONS OF RELEVANCE TO PAPUA NEW GUINEA AND MELANESIA

Bibliographic Citation List generated from MEDLARS

- 1 **Ataka Y, Inaoka T, Ohtsuka R.**
Knowledge, attitudes and practices relevant to malaria control in remote island populations of Manus, Papua New Guinea.
Trop Med Health 2011 Dec;39(4):109-117. Epub 2011 Dec 1.
A community-based cross-sectional survey of 262 participants in four island communities of Manus, Papua New Guinea was conducted using a structured questionnaire to examine possible factors of malaria prevalence, including education experiences, knowledge, attitudes and preventive behaviors, in relation to antimalarial antibody titers. Bivariate and multivariate analyses revealed that micro-environmental conditions caused inter-community differences in malaria prevalence. Ninety-nine percent of the subject villagers recognized mosquito bites as a cause of malaria transmission, which explains the high possession rate of bednets. There was a significant correlation between malaria education experience at schools and knowledge ($p < 0.01$) and between knowledge and bednet use ($p < 0.05$). However, regular bednet users were only 35% of the total, due primarily to feelings of discomfort, heat and stuffiness inside the bednet. Villagers' behavior of consulting an aid post orderly (APO) in case of high fever significantly lowered the titer level ($p < 0.05$), while their bednet use did not. This unexpected result was attributable to inappropriate bednet use and to daily living patterns, including both subsistence and social activities. We conclude that information regarding lifestyles and attitudes toward bednet use as well as malaria education experience at schools are particularly important for practical malaria prevention.
- 2 **Barnadas C, Kent D, Timinao L, Iga J, Gray LR, Siba P, Mueller I, Thomas PJ, Zimmerman PA.**
A new high-throughput method for simultaneous detection of drug resistance associated mutations in *Plasmodium vivax* *dhfr*, *dhps* and *mdr1* genes.
Malar J 2011 Sep 24;10:282.
BACKGROUND: Reports of severe cases and increasing levels of drug resistance highlight the importance of improved *Plasmodium vivax* case management. Whereas monitoring *P. vivax* resistance to anti-malarial drug by in vivo and in vitro tests remains challenging, molecular markers of resistance represent a valuable tool for high-scale analysis and surveillance studies. A new high-throughput assay for detecting the most relevant markers related to *P. vivax* drug resistance was developed and assessed on Papua New Guinea (PNG) patient isolates. METHODS: *Pvdhfr*, *pvdhps* and *pvmr1* fragments were amplified by multiplex nested PCR. Then, PCR products were processed through an LDR-FMA (ligase detection reaction - fluorescent microsphere assay). 23 SNPs, including *pvdhfr* 57-58-61 and 173, *pvdhps* 382-383, 553, 647 and *pvmr1* 976, were simultaneously screened in 366 PNG *P. vivax* samples. RESULTS: Genotyping was successful in 95.4% of the samples for at least one gene. The coexistence of multiple distinct haplotypes in the parasite population necessitated the introduction of a computer-assisted approach to data analysis. Whereas 73.1% of patients were infected with at least one wild-type genotype at codons 57, 58 and 61 of *pvdhfr*, a triple mutant genotype was detected in 65.6% of the patients, often associated with the 117T mutation. Only one patient carried the 173L mutation. The mutant 647P *pvdhps* genotype allele was approaching genetic fixation (99.3%), whereas 35.1% of patients were infected with parasites carrying the *pvmr1* 976F mutant allele. CONCLUSIONS: The LDR-FMA described here allows a discriminant genotyping of resistance alleles in the *pvdhfr*, *pvdhps* and *pvmr1* genes and can be used in large-scale surveillance studies.
- 3 **Barnadas C, Koepfli C, Karunajeewa HA, Siba PM, Davis TM, Mueller I.**
Characterization of treatment failure in efficacy trials of drugs against *Plasmodium vivax* by genotyping neutral and drug resistance-associated markers.
Antimicrob Agents Chemother 2011 Sep;55(9):4479-4481. Epub 2011 Jun 27.
Plasmodium vivax intervention trials customarily report uncorrected treatment failure rates. Application of recrudescence-reinfection genotyping and drug resistance single-nucleotide polymorphism typing to a 4-arm comparative efficacy trial illustrated that molecular approaches can assist in understanding the relative contributions of true drug resistance (recurrent with same genotype) and new infections to treatment failure. The PCR-corrected adequate clinical and parasitologic response may constitute an informative secondary endpoint in future *P. vivax* drug trials.
- 4 **Barry AE, Trieu A, Fowkes FJ, Pablo J, Kalantari-Dehaghi M, Jasinskas A, Tan X, Kayala MA, Tavul L, Siba PM, Day KP, Baldi P, Felgner PL, Doolan DL.**
The stability and complexity of antibody responses to the major surface antigen of *Plasmodium falciparum* are associated with age in a malaria endemic area.
Mol Cell Proteomics 2011 Nov;10(11):M111.008326. Epub 2011 Aug 8.
Individuals that are exposed to malaria eventually develop immunity to the disease with one possible mechanism being the gradual acquisition of antibodies to the range of parasite variant surface antigens in their local area. Major antibody targets include the large and highly polymorphic *Plasmodium falciparum* Erythrocyte Membrane Protein 1 (PfEMP1) family of proteins. Here, we use a protein microarray containing 123 recombinant PfEMP1-DBLα domains (VAR) from Papua New Guinea to

seroprofile 38 nonimmune children (<4 years) and 29 hyperimmune adults (≥ 15 years) from the same local area. The overall magnitude, prevalence and breadth of antibody response to VAR was limited at <2 years and 2-2.9 years, peaked at 3-4 years and decreased for adults compared with the oldest children. An increasing proportion of individuals recognized large numbers of VAR proteins (>20) with age, consistent with the breadth of response stabilizing with age. In addition, the antibody response was limited in uninfected children compared with infected children but was similar in adults irrespective of infection status. Analysis of the variant-specific response confirmed that the antibody signature expands with age and infection. This also revealed that the antibody signatures of the youngest children overlapped substantially, suggesting that they are exposed to the same subset of PFEMP1 variants. VAR proteins were either seroprevalent from early in life (<3 years), from later in childhood (≥ 3 years) or rarely recognized. Group 2 VAR proteins (Cys2/MFK-REY+) were serodominant in infants (<1-year-old) and all other sequence subgroups became more seroprevalent with age. The results confirm that the anti-PFEMP1-DBL α antibody responses increase in magnitude and prevalence with age and further demonstrate that they increase in stability and complexity. The protein microarray approach provides a unique platform to rapidly profile variant-specific antibodies to malaria and suggests novel insights into the acquisition of immunity to malaria.

5 Bradacs G, Heilmann J, Weckerle CS.

Medicinal plant use in Vanuatu: a comparative ethnobotanical study of three islands. *J Ethnopharmacol* 2011 Sep 1;137(1):434-448. Epub 2011 Jun 6.

ETHNOPHARMACOLOGICAL RELEVANCE: Our study shows that large parts of Vanuatu's medicinal flora remain unexplored and that a high variability of medicinal plant knowledge between islands exists. **AIM OF THE STUDY:** The following questions are comparatively analyzed for three islands of Vanuatu: who are the medicinal plant specialists and how important is their knowledge today? Which plants are used to treat common diseases? **MATERIALS AND METHODS:** On Loh, Ambrym and Aneityum plant related information was collected using semi-structured interviews, transect walks and participant observation. A total of 29 medicinal plant specialists were interviewed. **RESULTS:** Medicinal plant specialists are either peasants or people with a high rank in the local social system such as members of the chief's family or priests. Their knowledge may be very broad (Loh, Aneityum) or specialized on specific diseases (Ambrym). Medicinal plant knowledge is transmitted family and gender specific (Loh) or gender and family independent (Ambrym and Aneityum). Overall, 133 medicinal plant species were documented of which 117 are new to Vanuatu's ethnopharmacopoeia. Mainly members of the Euphorbiaceae and Fabaceae, followed by Asteraceae, Convolvulaceae, Moraceae and Zingiberaceae are utilized. The majority of documented species are trees (33%), followed by herbs (22%) and shrubs (21%). Leaves accounted for the highest number of use reports (43%). The highest diversity of medicinal plants is found for the most common diseases such as skin, gastrointestinal, respiratory system and urogenital system diseases. Only a small overlap of taxa between the islands was

found. **CONCLUSIONS:** The biocultural diversity of Vanuatu is reflected in the variability of medicinal plant knowledge and differences in the traditional medicinal system between the three islands investigated. Traditional medicine is more vital on remote islands. The better connected the islands are to the main city, the more dominant western medicine becomes and traditional medicine mainly remains to treat illnesses with a magical origin.

6 Brian G, du Toit R, Ramke J, Szetu J.

Population-based study of self-reported ocular trauma in Fiji.

Clin Experiment Ophthalmol 2011 Jul;39(5):441-448. doi: 10.1111/j.1442-9071.2010.02476.x. Epub 2011 Feb 1.

BACKGROUND: To characterize causes, risk factors and outcomes for ocular trauma among adults aged ≥ 40 years in Fiji. **DESIGN:** Population-based cross-sectional survey; multistage cluster random sampling. **PARTICIPANTS:** 1381 (= 73.0% participation); eight provinces on Viti Levu. **METHODS:** Interview-based questionnaire. Visual acuity measurement. Dilated ocular examination. **MAIN OUTCOME MEASURES:** Circumstances, management and consequences of self-reported ocular trauma. **RESULTS:** Of participants, 20.6% recalled ocular trauma: being Melanesian ($p < 0.001$) and male ($p < 0.001$) were predictive. Age at injury was ≤ 15 years for 13.0%: 78.4% occurred at home; 72.4% caused by sharp objects. For injury at >15 years: 38.5% occurred inside the home, most by sharp objects (51.6%) and domestic violence (28.4%); agricultural activities caused 20.6% of injuries; non-agricultural workplace incidents caused 16.2%, with chemicals responsible for 27.5% of these; public alcohol consumption was associated with 13.8% of injuries, mostly by assault (91.2%). Conventional medical services were the primary source of care for 47.2% of injured participants: 61.9% attended on injury day. For trauma: sample prevalence of vision impairment in at least one eye was 1.7% (95% confidence interval 1.1-2.4%), and 0.1% (95% confidence interval 0.02-0.5) for bilateral blindness. Injury at ≤ 15 years ($p = 0.008$) and at the workplace ($p = 0.044$) were predictive of ongoing vision impairment. Of visually impaired eyes, 36% had corneal opacity that may have been caused by relatively minor trauma. **CONCLUSIONS:** Ophthalmic service strengthening (including minor corneal trauma management) and specific injury prevention strategies (including behaviour change education and advocacy for legislation) are required to decrease the ocular trauma burden in Fiji.

7 Brian G, Ramke J, Szetu J, Qoqonokana MQ.

Cataract and its surgery in Fiji.

Clin Experiment Ophthalmol 2011 Jul;39(5):449-455. doi: 10.1111/j.1442-9071.2010.02477.x. Epub 2011 Feb 1.

BACKGROUND: To characterize cataract and its surgery among adults aged ≥ 40 years in Fiji. **DESIGN:** Population-based cross-sectional survey using multistage cluster random sampling. **PARTICIPANTS:** 1381 (= 73.0% participation); eight provinces on Viti Levu. **METHODS:** Interview-based questionnaire; visual acuity measured; autorefractometry; dilated ocular examination. **MAIN OUTCOME MEASURES:** Prevalence; predictors; surgical outcomes. **RESULTS:** Being Indian ($p = 0.001$), elderly ($p < 0.001$) and previous/current

smoker ($p = 0.036$) were predictive of at least one unoperated vision-impairing or operated cataract. Gender ($p = 0.062$) and diabetes ($p = 0.384$) were not. Unoperated cataract (predominantly nucleosclerosis) was the second most frequent (25.0%) cause of low vision ($<6/18$, $\geq 6/60$) and commonest (71.1%) of blindness ($<6/60$). Ethnicity-gender-age-domicile adjusted and extrapolating to the Fiji population aged ≥ 40 years, prevalence of cataract-induced low vision and blindness were each 1.7% (95% confidence interval [CI] 1.0-2.4%). At least one eye of 4.6% and both of 1.8% participants had surgery (86.4% extracapsular). Gender ($p = 0.213$), age ($p = 0.472$) and rural/urban domicile ($p = 0.895$) were not predictors of surgery among those who required it in at least one eye. After intraocular lens surgery: 50.7% had pupillary posterior capsular opacification; mean spherical equivalent was $-1.37 \pm 1.95D$ (range, -6.38 to $+2.25D$); mean cylindrical error was $2.31 \pm 1.75D$ (range, 0.0 to $8.75D$); $\geq N8$ for 39.5%; $\geq 6/18$ for 56.6%; $<6/60$ for 19.7%, with 2.6% no light perception. Ethnicity-gender-age-domicile adjusted and extrapolating to the Fiji population aged ≥ 40 years, Cataract Surgical Coverage (Person) was 47.5% (95%CI 29.2-65.8%) at $<6/18$, and 65.2% (95%CI 37.8-92.6%) at $<6/60$. CONCLUSIONS: Fiji cataract services and outcomes compare favourably with those of neighbouring Papua New Guinea and Timor Leste.

8 Brian G, Tousignant B, Venn BJ, McKay R, Gould C.

Serum retinol and xerophthalmia among a prison population in Papua New Guinea.

Ophthalmic Epidemiol 2011 Dec;18(6):288-294.

PURPOSE: To estimate the prevalence of vitamin A deficiency (VAD) and one of its clinical manifestations, xerophthalmia, and examine the predictive value of nyctalopia and ocular signs for serum retinol concentrations among a prison population in Papua New Guinea. **METHODS:** A cross-sectional study of 148 prisoners and 9 guards; all males aged ≥ 18 years. Interview-based questionnaire; ocular examination; serum retinol concentration determination. **RESULTS:** Two guards had marginal (retinol <1.05 – $\geq 0.70 \mu\text{mol/L}$) VAD. For prisoners: mean retinol was $0.84 \pm 0.49 \mu\text{mol/L}$; 43.9% (95% CI 35.9, 52.2) had VAD (retinol $<0.70 \mu\text{mol/L}$); 9.6% (95% CI 5.1, 17.0) self-reported nyctalopia prior to, and 36.1% (95% CI 27.7, 45.5) after incarceration; 10.9% (95% CI 6.7, 17.0) exhibited at least one sign of xerophthalmia (2 had fundus changes; all 4 with more than conjunctival xerosis alone had severe [$<0.35 \mu\text{mol/L}$] retinol deficiency). Prisoners with ocular signs were more likely than those without to have VAD (OR 10.4; 95% CI 2.5, 70.3; $p < 0.001$) and severe retinol deficiency (OR 19.1; 95% CI 5.5, 77.2; $p < 0.001$). Positive (PPV) and Negative (NPV) Predictive Values: of nyctalopia for any (PPV 62.9%; NPV 32.8%) and severe (PPV 25.7%; NPV 85.9%) retinol deficiency; of ocular signs for any (PPV 93.3%; NPV 38.2%) and severe (PPV 73.1%; NPV 87.8%) retinol deficiency, and VAD (PPV 86.5%, NPV 38.2%). **CONCLUSIONS:** VAD and xerophthalmia were present in this prison population. There may be VAD in the wider community. The former needs remedy and the latter deserves investigation. Self-reported nyctalopia was not a useful indicator of retinol deficiency. Absence of ocular signs was unhelpful for ruling out VAD.

9 Brolan CE, Upham SJ, Hill PS, Simpson G, Vincent SD.

Borderline health: complexities of the Torres Strait treaty.

Med J Aust 2011 Nov 7;195(9):503-506.

10 Bugoro H, Hii J, Russell TL, Cooper RD, Chan BK, Iro'ofa C, Butafa C, Apairamo A, Bobogare A, Chen CC.

Influence of environmental factors on the abundance of *Anopheles farauti* larvae in large brackish water streams in Northern Guadalcanal, Solomon Islands.

Malar J 2011 Sep 13;10:262.

BACKGROUND: The main vector of malaria in Solomon Islands is *Anopheles farauti*, which has a mainly coastal distribution. In Northern Guadalcanal, Solomon Islands, high densities of *An. farauti* are supported by large brackish streams, which in the dry season are dammed by localized sand migration. The factors controlling the high larval productivity of these breeding sites have not been identified. Accordingly the influence of environmental factors on the presence and density of *An. farauti* larvae was assessed in three large naturally dammed streams. **METHODS:** Larval sites were mapped and anopheline larvae were collected monthly for 12 months (July 2007 to June 2008) from three streams using standard dippers. Larval collections were made from 10 locations spaced at 50 m intervals along the edge of each stream starting from the coast. At each collection point, floating filamentous algae, aquatic emergent plants, sun exposure, and salinity were measured. These environmental parameters along with rainfall were correlated with larval presence and density. **RESULTS:** The presence and abundance of *An. farauti* larvae varied between streams and was influenced by the month of collection and distance from the ocean ($p < 0.001$). Larvae were more frequently present and more abundant within 50 m of the ocean during the dry season when the streams were dammed. The presence and density of larvae were positively associated with aquatic emergent plants (presence: $p = 0.049$; density: $p = 0.001$). Although filamentous algae did not influence the presence of larvae, this factor did significantly influence the density of larvae ($p < 0.001$). Rainfall for the month prior to sampling was negatively associated with both larval presence and abundance ($p < 0.001$), as high rainfall flushed larvae from the streams. Salinity significantly influenced both the presence ($p = 0.002$) and density ($p = 0.014$) of larvae, with larvae being most present and abundant in brackish water at $<10\%$ seawater. **CONCLUSION:** This study has demonstrated that the presence and abundance of *An. farauti* larvae are influenced by environmental factors within the large streams. Understanding these parameters will allow for targeted cost effective implementation of source reduction and larviciding to support the frontline malaria control measures i.e. indoor residual spraying (IRS) and distribution of long-lasting insecticidal nets (LLINs).

11 Bugoro H, Iro'ofa C, Mackenzie DO, Apairamo A, Hevalao W, Corcoran S, Bobogare A, Beebe NW, Russell TL, Chen CC, Cooper RD.

Changes in vector species composition and current vector biology and behavior will favour malaria elimination in Santa Isabel Province, Solomon Islands.

Malar J 2011 Sep 30;10:287.

BACKGROUND: In 2009, Santa Isabel Province

in the Solomon Islands embarked on a malaria elimination programme. However, very little is known in the Province about the anopheline fauna, which species are vectors, their bionomics and how they may respond to intensified intervention measures. The purpose of this study was to provide baseline data on the malaria vectors and to ascertain the possibility of successfully eliminating malaria using the existing conventional vector control measures, such as indoor residual spraying (IRS) and long-lasting insecticidal nets (LLIN). **METHODS:** Entomological surveys were undertaken during October 2009. To determine species composition and distribution larval surveys were conducted across the whole island. For malaria transmission studies, adult anophelines were sampled using human landing catches from two villages - one coastal and one inland. **RESULTS:** Five *Anopheles* species were found on Santa Isabel: *Anopheles farauti*, *Anopheles hinesorum*, *Anopheles lungae*, *Anopheles solomonis* and *Anopheles nataliae*. *Anopheles hinesorum* was the most widespread species. *Anopheles farauti* was abundant, but found only on the coast. *Anopheles punctulatus* and *Anopheles koliensis* were not found. *Anopheles farauti* was the only species found biting in the coastal village; it was incriminated as a vector in this study; it fed early in the night but equally so indoors and outdoors, and had a low survival rate. *Anopheles solomonis* was the main species biting humans in the inland village; it was extremely exophagic, with low survival rates, and readily fed on pigs. **CONCLUSION:** The disappearance of the two major vectors, *An. punctulatus* and *An. koliensis*, from Santa Isabel and the predominance of *An. hinesorum*, a non-vector species, may facilitate malaria elimination measures. *Anopheles farauti* was identified as the main coastal vector with *An. solomonis* as a possible inland vector. The behaviour of *An. solomonis* is novel as it has not been previously found biting humans in any numbers. Both species appear to be short-lived, a characteristic that will limit their transmission potential. The early night feeding behaviour and a degree of outdoor biting seen in *An. farauti* and particularly in *An. solomonis* will require that their response to IRS and LLIN be closely monitored. Coastal villages, where large, favourable breeding sites allow for high numbers of *An. farauti*, may require the addition of larval control to achieve elimination.

12 Capuano C, Ozaki M.

Yaws in the Western Pacific region: a review of the literature.

J Trop Med 2011;2011:642832. Epub 2011 Dec 22.

Until the middle of the 20th century, yaws was highly endemic and considered a serious public health problem in the Western Pacific region (WPR), leading to intensive control efforts in the 1950s-1960s. Since then, little attention has been paid to its reemergence. Its current burden is unknown. This paper presents the results of an extensive literature review, focusing on yaws in the South Pacific. Available records suggest that the region remains largely free of yaws except for Papua New Guinea, Solomon Islands and Vanuatu. Many clinical cases reported recently were described as "attenuated"; advanced stages are rare. A single intramuscular injection of benzathine penicillin is still effective in curing yaws. In the Pacific, yaws may be amenable to elimination if adequate resources are provided and political commitment revived. A mapping of yaws prevalence in PNG,

Solomon Islands and Vanuatu is needed before comprehensive country-tailored strategies towards yaws elimination can be developed.

13 Carter K, Cornelius M, Taylor R, Ali SS, Rao C, Lopez AD, Lewai V, Goundar R, Mowry C.

Mortality trends in Fiji.

Aust NZ J Public Health 2011 Oct;35(5):412-420. doi: 10.1111/j.1753-6405.2011.00740.x. Epub 2011 Sep 12.

OBJECTIVES: Mortality level and cause of death trends are evaluated to chart the epidemiological transition in Fiji. Implications for current health policy are discussed. **METHODS:** Published data for infant mortality rate (IMR), life expectancy (LE) and causes of death for 1940-2008 were assessed for quality, and compared with mortality indices generated from recent Ministry of Health death recording. Trends in credible mortality estimates are compared with trends in proportional mortality for cause of death. **RESULTS:** IMR declined from 60 deaths (per 1,000) in 1945 to below 20 by 2000. IMR for 2006-08 is estimated at 18-20 deaths per 1,000 live births. Excessive LE estimates arise by imputing from the IMR using inappropriate models. LE increased, but has been stable at 64 years for males and 69 years for females since the late 1980s and early 1990s respectively. Proportional mortality from diseases of the circulatory system has increased from around 20% in the 1960s to more than 45%. Extensive variation in published mortality estimates was identified, including clearly incompatible ranges of IMR and LE. **CONCLUSIONS:** Mortality decline has stagnated. Relatively low IMR and proportional mortality trends suggest this is largely due to chronic diseases (especially cardiovascular) in adults. **IMPLICATIONS:** Reconciliation of mortality data in Fiji to reduce uncertainty is urgently needed. Fiji's health services and donor partners should place continued and increased emphasis on effective control strategies for cardiovascular disease.

14 Clua E, Brena PF, Lecasble C, Ghnassia R, Chauvet C.

Prevalence and proposal for cost-effective management of the ciguatera risk in the Noumea fish market, New Caledonia (South Pacific).

Toxicon 2011 Nov;58(6-7):591-601. Epub 2011 Sep 14.

Ciguatera fish poisoning (CFP) is a common intoxication associated with the consumption of reef fish, which constitutes a critical issue for public health in many countries. The complexity of its epidemiology is responsible for the poor management of the risk in tropical fish markets. We used the example of the Noumea fish market in New Caledonia to develop a cost-effective methodology of assessing the CFP risk. We first used published reports and the knowledge of local experts to define a list of potentially poisonous local species, ranked by their ciguatoxic potential. Based on two 1-month surveys in the market, conducted in winters 2008 and 2009, we then calculated the consolidated ratio of biomass of potentially poisonous species vs. total biomass of fish sold on the market. The prevalence of high CFP-risk species in the market was 16.1% and 18.9% in 2008 and 2009, respectively. The most common high CFP risk species were groupers (serranids), king mackerels (scombrids), snappers (lutjanids), barracudas (sphyraenids), emperors (lethrinids) and wrasses (labrids). The size (age) of the fish also

plays a critical role in the potential ciguatoxic risk. According to proposals of average size thresholds provided by experts for high-risk species, we were also able to assess the additional risk induced by the sale of some large fish on the market. The data collected both from experts and from the market allowed us to develop a cost-effective proposal for improving the management of the CFP risk in this market. However, the successful implementation of any regulation aiming to ban some specific species and sizes from the market, with an acceptable economical impact, will require the improvement of the expertise in fish identification by public health officers and, ideally, the commitment of retailers.

- 15 **Coghlan B, Millan J, Malau C, Kaldor J, Toole M.** The HIV epidemic in Papua New Guinea. *J Acquir Immune Defic Syndr* 2011 Oct 1;58(2):e48-e51.

- 16 **De Oliveira EO, Graf KM, Patel MK, Baheti A, Kong HS, MacArthur LH, Dakshanamurthy S, Wang K, Brown ML, Paige M.** Synthesis and evaluation of hermitamides A and B as human voltage-gated sodium channel blockers. *Bioorg Med Chem* 2011 Jul 15;19(14):4322-4329. Epub 2011 May 30.

Hermitamides A and B are lipopeptides isolated from a Papua New Guinea collection of the marine cyanobacterium *Lyngbya majuscula*. We hypothesized that the hermitamides are ligands for the human voltage-gated sodium channel (hNav1.2) based on their structural similarity to the jamaicamides. Herein, we describe the nonracemic total synthesis of hermitamides A and B and their epimers. We report the ability of the hermitamides to displace [(3)H]-BTX at 10 μ M more potently than phenytoin, a clinically used sodium channel blocker. We also present a potential binding mode for (S)-hermitamide B in the BTX-binding site and electrophysiology showing that these compounds are potent blockers of the hNav1.2 voltage-gated sodium channel.

- 17 **Diarsvitri W, Utomo ID, Neeman T, Oktavian A.** Beyond sexual desire and curiosity: sexuality among senior high school students in Papua and West Papua Provinces (Indonesia) and implications for HIV prevention. *Cult Health Sex* 2011 Oct;13(9):1047-1060. Epub 2011 Aug 4.

When it comes to sexuality and norms, young Indonesians are becoming more open. Concern about this is related to the rapid increase in HIV prevalence in Indonesia, especially in Papua and West Papua Provinces. While much research has been conducted among youth who have left school, little is known about senior high school students' sexuality and sexual practices in these provinces. Using qualitative and quantitative data, we explore perspectives on and experiences of sexuality, contraceptive use, unintended pregnancy and unsafe abortion among 1082 Year 11 students from 16 senior high schools in both provinces. Findings suggest that around 38.3% of students reported having had sexual intercourse and 36.5% of these having had their first sexual encounter before they were 15 years old. Furthermore, contraceptive use among sexually active students was very low. Around 32% of female students who reported having had sexual intercourse also reported having an unintended pregnancy and the majority of them had had unsafe abortions. The

paper points to the implications of students' high-risk sexual behaviours for HIV prevention.

- 18 **Dixon BJ, Vasey PL, Sagata K, Sibanda N, Linklater WL, Dixon AF.**

Men's preferences for women's breast morphology in New Zealand, Samoa, and Papua New Guinea. *Arch Sex Behav* 2011 Dec;40(6):1271-1279. Epub 2010 Sep 23.

Sexual selection via mate choice may have influenced the evolution of women's breast morphology. We conducted an image-based questionnaire quantifying and comparing the preferences of men from Papua New Guinea (PNG), Samoa and New Zealand (NZ) for images of women's breast size, breast symmetry, areola size and areolar pigmentation. Results showed that men from PNG preferred larger breasts to a greater extent than men from Samoa and NZ, providing some support for the hypothesis that men from subsistence living cultures have a greater preference for morphological cues indicative of caloric reserves. Symmetrical breasts were most attractive to men in each culture. However, preferences were highest among NZ men, followed by men from Samoa, and were lowest among men from PNG. These results did not support the hypothesis that people living in higher pathogen environments have a greater preference for traits indicative of pathogen resistance and developmental stability. Large areolae were preferred among men from PNG, and to a lesser extent in Samoa, while in NZ men preferred medium-sized areolae. Thus, men's preferences for women's areolar size appear to be highly culturally specific. Darkly pigmented areolae were most attractive to men from Samoa and PNG, whereas men from NZ preferred areolae with medium pigmentation. These findings suggest that areolar pigmentation indicative of sexual maturity is preferred by men rather than lighter pigmentation, which may signal that a woman is in the early years of reproductive maturity. This study highlights the importance of cross-cultural research when testing the role of morphological cues in mate choice.

- 19 **Dunne EM, Ong EK, Moser RJ, Siba PM, Phanukoonnon S, Greenhill AR, Robins-Browne RM, Mulholland EK, Satzke C.**

Multilocus sequence typing of *Streptococcus pneumoniae* by use of mass spectrometry. *J Clin Microbiol* 2011 Nov;49(11):3756-3760. Epub 2011 Aug 31.

Multilocus sequence typing (MLST) is an important tool for the global surveillance of bacterial pathogens that is performed by comparing the sequences of designated housekeeping genes. We developed and tested a novel mass spectrometry-based method for MLST of *Streptococcus pneumoniae*. PCR amplicons were subjected to in vitro transcription and base-specific cleavage, followed by analysis of the resultant fragments by using matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS). Comparison of the cleavage fragment peak patterns to a reference sequence set permitted automated identification of alleles. Validation experiments using 29 isolates of *S. pneumoniae* revealed that the results of MALDI-TOF MS MLST matched those obtained by traditional sequence-based MLST for 99% of alleles and that the MALDI-TOF MS method accurately identified two single-nucleotide variations. The MALDI-TOF MS method was then used for MLST analysis of 43

S. pneumoniae isolates from Papua New Guinean children. The majority of the isolates present in this population were not clonal and contained seven new alleles and 30 previously unreported sequence types.

- 20 **Forrest P, Cheong JY, Vallely MP, Torzillo PJ, Hendel PN, Wilson MK, Bannontt PG, Bayfield MS, Herkes R, Walker SW.**

International retrieval of adults on extracorporeal membrane oxygenation support.

Anaesth Intensive Care 2011 Nov;39(6):1082-1085.

A retrieval service was established in New South Wales to provide mobile extracorporeal membrane oxygenation support to patients with severe, acute cardiac or respiratory failure. This service has also retrieved four adult patients from Nouméa, New Caledonia to Sydney on extracorporeal membrane oxygenation support, which are the first international retrievals of this type from Australia. We discuss our experience with these patients, three of whom survived to hospital discharge. However, one patient referred from New Caledonia died before extracorporeal membrane oxygenation could be established.

- 21 **Furusawa T, Naka I, Yamauchi T, Natsuhara K, Kimura R, Nakazawa M, Ishida T, Nishida N, Eddie R, Ohtsuka R, Ohashi J.**

The serum leptin level and body mass index in Melanesian and Micronesian Solomon Islanders: focus on genetic factors and urbanization.

Am J Hum Biol 2011 Jul-Aug;23(4):435-444. doi: 10.1002/ajhb.21124. Epub 2010 Dec 17.

OBJECTIVES: This study examined the association between the serum leptin level and body mass index (BMI) and the effects of urbanization and polymorphisms of leptin (LEP) or leptin receptor (LEPR) genes on the leptin level in three Solomon Islands populations. **METHODS:** A Melanesian population living in a remote area (participants: 106 males and 106 females, ages: 18-74 years), a Melanesian population in an urban area (89 and 94, 18-79 years) and a Micronesian population who migrated to a peri-urban area in the 1960s (84 and 69, 18-71 years) were studied. Anthropometric and serum leptin measurements and genotyping for LEP G-2548A and LEPR K109R and Q223R were performed. **RESULTS:** The prevalence of obesity (BMI ≥ 30 kg/m²) was the highest in the Micronesian population (30.1%), followed by the urban (18.6%) and the rural (2.4%) Melanesian population. The serum leptin concentration was the highest in the urban Melanesian, followed by the Micronesian and the rural Melanesian populations ($p < 0.05$). Interestingly, the parameter coefficients of the leptin concentrations on the BMIs were nearly identical in the urban and rural Melanesians after adjusting for age and gender. The LEPR 223Q/Q genotype was associated with an increased leptin level only in the Micronesian population after adjusting for BMI ($p = 0.0008$ and 0.0016 referenced to the Q/R and the R/R types, respectively). **CONCLUSIONS:** These observations suggest that the increase in obesity in the Micronesians had a genetic component while that in Melanesians might have been related to the urbanization.

- 22 **Gajraj-Singh P.**

Psychological impact and the burden of caregiving for persons with spinal cord injury (SCI) living in the community in Fiji.

Spinal Cord 2011 Aug;49(8):928-934. doi: 10.1038/sc.2011.15. Epub 2011 Mar 8.

STUDY DESIGN: This study was designed as a cross-sectional one. A set of structured questionnaires was administered. **OBJECTIVES:** The purpose of the study was to explore the psychological response of the caregivers of people with spinal cord injury (SCI) and to assess the burden of caregiving for SCI persons living in the community in Fiji. **SETTING:** Fiji, South Pacific. **METHODS:** A total of 30 primary caregivers of persons with SCI. The Index of Psychological Well-Being (IPWB) was used to assess the psychological impact of caregiving, and Caregiver Burden Inventory (CBI) was used to evaluate the burden associated with caregiving for persons with SCI. Barthel Index (BI) scale was used to measure the functional abilities of the care recipients. **RESULTS:** The majority of the participants ($n = 20$) were women, who had an ethnic Fijian background ($n = 18$) and were married ($n = 18$), and were spouses ($n = 13$). Mean BI of the persons with SCI was 7.1 (s.d. = 5.23) on a 0-20 scale, with 90% ($n = 27$) suffering from moderate-to-very severe disability (BI < 15). The mean duration of caregiving was 6.1 years (s.d. = 4.23). On average, the caregivers provided 6.1 h (s.d. = 2.19) of caregiving per day. The experiences of caregiving adversely affected the caregiver's psychological well-being. Participants demonstrated high levels of time-dependent and development burden. Caregiving was significantly related to the number of hours spent providing care ($r(s) = 0.35$, $p < 0.05$) and the older caregiver age ($r(s) = 0.46$, $p < 0.01$). **CONCLUSION:** Being a primary caregiver of an SCI person contributes to caregiver burden and psychological distress. The findings indicate that the contributions of these people should be recognized and interventions should be tailored not only toward the needs of the care recipients but also to the needs of the caregivers.

- 23 **Gordon S, Melrose W, Warner J, Buttner P, Ward L.**

Lymphatic filariasis: a method to identify subclinical lower limb change in PNG adolescents.

PLoS Negl Trop Dis 2011 Jul;5(7):e1242. Epub 2011 Jul 19.

Lymphedema related to lymphatic filariasis (LF) is a disabling condition that commonly manifests in adolescence. Fifty-three adolescents, 25 LF infected and 28 LF non-infected, in age and sex-matched groups, using the Binax ICT rapid card test for filarial antigen, were recruited to the study. None of the participants had overt signs of lymphedema. Lymphedema assessment measures were used to assess lower limb tissue compressibility (tonometry), limb circumference (tape measure), intra- and extra-cellular fluid distribution (bioimpedance) and joint range of motion (goniometry). The mean tonometric measurements from the left, right and dominant posterior thighs were significantly larger in participants with LF compared to participants who had tested negative for LF ($p = 0.005$, $p = 0.004$ and $p = 0.003$, respectively) indicating increased tissue compressibility in those adolescents with LF. ROC curve analysis to define optimal cut-off of the tonometry measurements indicated that at 3.5 sensitivity of this potential screening test is 100% (95%-CI = 86.3%, 100%) and specificity is 21.4% (95%-CI = 8.3%, 41.0%). It is proposed that this cut-off can be used to indicate tissue change characteristic of LF in an at-risk population of PNG adolescents.

Further longitudinal research is required to establish if all those with tissue change subsequently develop lymphedema. However, thigh tonometry to identify early tissue change in LF positive adolescents may enable early intervention to minimize progression of lymphedema and prioritization of limited resources to those at greatest risk of developing lifetime morbidity.

24 **Hedrick PW.**

Selection and mutation for α thalassemia in nonmalarial and malarial environments. *Ann Hum Genet* 2011 Jul;75(4):468-474. doi: 10.1111/j.1469-1809.2011.00653.x. Epub 2011 Apr 28.

α thalassemia is the result of the loss of one or both copies of the two human α globin genes. α thalassemia appears to be the most common monogenic disease in the world and is in high frequency where malaria is, or has been, endemic. In nonmalarial environments, α thalassemia is rare and its frequency can be explained by a balance of deletional mutation and purifying selection. In malarial environments, the loss of one or two copies of the four α globin genes in normal diploid genotypes confers resistance (lower mortality) to malaria. Fitness estimates from data from Kenyan and Papua New Guinea populations are used to predict the increase in the $-\alpha$ haplotype (with one deleted gene). The frequency of double deletions ($--$ haplotypes) is higher in some Asian populations than that of single deletions. In this case, heterozygotes with normal $\alpha\alpha$ haplotypes are expected to have the highest fitness. Overall, this population genetic examination provides an evolutionary framework for understanding the worldwide frequency of α thalassemia and the deletions that cause it in both nonmalarial and malarial environments.

25 **Horwood PF, Collins D, Jonduo MH, Rosewell A, Dutta SR, Dagina R, Ropa B, Siba PM, Greenhill AR.**

Clonal origins of *Vibrio cholerae* O1 El Tor strains, Papua New Guinea, 2009-2011. *Emerg Infect Dis* 2011 Nov;17(11):2063-2065.

We used multilocus sequence typing and variable number tandem repeat analysis to determine the clonal origins of *Vibrio cholerae* O1 El Tor strains from an outbreak of cholera that began in 2009 in Papua New Guinea. The epidemic is ongoing, and transmission risk is elevated within the Pacific region.

26 **Joseph H, Maiava F, Naseri T, Taleo F, 'ake M, Capuano C, Melrose W.**

Application of the filariasis CELISA antifilarial IgG₄ antibody assay in surveillance in lymphatic filariasis elimination programmes in the South Pacific. *J Trop Med* 2011;2011:492023. Epub 2011 Sep 26.

Elimination of lymphatic filariasis (LF) in the Pacific Island Countries and Territories (PICT) has been defined as <0.1% circulating filarial antigen (CFA) prevalence in children born after the implementation of successful mass drug administrations (MDAs). This research assessed the feasibility of CFA and antibody testing in three countries: Tonga, Vanuatu and Samoa. Transmission is interrupted in Vanuatu and Tonga as evidenced by no CFA positive children and a low antibody prevalence and titre. Transmission is ongoing in Samoa with microfilaraemic (Mf) and CFA positive children and a high antibody prevalence and titre. Furthermore, areas of transmission were identified with Mf positive adults, but no CFA positive

children. These areas had a high antibody prevalence in children. In conclusion, CFA testing in children alone was not useful for identifying areas of residual endemicity in Samoa. Thus, it would be beneficial to include antibody serology in the PICT surveillance strategy.

27 **Kaba M, Davoust B, Cabre O, Colson P.**

Hepatitis E virus genotype 3f in pigs in New Caledonia. *Aust Vet J* 2011 Dec;89(12):496-499. doi: 10.1111/j.1751-0813.2011.00848.x.

BACKGROUND: Hepatitis E virus (HEV) is highly prevalent in farm pigs worldwide and an increasing body of data from industrialised countries suggests that it is an agent of a porcine zoonosis. **METHODS:** We used in-house real-time reverse transcription polymerase chain reaction to study HEV infection in 4-26-week-old pigs on a pig farm in New Caledonia, Oceania, for which no data are available. **RESULTS:** HEV RNA was detected in faeces from 6 of 92 (6.5%) pigs tested and all were 9-16 weeks old. Phylogenetic analysis showed that the HEV open reading frame 1 and 2 sequences recovered in this study formed a single cluster among HEV genotype 3 subtype f. **CONCLUSIONS:** Our work shows for the first time that pigs are a reservoir for HEV in New Caledonia. Further studies are needed to assess the prevalence and phylogenetic relationships of HEV in pigs and humans in this French overseas collectivity.

28 **Kelly GC, Seng CM, Donald W, Taleo G, Nausien J, Batarii W, Iata H, Tanner M, Vestergaard LS, Clements AC.**

A spatial decision support system for guiding focal indoor residual interventions in a malaria elimination zone.

Geospat Health 2011 Nov;6(1):21-31.

A customized geographical information system (GIS) has been developed to support focal indoor residual spraying (IRS) operations as part of a scaled-up campaign to progressively eliminate malaria in Vanuatu. The aims of the GIS-based spatial decision support system (SDSS) were to guide the planning, implementation and assessment of IRS at the household level. Additional aims of this study were to evaluate the user acceptability of an SDSS guiding IRS interventions. IRS was conducted on Tanna Island, Republic of Vanuatu between 26 October and 5 December 2009. Geo-referenced household information provided a baseline within the SDSS. An interactive mapping interface was used to delineate operation areas and extract relevant data to support IRS field teams. In addition, it was used as a monitoring tool to assess overall intervention coverage. Surveys and group discussions were conducted during the operations to ascertain user acceptability. Twenty-one operation areas, comprising a total of 187 settlements and 3,422 households, were identified and mapped. A total of 3,230 households and 12,156 household structures were sprayed, covering a population of 13,512 individuals, achieving coverage of 94.4% of the households and 95.7% of the population. Village status maps were produced to visualize the distribution of IRS at the sub-village level. One hundred percent of survey respondents declared the SDSS a useful and effective tool to support IRS. The GIS-based SDSS adopted in Tanna empowered programme managers at the provincial level to implement and assess the IRS intervention with the degree of detail required for malaria elimination. Since completion, SDSS

applications have expanded to additional provinces in Vanuatu and the neighbouring Solomon Islands supporting not only specific malaria elimination and control interventions, but also the broader public health sector in general.

29 Kitau R, Tsey K, McCalman J, Whiteside M.

Adaptability and sustainability of an Indigenous Australian family wellbeing initiative in the context of Papua New Guinea: a follow-up.

Australas Psychiatry 2011 Jul;19 Suppl 1:S80-S83.

OBJECTIVE: This paper describes the follow-up phase of a pilot collaborative initiative between the University of Papua New Guinea and James Cook University aimed at determining the relevance of an Indigenous Australian Family Wellbeing (FWB) empowerment program in the context of Papua New Guinea (PNG). It describes opportunities and challenges involved in adapting and sustaining the FWB approach to the PNG context. Two evaluation questionnaires were administered to 60 course participants. **CONCLUSIONS:** Findings revealed that the course was relevant, adaptable and could readily be integrated with other health programs. In the context of PNG's target to meet its United Nations Millennium Development Goals by 2015, the Family Wellbeing approach offers an innovative approach to enhance existing health and community development initiatives.

30 Koepfli C, Ross A, Kiniboro B, Smith TA, Zimmerman PA, Siba P, Mueller I, Felger I.

Multiplicity and diversity of *Plasmodium vivax* infections in a highly endemic region in Papua New Guinea.

PLoS Negl Trop Dis 2011 Dec;5(12):e1424. Epub 2011 Dec 20.

Plasmodium vivax is highly endemic in the lowlands of Papua New Guinea and accounts for a large proportion of the malaria cases in children less than 5 years of age. We collected 2117 blood samples at 2-monthly intervals from a cohort of 268 children aged 1 to 4.5 years and estimated the diversity and multiplicity of *P. vivax* infection. All *P. vivax* clones were genotyped using the merozoite surface protein 1 F3 fragment (msp1F3) and the microsatellite MS16 as molecular markers. High diversity was observed with msp1F3 (H(E) = 88.1%) and MS16 (H(E) = 97.8%). Of the 1162 *P. vivax* positive samples, 74% harbored multi-clone infections with a mean multiplicity of 2.7 (IQR = 1-3). The multiplicity of *P. vivax* infection increased slightly with age ($p = 0.02$), with the strongest increase in very young children. Intensified efforts to control malaria can benefit from knowledge of the diversity and MOI both for assessing the endemic situation and monitoring the effects of interventions.

31 Kremer P, Waqa G, Vanualilailai N, Schultz JT, Roberts G, Moodie M, Mavoa H, Malakellis M, McCabe MP, Swinburn BA.

Reducing unhealthy weight gain in Fijian adolescents: results of the Healthy Youth Healthy Communities study.

Obes Rev 2011 Nov;12 Suppl 2:29-40. doi: 10.1111/j.1467-789X.2011.00912.x.

Obesity is a significant problem among adolescents in Pacific populations. This paper reports on the outcomes of a 3-year obesity prevention study, Healthy Youth Healthy Communities, which was part of the Pacific Obesity Prevention in Communities project,

undertaken with Fijian adolescents. The intervention was developed with schools and comprised social marketing, nutrition and physical activity initiatives and capacity building designed to reduce unhealthy weight, and the individual exposure period was just over 2-year duration. The evaluation incorporated a quasi-experimental, longitudinal design in seven intervention secondary schools near Suva ($n = 874$) and a matched sample of 11 comparison secondary schools from western Viti Levu ($n = 2,062$). There were significant differences between groups at baseline; the intervention group was shorter, weighed less, had a higher proportion of underweight and lower proportion of overweight, and better quality of life (Pediatric Quality of Life Inventory only). At follow-up, the intervention group had lower percentage body fat (-1.17) but also a lower increase in quality of life (Assessment of Quality of Life instrument: -0.02; Pediatric Quality of Life Inventory: -1.94) than the comparison group. There were no other differences in anthropometry, and behaviours' changes showed a mixed pattern. In conclusion, this school-based health promotion programme lowered percentage body fat but did not reduce unhealthy weight gain or influence most obesity-promoting behaviours among Fijian adolescents. Despite growing evidence supporting the efficacy of community-based approaches to reduce obesity among children of European descent, findings from this study failed to demonstrate the efficacy of a community capacity-building approach among an adolescent sample drawn from a different sociocultural, economic and geographical context. Additional 'top-down' or other innovative approaches may be needed to reduce adolescent obesity in the Pacific.

32 Langley MC, Clarkson C, Ulm S.

From small holes to grand narratives: the impact of taphonomy and sample size on the modernity debate in Australia and New Guinea.

J Hum Evol 2011 Aug;61(2):197-208. doi: 10.1016/j.jhevol.2011.03.002. Epub 2011 Apr 13.

Our knowledge of early Australasian societies has significantly expanded in recent decades with more than 220 Pleistocene sites reported from a range of environmental zones and depositional contexts. The uniqueness of this dataset has played an increasingly important role in global debates about the origins and expression of complex behaviour among early modern human populations. Nevertheless, discussions of Pleistocene behaviour and cultural innovation are yet to adequately consider the effects of taphonomy and archaeological sampling on the nature and representativeness of the record. Here, we investigate the effects of preservation and sampling on the archaeological record of Sahul, and explore the implications for understanding early cultural diversity and complexity. We find no evidence to support the view that Pleistocene populations of Sahul lacked cognitive modernity or cultural complexity. Instead, we argue that differences in the nature of early modern human populations across the globe were more likely the consequence of differences in population size and density, interaction and historical contingency.

33 Mani L, Petek S, Valentin A, Chevalley S, Folcher E, Aalbersberg W, Debitus C.

The in vivo anti-plasmodial activity of haliclonacyclamine A, an alkaloid from the marine sponge, *Haliclona* sp.

Nat Prod Res 2011 Dec;25(20):1923-1930. Epub 2011 Sep 6.

The compound haliclonacyclamine A was isolated from the *Haliclona* sponge at Solomon Islands. It acts as a powerful in vitro and in vivo anti-plasmodial agent against the chloroquine-resistant *Plasmodium falciparum* strain FCB1 and *Plasmodium vinckei petteri*-infected mice, respectively.

- 34 **Manning L, Laman M, Greenhill AR, Michael A, Siba P, Mueller I, Davis TM.**

Increasing chloramphenicol resistance in *Streptococcus pneumoniae* isolates from Papua New Guinean children with acute bacterial meningitis. *Antimicrob Agents Chemother* 2011 Sep;55(9):4454-4456. Epub 2011 Jun 27.

In Papua New Guinean (PNG) children with acute bacterial meningitis (ABM), all *Haemophilus influenzae* isolates were resistant to chloramphenicol. Although *Streptococcus pneumoniae* isolates had a median chloramphenicol MIC of 3 µg/ml, it was ≥4 µg/ml in 42.8%, and the likelihood of an area under the 24-hour concentration-time curve/MIC ratio of >100 h at an MIC of ≥4 µg/ml was approximately 50%. All isolates were ceftriaxone sensitive. These data support ceftriaxone rather than conventional chloramphenicol for all PNG children with suspected ABM.

- 35 **Manning L, Laman M, Law I, Bona C, Aipit S, Teine D, Warrell J, Rosanas-Urgell A, Lin E, Kiniboro B, Vince J, Hwaiwhanje I, Karunajeewa H, Michon P, Siba P, Mueller I, Davis TM.**

Features and prognosis of severe malaria caused by *Plasmodium falciparum*, *Plasmodium vivax* and mixed *Plasmodium* species in Papua New Guinean children.

PLoS One 2011;6(12):e29203. Epub 2011 Dec 22.

BACKGROUND: Mortality from severe pediatric falciparum malaria appears low in Oceania but *Plasmodium vivax* is increasingly recognized as a cause of complications and death. The features and prognosis of mixed *Plasmodium* species infections are poorly characterized. Detailed prospective studies that include accurate malaria diagnosis and detection of co-morbidities are lacking. **METHODS AND FINDINGS:** We followed 340 Papua New Guinean (PNG) children with PCR-confirmed severe malaria (77.1% *P. falciparum*, 7.9% *P. vivax*, 14.7% *P. falciparum/vivax*) hospitalized over a 3-year period. Bacterial cultures were performed to identify co-incident sepsis. Clinical management was under national guidelines. Of 262 children with severe falciparum malaria, 30.9%, 24.8% and 23.2% had impaired consciousness, severe anemia and metabolic acidosis/hyperlactatemia, respectively. Two (0.8%) presented with hypoglycemia, seven (2.7%) were discharged with neurologic impairment and one child died (0.4%). The 27 severe vivax malaria cases presented with similar phenotypic features to the falciparum malaria cases but respiratory distress was five times more common ($p = 0.001$); one child died (3.7%). The 50 children with *P. falciparum/vivax* infections shared phenotypic features of mono-species infections, but were more likely to present in deep coma and had the highest mortality (8.0%; $p = 0.003$ vs falciparum malaria). Overall, bacterial cultures were positive in only two non-fatal cases. 83.6% of the children had alpha-thalassemia trait and seven with coma/impaired consciousness had South Asian ovalocytosis (SAO). **CONCLUSIONS:** The

low mortality from severe falciparum malaria in PNG children may reflect protective genetic factors other than alpha-thalassemia trait/SAO, good nutrition, and/or infrequent co-incident sepsis. Severe vivax malaria had similar features but severe *P. falciparum/vivax* infections were associated with the most severe phenotype and worst prognosis.

- 36 **Manning L, Laman M, Page-Sharp M, Salman S, Hwaiwhanje I, Morep N, Siba P, Mueller I, Karunajeewa HA, Davis TM.**

Meningeal inflammation increases artemether concentrations in cerebrospinal fluid in Papua New Guinean children treated with intramuscular artemether.

Antimicrob Agents Chemother 2011 Nov;55(11):5027-5033. Epub 2011 Aug 22.

Although the artemisinin-associated neurotoxicity identified in vitro and in animal studies has not been confirmed clinically, only one adult study has measured cerebrospinal fluid (CSF) concentrations after administration of conventional doses. Potential artemisinin neurotoxicity could be serious in children, especially those with meningitis and, consequently, a compromised blood-brain barrier. We measured CSF/plasma artemether and dihydroartemisinin (DHA) concentrations in 32 Papua New Guinean children with a mean age of 39 months with suspected or proven severe falciparum malaria who underwent a single lumbar puncture after intramuscular artemether administration. CSF artemether concentrations were 0 to 43.5 µg/liter and CSF concentration/plasma concentration ratios were 0 to 38.1%. DHA was measurable in CSF in only two children. The seven children with meningeal inflammation (CSF white cell count > 20/mm³) had higher CSF artemether concentration/plasma artemether concentration ratios than those without (median, 6.7% [interquartile range, 2.5 to 27.8%] versus 0.0% [interquartile range, 0.0 to 2.5%]; $p = 0.002$). Meningeal inflammation was associated with a 4.6-fold increase in the CSF artemether concentration/plasma artemether concentration ratio in a population pharmacokinetic model. These data suggest that pharmacovigilance should be heightened when intramuscular artemether is given to severely ill children with evidence of meningeal inflammation.

- 37 **Manning L, Laman M, Townsend MA, Chubb SP, Siba PM, Mueller I, Davis TM.**

Reference intervals for common laboratory tests in Melanesian children.

Am J Trop Med Hyg 2011 Jul;85(1):50-54.

Pediatric reference intervals for biochemical tests are often derived from studies in Western countries and may not be applicable to the developing world. No such intervals exist for Melanesian populations. The aim of this study was to provide specific reference intervals for children from Papua New Guinea (PNG). We assayed plasma from 327 healthy Melanesian children living in Madang Province for common biochemical and hematological analytes. We used well-validated commercially available assay methodology. Compared with reference intervals from children from Western countries and/or African children, there were substantial differences in hemoglobin, soluble transferrin receptor, ferritin, calcium, phosphate and C-reactive protein. Differences in the upper limits of reference intervals for bilirubin and alanine aminotransferase were also observed. Available reference intervals from

Western and African countries may be inappropriate in PNG and other Melanesian countries. This has implications for clinical care and safety monitoring in pharmaceutical intervention trials and vaccine studies.

- 38 **McCabe MP, Mavoa H, Ricciardelli LA, Schultz JT, Waqa G, Fotu KF.**

Socio-cultural agents and their impact on body image and body change strategies among adolescents in Fiji, Tonga, Tongans in New Zealand and Australia. *Obes Rev* 2011 Nov;12 Suppl 2:61-67. doi: 10.1111/j.1467-789X.2011.00922.x.

This paper reports on the findings of studies that were conducted as part of the Pacific Obesity Prevention in Communities project. The studies evaluated the types of messages that adolescents received in relation to body image, physical activity and eating. The participants were male and female adolescents from Fiji (two cultural groups), Tonga, New Zealand (Tongans) and Australia (European Australians). Three studies were conducted: interviews with 48 adolescents (24 male, 24 female) from each cultural group, questionnaires with 600 adolescents (300 male, 300 female) from each cultural group and the perceptual distortion study with 100 adolescents (50 male, 50 female) from the two cultural groups in Fiji and European Australians. The results demonstrate that parents, peers, the media, as well as religious influences impact on the type of body valued by adolescents in each of the cultural groups, as well as their levels of body satisfaction. These influences also shape the type and volume of food consumed, and the type and frequency of physical activity. The results of these studies highlight the major role played by the broader societal values in shaping the nature of the messages that adolescents receive in relation to their body size, eating and physical activity.

- 39 **McIver LJ, Parish ST, Jones SP, Kippin AN, Furlong TJ.**

Acute glomerulonephritis in a child with multidrug-resistant tuberculosis and multibacillary leprosy. *Med J Aust* 2011 Aug 1;195(3):150-152.

A 10-year-old boy from Papua New Guinea with multidrug-resistant tuberculosis and multibacillary leprosy developed acute glomerulonephritis while being treated as an inpatient at Thursday Island Hospital in the Torres Strait, Queensland. This is the first such case to be reported in Australia, where these diseases are uncommon and the combination is extremely rare, and it outlines important learning points regarding the aetiology of renal disease among patients with tuberculosis and leprosy.

- 40 **Mitjà O, Hays R, Lelngel F, Laban N, Ipai A, Pakarui S, Bassat Q.**

Challenges in recognition and diagnosis of yaws in children in Papua New Guinea. *Am J Trop Med Hyg* 2011 Jul;85(1):113-116.

A global resurgence of yaws in developing countries highlights the need for reliable diagnostic criteria for this neglected infection. We conducted a clinical and serologic survey of 233 children less than 15 years of age who had clinically suspected yaws. A total of 138 (59%) cases were confirmed serologically, and 10 of 12 primary stage cases showed positive results for *Treponema pallidum* by a polymerase chain reaction assay that has not yet been validated for identification of yaws. A high proportion of cases

(46%) were in the secondary stage; 92% of them had osteoarticular involvement, and only 24% had a Venereal Disease Research Laboratory titer greater than 32.

- 41 **Mitjà O, Hays R, Malken J, Ipai A, Kangapu S, Robson J, Bassat Q.**

HMS-related hemolysis after acute attacks of *Plasmodium vivax* malaria.

Am J Trop Med Hyg 2011 Oct;85(4):616-618.

Among a cohort of 1,213 cases treated for *Plasmodium vivax* malaria from an isolated Papua New Guinean population, seven adults with severe and sustained hemolytic anemia after clearance of the peripheral parasitemia were prospectively investigated. All the patients fulfilled the criteria for hyper-reactive malarial splenomegaly and in 2 of 7 cases an IgG warm antibody was identified. Hereditary hemolytic anemia was excluded in 5 of 5 patients. All treated cases improved after an initial high dose of prednisone and antimalarial chemoprophylaxis. The persistence of marked anemia in a patient with splenomegaly after a *P. vivax* attack should raise the suspicion of hyper-reactive malarial splenomegaly.

- 42 **Mitjà O, Paru R, Hays R, Griffin L, Laban N, Samson M, Bassat Q.**

The impact of a filariasis control program on Lihir Island, Papua New Guinea.

PLoS Negl Trop Dis 2011 Aug;5(8):e1286. Epub 2011 Aug 23.

BACKGROUND: Annual mass drug administration (MDA) over five years is the WHO's recommended strategy to eliminate lymphatic filariasis (LF). Some experts, however, consider that longer periods of treatment might be necessary in certain high prevalence and transmission environments based upon past unsuccessful field experience and modelling. **METHODOLOGY/PRINCIPAL FINDINGS:** To evaluate predictors of success in an LF control program we conducted an ecological study during a pre-existing MDA program. We studied 27 villages in Lihir Island, Papua New Guinea, from two areas with different infection rates before MDA. We undertook surveys to collect information on variables potentially having an influence on the outcome of the program, including epidemiological (baseline prevalence of infection, immigration rate), entomological (vector density) and operational (treatment coverage, vector control strategies) variables. The success in a village was defined using variables related to the infection (circulating filarial antigenemia prevalence <1%) and transmission (antigenemia prevalence <1 in 1000 in children born since start of MDA). 8709 people were involved in the MDA program and average coverage rates were around 70%. The overall prevalence of filariasis fell from an initial 17.91% to 3.76% at round 5 ($p < 0.001$). Viewed on a village by village basis, 12/27 (44%) villages achieved success. In multivariate analysis, low baseline prevalence was the only factor predicting both success in reducing infection rates (OR 19.26; CI 95% 1.12 to 331.82) and success in preventing new infections (OR 27.44; CI 95% 1.05 to 719.6). Low vector density and the use of an optimal vector control strategy were also associated with success in reducing infection rates, but this did not reach statistical significance. **CONCLUSIONS/SIGNIFICANCE:** Our results provide the data that support the recommendation that high endemic areas may require longer duration MDA programs, or alternative control strategies.

43 **Nair A, Strauch S, Lauwo J, Jähnke RW, Dressman J.**

Are counterfeit or substandard anti-infective products the cause of treatment failure in Papua New Guinea? *J Pharm Sci* 2011 Nov;100(11):5059-5068. doi: 10.1002/jps.22691. Epub 2011 Jun 30.

Counterfeit and substandard products present a big challenge to any national plan or policy devised to improve public health. Poor quality drug products are especially a problem in lower income countries where product information and drug regulation enforcement are scant or absent. The primary aim of the present study was to evaluate the quality of amodiaquine and amoxicillin formulations sold in Papua New Guinea (PNG) and to detect the presence of counterfeit or substandard drugs in circulation, if any. Fourteen samples, collected from five registered pharmacies in Port Moresby, PNG, were subjected to visual inspection, quality control tests and verification of product authenticity. The quality control tests included weight variation, content uniformity, thin layer chromatography and dissolution. None of the products complied with all of the evaluation criteria. Two products, one of which was purportedly distributed by a company which proved to be nonexistent, contained no detectable amodiaquine. The present study confirms that counterfeit and substandard amodiaquine and amoxicillin products are finding their way into the distribution chain in Port Moresby, PNG. This quality problem with anti-infective products is of great concern, as it not only exposes patients to poor quality products but also fosters the development of resistant bacterial strains.

44 **O'Sullivan M, Kenilorea G, Yamaguchi Y, Bobogare A, Losi L, Atkinson JA, Vallely A, Whittaker M, Tanner M, Wijesinghe R.**

Malaria elimination in Isabel Province, Solomon Islands: establishing a surveillance-response system to prevent introduction and reintroduction of malaria. *Malar J* 2011 Aug 11;10:235.

BACKGROUND: The Solomon Islands National Malaria Programme is currently focused on intensified control and progressive elimination. Recent control efforts in Isabel Province have reduced their malaria incidence to 2.6/1,000 population in 2009 whereas most neighbouring provinces have much higher incidences. A malaria surveillance-response system that involves testing all travellers entering Isabel Province using rapid diagnostic tests (RDT) to prevent cases being imported had been proposed by local health authorities. This study provides information on the feasibility and acceptability of implementing a new approach of surveillance and response in the context of low levels of indigenous malaria transmission in Isabel Province. **METHODS:** A total of 13 focus group discussions (FGD) and 22 key informant interviews (KII) were conducted in Isabel Province, Solomon Islands. Key topics included: the travel patterns of people to, from and within Isabel Province; the acceptability, community perceptions, attitudes and suggestions towards the proposed surveillance programme; and management of suspected malaria cases. This information was triangulated with data obtained from port authorities, airlines and passenger ships travelling to and from Isabel Province in the preceding two years. **RESULTS:** Travel within Isabel Province and to and from other provinces is common with marked seasonality. The majority of inter-provincial travel is done on scheduled public transport, namely passenger ships and aircraft. In

Isabel Province there is a healthy community spirit as well as high concern regarding malaria and its importation and there is currently effective malaria passive case detection and management. Conducting malaria screening at ports and airports would be acceptable to the community. **CONCLUSION:** A robust surveillance-response system is essential when moving towards malaria elimination. Many factors contribute positively towards the feasibility of an RDT based malaria surveillance system in Isabel Province. Due to financial and logistical restraints local health authorities have concluded that a system of community-based vigilance to identify new arrivals in villages and direct them to have malaria testing is more feasible than formal screening at ports and airports. A surveillance response system to prevent introduction of malaria into Isabel Province can be integrated into the National Malaria Control Programme provided the operational steps are carefully planned with regard to human and financial resources.

45 **Perez J, Brescia F, Becam J, Maunon C, Goarant C.**

Rodent abundance dynamics and leptospirosis carriage in an area of hyper-endemicity in New Caledonia.

PLoS Negl Trop Dis 2011 Oct;5(10):e1361. Epub 2011 Oct 25.

BACKGROUND: Widespread but particularly incident in the tropics, leptospirosis is transmitted to humans directly or indirectly by virtually any mammal species. However, rodents are recognized as the most important reservoir. In endemic regions, seasonal outbreaks are observed during hot rainy periods. In such regions, hot spots can be evidenced, where leptospirosis is "hyper-endemic", its incidence reaching 500 annual cases per 100,000. A better knowledge of how rodent populations and their *Leptospira* prevalence respond to seasonal and meteorological fluctuations might help implement relevant control measures. **METHODOLOGY/PRINCIPAL FINDINGS:** In two tribes in New Caledonia with hyper-endemic leptospirosis, rodent abundance and *Leptospira* prevalence was studied twice a year, in hot and cool seasons, for two consecutive years. Highly contrasted meteorological situations, particularly rainfall intensities, were noted between the two hot seasons studied. Our results show that during a hot and rainy period, both the rodent populations and their *Leptospira* carriage were higher. This pattern was more salient in commensal rodents than in the sylvatic rats. **CONCLUSIONS/SIGNIFICANCE:** The dynamics of rodents and their *Leptospira* carriage changed during the survey, probably under the influence of meteorology. Rodents were both more numerous and more frequently carrying (therefore disseminating) leptospires during a hot rainy period, also corresponding to a flooding period with higher risks of human exposure to waters and watered soils. The outbreaks of leptospirosis in hyper-endemic areas could arise from meteorological conditions leading to both an increased risk of exposure of humans and an increased volume of the rodent reservoir. Rodent control measures would therefore be most effective during cool and dry seasons, when rodent populations and leptospirosis incidence are low.

46 **Poespoprodjo JR, Fobia W, Kenangalem E, Hasanuddin A, Sugiarto P, Tjitra E, Anstey NM,**

Price RN.

Highly effective therapy for maternal malaria associated with a lower risk of vertical transmission. *J Infect Dis* 2011 Nov 15;204(10):1613-1619. Epub 2011 Sep 9.

BACKGROUND: The epidemiology of congenital malaria was investigated in a hospital-based malaria surveillance study in Papua, Indonesia. **METHODS:** From April 2005 to January 2010, 4878 delivering women and their newborns underwent prospective clinical review and malaria screening by peripheral blood microscopy. **FINDINGS:** Congenital malaria occurred in 8 per 1000 (38/4884) live births, with *Plasmodium falciparum* accounting for 76.3% (29) and *P. vivax* for 15.8% (6) of infections. Maternal malaria at delivery (adjusted odds ratio [AOR], 9.5; 95% confidence interval [CI], 4.2-21.5; $p < 0.001$), age ≤ 16 years (AOR, 4; 95% CI, 1.4-12.1; $p = 0.011$) and prior malaria during pregnancy (AOR, 2.2; 95% CI, 1.1-4.4; $p = 0.022$) were independent risk factors for vertical transmission. Of 29 mothers and neonates with contemporaneous peripheral parasitemia, 17% (5) had discordant parasite species, suggesting possible antenatal malaria transmission. Newborns with malaria were at significantly greater risk of low birth weight (AOR, 2.8; 95% CI, 1.2-6.6; $p = 0.002$). Following introduction of dihydroartemisinin-piperaquine for uncomplicated malaria in the second and third trimesters of pregnancy, congenital malaria incidence fell from 3.2% to 0.2% (odds ratio, 0.07; 95% CI, 0.03-0.15; $p < 0.001$). **CONCLUSIONS:** Congenital malaria is an important cause of neonatal morbidity in this region co-endemic for *P. falciparum* and *P. vivax* malaria. The introduction of artemisinin-combination therapy was associated with a significant risk reduction in the vertical transmission of malaria.

47 Popescu F, Wyder M, Gurtner C, Frey J, Cooke RA, Greenhill AR, Posthaus H.

Susceptibility of primary human endothelial cells to *C. perfringens* beta-toxin suggesting similar pathogenesis in human and porcine necrotizing enteritis.

Vet Microbiol 2011 Nov 21;153(1-2):173-177. Epub 2011 Feb 23.

Clostridium perfringens type C causes fatal necrotizing enteritis in different mammalian hosts, most commonly in newborn piglets. Human cases are rare, but the disease, also called pigbel, was endemic in the Highlands of Papua New Guinea. Lesions in piglets and humans are very similar and characterized by segmental necro-hemorrhagic enteritis in acute cases and fibrino-necrotizing enteritis in subacute cases. Histologically, deep mucosal necrosis accompanied by vascular thrombosis and necrosis was consistently reported in naturally affected pigs and humans. This suggests common pathogenetic mechanisms. Previous in vitro studies using primary porcine aortic endothelial cells suggested that beta-toxin (CPB) induced endothelial damage contributes to the pathogenesis of *C. perfringens* type C enteritis in pigs. In the present study we investigated toxic effects of CPB on cultured primary human macro- and microvascular endothelial cells. In vitro, these cells were highly sensitive to CPB and reacted with similar cytopathic and cytotoxic effects as porcine endothelial cells. Our results indicate that porcine and human cell culture based in vitro models represent valuable tools to investigate the pathogenesis of this bacterial disease in animals and humans.

48 Prow NA, May FJ, Westlake DJ, Hurrellbrink RJ, Biron RM, Leung JY, McMinn PC, Clark DC, Mackenzie JS, Lobigs M, Khromykh AA, Hall RA.

Determinants of attenuation in the envelope protein of the flavivirus Alfuy.

J Gen Virol 2011 Oct;92(10):2286-2296. Epub 2011 Jul 6.

Murray Valley encephalitis virus (MVEV) is a mosquito-borne flavivirus endemic to Australia and Papua New Guinea. Most strains of MVEV cause potentially fatal cases of encephalitis in humans and horses, and have been shown to be highly neuroinvasive in weanling mice. In contrast, the naturally occurring subtype Alfuy virus (ALFV) has never been associated with human disease, nor is it neuroinvasive in weanling mice, even at high doses. To identify viral factors associated with ALFV attenuation, a chimeric infectious clone was constructed containing the structural genes premembrane (prM) and envelope (E) of ALFV swapped into the MVEV genome. The resulting virus (vMVEV/ALFVstr) was no longer neuroinvasive in mice, suggesting that motifs within prM-E of ALFV confer attenuation. To define these motifs further, mutants were constructed by targeting divergent sequences between the MVEV and ALFV E proteins that are known markers of virulence in other encephalitic flaviviruses. MVEV mutants containing a unique ALFV sequence in the flexible hinge region (residues 273-277) or lacking the conserved glycosylation site at position 154 were significantly less neuroinvasive in mice than wild-type MVEV, as determined by delayed time to death or increased LD₅₀. Conversely, when the corresponding MVEV sequences were inserted into the vMVEV/ALFVstr chimera, the mutant containing the MVEV hinge sequence was more neuroinvasive than the parental chimera, though not to the same level as wild-type MVEV. These results identify the hinge region and E protein glycosylation as motifs that contribute to the attenuation of ALFV.

49 Rahman M, Haque SE, Mostofa MG, Tarivonda L, Shuaib M.

Wealth inequality and utilization of reproductive health services in the Republic of Vanuatu: insights from the multiple indicator cluster survey, 2007.

Int J Equity Health 2011 Dec 2;10:58.

BACKGROUND: Although the Republic of Vanuatu has improved maternal indicators, more needs to be done to improve equity among the poorest in the use of reproductive health services to expedite the progress towards the Millennium Development Goal 5 (MDG 5) target. While large developing country studies provide evidence of a rich-poor gap in reproductive health services utilization, not much is written in terms of Pacific Islands. Thus, this study aims to examine the degree of inequality in utilization of reproductive health services in a nationally representative sample of Vanuatu households. **METHODS:** This paper used data from the 2007 Vanuatu Multiple Indicator Cluster Survey (MICS). The analyses were based on responses from 615 ever married women, living with at least one child below two years of age. Outcomes included antenatal care (ANC) and use of birth attendants at delivery, place of delivery, and counseling and testing for HIV/AIDS. Descriptive statistics and multivariate logistic regression methods were employed in the analysis. **RESULTS:** Findings revealed that the economic well-being status of the household to which women belong

played a crucial role in explaining the variation in service utilization. Inequality in utilization was found to be more pronounced between the poorest and richest groups within the wealth quintiles. In adjusted models, mothers in the richest bands of wealth were 5.50 (95% confidence interval [CI]: 1.34-22.47), 2.12 (95% CI: 1.02-3.42), 4.0 (95% CI 1.58-10.10) and 2.0 (95% CI 1.02-5.88) times more likely to have assisted delivery from medically trained personnel, have institutional deliveries, and have counseling and testing for HIV/AIDS. **CONCLUSIONS:** Associations between household wealth inequality and utilization of ANC and delivery assistance from medically trained personnel, institutional delivery, and counseling and testing for HIV/AIDS suggest that in promoting higher utilization of reproductive health care services in Vanuatu poor-rich inequalities need to be addressed. Reducing poverty and making services more available and accessible to the poor may be essential for improving the overall reproductive health care utilization rate in Vanuatu.

50 Rao C, Kosen S, Bisara D, Usman Y, Adair T, Djaja S, Suhardi S, Soemantri S, Lopez AD.

Tuberculosis mortality differentials in Indonesia during 2007-2008: evidence for health policy and monitoring.

Int J Tuberc Lung Dis 2011 Dec;15(12):1608-1614.

BACKGROUND: Indonesia bears the third highest tuberculosis (TB) burden in the world. Current mortality estimates are based on notification and case fatality rates derived from the National TB Control Programme. **OBJECTIVE:** To report TB mortality measures for 2007-2008 based on death registration systems in selected populations in five provinces of Indonesia. **METHODS:** Data were compiled from sites in Central Java, Lampung, Gorontalo, West Kalimantan and Papua in 2007-2008, covering 2.5 million people. Overall mortality levels and TB mortality indicators were computed. Data quality was assessed in terms of completeness of death registration and strength of evidence in verbal autopsy questionnaires. **RESULTS:** A total of 1547 TB deaths were diagnosed in the five provinces. There was direct or indirect evidence of incomplete death registration at all sites. More than 90% of TB diagnoses from verbal autopsies were based on strong evidence. The results demonstrate high TB death rates in Papua, and significant mortality differentials across provinces. **CONCLUSIONS:** The measurement of cause-specific mortality is feasible by strengthening death registration in Indonesia. Observed TB mortality rates from five sites are baseline evidence for monitoring TB control programmes. Sustained efforts are required to develop death registration as a routine annual source of mortality data for Indonesia.

51 Rees S, Silove D.

Sakit Hati: a state of chronic mental distress related to resentment and anger amongst West Papuan refugees exposed to persecution.

Soc Sci Med 2011 Jul;73(1):103-110. Epub 2011 May 20.

There has been an increasing interest in the role of gross injustices in generating pathological states of anger. The goal of this study amongst 41 West Papuan refugees conducted in Australia between 2007 and 2010 was to explore the phenomenology of Sakit Hati, a condition in which there appeared to be a close link between human rights violations

and anger. West Papuan refugee participants made repeated reference to the condition of Sakit Hati in the early phase of the study so that the remainder of the study focused specifically on this construct. The qualitative approach involved an iterative process including focus groups, in-depth interviews and semi-structured confirmatory interviews. The research revealed that Sakit Hati included elements of chronic brooding, resentment and anger attributed to experiences of injustice, a state that created vulnerability to episodes of explosive rage and aggression in response to reminders of persecution. Sakit Hati was distinguished from a depression-loss constellation, Susah Hati, although the two reactions overlapped. Sakit Hati led to substantial personal suffering and interpersonal difficulties. The intractable political conditions in West Papua made it difficult to achieve a durable resolution for the condition. Sakit Hati provides a cross-cultural illustration of the nexus between injustice and chronic anger, demonstrating how this dynamic interaction can be perpetuated by ongoing social and political forces. Greater attention may be warranted by psychiatric classification systems to the recognition of anger as an affective state that may be provoked and maintained by experiences of injustice.

52 Reeves BM, Kado J, Brook M.

High prevalence of rheumatic heart disease in Fiji detected by echocardiography screening.

J Paediatr Child Health 2011 Jul;47(7):473-478. doi: 10.1111/j.1440-1754.2010.01997.x. Epub 2011 Feb 18.

AIM: Rheumatic heart disease poses a huge burden for developing countries, with Pacific Island nations having among the highest prevalence reported in the world. It is recognised that echocardiography is much more sensitive than clinical examination for detection of rheumatic heart disease, but resource and cost limitations are delaying implementation of screening programmes in developing nations. Rapid echocardiography using low-cost portable machines and a non-expert operator may be a useful compromise, allowing widespread screening and control of rheumatic heart disease in developing countries. **METHODS:** In-school echocardiography and clinical examination was carried out on primary school children (aged five to 14) in Lautoka, Fiji. All of the children with abnormal findings were then recalled for complete in-hospital clinical and echocardiographic assessment by a paediatrician with expertise in rheumatic heart disease and echocardiography. **RESULTS:** Using screening echocardiography averaging less than 4 min per patient, the prevalence of definite rheumatic heart disease detected by echocardiogram screening was 55.2 per 1000 compared with 11 per 1000 detected by clinical examination ($p < 0.001$). It was demonstrated that echocardiography is five times more sensitive at detecting rheumatic heart disease than clinical examination. A comprehensive screening programme is estimated to cost less than US\$40 per patient detected. **CONCLUSION:** This study confirms that Fiji has the highest documented prevalence of rheumatic heart disease in the world. Rapid echocardiography has the potential to screen large numbers of patients by non-specialist operators, which encourages its use in larger scale screening and prevention strategies in developing countries.

- 53 **Reynolds PN, Turnidge JD, Gottlieb T, Moore MJ; Thoracic Society of Australia and New Zealand; Australian Society for Microbiology; Australasian Society for Infectious Diseases; Public Health Association of Australia.**

Cross-border patients with tuberculosis.

Med J Aust 2011 Nov 7;195(9):523-524.

- 54 **Rothwell SP, Rosengren DJ, Rojek AM, Williams JM, Lukin WG, Greenslade J.**

Exercise-associated hyponatraemia on the Kokoda Trail.

Emerg Med Australas 2011 Dec;23(6):712-716. doi: 10.1111/j.1742-6723.2011.01470.x. Epub 2011 Sep 7.

OBJECTIVE: The objective of the present study was to determine the prevalence of exercise-associated hyponatraemia in hikers/trekkers along the Kokoda Trail. **METHODS:** This was a cross-sectional study of 191 trekkers on the Kokoda Trail, Papua New Guinea. Blood was taken and analysed immediately using point-of-care technology 2 days walk from each end of the Trail. **RESULTS:** The main outcome measure was hyponatraemia defined as serum sodium level less than 135 mmol/L. Three participants (1.6%, 95% CI 0.5-4.5%) were found to have mild hyponatraemia. The hyponatraemic group had a median estimated fluid intake on the day of testing that was almost double that of the normal sodium group (6 L vs 3.3 L). **CONCLUSION:** Exercise-associated hyponatraemia occurs in trekkers on the Kokoda Trail. Strategies for prevention of exercise-associated hyponatraemia should be delivered to trekkers via the trekking companies, chiefly focussing on only drinking in response to thirst.

- 55 **Salman S, Page-Sharp M, Griffin S, Kose K, Siba PM, Ilett KF, Mueller I, Davis TM.**

Population pharmacokinetics of artemether, lumefantrine, and their respective metabolites in Papua New Guinean children with uncomplicated malaria.

Antimicrob Agents Chemother 2011 Nov;55(11):5306-5313. Epub 2011 Aug 29.

There are sparse published data relating to the pharmacokinetic properties of artemether, lumefantrine and their active metabolites in children, especially desbutyl-lumefantrine. We studied 13 Papua New Guinean children aged 5 to 10 years with uncomplicated malaria who received the six recommended doses of artemether (1.7 mg/kg of body weight) plus lumefantrine (10 mg/kg), given with fat over 3 days. Intensive blood sampling was carried out over 42 days. Plasma artemether, dihydroartemisinin, lumefantrine and desbutyl-lumefantrine were assayed using liquid chromatography-mass spectrometry or high-performance liquid chromatography. Multicompartmental pharmacokinetic models for a drug plus its metabolite were developed using a population approach that included plasma artemether and dihydroartemisinin concentrations below the limit of quantitation. Although artemether bioavailability was variable and its clearance increased by 67.8% with each dose, the median areas under the plasma concentration-time curve from 0 h to infinity ($AUC(0-\infty)$ s) for artemether and dihydroartemisinin (3,063 and 2,839 $\mu\text{g} \cdot \text{h}/\text{liter}$, respectively) were similar to those reported previously in adults with malaria. For lumefantrine, the median $AUC(0-\infty)$ (459,980 $\mu\text{g} \cdot \text{h}/\text{liter}$) was also similar to that in adults with malaria.

These data support the higher dose recommended for children weighing 15 to 35 kg (35% higher than that for a 50-kg adult) but question the recommendation for a lower dose in children weighing 12.5 to 15 kg. The median desbutyl-lumefantrine/lumefantrine ratio in the children in our study was 1.13%, within the range reported for adults and higher at later time points because of the longer desbutyl-lumefantrine terminal elimination half-life. A combined desbutyl-lumefantrine and lumefantrine $AUC(0-\infty)$ weighted on in vitro antimalarial activity was inversely associated with recurrent parasitemia, suggesting that both the parent drug and the metabolite contribute to the treatment outcome of artemether-lumefantrine.

- 56 **Schultz JT, Moodie M, Mavoa H, Utter J, Snowdon W, McCabe MP, Millar L, Kremer P, Swinburn BA.**

Experiences and challenges in implementing a complex community-based research project: the Pacific Obesity Prevention in Communities project. *Obes Rev* 2011 Nov;12 Suppl 2:12-19. doi: 10.1111/j.1467-789X.2011.00911.x.

Policy makers throughout the world are struggling to find effective ways to prevent the rising trend of obesity globally, particularly among children. The Pacific Obesity Prevention in Communities project was the first large-scale, intervention research project conducted in the Pacific aiming to prevent obesity in adolescents. The project spanned four countries: Australia, New Zealand, Fiji and Tonga. This paper reports on the strengths and challenges experienced from this complex study implemented from 2004 to 2009 across eight cultural groups in different community settings. The key strengths of the project were its holistic collaborative approach, participatory processes and capacity building. The challenges inherent in such a large complex project were underestimated during the project's development. These related to the scale, complexity, duration, low research capacity in some sites and overall coordination across four different countries. Our experiences included the need for a longer lead-in time prior to intervention for training and upskilling of staff in Fiji and Tonga, investment in overall coordination, data quality management across all sites and the need for realistic capacity building requirements for research staff. The enhanced research capacity and skills across all sites include the development and strengthening of research centres, knowledge translation and new obesity prevention projects.

- 57 **Senn N, Luang-Suarkia D, Manong D, Siba PM, McBride WJ.**

Contribution of dengue fever to the burden of acute febrile illnesses in Papua New Guinea: an age-specific prospective study.

Am J Trop Med Hyg 2011 Jul;85(1):132-137.

Malaria is a major contributor to the burden of febrile illnesses in Papua New Guinea (PNG). Dengue fever (DF) is likely to contribute; however, its epidemiology in PNG is poorly understood. We performed a prospective age-stratified study in outpatient clinics investigating the prevalence of DF; 578 patients were enrolled, and 317 patients with a negative rapid diagnostic test (RDT) for malaria were tested for dengue. Malaria was confirmed in 52% (301/578, 95% confidence interval [CI] = 48-56%), DF was diagnosed in 8% (46/578, 95% CI = 6-10%), and 40% (95% CI = 36-44%) had neither diagnosis. Among the 317 malaria RDT-negative

patients, 14% (45/317, 95% CI = 10-18%) had DF. The seroprevalence of dengue immunoglobulin G (IgG) was 83% (204/247, 95% CI = 78-87%), and no dengue hemorrhagic fever was seen. This study provides good evidence for the first time that DF is common in PNG and is responsible for 8% of fever episodes. The common occurrence of DF in a population with presumed previous exposure to dengue is an important observation.

58 Simonin A, Bushee J, Courcaud A.

Social, cultural and political factors in the design of HIV programmes with Papuan highland communities. *Cult Health Sex* 2011 Dec;13 Suppl 2:S185-S199. Epub 2011 Nov 8.

The Indonesian province of Papua faces a growing HIV epidemic, particularly amongst remote highland Papuans, such as the Western Dani. The specific, challenging political and sociocultural context of Papuan highland communities greatly influences the transmission of HIV. Different initiatives have struggled to meet the sexual and reproductive health needs of Papuan communities and of minority ethnic communities and the challenges they pose. The prolonged cultural tensions between Papuan and Indonesian communities are a major barrier to effective dialogue between the Indonesian state and its minority ethnic communities, the absence of which only exacerbates the epidemic. Tackling HIV in Papua requires responses that are both culturally and politically sensitive, in direct challenge to existing development paradigms.

59 Stoneking M, Krause J.

Learning about human population history from ancient and modern genomes. *Nat Rev Genet* 2011 Aug 18;12(9):603-614. doi: 10.1038/nrg3029.

Genome-wide data, both from SNP arrays and from complete genome sequencing, are becoming increasingly abundant and are now even available from extinct hominins. These data are providing new insights into population history; in particular, when combined with model-based analytical approaches, genome-wide data allow direct testing of hypotheses about population history. For example, genome-wide data from both contemporary populations and extinct hominins strongly support a single dispersal of modern humans from Africa, followed by two archaic admixture events: one with Neanderthals somewhere outside Africa and a second with Denisovans that (so far) has only been detected in New Guinea. These new developments promise to reveal new stories about human population history, without having to resort to storytelling.

60 Street A.

Artefacts of not-knowing: the medical record, the diagnosis and the production of uncertainty in Papua New Guinean biomedicine. *Soc Stud Sci* 2011 Dec;41(6):815-834.

Anthropological and STS scholars of biomedical work have traditionally explored contexts where inconsistencies and lacunas in diagnostic knowledge-production are problematic for medical practitioners, and such scholars have consequently focused on the social and political processes by which such epistemic uncertainties are resolved. This article draws on ethnographic material from a Papua New Guinean hospital where diagnostic uncertainty is not rendered problematic and where the open-endedness

of the diagnostic process gives rise to new forms of medical expertise and practice. The paper focuses on the medical record as an artefact of not-knowing that both documents and performs uncertainty as a valuable resource. It shows that medical records can operate as either technologies of 'opening' that multiply opportunities for pragmatic action within a hospital space or as technologies of 'closure' that move people and documents between spaces. Practices of not-knowing and knowing are therefore shown to be interdependent and interchangeable 'moments' of bureaucratic-biomedical work.

61 Swinburn BA, Millar L, Utter J, Kremer P, Moodie M, Mavoa H, Snowdon W, McCabe MP, Malakellis M, de Courten M, Waqa G, Fotu KF, Roberts G, Scragg R.

The Pacific Obesity Prevention in Communities project: project overview and methods. *Obes Rev* 2011 Nov;12 Suppl 2:3-11. doi: 10.1111/j.1467-789X.2011.00921.x.

Obesity is increasing worldwide with the Pacific region having the highest prevalence among adults. The most common precursor of adult obesity is adolescent obesity making this a critical period for prevention. The Pacific Obesity Prevention in Communities project was a four-country project (Fiji, Tonga, New Zealand and Australia) designed to prevent adolescent obesity. This paper overviews the project and the methods common to the four countries. Each country implemented a community-based intervention programme promoting healthy eating, physical activity and healthy weight in adolescents. A community capacity-building approach was used, with common processes employed but with contextualized interventions within each country. Changes in anthropometric, behavioural and perception outcomes were evaluated at the individual level and school environments and community capacity at the settings level. The evaluation tools common to each are described. Additional analytical studies included economic, socio-cultural and policy studies. The project pioneered many areas of obesity prevention research: using multi-country collaboration to build research capacity; testing a capacity-building approach in ethnic groups with very high obesity prevalence; costing complex, long-term community intervention programmes; systematically studying the powerful socio-cultural influences on weight gain; and undertaking a participatory, national, priority-setting process for policy interventions using simulation modelling of cost-effectiveness of interventions.

62 Tabrizi SN, Law I, Buadromo E, Stevens MP, Fong J, Samuela J, Patel M, Mulholland EK, Russell FM, Garland SM.

Human papillomavirus genotype prevalence in cervical biopsies from women diagnosed with cervical intraepithelial neoplasia or cervical cancer in Fiji. *Sex Health* 2011 Sep;8(3):338-342.

BACKGROUND: There is currently limited information about human papillomavirus (HPV) genotype distribution in women in the South Pacific region. This study's objective was to determine HPV genotypes present in cervical cancer (CC) and precancers (cervical intraepithelial neoplasia (CIN) level 3) in Fiji. **METHODS:** Cross-sectional analysis evaluated archival CC and CIN3 biopsy samples from 296 women of Melanesian Fijian ethnicity (n = 182, 61.5%) and Indo-Fijian ethnicity (n = 114, 38.5%). HPV genotypes were evaluated using the

INNO-LiPA assay in archival samples from CC (n = 174) and CIN3 (n = 122) among women in Fiji over a 5-year period from 2003 to 2007. RESULTS: Overall, 99% of the specimens tested were HPV DNA-positive for high-risk genotypes, with detection rates of 100%, 97.4% and 100% in CIN3, squamous cell carcinoma (SCC) and adenosquamous carcinoma biopsies, respectively. Genotypes 16 and 18 were the most common (77%), followed by HPV 31 (4.3%). Genotype HPV 16 was the most common identified (59%) in CIN3 specimens, followed by HPV 31 (9%) and HPV 52 (6.6%). Multiple genotypes were detected in 12.5-33.3% of specimens, depending on the pathology. CONCLUSION: These results indicated that the two most prevalent CC-associated HPV genotypes in Fiji parallel those described in other regions worldwide, with genotype variations thereafter. These data suggest that the currently available bivalent and quadrivalent HPV vaccines could potentially reduce cervical cancers in Fiji by over 80% and reduce precancers by at least 60%.

63 **Thow AM, Snowdon W, Schultz JT, Leeder S, Vivili P, Swinburn BA.**

The role of policy in improving diets: experiences from the Pacific Obesity Prevention in Communities food policy project.

Obes Rev 2011 Nov;12 Suppl 2:68-74. doi: 10.1111/j.1467-789X.2011.00910.x.

There is global interest in using multisectoral policy approaches to improve diets, and reduce obesity and non-communicable disease. However, there has been ad hoc implementation, which in some sectors such as the economic sector has been very limited, because of the lack of quality evidence on potential costs and impacts, and the inherent challenges associated with cross-sectoral policy development and implementation. The Pacific Obesity Prevention in Communities food policy project aimed to inform relevant policy development and implementation in Pacific Island countries. The project developed an innovative participatory approach to identifying and assessing potential policy options in terms of their effectiveness and feasibility. It also used policy analysis methodology to assess three policy initiatives to reduce fatty meat availability and four soft drink taxes in the region, in order to identify strategies for supporting effective policy implementation.

64 **Tisch DJ, Alexander ND, Kiniboro B, Dagoro H, Siba PM, Bockarie MJ, Alpers MP, Kazura JW.**

Reduction in acute filariasis morbidity during a mass drug administration trial to eliminate lymphatic filariasis in Papua New Guinea.

PLoS Negl Trop Dis 2011 Jul;5(7):e1241. Epub 2011 Jul 12.

BACKGROUND: Acute painful swelling of the extremities and scrotum are debilitating clinical manifestations of *Wuchereria bancrofti* infection. The ongoing global program to eliminate filariasis using mass drug administration is expected to decrease this and other forms of filarial morbidity in the future by preventing establishment of new infections as a consequence of eliminating transmission by the mosquito vector. We examined whether mass treatment with anti-filarial drugs has a more immediate health benefit by monitoring acute filariasis morbidity in Papua New Guinean communities that participated in a 5-year mass drug administration trial. METHODOLOGY/PRINCIPAL FINDINGS: Weekly

active surveillance for acute filariasis morbidity defined by painful swelling of the extremities, scrotum and breast was performed 1 year before and each year after 4 annual mass administrations of anti-filarial drugs (16,480 person-years of observation). Acute morbidity events lasted <3 weeks in 92% of affected individuals and primarily involved the leg (74-79% of all annual events). The incidence for all communities considered together decreased from 0.39 per person-year in the pre-treatment year to 0.31, 0.15, 0.19 and 0.20 after each of 4 annual treatments (p <0.0001). Residents of communities with high pre-treatment transmission intensities (224-742 infective bites/person/year) experienced a greater reduction in acute morbidity (0.62 episodes per person-year pre-treatment vs. 0.30 in the 4th post-treatment year) than residents of communities with moderate pre-treatment transmission intensities (24-167 infective bites/person/year; 0.28 episodes per person-year pre-treatment vs. 0.16 in the 4th post-treatment year). CONCLUSIONS: Mass administration of anti-filarial drugs results in immediate health benefit by decreasing the incidence of acute attacks of leg and arm swelling in people with pre-existing infection. Reduction in acute filariasis morbidity parallels decreased transmission intensity, suggesting that continuing exposure to infective mosquitoes is involved in the pathogenesis of acute filariasis morbidity.

65 **Tousignant B, Du Toit R.**

Adapting the World Federation for Medical Education standards for use in a self-audit of an eye care training programme.

Educ Health (Abingdon) 2011 Dec;24(3):641. Epub 2011 Dec 4.

INTRODUCTION: In 2006, a Postgraduate Diploma in Eye Care (PGDEC) for mid-level health personnel was initiated in Papua New Guinea, in partnership with The Fred Hollows Foundation New Zealand, the local government and Divine Word University. In the absence of national accreditation and with limited resources, an interim evaluation was needed. METHODS: We adapted the World Federation for Medical Education (WFME) standards to use in a self-audit to evaluate nine areas and 38 subareas of programme structure, processes and implementation. We developed a rating system: each area and subarea was scored for partial or complete attainment of basic or quality development levels. Ratings were referenced with supporting documents. Data were gathered internally, through document census and meetings between stakeholders. FINDINGS: A qualitative and quantitative portrait emerged: all nine programme areas completely attained at least basic level and two completely attained the quality development level. Twenty-six (68%) subareas completely attained the quality development level. Key successes included the administration of the PGDEC, synergies between the partnership's stakeholders and its relationship with the public health system. DISCUSSION AND CONCLUSIONS: This self-audit adapted from WFME standards provided a simple, yet systematic and largely objective evaluation. It proved beneficial to further develop the program, highlighting strengths and areas for improvement.

66 **Tynan A, Atkinson JA, Toaliu H, Taleo G, Fitzgerald L, Whittaker M, Riley I, Schubert M, Valley A.**

Community participation for malaria elimination in

Tafea Province, Vanuatu: part II. Social and cultural aspects of treatment-seeking behaviour.

Malar J 2011 Jul 26;10:204.

BACKGROUND: Early diagnosis and prompt effective case management are important components of any malaria elimination strategy. Tafea Province, Vanuatu has a rich history of traditional practices and beliefs, which have been integrated with missionary efforts and the introduction of modern constructions of health. Gaining a detailed knowledge of community perceptions of malarial symptomatology and treatment-seeking behaviours is essential in guiding effective community participation strategies for malaria control and elimination. **METHOD:** An ethnographic study involving nine focus group discussions (FGD), 12 key informant interviews (KII) and seven participatory workshops were carried out on Tanna Island, Vanuatu. Villages in areas of high and low malaria transmission risk were selected. Four ni-Vanuatu research officers, including two from Tanna, were trained and employed to conduct the research. Data underwent thematic analysis to examine treatment-seeking behaviour and community perceptions of malaria. **RESULTS:** Malaria was perceived to be a serious but relatively new condition, and in most communities identified as being apparent only after independence in 1980. Severe fever in the presence of other key symptoms triggered a diagnosis of malaria by individuals. Use of traditional or home practices was common: perceived vulnerability of patient and previous experience with malaria impacted on the time taken to seek treatment at a health facility. Barriers to health care access and reasons for delay in care-seeking included the availability of health worker and poor community infrastructure. **CONCLUSION:** Due to programme success of achieving low malaria transmission, Tafea Province has been identified for elimination of malaria by 2012 in the Government of Vanuatu Malaria Action Plans (MAP). An effective malaria elimination programme requires interactions between the community and its leaders, malaria workers and health providers for success in diagnosis and prompt treatment. As malaria becomes more uncommon, utilizing unique motivators for communities to seek early diagnosis and treatment is important, particularly as other health conditions that cause fevers become increasingly more common. The design of these interventions are dependent upon robust understanding of community perceptions of disease, and the evolving nature of these perceptions.

67 **Uauy R, Corvalan C, Kain J.**

The Pacific Obesity Prevention in Communities (OPIC) project.

Obes Rev 2011 Nov;12 Suppl 2:1-2. doi: 10.1111/j.1467-789X.2011.00924.x.

68 **van den Biggelaar AH, Pomat W, Bosco A, Phuanukoannon S, Devitt CJ, Nadal-Sims MA, Siba PM, Richmond PC, Lehmann D, Holt PG.**

Pneumococcal conjugate vaccination at birth in a high-risk setting: no evidence for neonatal T-cell tolerance.

Vaccine 2011 Jul 26;29(33):5414-5420. Epub 2011 Jun 7.

Concerns about the risk of inducing immune deviation-associated "neonatal tolerance" as described in mice have restricted the widespread adoption of neonatal vaccination. The aim of this study was to demonstrate the immunological

feasibility of neonatal pneumococcal conjugate vaccination (PCV) which could potentially protect high-risk infants in resource poor countries against severe pneumococcal disease and mortality in the early critical period of life. Papua New Guinean infants were randomized to be vaccinated with the 7-valent PCV (7vPCV) at birth, 1 and 2 months (neonatal group, n = 104) or at 1, 2 and 3 months of age (infant group, n = 105), or to not receive 7vPCV at all (control group, n = 109). Analysis of vaccine responses at 3 and 9 months of age demonstrated persistently higher type-1 (IFN- γ) and type-2 (IL-5 and IL-13) T-cell responses to the protein carrier CRM₉₇ and IgG antibody titres to 7vPCV serotypes in children vaccinated with 7vPCV according to either schedule as compared to unvaccinated children. In a comprehensive immuno-phenotypic analysis at 9 months of age, no differences in the quantity or quality of vaccine-specific T cell memory responses were found between neonatal vaccinations versus children given their first PCV dose at one month. Hospitalization rates in the first month of life did not differ between children vaccinated with PCV at birth or not. These findings demonstrate that neonatal 7vPCV vaccination is safe and not associated with immunological tolerance. Neonatal immunisation schedules should therefore be considered in high-risk areas where this may result in improved vaccine coverage and the earliest possible protection against pneumococcal disease and death.

69 **Vignier N, Lert F, Salomon C, Hamelin C.**

Kava drinking associated with suicidal behaviour among young Kanaks using kava in New Caledonia. *Aust NZ J Public Health* 2011 Oct;35(5):427-433. doi: 10.1111/j.1753-6405.2011.00737.x. Epub 2011 Sep 12.

OBJECTIVE: To examine associations between recreational use of kava and indicators of suicidal behaviour among youth in New Caledonia. **METHODS:** This cross-sectional community-based survey was administered to 1,400 young people aged 16-25 years. A multivariate analysis tested for associations between lifetime kava use and lifetime suicidal ideation and attempts. Because ethnicity affected the correlation between kava use and suicidal behaviour, data were analysed separately for Kanak youth and youth of other ethnic communities. **RESULTS:** Overall, 42% of respondents reported any lifetime kava use, 34% reported past suicidal ideation and 12% any suicide attempts. Among Kanak youth, kava use increased the likelihood of reporting both suicidal ideation (aOR = 2.40, 95% CI: 1.58-3.66) and suicide attempts (aOR = 1.98, 95% CI: 1.11-3.52). No such association was found in the non-Kanak group. **CONCLUSIONS:** The discrepancy between the effects of kava drinking on suicidal behaviour between Kanak youth and youth of other ethnic groups may be related to differences in patterns and quantity of kava use. In view of the paucity of data on the effects of kava on mental health in young people, further investigation is required. **IMPLICATIONS:** The results call for an increased awareness of the potential adverse health effects of kava consumption in New Caledonia, where it has spread in recent times and among communities where previously it was never used.

70 **Vincent SD.**

A clinician's perspective on providing TB services in

the Torres Strait.

Med J Aust 2011 Nov 7;195(9):506-507.

- 71 **Warurui J, Sipana B, Koch M, Barrows LR, Matainaho TK, Rai PP.**

An ethnobotanical survey of medicinal plants used in the Siwai and Buin districts of the Autonomous Region of Bougainville.

J Ethnopharmacol 2011 Nov 18;138(2):564-577. Epub 2011 Oct 6.

ETHNOPHARMACOLOGICAL RELEVANCE:

Traditional knowledge of medicinal plant use in many regions of Papua New Guinea and the Autonomous Region of Bougainville is poorly described and rapidly disappearing. A program initiated by the University of Papua New Guinea to systematically document and preserve traditional knowledge of medicinal plant use was initiated with WHO help in 2001. AIM OF THE STUDY: To document and compare medicinal plant use in the Siwai and Buin districts of the Island of Bougainville. Siwai and Buin districts represent two adjacent geographic regions of differing language traditions. MATERIALS AND METHODS: This report is a combination of two University of Papua New Guinea reports generated using a University of Papua New Guinea and Papua New Guinea Department of Health approved survey questionnaire "Information sheet on traditional herbal preparations and medicinal plants of Papua New Guinea". RESULTS: Although Siwai and Buin districts are adjacent in Southern Bougainville, there is considerable variation in the specific plants used medicinally and the specific uses of those plants that are used commonly in the two regions. In addition, many of the plants used in the region are widely distributed species that are used medicinally in other settings. Nevertheless, the high endemicity of plants and the extraordinary cultural diversity in the Autonomous Region of Bougainville has yielded description of the medicinal use of many plants that have not previously been reported in the wider scientific literature. CONCLUSIONS: Efforts to document and preserve traditional knowledge of plant use in Papua New Guinea have yielded important new records of plants with potential application in the provision of health care for a developing nation with an underdeveloped Western style rural health care system. This report documents substantial commonality in the general modes of medicinal plant preparation and in the health care applications of plant use in the Siwai and Buin traditions; however, there was considerable difference noted in the particular uses of the specific plants used in one or another of the districts.

- 72 **Wilson DW, Fowkes FJ, Gilson PR, Elliott SR, Tavul L, Michon P, Dabod E, Siba PM, Mueller I, Crabb BS, Beeson JG.**

Quantifying the importance of MSP1-19 as a target of growth-inhibitory and protective antibodies against *Plasmodium falciparum* in humans.

PLoS One 2011;6(11):e27705. Epub 2011 Nov 15.

BACKGROUND: Antibodies targeting blood stage antigens are important in protection against malaria, but the key targets and mechanisms of immunity are not well understood. Merozoite surface protein 1 (MSP1) is an abundant and essential protein. The C-terminal 19 kDa region (MSP1-

19) is regarded as a promising vaccine candidate and may also be an important target of immunity. METHODOLOGY/FINDINGS: Growth inhibitory antibodies against asexual-stage parasites and IgG to recombinant MSP1-19 were measured in plasma samples from a longitudinal cohort of 206 children in Papua New Guinea. Differential inhibition by samples of mutant *P. falciparum* lines that expressed either the *P. falciparum* or *P. chabaudi* form of MSP1-19 were used to quantify MSP1-19 specific growth-inhibitory antibodies. The great majority of children had detectable IgG to MSP1-19, and high levels of IgG were significantly associated with a reduced risk of symptomatic *P. falciparum* malaria during the 6-month follow-up period. However, there was little evidence of PfMSP1-19 specific growth inhibition by plasma samples from children. Similar results were found when testing non-dialysed or dialysed plasma, or purified antibodies, or when measuring growth inhibition in flow cytometry or microscopy-based assays. Rabbit antisera generated by immunization with recombinant MSP1-19 demonstrated strong MSP1-19 specific growth-inhibitory activity, which appeared to be due to much higher antibody levels than human samples; antibody avidity was similar between rabbit antisera and human plasma. CONCLUSIONS/SIGNIFICANCE: These data suggest that MSP1-19 is not a major target of growth inhibitory antibodies and that the protective effects of antibodies to MSP1-19 are not due to growth inhibitory activity, but may instead be mediated by other mechanisms. Alternatively, antibodies to MSP1-19 may act as a marker of protective immunity.

- 73 **Zwi AB, Blignault I, Bunde-Birouste AW, Ritchie JE, Silove DM.**

Decision-makers, donors and data: factors influencing the development of mental health and psychosocial policy in the Solomon Islands.

Health Policy Plan 2011 Jul;26(4):338-348. doi: 10.1093/heapol/czq069. Epub 2010 Nov 28.

Mental disorders and psychosocial problems are common, and present a significant public health burden globally. Increasingly, attention has been devoted to these issues in the aftermath of violent conflict. The Solomon Islands, a small Pacific island nation, has in recent years experienced periods of internal conflict. This article examines how policy decisions regarding mental health and wellbeing were incorporated into the national agenda in the years which followed. The study reveals the policy shifts, contextual influences and players responsible. The Solomon Islands' experience reflects incremental change, built upon longstanding but modest concern with mental health and social welfare issues, reinforced by advocacy from the small mental health team. Armed conflict and ethnic tensions from 1998 to 2003 promoted wider recognition of unmet mental health needs and psychosocial problems. Additional impetus was garnered through the positioning of key health leaders, some of whom were trained in public health. Working together, with an understanding of culture and politics, and drawing on external support, they drove the agenda. Contextual factors, notably further violence and the ongoing risk of instability, a growing youth population, and emerging international and local evidence, also played a part.

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